

17TH ANNUAL  
INTERNATIONAL  
SUSTAINABLE  
DEVELOPMENT  
RESEARCH  
CONFERENCE

# Moving Toward a Sustainable Future: **OPPORTUNITIES AND CHALLENGES**

May 8–10, 2011 • Columbia University • New York, NY, USA

## Abstracts



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# Population Dynamics

Robert Engelman & Gerhard Heilig

## Oral Presentations

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### **Population Stresses and Sustainable Development in India: Need for a Legislation**

Ikshaku Bezbaroa

In India, and in most countries of the world, development has been predominantly seen in terms of the economic growth of the country. The consequent headlong rush toward a globalised marketplace paid only modest heed to the other factors which the term 'development' a

iso actually encompasses. Today, we thus come to a crossroads in making a policy-decision, where the fruits of India's economic growth, fuelled by long years of liberalization policies, are yet to reach the masses in any significant way and the maintenance of a sustainable environment is increasingly understood as a downright necessity. All these, in addition to the meandering population growth rate of the country, leads to worrying questions about whether this speed of economic growth can be maintained without compromising on the needs of the environment, and thus our future. The rapidly growing population of India is no secret to the world. India is the world's second most populous country and its growing population is its major concern. Population growth means shrinking land, soil, water and biological resources per capita, a need for higher yields per hectare, and an accelerating dependence on fossil energy. India is soon expected to be the largest contributor to world population growth by far, adding around 570 million persons to the world population, by 2050. Therefore, urgent steps need to be taken to stabilise the population for sustainable development. In light of this, the National Population Policy for India announced that the year 2000 had special significance. Its change in focus from merely setting target population figures to achieving population control, through more emphasis on socio-economic issues, gives it greater breadth and depth thereby holding forth better promise of achieving its long-term objective of a stable population by middle of the 21st century. The official realization that population is not merely about numbers but about the health and quality of life of people is a huge leap forward. However, we have to bear in mind the carrying capacity of the land mass and resources available at our disposal; resurrecting the importance of numbers. This is because natural resources are limited and need to be used prudently and justifiably. Having mentioned this, the Indian government is not in favour of controlling population growth through any kind of legislation, but merely by the sinuous method of generating awareness and persuading people to have a small family size on grounds of betterment of the health of the mother and child. However in a time of escalating inflation and diminishing food stocks, the failure of the ambitious National Population Policy-2000 to manage a gradual reduction in the population growth rate has meant that the country has five crore more mouths to feed than anticipated. Accordingly, the question that remains to be answered is: Is it advisable to continue with the stand of not bringing in legislation to control population? We agree that democracy and sustainable development are not paradoxical and go hand in hand. In the garb of furthering democratic ideals, is it acceptable to compromise on sustainable development-the need of the day. In this paper, we seek to answer these questions and many more. We also propose that a legislation to check population growth, if justifiably framed, would go a long way in eradicating the same.

### **Easter Island: If no Collapse, what else? Cultural adaptations in a changing environment**

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For many scholars Easter Island (Rapa Nui) is a textbook example of a flourishing and highly developed culture with fascinating religious practices that has collapsed due to the overexploitation of its natural resources. This pre-modern collapse story made its way into many environmental science textbooks. According to Clive Ponting (*Green History of the World*, 1991) and Jared Diamond (*Collapse*, 2005) it is a grim warning to the world, Earth Island is Easter Island. The story has also met a few critics; their doubts about this 'overshoot and collapse' theory have been voiced since 2002.

A collapse in the way most authors have described it, involving a deforestation followed by hunger, starvation, tribal warfare and even cannibalism is neither supported by the earliest historical writings – the 18th century journals of European explorers - nor by the scientific evidence. More recently, strong evidence has been presented in favour of a relatively late arrival of the Polynesian settlers and a major role (by preventing regeneration) of the Polynesian rats in the apparent deforestation. However, the stronger the case grew against the repeated claims of a pre-European 'ecocide' the greater the need for a more reliable picture of the past. Hunt's hypothetical population model is dissatisfying in this respect and seriously flawed for the period after the first European contact with Easter Island (Hunt 2007). While Hunt's model suggests a demographic collapse following the first visit by the Dutch in 1722, my take is that Easter Island has undergone an unexceptional demographic transition. An improved model developed in collaboration with Ruben Huele (Leiden University) will be presented.

Finally I will raise the question if this 'reconstructing the past' bears any relevance to the present day debate on sustainability, quality and the role of religion. Do we need an 'ecoreligion' as proposed by Bahn and Flenley (1992)?

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Diamond, Jared (2005) *Collapse How Societies Choose to Fail or Survive*. Allen Lane, Penguin Books, London.

Hunt, Terry L. (2007) Rethinking Easter Island's ecological catastrophe. *Journal of Archaeological Science*, 34, 485-502.

Ponting, Clive (1991) *A Green History of the World*. Sinclair-Stevenson, London.

### **Population Dynamics Of Russian Federation**

Alfiya Davletbaeva

The government pays a lot more attention to the demographic situation because the numbers and statistics show the problems that make the face of the country. Russia is currently experiencing high mortality rates and fertility rates that are among the lowest in the world. Consequently, the population growth rate in Russia has become negative, life expectancy appears to be decreasing, and the population has been aging rapidly. The evidence now available on these changes has led a number of observers to call the present situation a “demographic crisis”.

The population of Russia is 141,927,297 as of January 2010. The Russian death rate in 2009 was a very high 14.2 per 1000 citizens. This is far higher than the world’s average death rate of just under 9. The birth rate of Russia was a very low 12.4 per 1000 people. While the average birth rate for the world is 19.95.

Contemporary demographic situation in Russia’s regions was mostly caused by spontaneous progress of the social and economic reforms. Privatization of state property and the cancellation of the state of consumer prices devalued savings and created massive unemployment and crushed the purchasing power of the population. That is why Russia has experienced a decline in population since 1992. This coincidence suggests that the solution of demographic problems must begin from researching of the interaction of economic and demographic systems. Russia’s demographic crisis interprets by the coincidence of social and economic reforms which were the reasons that provoked the social stress.

Negative demographic situation with high mortality rates in Russia is mostly generated by the problems in the economic and social structure of society in the period of 1990.

According to statistics a significant increase in deaths is by reason of infectious parasitic diseases which show the level of poverty. Among the causes of deaths from external sources is suicide. Thus, the main reason for the catastrophic deterioration of the demographic situation and trends comes from the psychological stress associated with a low estimating of social perspectives, the hopelessness of the socio-economic status. The effect of negative social pressure is similar to the effect of severe depression in which the value of life lost. Indeed, the socio-economic transformations in Russia especially in the initial phase were carried out primarily through the impoverishment of the population. The biggest negative role played by the so-called “shock strategy” an accelerated privatization in 1992-1994 and default in August 1998. “Shock strategy” of the reforms has caused a sharp deterioration in the quality of life, loss of efficiency of work motivation and development of social stress. This immediately led to the collapse of health and demographic indicators. From the financial crisis in August 1998, employers again came at the expense of deeper impoverishment of the population, extremely aggravated social stress. Therefore, logically, that it was after the default of Russia’s population decline was roughly a million people a year. Thus, the root causes of such a sharp increase in mortality in Russia, decline of fertility and the development of the demographic crisis is a long-acting social stress caused by the decline in the quality of life in most families. Moreover, the changes taking place in Russia since 1990, characterized by instability and reversible processes. The problem arises to determine the surest ways to control such development. In this case, the demographic situation should be viewed as an open system interacting with the socio-economic and demographic systems. Socio-economic resources characterize the features of the demographic situation. According to our point of view the effective socio-economic developments in Russia are state and trends, in which the country will be ensured stability and processes of population reproduction, through the effective using of limited socio-economic resources.

As a keyword indicator for assessing the effectiveness of the demographic development has been chosen the rate of natural population growth. As factors of social and economic development were selected integral factors influencing for the birth rate and mortality coefficients.

By carrying out correlation analysis of indicators we took important factors influencing mortality and fertility rates.

The first factor shows the effectiveness of incentives of fertility by the government. The second and fourth factors reflect the impact on fertility levels of life and livelihood, the third - the impact on her family of modern human behavior. The fourth factor reflects the influence of the level of life and livelihood on mortality, the fifth - the impact of the public health system, the sixth - the condition of the labor market.

Consequently, the considered factors can be used as criteria for the control and management.

## **A World of Intended Pregnancies**

Robert Engelman, Worldwatch Institute

Although population is a perpetually contentious topic, few would disagree that population growth below that of the United Nations Population Division’s widely cited medium projection would contribute to long-term global environmental sustainability.[1]

Researchers with the Futures Group have estimated demographic impacts from, and the financing and policy

implications of, meeting unmet need for family planning in the United States and most developing countries.[2] The Guttmacher Institute has developed estimates of the rates and proportions of unintended pregnancies worldwide and their impacts on rates and numbers of births that are unplanned.[3] Based on the Guttmacher data, and allowing for unplanned births that result from mistimed rather than never-wanted pregnancies, this paper will project total fertility and growth rates of world population under a hypothetical scenario in which all future births are outcomes of intended pregnancies. I will test the hypothesis that under quite conservative assumptions about the contribution of mistimed pregnancies to later intended pregnancies, total world fertility would fall below replacement immediately. Under less conservative assumptions world population growth could reverse before 2050. The paper will explore the concept of “intended pregnancy” and research challenges in this work.

Most people can relate to the feelings of either elation or dread that a woman feels on learning that she has become pregnant. Successfully communicating that population policy aims to increase to the highest possible levels the proportion of pregnancies that are welcome rather than unintended, public support for such policies would be strengthened. If, in addition, it could be shown that a benefit effect of such policies, beyond directly improving individual well-being, would be to slow and eventually reverse world population growth—with all environmental benefits this would help bring about—public support for rights-based population policies would likely grow in both the developing and industrialized worlds.

This paper will take on a two-fold task in this complex arena. Qualitatively, it will lay out the issues involved in considering demographic impacts of raising the proportion of births that result from intended pregnancy (as well as to point out the reasons for doing so). And it will address some of the challenges of attempting to assess the proportion and magnitude of such births in the human population. I will make a first-order assessment suggesting how future population would change from the “expected” future if we could somehow instantaneously empower all women worldwide to have personal control over the timing of pregnancy. Based primarily on the Guttmacher Institute data on intended pregnancies and resulting “unplanned births,” I will calculate what the global total fertility rate would be if such births did not occur and hence did not contribute to total fertility or future population growth.

The Guttmacher Institute estimates that 22 percent of all births worldwide are the outcomes of unintended pregnancies. There is considerable some variation by region and country. If we used these figures to calculate birthrates and life tables without such births, our task would be relatively easy—and total fertility rates would be well below replacement for the world as a whole. (Current replacement fertility worldwide is 2.34, based on dividing total fertility by net reproduction, using data from the United Nations Population Division’s 2008 revision of its World Population Prospects.[4]) But the task is much more complicated. Guttmacher Institute data also suggest that most unintended pregnancies are mistimed rather than unwanted altogether, so I must make assumptions about the demographic impact of preventing mistimed pregnancies. Will not such prevention result in an increase of later intended pregnancies? Probably, but in some cases, later circumstances would be no better than current ones for an intended pregnancy. In others, the woman’s age-related fecundity may not allow for the later intended pregnancy. In short, the amount and timing of births from intended pregnancies that result from earlier prevented mistiming of pregnancy cannot be predicted based on available data. To address this problem I will present a range of estimates and projections of birthrates and future population growth, bounded by two assumptions. On the most conservative side, we will simply exclude all mistimed pregnancies from our calculations of births from unintended pregnancies, based on the best estimates of global rates of mistimed pregnancies. In effect, this is biologically unrealistic in the extreme, since it essentially assumes that prevention of a mistimed pregnancy is immediately followed by an intended one—in the same year. For that reason, this boundary offers an unassailably conservative basis for one end of our range of calculations.

As the use of such assumptions indicates, the available data lack the comprehensive geographical and temporal accuracy that would support a robust estimate of the demographic impacts of women’s control of pregnancy timing. Why go through the exercise, then? The idea that prevention of unintended pregnancy could actually turn population dynamics into an environmentally positive force is among the most hopeful available in the consideration of the sustainability crisis. We need to begin the difficult process of assessing whether the idea is realistic or a fantasy, yet almost no work on this important question has gone forward. If the data are insufficient to answer our questions today, we need to find ways to develop better data, rather than dismiss the inquiry as too speculative due to the lack of data.

- [1] United Nations, *Seminar on the Relevance of Population Aspects for the Achievement of the Millennium Development Goals*, United Nations, New York, 2005, p. XII-1.
- [2] Scott Moreland, Ellen Smith and Suneeta Sharma, *World Population Prospects and Unmet Need for Family Planning*, Futures Group, Washington, D.C., April 20, 2010, available at <http://www.futuresgroup.com/publications/world-population-prospects-and-unmet-need-for-family-planning/>, accessed September 16, 2010.
- [3] Susheela Singh et al., *Abortion Worldwide: A Decade of Uneven Progress*, Guttmacher Institute, New York, 2009, available at <http://www.guttmacher.org/pubs/AWWfullreport.pdf>, accessed September 16, 2010.
- [4] United Nations Population Division, *World Population Prospects: The 2008 Revision Population Database*, available on-line at <http://>



## **Providing National Food Security in India: A Retrospective Analysis of Food Subsidy for the Poor**

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Ensuring food and nutrition security poses a considerable challenge for India. The country's population is approaching almost 1.2 billion today, and it is likely to be the most populous country on this planet by 2030 with 1.6 billion people. This currently accounts for more than 17% of the global population, with 456 million poor people (or 41.6%) living on less than \$1.25 a day (Chen and Ravallion 2008).

Food spending accounts for a significant share of budgets of poor households in India and their economic welfare is therefore sensitive to food prices. Some literatures (ADB 2008, de Janvry and Sadoulet 2009, Masters and Shievely 2008, Son 2008) have shown that higher prices of food staples have a significant adverse effect on the poor.

The government of India proposes to ensure that every below the poverty line (BPL) family in the country shall be entitled to 35 kg rice per month @ Rs. 3.00 per kg. India's Planning Commission currently estimates that 37.2 per cent of the total Indian population lives below the poverty line.

In this paper, we examine the outcomes of removing the rice subsidies for the BPL population using the IRRI Global Rice Model (IGRM) – a partial equilibrium structural econometric simulation model. The IGRM consists of 21 major rice producing, consuming and trading countries. The representative country model includes supply, demand, trade, ending stock and market equilibrium conditions.

The IGRM will be used to estimate a baseline demand for rice that incorporates both BPL and non-BPL demand for the last ten years with a set of exogenous factors about the general economy, agricultural policies, and technology changes in net exporting and net importing countries. A scenario will be developed by removing the BPL demand. The scenario results will be compared with the baseline to quantify the effect of lifting the BPL demand for rice on national food security.

## **Declining Work-Age Population Threats Global Economic Sustainability**

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World population exploded throughout the last century; it increased from 2.55 billion in 1950 to 6.396 billion in 2004, and is projected to reach 9.276 billion in 2050 (UN 2005). There is a hidden momentum of population growth; it has a built in tendency to continue growing even after birthrates have declined substantially or to a replacement rate. It is estimated that if the population continues to grow at 1990 rates, world population will reach to 694 billion by 2150; if it grows at a rate just one-tenth above the replacement rate it will reach the level of 12.5 billion by 2050 and 20.8 billion by 2150; and if it grows just at the replacement rate it will reach to 7.7 billion by 2050 and 8.4 billion by 2150 (Cohen 1995). These numbers, however, are to be considered in conjunction with the limits of earth's population carrying capacity. Based on the agricultural carrying capacity earth's population carrying capacity was estimated to be only 902 million in 1945 and as high as 147 billion in 1967. However, almost all the scholars seem to agree that the earth's human carrying capacity finally depends on the technological capacity (ability to unlock/create useful resources from the earth's nature and environment) and the social choices (life style, social structure, etc.). Its biophysical carrying capacity sets the maximum population size that could be sustained biophysically under the given technological capabilities and its social carrying capacity sets the maximum size that could be sustained under the various social systems. It is worth noting that human ingenuity, through innovations and adaptations of social and industrial engineering and technology, has enabled dramatic increases in both the biophysical and the social population carrying capacity of the planet. The truth of the matter is that there is no single numerical answer, now or ever, to the question how many people the earth can carry; it can at best be conditional (Weil 2009, pp.139).

However, Desvaux (2007) cautions that failing to control population growth the humans risk the worst population crash. Earlier in 1950s there was a similar alarm on the danger of population explosion. In response to that warning a worldwide population stabilization policy was strongly emphasized. Most countries took measures to arrest population growth. It is now envisaged that the annual growth rate of population will decline from 1.21% during 2000-2005 to 0.38% in 2045-2050 (UN 2005) causing significant negative effect on the world economy. It is feared that from 2050 onward the whole world will face the greatest problem of declining work-age population. At that time the work-age dependency ratio - the proportion of youth (under age 15) and old people (over age 65) to economically active adults (age 15-65) - will become higher and it will be more difficult for a declining economically active population to support an increasing economically dependent population. Declining of the work-age population will generate low gross domestic product (GDP), low gross national income (GNI), and low tax revenue for the government. It is feared that during the coming decades of this century most of the countries, specially the developed countries, will face the problem of the low tax revenue available to meet the high subsidized expenditure for larger number of the old-age people. This will cause the governments to maintain deficit budgets all the time. In fact, Japan, Germany, Switzerland and some other countries are already under the threat of this phenomenon. Moreover, due to decline in the labor force, cost of production will rise and the cost push inflation rate will be very high. Therefore, an economic crisis is likely to prevail all over the world especially in the period after 2050. The decline in work-age population will also seriously affect the technological advancement in the existing and new sectors. If nations fail to engage required number of researchers it will lead to a stagnation of technological growth. Furthermore, the industrial revolution has not yet happened in many parts of the world. When industrialization process will start in these countries, huge labor force will be needed there.

The labor-short industrialized countries are now trying to cope up with the situation through short-time importation and permanent migration of manpower mostly from the high fertility developing countries. This is done in different ways like granting of citizenship, permanent residence status (PR certificate, green card, diversity visa-DV, etc), work permits to foreigners, accepting asylum seekers and refugees, admitting international students and permitting them to stay on to work after completion of studies, etc. Under the DV scheme alone US receives every year 50,000 permanent immigrants from the developing countries. During 2005-2007 more than 1.1 million foreigners per year were granted permanent resident status in the USA. Most of the labor-short industrialized countries are currently using migration as a source of additional supply of labor to meet the growing demand. However, in the world context migration is a zero-sum game - an increase in the number of migrant population in the receiving country is just equal to a decrease in the number of population in the sending country. For a long run solution the world population has to grow. To support the growing population there is a need for increasing the earth's carrying capacity. Planet's capacity to support any sustainable size of population depends primarily on the sophistication of the society's life style (including distribution of population and resources) and the technological advancement.

It is expected that in response to the ethical and environmental demands the future social engineering and technology advancement will be geared toward development of a practicable structure of a life style based on a 'slim-green' consumption choice founded on the principle of 'simple living and high thinking'. Society will be more ethical and health conscious and will prefer to return from consumerism. This life style of the society will result in resource saving, resource conservation, waste minimization, etc. It will enhance earth's capacity to carry a larger sustainable population. In addition, it may also focus on the planned redistribution of population from the resource poor crowded countries to the resource rich sparsely populated countries to temporarily reduce labor shortage problems in some countries and labor unemployment problems in other countries. The future industrial engineering and technology development will focus on development of: a) resource saving technology, in terms of method, process and product, to enable production of same amount of outputs with reduced resource uses (for instance, the energy saving bulb consumes less energy to produce same amount of light; the system of quicker growing livestock and poultry, genetically modified organism and hybrid food etc. are other products of such technology); and b) resource increasing technology for unlocking new resources from the nature and environment of the earth, like finding or producing new outputs from the sea, desert, air, sunlight etc. (growing seaweed as a food item, solar energy like photovoltaic cells, wind mills, utilization of unused and rival resources like wastes for production purposes, etc. are the products of such technology).

Emphasis on population stabilization policy has led the fertility rate to fall and the work-age population for the future to shrink. This will push the world to a serious economic crisis more particularly after 2050 when only a decreasing size of the work-age population will be available to look after an increasing size of the dependent population. An appropriate solution of this worldwide potential problem must be sought through a policy of maintaining optimal rate of world population growth consistent with the growth of the social and industrial technology, the resultant life style of the people, and the increase in earth's absorption capacity. The paper argues that to maintain a sustainable economic growth and support the associated technological advancements in the future there will be demand for a larger labor force. It notes that the industrialized countries are now temporarily managing with the migrant population drawn mostly from the

high fertility low income countries. But in the world context this is only a zero-sum game without increasing the stock of world's total labor force. Therefore world population needs to grow to meet the growing demand for a larger labor force for economic sustainability. It notes that population growth rate through increased child birthrate passes through a considerable time-lag because of what may be called 'Child Bearing Habitual Gap' and 'Work-age Formation Gap' (Alam, et. al., 2009). It also argues that since the earth's population carrying capacity largely depends on the technological capability and the life style of the society the world should not be scared of a planned population growth. It foresees that in the future the social engineering and technological innovations may give birth to an ethics and environment friendly 'slim-green' life style founded on the principle of 'simple living and high thinking', which will increase the earth's population absorption capacity.

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## Posters

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### **A Study of Scenarios for Metropolitan Development Based on Smart Growth Policies: A Case Study of Kaohsiung metropolitan area**

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"Sustainable development" has been a well-known global agenda. For urban development, it is important to consider about how to develop a sustainable city and deal with the delicate balance between economic development and ecological preservation. "Urban sprawl" describes a phenomenon that urbanized areas extend outward rapidly during the suburbanization process, encroaching large amount of farmland and forests, bringing negative effects to environments, and causing more traffic problems. It is believed to break the balance and impede sustainable urban development. In order to prevent urban sprawl, smart growth policy has been proposed to pursue a sustainable future. It emphasizes on compact city, pedestrian friendly, transit-oriented development and re-infill development. Most existing researches on the relationships between smart growth policy and physical environments analyze the change of spatial structure by review rather than predict it. Our research uses new methods for simulating the future growth of a metropolitan area based on smart growth policy.

The aim of this study is to investigate the question of: how can smart growth policy affect metropolitan growth and guide the metropolitan area develop sustainably? Based on the aim, an appropriate set of tools is needed for simulating the changes in the development of metropolitan area and for demonstrating smart growth policy development scenarios, as the future reference for the assessment of development strategies. Planning support systems (PSS) are a subset of computer-based instruments that integrate geo-information system (GIS), decision support system (DSS) and planning theory. It is intended to support planners in planning tasks such as information handling, communication and analysis in planning process. "What If?" PSS, developed by Klosterman [1999], is a scenario-based, policy oriented PSS that uses GIS data to conduct land suitability analysis, project future land use demand, and allocate these projected demands to the most suitable locations. It offers an evidence-based approach for incorporating socioeconomic and biophysical data to formulate land use change scenarios. It also allows users to create future urban growth scenarios and determine the impacts of alternative policy choices on future land use patterns and social trends.

A case study approach is undertaken for Kaohsiung metropolitan area in southern Taiwan. Taiwan is an island lies off the southeastern coast of mainland Asia. In the last 40 years, cities in Taiwan have grown so fast and sprawled consistently. Kaohsiung metropolitan area is formed by a large amount of urbanized areas. It is the only metropolitan area with sea and air ports and also developed the rapid transit system in recent years. Due to the great advantage of transportation, the accessibility advanced and it has become one of the major metropolitan areas facing the heavy pressure of population growth. The population has grown rapidly and also caused serious urban sprawl in Kaohsiung metropolitan area in recent years.

Application of the collaborative GIS-based What If? planning support system is used in this study for managing data and creating exploratory future land use change scenarios for Kaohsiung metropolitan area. Formulating planning scenario

required different socioeconomic, physical and environmental data inputs. Socioeconomic data inputs for computing the future demand of development, included population projections, industry employment projections, projected average household size, and the projected number of dwellings. Physical and environmental data inputs to analyze the suitability of land use. It consisted of slope, flood area, areas of prime agricultural land, road, stream, land use, existing open space and locations of MRT station, airport and seaport.

Three potential urban growth scenarios are put forth to address this issue. The first scenario is the future trends scenario, based upon existing regional and urban trends. This scenario only considered about the impact of normal zoning regulation and every suitability factors. The second and third scenarios are based on the smart growth policy, transit-oriented development (TOD) scenario and urban renewal scenario. The TOD scenario utilized most of the concepts in smart growth policy including the compact city strategy and natural resources preservation. The urban renewal scenario not only utilized the TOD concept but also the re-infill development. It is willing to guide the development into the existing area that is benefited by the public facilities to decrease the opportunity of urban sprawl. In order to analyze the impact of different kinds of scenarios, a geo-spatial indices system for measuring sprawl is applied to evaluate the performance of the urban pattern.

In terms of the result of simulations, the performance of Kaohsiung metropolitan area under the evaluation of urban sprawl indices system shows that it has been effectively controlled from urban sprawl by implementing smart growth policy. In the future trend scenario, most of the new developments are near the urban planning area, those sporadic development activities are lack of efficient based on the point of view of smart growth. Compared to the future trend scenario, the TOD scenario guides most of the development into the urban planning area and controls the population. Nevertheless the inner city doesn't have enough empty space, the development still spreads out. Most of all, the re-infill scenarios can not only effectively control the population in urban areas but also inhibit the improper expansion among the city. It can contribute to the compact development and increase the efficiency of metropolitan development. In pursuit of economic development, taking the importance of environmental protection into account promotes the Kaohsiung metropolitan area towards sustainable development.

Our research simulated the future development of metropolitan area under smart growth policy by the application of What If?. Although it can't precisely predict the future, it allows planners understand the effect of smart growth policy. This result can provide a reference to administration of Kaohsiung for sustainable metropolitan development.

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## A Proposal of Putrajaya Green City 2025 in Malaysia

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This study presents the feasibility of developing a low-carbon society in Putrajaya, Malaysia. Putrajaya is Malaysia's federal administrative capital, which is located 25 km south of Kuala Lumpur. The development of this 49,310 m<sup>2</sup> city started in 1995 and is planned to complete by 2012. The population in 2007 was 49,452, and is planned to become 347,700 in 2025 (Perbadanan Putrajaya, 2009). As of January 2006, nineteen government ministries and the Supreme Court have been transferred to Putrajaya from Kuala Lumpur. The transfer of other government ministries and departments will be an ongoing process till 2023.

Malaysia's national target is to reduce 40% of GHG emission intensity by 2020 compared to 2005 level. In his 2010 Budget speech, The Prime Minister of Malaysia; YAB Dato' Sri Mohd. Najib bin Tun Abdul Razak announced the national aim to develop Putrajaya and Cyberjaya as pioneer township in Green Technology, these towns will be a showcase for the development of other township. In response to this, a research project titled "Putrajaya Green City 2025" (PGC2025) began as support to policy makers. This research was initiated by a University Teknologi Malaysia and Putrajaya Corporation (PJC) with the support from counterparts from Malaysia and Japan. PJC who is the local authority of Putrajaya plays the role of managing and administrating all activities in Putrajaya.

In this project, three quantitative environmental targets are set, they are as follows: (i) Low-carbon Putrajaya: Reduce CO<sub>2</sub> emission per economic activity (multiplication of the number of employment and national per capita GDP) by 60% compared to 2007 level. (ii) Cooler Putrajaya: Reduce peak temperature by 2 degrees centigrade compared to 2007 level. (iii) 3R Putrajaya: Reduce final disposal of solid waste and GHG emission from solid waste management by 50% compared to the level in 2025 business as usual scenario (2025BaU).

The originality of this study lies in the uniqueness of combining these three environmental targets towards achieving Putrajaya as Green City in 2025. Here we are not only focusing on CO<sub>2</sub> emission, however, we are considered the relationship between all three targets mentioned above. For instance, by mitigating the urban environment in (2), the uses of air conditioners are expected to be reduced, and people will shift from automobile to walk or bicycle, contributing to (1). And also the target in (3) includes low-carbon target.

To estimate CO<sub>2</sub> emission for "Low-carbon Putrajaya", we developed a tool named "Community Extended Snapshot Tool (C-ExSS)". C-ExSS is an estimation tool to design low-carbon society for communities which do not have the industrial sector. This tool illustrates the quantitative future snapshot of the community, and estimates the future environmental load of emissions. Following this, it defines a portfolio of measures to meet environmental target which will assist the government in future decision making process. It aims at "community", small area, for which detailed data for like employment or floor area are available.

The features of C-ExSS are as mentioned below; (a) The Industrial sector does not need to be set, and users can set the detailed classification in sectors as block or building level to meet the function of their target region. That makes it possible to know needed introduction amount of countermeasures for each of them. (b) The household sector is classified by income classes, so it is possible to consider household structure change. (c) The energy demand is driven by population, floor area and the number of employment.

Using C-ExSS, we estimated energy demand and CO<sub>2</sub> emission in 2007 and in two future scenarios; 2025 Business as Usual (2025BaU) and 2025 with countermeasures scenario (2025CM). For the case of 2025CM, we also estimated measures which can be introduced and how much of these measures need to be introduced to achieve the three targets mentioned above. The classification of sectors set in this study is: Commercial, Public amenities & facilities, Government departments and Residential.

According to Perbadanan Putrajaya (2009), the population will increase about 7 times in 2025 compared to 2007 level and the number of employment in 2007 which was 45,000 will increase to 164,500 in 2025 (3.66 times). The floor area of

development is planned to increase in the same duration of time by 3.73 times.

As a result from our calculation, the final energy demand and CO<sub>2</sub> emission was estimated to increase 6.70 times and 7.32 times respectively in 2025BaU scenario. By introducing measures, these levels can be reduced 55% and 58% respectively from the level in 2025BaU scenario. The per capita CO<sub>2</sub> emission is estimated to be 8.68[tCO<sub>2</sub>] in 2007, 8.62[tCO<sub>2</sub>] in 2025BaU, and with the introduction of countermeasures, this can be reduced to 4.19[tCO<sub>2</sub>] in 2025CM. The reason as to why there is a decrease in CO<sub>2</sub> emission from 2007 to 2025BaU even without countermeasures is because the population growth is higher than increase in employment. As for CO<sub>2</sub> emission per economic activity, if the economic activity is defined as one (1) in 2007, it is estimated to be 0.94 in 2025BaU and can be further reduce to 0.40 in 2025CM.

The result from the calculations, the most effective measures which can be introduced in Putrajaya are: "Introduction of energy-efficient appliances (Contribution: 26%)" and "Low-emission vehicles (20%)", and "Efficiency improvement of central power generation (15%)". In this study, the countermeasures are classified into 12 "Actions" as following, to ease the decision making procedure; (1)Integrated City Planning & management (2)Low-carbon Transportation (3)Cutting-Edge Sustainable Buildings (4)Low-carbon Lifestyle (5)More and More Renewable Energy (6)The Green Lung of Putrajaya (7) Cooler Urban Structures and Buildings (8)Community and Individual Action to Reduce Urban Temperature (9)Use Less Consume Less (10)Think Before You Throw (11)Integrated Waste Treatment (12)Green Incentives and Capacity Building. The most effective action is (3), which includes energy efficiency improvement of buildings, and the second one is (2).

The findings from this research are able to assist policy makers towards making Putrajaya a Green City by 2025. However, in this research the energy demand is calculated based the downscaled national energy demand of Malaysia. This can be further improved if we can obtain the first hand data about energy demand in Putrajaya.

This research was supported by JST/JICA, SATRESPS.

Perbadanan Putrajaya (2009): Laporan Pemeriksaan Draf Rancangan Struktur Putrajaya, Jun 2009.

## **The Research for Urban Sprawl and Tendency Patterns of Development in Tainan Metropolitan**

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The expansion of urban space makes positive benefits and negative impacts on sustainable development. It helps to ease the speed of population growth, the over-developing industrial development and the high housing prices pressure. It also improves living standards and social welfare. However, without well-prepared considerations and regulations, urban sprawl may make urban patterns turn into low-density, leapfrog and fragmentation and it will make negative impacts on urban landscape, land use, transportation, finance, public facilities, and increase the cost of urban planning.

To this issue, we need a comprehensive and scientific way of measuring the characteristics of urban sprawl in order to improve urban sustainable planning. Since Urban sprawl is a complicated phenomenon which has many urban growth characteristics, it is difficult to observe with single indicator. This study attempts to measure urban sprawl from the view of landscape ecology: by using the land-use survey data and geographic information system, we can establish the urban sprawl index, so we can clarify its development patterns and trends.

After considering the characteristics of urban development in Taiwan, the appropriate of the indicator representative, indicator of the data could be operational and whether the data have obtained or not. This paper classifies them in two dimension: Development density and Land cover: including gross population density, net population density, the ratio of build-up area, patch size standard deviation, landscape shape index, landscape fractal dimension and the other indicators. In addition, without losing their statistical significance, we use Z-Score to make each index consistency, so it helps interpret the spread out of the phenomenon. To further demonstrate their differences and characters, this paper runs through the hierarchical cluster methods and K-means methods to separate them into appropriate classes. At the same time, we use one-way ANOVA to interpret the remarkable extent of the assessment indicators.

To sum up, in this study, the research uses the Tainan metropolitan, Taiwan, as the research object. The research establishes the index of urban sprawl between 1995 and 2006 which is measured by the viewpoint of landscape ecology. The research hopes to discover some changes in trends, clarify the trend of Tainan metropolitan which tends to spread or become more closely. We consider administrative zone as our research unit so that we can use the research results to provide it to practical use for urban development planning.

# Stresses on natural systems

Stefan Bringezu & Yochanan Kushnir

## Oral Presentations

### Optimum Cropping Pattern for Food Security in India under Climate Change and Water Scarcity

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Generally, Links and interactions between water, climate, population, energy, food and environment will determine future global food security. Climate change, rapid population growth, and water scarcity are the main constraints of food security in India. The existing studies present that climate change models can be a way forward for future climate projections. Meanwhile, future projections of more than one climate model are necessary for providing insights into model uncertainties, as well as to develop risk management strategies. Therefore, optimizing cropping pattern to maximize water use and to meet population nutrition under water scarcity and climate change scenarios became an urgent need. Therefore, climate change scenarios for each district will be created by combining the output of three equilibrium 2xCO<sub>2</sub> General Circulation Models (GCMs) with the daily climate data for each district. The three GCMs are Canadian Climate Change Model (CCCM), Geophysical Fluid Dynamics Laboratory (GFDL R-30), and (GFDL 0.01/yr transient). These models will be used to create the climate change scenarios at the high end of the IPCC range (1.5oC to3.5oC). Outputs of the three GCMs will be used to evaluate the impact of climate change on the main Indian crops in rainfed and irrigated areas. The modified climate data will be incorporated into the CROPWAT model and will be used to evaluate the potential impact of climate change on crop water requirements in India. Crop yield prediction of the Indian main crops will be studied using DSSAT4.5 model. A linear programming optimization model was developed to maximize the net national agricultural revenue and to meet the nutrition needs of the country. The preliminary results of the rainfed scenarios show that national food security and nutrition requirements can be met without irrigation even though potential yields are reduced.

### Biofuels, Wastelands and Livelihoods: How India's *Jatropha* Biodiesel Program is Backfiring on the Rural Poor

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Representative of recent trends in sustainable biofuel promotion, India's current biodiesel policy mandates the use of non-edible oilseeds grown on marginal lands so as to avoid competition with food production and to maximize benefits to rural welfare, energy security and environmental quality. However, the extent of marginal lands, referred to as wastelands in India, as well as their significance to rural livelihoods, is poorly understood.

Through a case study of *Jatropha curcas* biodiesel production in Tamil Nadu, this paper highlights the ambiguities, contradictions and omissions embodied in the concept of wastelands. Multiple assessments exist, each yielding different results and each underplaying the linkage between wastelands and rural livelihoods. Stakeholders are united in the belief that there is no such thing as wastelands but with different corollaries. Government and corporate officials assert these areas could be put to better economic uses while village stakeholders claim there are no wasted lands within the village bounds.

Further, the wasteland areas targeted for biofuel production are currently cultivated with *Prosopis juliflora*, a drought tolerant tree presently used as a feedstock for a host of energy applications including fuelwood, charcoal and electricity production. *Prosopis* coppicing also provides annual employment to marginal farmers and the landless poor. *Prosopis* would have to be removed for *Jatropha* cultivation as the two trees cannot grow symbiotically. This paper will also present a comparative analysis of the livelihood significance of the *Jatropha* and *Prosopis* economies in terms of their employment potential for rural communities.

Findings from this paper, based on nine months of fieldwork in India, will provide bottom up insights into the linkages between marginal lands, livelihoods, energy policy and sustainable development.

## Technological Impact of Placer Gold Mine on Water Quality: a Case Study of Tuul River Valley in the Zaamar Goldfield, Mongolia

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Mining industry is now being considered as a main source of the growth and development of Mongolia. It is significantly contributing to the national economic and social development, however in fact its impact on the environment is becoming more serious when it comes to the case of a placer (also called as alluvial or hydraulic) gold mine, which dominantly uses water in all through its recovery procedures. The main objectives of the study are to assess the impacts of the placer gold mining activities on the water quality and evaluate the main determinants of technologies applied in the gold mines in case of Zaamar goldfield. We applied both qualitative and quantitative approaches in the study. Field study was done to take water quality sampling at 15 points measuring the chemical concentrations of pollutants and survey was conducted to 7 mine managers in the Tuul river valley in the Zaamar goldfield in October 2010.

Through the water sampling and quality measurement, we found higher concentrations of heavy metals and other chemicals pollution in the surface water, which is significantly contaminated by the extensive placer gold mining activities along the river. The water quality in the sampling points varies from mine to mine basically depending on the types of gold recovery technologies applied. In general, three different types of gold recovery technologies: primitive, medium and advanced are available in gold processing, however, only the primitive techniques are dominating in the Zaamar goldfield as observed. Initial assumption on the determinants of technology adoption was that the mines with foreign ownership might have cleaner technologies with less impact on the water quality than the local ones. However the result from the field study shows that the mines jointly owned by Russian or Chinese companies in Zaamar area have more polluting technologies than the local smaller companies.

Although today the mine revenues are significantly contributing to the national economy of Mongolia, the current-polluting practices in the Zaamar goldfield can have detrimental expense to the local economy in the future due to restoration of extensively damaged ecosystem. Therefore, as it could be one of the most reasonable and practicable solutions, we recommend that polluter-pays-principle shall be adhered in order to help to promote cleaner technology adoption and minimize the impacts from gold recovery technologies in the long run.

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## Impact mitigation of Climate Change Variability on Resource Base Carrying Capacity

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The theme of the study is based on the assessment of “the link Between Resources Base Carrying Capacity, Climate Change Variability and Population Growth” in twelve communities based primarily on the assessment of the existing natural resource base and socioeconomic conditions of the communities.

Participatory Rapid Rural Appraisal was used to assess the socioeconomic situation of the farming communities. Semi-structured interviews of 566 household heads, selected Focus Group Discussions and Key informant interviews were



carried out, using a household questionnaire focused on the socioeconomic conditions. These included demographic characteristics, land use system, farming system, land holding and livestock population, agricultural production and productivity, technological inputs, available social service/ infrastructure, on/off-farming activities, forest resources management, soil and water conservation activities, access to land resources and constraints to agricultural production as perceived by the respondents. Climatic data (precipitation and temperature data, time series of monthly rainfall, monthly maximum temperature and monthly minimum temperature using FAO crop-wat8 software) was assessed for the past 30 years. Satellite imageries of 2007 with a spatial resolution covering the study areas, available records or results of Population Census and available reports including published and unpublished articles and research works on the study areas were also used to glean secondary data.

The study area consists of six communities (Fikre Selam, Gosh Wuha, Kara Amba, Kokeb Mesk, Lamgeno, Salayish, Dire Doyo, Girar Geber, Gishe Uosmani, Torban Ashe and Wertu) of Amhara and Oromia Regional States. The altitude of the study area ranges from 1300 to 2600 meters. The rainfall distribution in this study area is bimodal, with Kiremt season that extends from August to September and the short Belg rains of March to May. According to the record of the past 30 years, the mean annual rainfall is about 1200 mm, while the annual average temperature is about 14.80C.

The major constraints to livelihood security in the study areas are land shortage, erratic rains, lack of improved farming technologies and agricultural inputs, shortage of livestock feed (grazing area), diseases and lack of vet service. Woody biomass is the major source of energy supply, providing over 73% of the domestic energy requirement.

The analysis of rainfall variability, temperature and potential evapo-transpiration shows that the area has a crop-growing period of about five to six months and is suitable for double cropping of short to medium crops and for single cropping of long cycle crops. This may result in more evapo-transpiration and thus in rainfall deficient years, the impact on crops can be more severe. The increasing trend of the annual average and minimum temperature, though having some positive side in decreasing frost risk, can also bring disastrous consequences in the long run.

Analysis on the degree of population pressure on land resources was carried out through compilation of the annual energy (Kcal) requirement per household, total energy supply from on farm crop production and the balance of energy supply vs. consumption from the present farmland. The result of the analysis shows that in the study area of Ensaro, the annual energy supply from on-farm production is only 3,338,945 Kcal, or about 91.5% of the requirement, while in G. Jarso, the supply is more than the consumption. However, based on population growth rate (2.9%), the study area annual energy requirement will exceed the supply from the farm production.

Land shortage, erratic rain, poor agricultural production and shortage of grazing area are the major socioeconomic problems in the study area. Rapid population growth is one of the major factors that contributed to the problem of land scarcity. Normally, each household is obliged to allocate land to descendants when they reached maturity and form their own households. However, the current land holding in the study area is 1.01 ha/ household. Thus, with this size of land holding and the average family size, a typical household could not provide secure livelihood or a reasonable size of land to its descendants.

Climate variability has already posed significant threat to agricultural production, resulting in poor crop production and productivity in the study area. The problem of climate change is recognized very well by most of the sampled household heads. Thus, the majority of the household heads (81%); do recognize the occurrence of climate change in their area. According to these groups, the signals for climate change include erratic rain, increase in temperature, frost and shortage of rain. More than a quarter of the group pointed out that change in climate has brought decrease in agricultural production, shortage of food, increased cost of living and shortage of livestock feed and hence death of cattle.

In line with this, some of the traditional methods of adaptive mechanisms identified by households include early cultivation, cultivation of short season crops, undertaking of off-farm activities (employment) and sale of property. The majority of respondents (91%) agree that family size affects the ability to cope with the problems emanated from climate change. According to this group, the increase in family size results in shortage of land and deforestation, and these in turn leads to increased demand on products; thus decreasing the capacity to cope with the problems caused by climate change. Further, the majority of the respondents think that in future, there will be even more risks to be brought by climate change, and they indicated that these risks or climate change related hazards could be shortage of rain, poverty, famine, drought/ migration and decrease of agricultural production.

Significant measures have not been taken since 1974 to alleviate the problem of land shortage, to introduce conservation oriented land resources management and sound farming practices in the study area; having a high contribution towards the loss of natural vegetation resources and land degradation, which in aggregate affect the climate directly by increasing the level of green house gases. The same source also reported that forests could mitigate the effect of climate changes because of their ability to absorb CO<sub>2</sub> and store in their woody tissue. Hence, their removal results in massive release

of carbon, primarily as CO<sub>2</sub>, into the atmosphere and can alter climate through increasing reflectivity (albedo) and decreasing evapo-transpiration.

Unless the population growth is controlled, which stands at the regional growth rate of 2.9%, it is estimated to double within 14 years, reducing the present average land holding (1.2 ha) to about 0.2 ha per household in the near future. There is therefore strong correlation between population growth, degradation and shrinking land holding that leads to land hunger. The problems can be partially alleviated by increasing the productivity of existing farmlands through introduction of sound land management, improved farming system and sustainability of agricultural land. As much as 80% of deforestation for expansion of agricultural land can be eliminated through promotion of sustainable cropping systems, which include introduction of crop mixes, planting and management systems and improved genetic strains of crops.

Therefore, besides the introduction of conservation oriented land management and farming practices, there is also a need to introduce non-farm activities. Schemes of alternative means of income generations such as cottage industries have to be introduced, further supported with relocation measures. Those households with smallholdings and the landless have to be relocated to sparsely populated areas within the region or in the country. In line with this, some of the existing policies have to be revised to devise strategies that that can possibly encourage a free mobility of the rural population from areas of land shortage to areas of abundance.

The danger of population growth to the natural resources of the country, and the need to control this problem has been repeatedly articulated in a number of the country's conservation programs and action plans and the Plan for Accelerated and Sustainable Development to end Poverty. Hence, there should be concerted effort to control effectively the high growth rate of human population in the study area. This can be achieved among others, through introduction of voluntary family planning program, which provide information on and access to contraceptives.

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## **Environmental Impacts of Fly Ash Generated from a Coal Fired Power Plant in Indian Subcontinent**

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Coal has always been the backbone of any industrialized nation as it fulfills the energy requirement for all developmental activities. Coal occupies an important position in energy sector in India since India has vast reserves of thermal grade coal. Combustion of coal to generate electricity produces large volumes of coal combustion residues (CCRs) particularly fly ash as Indian coals contain high ash. These fly ash dominated CCRs accumulates in on-site piles and ash ponds leading to serious environmental problems, particularly contamination of ground and surface waters due to leaching of trace elements.

The present study deals with assessment of impacts of fly ash generated from a coal fired power plant located on eastern region of India. The results of the study show the presence of many trace elements in different layers of the soil. Soil samples from different layers were collected and tested for the presence of trace elements. The results of this study indicate that some of the trace elements from fly ash permeated the soil horizon around the coal fired power plant.

A great ongoing social challenge for the coal fired power plants in India is sustainable development and community acceptance of its role in society. The study shows that the problems of industry induced displacement and resettlement poses major risks to societal sustainability in India and this is accompanied by the resettlement effect, defined as the loss of physical and non-physical assets, including homes, communities, productive land, income-earning assets and sources, resources, cultural sites, social structures, community relations, cultural identity and mutual help mechanisms. Other concerns are change in population dynamics, health impacts, addictions, economic disparity in the vicinity of the coal fired power plant.

## The Case for Cross-Sectoral Water Reuse in Saudi Arabia: Bringing Energy into the Water Equation

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Saudi Arabia occupies an area approximately  $\frac{1}{4}$  the size of the U.S., and is the largest country in the world with no lakes or rivers to sustain its population of 25.7 million. Despite possessing annual renewable water resources of only 2.4 billion m<sup>3</sup> [1], Saudi Arabia's water withdrawals exceeded 20 billion m<sup>3</sup> in 2010 [1, 2], making it the third-largest per capita water user worldwide [2]. Over 80% of Saudi Arabia's water supply is withdrawn from non-renewable groundwater aquifers [3] which we estimate to contain only a 15-25 year supply at present abstraction rates [1, 4]. Water demands, exacerbated by rapid population growth and increased urbanization, are expected to double over the next two decades [5], with the municipal and industrial sectors increasingly reliant on desalination.

Desalination – particularly the large-scale thermal desalination prevalent in Saudi Arabia – is a capital and energy-intensive means of producing fresh water. The operation of a multi-stage flash (MSF) cogeneration plant results in GHG emissions of 10-20 kg CO<sub>2</sub>/m<sup>3</sup> and costs approximately \$0.60/m<sup>3</sup>, of which 77% is attributable to thermal and electrical energy [6]. Thermal desalination is feasible because of Saudi Arabia's substantial oil and gas resources: the largest producer and exporter of total petroleum liquids worldwide, it also possesses the fourth-largest natural gas reserves globally [7]. Saudi Arabia's economy is also highly carbon intensive, with a carbon intensity of 1.15 tonnes of CO<sub>2</sub> per thousand US dollars in 2009 in comparison to the U.S. economy's carbon intensity of only 0.38 [8]. The Saudi Minister of Water and Electricity has estimated that 25% of Saudi oil and gas production in 2009 was used domestically to generate electricity and produce water, while present demand rates suggest that this figure will reach 50% by 2030 [9].

The majority of natural gas in Saudi Arabia (50-60%) is associated with petroleum deposits, and associated gas production costs have to date been consistent with the subsidized domestic gas price of \$0.75/MMBtu [7]. However, increasing domestic demand and OPEC crude oil production constraints have necessitated the development of offshore high-sulfur gas fields with estimated production costs of \$3.50-\$5.50/MMBtu [7]. The disparity between these production costs will likely impact the domestic gas price, suggesting that power generation and thermal desalination will become even more expensive in the near future. The carbon intensity of the Saudi economy and increasing evidence of the negative impacts of CO<sub>2</sub> emissions also imply that over time, even fossil-rich countries will need to reduce carbon intensity. The continued use of natural gas in the desalination industry is less justified with rising prices and also contributes to the carbon intensity of Saudi Arabia's economy, making it increasingly urgent to identify ways to meet the domestic water demand both inexpensively and sustainably.

Increased wastewater reuse has long been recognized as a potential intervention strategy in addressing water scarcity [10], however the lack of national policies and/or strategies to support wastewater treatment and reuse has significantly restricted reuse in most Arab countries [6], including Saudi Arabia. This study takes a novel approach in exploring the potential for increased wastewater reuse in Saudi Arabia by evaluating not only the economic and environmental implications but also the potential energy savings from reusing reclaimed wastewater, rather than fossil groundwater and/or desalination, in the industrial and municipal sectors. As the petrochemical sector is responsible for over 80% of Saudi Arabia's GDP, our industrial assessment focused on the cost and energy implications of reducing groundwater withdrawals in the oil and natural gas industries. Similarly, our municipal analysis explored the energy, environment, and cost implications of transporting desalinated water to six inland cities that together contain approximately 35% of the total population.

Case study data from the national oil company Saudi Aramco indicated that an existing natural gas plant could reduce its annual water withdrawals of 1.98 million m<sup>3</sup> by almost 45% by implementing water conservation, reuse and recovery mechanisms [11]. These measures, when applied across Saudi Arabia's natural gas sector, could conserve 23 million m<sup>3</sup> of water as well as up to  $1.6 \times 10^6$  kWh of energy and  $1.5 \times 10^6$  kg CO<sub>2</sub>. Saudi Aramco's Riyadh Oil Refinery was also able to reduce its daily water consumption of 12,200 m<sup>3</sup> by 69% [12] through the institution of conservation and reuse measures, and such initiatives at oil refineries across the sector could save up to 199 million m<sup>3</sup> of water annually. Assuming that seawater reverse osmosis is used to supply potable water in the oil industry, this could also result in annual cost savings of over \$91 million, and energy and GHG savings of up to 1.79 billion kWh and 1.72 billion kg CO<sub>2</sub>. Total potential water savings across both the oil and natural gas sectors were estimated at ~29% of total industrial water withdrawals in 2009.

In the municipal sector, the economic and energy costs of desalinated water production and transportation relative to local wastewater treatment were modeled for six inland population centers: Mecca, Taif, Medina, Khamis, Abha, and

Riyadh. For all of these inland cities, the provision of desalinated water is more energy-intensive than the secondary or tertiary treatment of local wastewater. Secondary wastewater treatment also resulted in substantial cost savings for all of the cities considered, although tertiary wastewater treatment was in some cases more expensive than desalinated water provision. Overall, an estimated 26% of urban water needs could be met by treated wastewater, resulting in savings of up to  $4.0 \times 10^9$  kWh of energy (2% of Saudi Arabia's electricity consumption in 2010 [13]), in these cities alone.

The reduction of water withdrawals from non-renewable groundwater and desalination by increasing wastewater reuse is therefore even more promising if the energy and CO<sub>2</sub> emissions of desalination versus reuse are considered. However, the increase in sewerage networks to facilitate wastewater collection and treatment is crucial. Plans to increase the exceedingly low urban water tariff from \$0.027/m<sup>3</sup> to as much as \$1.40/m<sup>3</sup> [14] should be accelerated to reduce overall water consumption and more adequately represent the costs of water provision and treatment. Tariffs for desalinated water and natural gas should also be increased to reflect production costs while the use of treated wastewater should be subsidized to increase user uptake.

Although the agricultural sector is by far the largest water user in Saudi Arabia, the reuse of wastewater within specific industrial sectors (rather than agriculture) may present fewer public health implications. Financial support from the government (e.g., loans, loan guarantees, tax credits) could also encourage water conservation and reuse within the industrial sector by subsidizing renovations and process improvements to increase water efficiency.

In summary, industrial and urban wastewater reuse should be considered along with desalination as options for water supply in Saudi Arabia. Although the Saudi Ministry for Water and Electricity has estimated that an investment of \$53 billion will be required for water desalination projects over the next 15 years [15], the evolving necessity to conserve fossil resources and mitigate GHG emissions requires Saudi policy makers to weigh in much more heavily the energy and environmental costs of desalination. Anticipated investments in desalination projects could be deferred by prioritizing investment in sewage and water distribution networks that would ensure more effective water reclamation and reuse while simultaneously conserving non-renewable groundwater and natural gas resources and preventing the lock-in of potentially unnecessary desalination infrastructure that will likely become more efficient in future.

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### Local participation in the Barekese basin: implications for sustainable water management

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Water is critical natural resource that a country must harness in the quest for rapid economic growth. It plays a vital role in the promotion of economic growth, improving health and livelihood, and reducing vulnerability. Currently, trends point to the fact that an integrated water resources management approach is needed to ensure that water does not become

a constraint to national development. It has been suggested that scarcity and misuse of freshwater pose a serious and growing threat to sustainable development and the protection of the environment (ICWE Secretariat, 1992; FAO, 2000).

Ghana like any developing country has a fast growing population of 23 million and this presents a number of environmental threats to water resources. Throughout the country, problems of urban and rural water supply are prolific because the Aqua Vitens Rand Ltd. (AVRL) / Ghana Water Company Limited (GWCL) and the Community Water and Sanitation Agency (CSWA) have not been able to supply water to meet urban, peri-urban and rural water demand.

The Barekese basin in Ghana is a facility created to serve the purpose of reserving water for treatment and consequent consumption of the populace in the Kumasi Metropolis and its environs. The reservoir which provides over 80 percent of the total public water supply is challenged with persistent degradation through human activities in its catchment which also raises concern on the deteriorating water quality and quantity. The objectives of this study is to bring to light the attitudes of the catchment inhabitants towards their involvement in the exploitation and sustainable management of the Barekese basin as a natural resource and explore ways of sustainably managing the basin to improve the deteriorating water quality.

Seven communities in the Barekese catchment were systematically sampled for this research. They include Nkwanta Penten, Nkwantakese, Pampatia, Esaase, Denasi, Ayensua Fufuo and Ayensua Kokoo. These communities lost their lands during the construction of the dam. A total of 370 questionnaires were administered in the communities. A multiple approach of data gathering was adopted for this research which included; questionnaires and interviews. Informal village appraisals were conducted in the communities. Participatory Rural Appraisals (PRAs) tools were used to collect information on the local perceptions on land use, linkage to water quality and ways of improvement (Malley et al., 2007). The PRA tools used were: focused group discussions, problem analysis chart, flow diagramming, trend analysis and participant observations.

Farming was identified as the dominant economic activity and the communities were characterized by the lack of Kumasi Ventilated Improved Pit (KVIP) facilities, potable drinking water and increasing population. Improving access to safe drinking water may possibly have a dramatic effect on reducing health problems and, concurrently, on poverty in the communities in the Barekese catchment and in the reinforcement of the family fabric. Anthropogenic modifications such as logging of economic trees, farming on watercourses and in the Barekese reserve, the use of inorganic fertilizers and the indiscriminate dumping of solid waste as well as open defecation were found to have a negative impact on the quality of surface water bodies in the communities. Some of the adverse impacts of the human activities included widespread floods, seasonal drought conditions where tributary streams dried, decline in catch per unit of effort and changes in the hydrology of rivers.

The underlying factors to the illegal use of the reserve were attributed to the nonpayment of compensation to the communities who lost their lands to the construction of the Barekese Dam and the fact that the lands in the reserve were more fertile. The issue of negligence and lack of concern on the part of the communities in the management of the reservoir and reserve is as a result of the non involvement of the locals and the numerous unfulfilled promises that were made to the communities who lost access to their farmlands as a result of the construction of the dam in 1969. Community participation in the sustainable management of the Barekese catchment has not been considerable and most implementation problems stem from lack of involvement and social equity. Impediments to local participation have been: the underestimation of knowledge and experience of the local communities; and a prejudice for technical rather than social considerations in natural resource management efforts. Community conservation projects should aim to ensure that all segments in the community contribute their knowledge and opinions, and benefit equitably.

This research was significant in producing some direct policy recommendations that can be applied by the government, bilateral and multilateral agencies, Non-Governmental Organisations (NGOs) and traditional rulers. It will also inform policymakers' with regards to improving the management of water resources in Ghana with the aim of achieving the Millennium Development Goal target of halving the proportion of people without sustainable access to safe water by the year 2015. The policy measures and benefits outlined for the government to consider for the timely facilitation and implementation include the consideration of affected communities in the development of projects as shareholders of the project, the empowerment of women under the customary land tenure, a review of existing environmental legislation to reflect current trends, the adoption of indigenous knowledge in policy formulation, the involvement of affected local communities and the public in proposed and ongoing projects, the enactment of environmental bye-laws at the District Assembly level, the training of personnel at the District Assembly level on environmental issues and the conducting of periodic and systematic ex post evaluation to include environmental auditing and monitoring of the Barekese water project.

## Energy and water use in multi-family apartment buildings - does occupant behavior matter?

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The building sector is a major consumer of global energy and water resources. More specifically, the built environment accounts for roughly 40% of the global annual energy consumption, and the residential sector alone for almost 30% of the same (UNEP 2007; Munksgaard et al. 2000). Consequently, the built environment generates a high amount of anthropogenic greenhouse gases, and thus, contributes to climate change. Typically in regions where water resources are plentiful, water consumption is not considered a critical environmental factor; however, for instance in Finland approximately one fifth of the energy used by households goes to heating of hot water (Nissinen & Dahlbo 2009). Fortunately, the building sector also represents significant energy-efficiency potential (Reinders et al. 2003; UNEP 2007). As a general rule, in the case of existing buildings, efficiency may be achieved through one of the following: proper maintenance and management, replacing technical installations, or enhancing occupant behavior. This study looks into the role of the occupants.

One aim of the research is to evaluate the water and energy use, as well as greenhouse gas emissions from a residential area in suburban Helsinki. The main motivation, however, is to identify and understand the role of occupants in the environmental performance of multi-family apartment buildings. In Finland, residents' behavioral patterns and their impacts on energy consumption have received a lot of attention in the media and even governmental authorities (Nissinen & Dahlbo 2009). Notwithstanding, this study hypothesizes that, particularly in multi-family buildings, other actors, such as housing managers (Brunklaus 2009) or building characteristics, may be more influential.

The research is comprised of a multiple case study of seven housing companies and altogether 44 buildings located within the same residential area in the Finnish capital Helsinki. The area was developed in the late 1960's. Similar to other buildings from that era, the 44 buildings included in the case study do not match current technical standards with regard to, for example, energy-efficiency. The buildings are home to 1650 residents. The apartments are all privately owned, and most are owner occupied. All seven housing companies share the same housing manager, heating system and energy provider.

For the purpose of this study, the housing management provided two separate data sets for analysis. The first set of data comprises financial statements from the year 2009 for all seven housing companies. The financial statements entail economic input data for different activities of the housing companies, including heating energy, electricity consumption, water and wastewater. The other data set comprises metric utility (electricity, heating, and water) consumption data. The two data sets allowed for an economic input-output-based, hybrid life-cycle assessment (LCA) (Haes et al. 2004; Hendrickson et al. 1998) to estimate the housing companies' greenhouse gas emissions. Additionally, consumption per apartment, resident, square meter (m<sup>2</sup>), and cubic meter (m<sup>3</sup>) was calculated using the metric consumption data.

As anticipated, heating energy use was the main contributor to greenhouse gases with approximately 67% of all emissions. Electricity (including both communal and household specific electricity use) was the second largest portion with over 14%. Water and wastewater management accounted for less than 6%, but was nonetheless the third largest greenhouse gas emitter. When comparing the different housing companies with regard to these three main activities, annual CO<sub>2</sub>e emissions per resident varied between 3.3 and 4.3 tons, averaging at 3.6 tons. For reference, previous studies have estimated the carbon footprint of a Helsinki inhabitant at 12.5 t CO<sub>2</sub>e per annum (Heinonen & Junnila 2010).

The study found that even though the CO<sub>2</sub>e emissions, as well as energy and electricity (kWh) and water use (liters) varied a little between the different housing companies when divided by the number of residents; hardly any variation was found when divided by the area (m<sup>2</sup>) occupied by each housing company. This would indicate that the only effective way for residents to influence the environmental load of their housing unit is by occupying a smaller area i.e., reducing their living space. Furthermore, the housing company with the highest energy, electricity and water consumption per resident had the lowest consumption per apartment. In other words, for the housing company with the smallest average apartment size (53.7 m<sup>2</sup>), but the largest living space per person (41.2 m<sup>2</sup>), the consumption per resident was the highest. Interestingly, the housing company with the largest average apartment size (77 m<sup>2</sup>) had the second largest living space per person (40.2 m<sup>2</sup>), and therefore consumption per resident was nearly as high. It appears neither small nor large apartments appear optimal for space use efficiency.

Exceptionally comprehensive and comparable data were available for analysis. All studied housing companies date from the same era, are of similar technical standard, and share the same housing manager, energy system, and energy

provider. In other words, all variables, except for the residents, are fixed, allowing for the individual resident's role to be examined. The results show very little variation between the different housing companies. Similar buildings from the same geographical location, dating from the same time period, using the same heating system and employing the same housing manager, consume similar amounts of energy, electricity or water consumption, and consequently, produce equal amounts of greenhouse gas emissions. Moreover, even less variation was visible in the emissions per square meter, suggesting that possibly the only way residents can influence their carbon load is by reducing their individual living space. The residents' behavioral patterns are too similar to make a significant difference on the overall consumption.

Put in other words, individual residents of multi-family apartment buildings have relatively little control over the resource consumption and greenhouse gas emissions of their housing unit, once the choice of residence has been made. This information can be considered valuable given that a significant portion of an individual's annual carbon footprint is derived from housing activities alone. With the results of the research, attention can hopefully be focused on the right energy and water saving measures. Even though engaging residents in energy and water saving actions may be justified from a social view point, it is considered potential that housing management practices have a more significant effect and should therefore be the subject of more research and attention in the future.

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## **Anthropogenic Phosphorus Flow Analysis and Optimization: Case study of Lujiang County, Anhui Province, Central China**

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Phosphorus is one of the dominant nutrients which are responsible for the eutrophication of surface waters. This study aims at quantifying phosphorus flows and stocks within a county-level socioeconomic system, Lujiang County, over 2008. A phosphorus-flow analytical model is developed based on substance flow analysis (SFA). The model contains six major subsystems: extraction, phosphorus chemical industry, agriculture, animal husbandry, human consumption, and phosphorus waste management. Approaches to data include searching statistical reports, questionnaire-based surveys on residents and face-to-face interviews with government officials, enterprise representatives, environmental scientists and farmers. Calculation methods of flows and stocks are classified into three kinds: a) quantifying the flows or stocks by multiplying fixed activity level data and phosphorus intensity parameters; b) calculating the flows or stocks based on other flows to get the relative quantities; and c) accounting the flows or stocks by balancing all flows of a subsystem. The results show that the total phosphorus input into Lujiang in 2008 reached 8311.47 tons, mainly as chemical fertilizers and animal feedstuff. Throughout its pathways in Lujiang County, 45.48% of the total phosphorus input was exported to other counties, and 22.67% entered the environment, while 31.85% was left in the county. A total of 1666.74 tons of phosphorus in wastewater was discharged into the recipient waters, of which animal husbandry was the dominant contributor (55.76%), followed by human consumption (23.01%), agriculture (21.22%) and phosphorus chemical industries (0.01%), since no phosphorus ores mining activities occurred in Lujiang. Chemical fertilizer overdoses increased phosphorus load in the paddy land drainage and constituted a big risk to surface water quality. On the basis of the above analysis, we provide a series of targeted engineering techniques for reducing phosphorus emissions, including building wastewater treatment plants and promoting the application of soil testing and formulated fertilizer technology. Scenario analysis is employed to simulate the effects of these measures on phosphorus emission reduction. A wastewater treatment plant is built in Lujiang County to process wastewater from previous subsystems. Phosphorus enriched in sludge is reused to arable lands. The new technology is promoted in agriculture to examine phosphorus required for plants and help reduce chemical fertilizer application. The results reveal that these measures can especially

increases phosphorus reuse from animal husbandry to agriculture, which consequently reduce the use of chemical fertilizers and extraction of phosphate ores, and finally ameliorate the aquatic environment. Annual phosphorus discharge into surface waters is thus reduced to 560.64 tons. In short, it should be of central concern for policy makers to improve the efficiency of phosphorus reuse. Limitations of the methodology and data are also discussed in terms of model establishment and data collection.

## Acknowledgments

The research was financially supported by China's Water Pollution Control Program (2008ZX07103-007), and the Natural Science Foundation of China (40971302).

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## **Sustainability of Deeper Aquifers as the Sources of Low-Arsenic Drinking Water in Bangladesh: Hydrological Considerations at the Local Scale**

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For tens of millions of people in Bangladesh and other South and SE Asian countries, drinking water from shallow tubewells comes with arsenic (As), a tasteless and invisible poison, at concentrations well above the WHO upper limit of 10 µg/L. One of the most successful As mitigation strategies in Bangladesh has been the installation of >100,000 wells across the country that tend to provide low-As water from a deeper zone often >200 m below ground level. With the increased pumping from deeper aquifers comes a concern for their sustainability, particularly whether they will continue to provide low-As water. Shallow, contaminated groundwater could leak from the overlying aquifers if the confinement is poor due to patchy distribution of clay layers, or due to human factors, such as poor well installation or well overuse. Pumping of the deeper aquifer for urban water supply has already created a depression cone around the capital city of Dhaka, inducing a downward pressure gradient between the shallower and the deeper aquifers, and thus setting up the stage for the possibility of wider-scale shallow groundwater intrusion. Basin-wide hydrological models (as in Michael & Voss, 2008) have already shown that pumping deeper aquifers for large public supply and irrigation projects, as opposed to small-scale pumping for drinking water, is likely to contaminate the deeper aquifers. This model assumed representative, but homogeneous, average conditions for the Bengal basin, yet local hydrogeologic conditions can be highly variable, hence adopting a local-scale hydrologic approach will be necessary to ascertain deeper aquifer sustainability.

In our 25 km<sup>2</sup> field area of Araihasar upazila (Bangladeshi “district”), Columbia University and partner institutions in Bangladesh installed 51 deep community wells in 2001-2003 at various As-free depths, as a part of an ongoing mitigation effort. After a span of good operation, four of the wells failed to produce groundwater that meets Bangladeshi standard of 50 µg/L As, thus they were reinstalled. Broken pipes letting in groundwater from high-As zone were suspected in two of the failures, and demonstrated in a third by pumping from isolated sections of the well. However, the failure of the remaining well 18 months after its initial installation could not be attributed to a broken casing. Interestingly, when it was reinstalled slightly deeper within the same 30m-thick aquifer, the well failed again within <1 year. The aquifer where the initial two wells were screened is separated by ~10m of silty clay from the shallow, high-As aquifer, and by another ~7m-thick hard clay layer from the underlying deeper, As-free aquifer. The analysis of leachates from this intermediate aquifer, after the second well failure, showed that As was present at elevated levels in the sediments located near the depth of the two failed wells - thus the sediment was either a source of mobilizable As, or a sorption sink of As for shallow groundwater intruding from above. The current safe community well at the location was eventually installed below the deep layer of hard clay.

Our recent work focused on the site of the twice-failed community well installed in the intermediate aquifer for two reasons: (1) to investigate the actual reason for the well failure, and (2) to showcase a small-scale hydrological study from which general principles can be extracted for the future assessments of safe aquifer sustainability. The motivating hypotheses for our work were that the wells failed either due to the flow of shallow groundwater along the outer surface of the well casing, or due to a slightly broader-scale leakage of shallow groundwater through the confining unit (silty clay) of the aquifer. To answer these questions, properties of the confining unit and the aquifer must be known, such as the vertical and horizontal hydraulic conductivities and the extent of their spatial variability, as well as the chemical composition of groundwater and its distribution.

Lithologs from 6 boreholes located within a 70m radius from the initial community well showed that local stratigraphy was contiguous across the site, and X-ray fluorescence profiles of the total sediment As, Fe, and Mn also indicated that sediment at equivalent depths was laterally uniform. Three pumping wells were installed in December 2010, as well as 18 observation wells screened at strategic depths and grouped in 4 spatial clusters across the site. These were extensively sampled, followed by a series of pumping tests to probe the role of leakage from the overlying high-As aquifer in the failure of the intermediate-depth community wells. Pumping tests 8 to 48 hours long were performed from wells screened across the entire vertical extent of either aquifer, as well as from isolated sections of the intermediate aquifer, followed by a resampling of the critical observation wells located near the pumping wells.

Results are only preliminary, but indicate that high-As groundwater is not present widely across the site at the depth of well failures (middle and lower section of the intermediate aquifer). However, groundwater from the upper section of the same aquifer (right below the silty clay) had elevated levels of ammonia, iron, and As, source of which could potentially be from above. Water levels were ~1m higher in the shallow than in the intermediate aquifer, and pumping from one aquifer did not induce measurable drawdown in the other, both observations implying that a degree of hydraulic separation between the two aquifers exists. On the other hand, water levels in the confined intermediate aquifer reached equilibrium within 12 hours, the rather short time indicating a possible leak of shallow groundwater through the silty clay aided by the pre-pumping downward hydraulic gradient.

We hope that the pending analyses will shed more light on the cause of well failures and on the hydrology at this site, thus providing a set of critical evidence for the comparison of local and larger-scale models. Local hydrologic studies are likely to be necessary after the averaged, large-scale conditions have been determined and central sources of funding put in place to sustainably manage low-As aquifers.

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## **Energy and Water Sustainability Amongst the Low Income Economies – A Study of the Northeast Region of Peninsular Malaysia**

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The IPCC 2007 report on the “Science of Climate Change” shows a small increase in temperature (~ 0.3 oC ) and rainfall (~ 3%) for the Southeast Asia Region in the last decade or so, however, there is general agreement amongst scientists that the changing behavioural patterns of the el-Nino ENSO , Monsoons and to a certain extent the Indian Dipole Oscillation circulation systems are triggering weather extremes and variability to influence changing behavioural patterns of hydro-meteorological and geomorphological events in the country. In addition to these events, the Region would also be exposed to increasing threats (directly or indirectly) from low pressure atmospheric cells that develops in the South Indian Ocean (cyclones) and the Pacific – South China Sea Regions (typhoons). These events are triggered by the warming ocean surface waters due to the global warming – climate change effect. To this date the impact of these changes can still be absorbed by the strong foundations of Malaysia’s environmental management programmes and backed by stringent economic policies including effective poverty eradication and food production programs. However, it must be understood here that the environmental policies addresses only the environmental change threat and not specifically the climate change threat where in the long term the impact scenario would generally diverge, and the resilience of Malaysia to the climate change threat would generally decrease and her vulnerability increases. This scenario can change if the gradual increase in global warming is left unchecked and unabated because increasing global temperatures could lead to thresholds been breached where habitats and ecosystems could not recover to existing equilibrium and stable conditions. Ecosystems disequilibrium would influence human livelihood activities that are very much dependent on their stability. These changes would have a tremendous impact on Low Income Economies and their sustainability especially, as they are very dependent on ecosystem resources and conditions such as those associated with coastal fishing, rural agriculture, urban commerce and many forms of rural cottage industries. These low income populations hovers just above the poverty threshold line and any change in their income generation activity would make them fall below the poverty line, and for Malaysia this could compromise the achievement of the Millennium Development Goals Objectives (MDGs). Climate extremes, variability and anomalies will threaten the bases of many of the country’s populace livelihoods and her major economic systems, especially vulnerable are the poor and those living at the threshold of the poverty line. The low income economic systems are especially vulnerable as their practices are dictated and sustained by climate – weather behavioral patterns. Any changes to these behavioral patterns would seriously affects the daily practices and livelihoods of highland farmers, traditional fishing and agriculture practices of coastal regions, and other forms of rural cottage industries. Malaysia’s large scale economic systems such as agriculture, fishing, hydro-electric power generation and tourism related activities are also vulnerable to climate variabilities and extremes as these industries to a major extent are environmentally driven. Climate change will hit Malaysia hard. Timely adaptation measures should therefore be an integral element of her national policies. However, like most developing countries, Malaysia lacks the skills and capacities to implement effective adaptation measures at all levels of systems been threatened. Moreover, the impacts of climate change will increase the vulnerability of weak and the more fragile systems and further reduce their adaptive capacities. The nature of vulnerability and resilience of these systems to the climate change threat needs to be assessed and understood. There’s not much that Malaysia can do in mitigating and curtailing green house gases emission, where her role lies mainly to provide a powerful voice in support of global efforts in green house gases

reduction and mitigation, however there's much that can be done in order to reduce vulnerability and resilience of her populace and livelihood systems. In general it can be said that the greater the warming, the greater the security risks to be anticipated, and Malaysia needs to adapt to these impending risks. The objectives of this paper is to discuss, (1) the potential inducers of climate change stresses on the utilization of energy and water amongst the Low Income Economies (2) what makes these Low Income Economies vulnerable? (3) What are the inherent adaptive capacities to sustain the economies, and (4) the adaptation needs to sustain the economies in the short and long term?

## **Estimating and Analyzing Energy Efficiency in German and Colombian Manufacturing Industries Using DEA and Data Panel Analysis**

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In this research, data envelopment analysis (DEA) is employed to study the comparative performance of German and Colombian manufacturing industries between 1998 and 2005. The results of the DEA indicate that the great majority of manufacturing industrial sectors improved on this index during the sample period, demonstrating that energy input is an important variable within the production structure and a key element in technology development. At a second stage, regression analysis using panel data analysis reveals that several factors, including labour productive, enterprise size, investments and capital input can be considered determinants of differences in energy efficiency among German and Colombian manufacturing industries. Our results also show that different energy policies should apply across manufacturing industries and that they should encourage the importance of energy efficiency in order to improve it, especially in non-energy-intensive sectors, small and medium enterprises and manufacturing industries of developing countries.

Energy efficiency has become the first step to controlling and stabilising greenhouse gas concentrations because it is the most cost-effective and expedient option (IEA; 2007). This approach slightly improves an energy system by reducing losses and overload, it may reduce investments in energy infrastructure; it will help mitigate energy price increases and volatility by easing short- and medium-term imbalances between demand and supply; and it will also help reduce CO<sub>2</sub> emissions and increase energy security (CEU, 2005).

Generally, energy efficiency is measured through energy intensity indicators, which assess the quantity of energy required to perform an activity in terms of monetary or physical units (e.g., Mega-joule/Euro (MJ/€) or MJ/Ton). Recently, the use of data envelopment analysis (DEA) for measuring energy efficiency in manufacturing sectors has increased, as this method can relate changes in energy consumption to growth in specific activities or structural changes and does not involve any assumptions with regard to the disaggregation of energy consumed in terms of activity growth or structural changes (Azadeh et al., 2007).

Unlike the other studies, our focus is on the patterns and factors influencing energy efficiency performance within the manufacturing industry by differentiating between energy-intensive sectors (EISs) and non-energy-intensive sectors (NEISs) because the studies on energy efficiency have been focalised mainly in EISs whereas NEISs have been relegated. Moreover, the use of techniques of panel data analysis in the second stage of a two-stage procedure that involving non parametric estimation of efficiency in the first stage is limited.

This analysis consists of three phases: First, we define energy intensive sectors (EISs) and non-energy intensive sectors (NEISs) taking into account German energy tax law (German energy tax law defines EISs as sectors where the cost of energy is above 3% of total costs) and cluster analysis. Second, we examine the traditional measure of energy efficiency by computing the energy intensities defined as the energy used per unit of economic production (Giga-joule/Euro (GJ/€)) and a DEA model for measuring energy efficiency, which generates energy efficiency DEA scores for each EIS and NEIS in both countries. In the third stage, the energy efficiency scores are regressed (using an appropriate technique of panel data analysis) against different variables in an attempt to understand the determinants of energy efficiency during the sample period.

The average energy intensity of EISs in Germany and Colombia between 1998 and 2005 was 15.1 and 35.9 GJ/€, respectively, implying that in order to produce 1€ worth of output, the German and Colombian EISs used, on average, about 15.1 and 35.9 GJ of energy, respectively. The average energy-efficiency index of German and Colombian NEISs over the eight-year sample period was 0.73 and 0.63, respectively.

In the German case, the energy-efficiency indexes indicate that it is necessary to achieve technical efficiency to improve energy efficiency. On the other hand, in the Colombian case, we saw that the energy-efficiency indexes in both sectors were lower than in the German case, which might indicate that the Colombian manufacturing industries have an emerging and expanding industrial infrastructure with great potential to improve their energy efficiency.

In Colombian EISs, the improvements in energy efficiency are meaningful. Hence, these results show the potential of EISs to improve technical efficiency, especially in Colombia. This fact was mentioned in the study of IEA (2007), where it was suggested that the technical efficiency improvement potential for the whole manufacturing industry ranged from 18-26%, taking into account both process improvement and technological change.

In German EISs, labour productive, size of enterprise and investments have played an important role in the improvement of energy efficiency, whereas in Colombian EISs, labour productivity and capital input are positively associated with energy efficiency.

For NEISs in both countries, the results show that only labour productivity has influenced energy efficiency performance, probably because energy consumption is lower than other inputs in terms of production costs. Therefore, NEISs do not see energy efficiency as a strategy to improve general productive efficiency. Moreover, the low energy cost among the NEISs has important implications for energy policy instruments, especially because this sector does not have as its main objective the adoption of energy technologies and energy-management practices and because the influence of higher energy prices may influence investment decisions related to energy conservation (Kander and Schön, 2007).

The results of EISs could indicate that the main factor behind improvement in energy efficiency is the technological change. Therefore, it is important to design energy policies that seek to generate possibilities for technology transfer in order to improve energy efficiency especially in developing countries as show Colombian case.

DEA is used in this research to compute energy-efficiency indexes from 1998 to 2005 for German and Colombian EISs and NEISs. The results show that the great majority of manufacturing industries improved on this index during the sample period, demonstrating that energy input is an important variable within the production structure and a key element in technology development.

A second-stage regression analysis revealed that, for German EISs, labour productive, size of enterprise and investments have played an important role in the improvement of energy efficiency, whereas in Colombian EISs, labour productivity and capital input are positively associated with energy efficiency. In German and Colombian NEISs, energy efficiency is positively associated with labour productivity and size of enterprise.

From methodology used, the tests of cross-sectional dependence, heteroskedasticity and serial correlation demonstrated that both DEA scores and the data panel techniques are adequate to analyse energy efficiency with different approaches and using no traditional measures in the manufacturing industries.

Our findings have important policy implications where to improve energy efficiency; it should encourage the importance of energy efficiency, especially among SMEs and developing countries (according to the results for the Colombian case), increase the application of energy-efficient best practices, technologies, and innovations, and motivate investments related to energy conservation in manufacturing industries.

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## Energy Efficiency and Climate Change: A Developing country perspective

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For over two decades, scientific and political communities have debated whether and how to act on climate change. The present paper revisits these debates and synthesizes the long-standing arguments. It provides an overview of the development of international climate policy and discusses clashing positions represented by sceptics and supporters of action on climate change. The paper looks at the issue from a developing country perspective and demonstrates how the great climate debate between the 'skeptics' and 'supporters' does not lead developing countries anywhere. Considering India as a case study, the paper develops an outline of a win-win-oriented climate policy around development priorities

and suggests that “no regret options” such as energy efficiency (EE). The proponents of this approach are termed as ‘climate realists’, who consider climate mitigation as a by-product of sustainable development solutions.

Asia is driving the world energy markets, largely propelled by demand in China and India. As per International Energy Agency (IEA, 2008) estimates, the world energy consumption will increase by 45% in 2030 from its 2006 level, and India will account for 13.5% of that growth. India’s high energy demand is driven by its high growth path. India is also characterized by a large populace who is deprived of modern energy services; 45% rural households and 7.8% urban households do not have access to electricity and 90% rural households and 33% of urban households do not use clean cooking fuel (NSSO, 2007). To attain energy universalization and sustain growth, India needs to step up its energy use. However, like other developing countries, India is constrained by the environmental consequences of energy use. Energy, which accounts for about 60% of Green House Gas (GHG) emissions, has a strong linkage with climate. Globally, since the beginning of industrial revolution, there has been an increase of 30% Carbon Dioxide (CO<sub>2</sub>), 15% Nitrous Oxide (N<sub>2</sub>O) and 145% methane (CH<sub>4</sub>) (Environment Canada, 1999). To limit the global temperature to 2°C more from its pre-industrial value, the global GHG emissions must be halved by 2050 from its 1990 level (EU, 2008). India’s heavy reliance on coal, which is relatively unclean compared to other fossil fuels[1], and very low share in zero-carbon fuels (only 1%) made energy related CO<sub>2</sub> emission more profound. Additionally, the biomass consumption, which satisfies 72% of the domestic energy and 90% of all rural energy needs in India, contributes to climate change through its black carbon emissions.

Energy efficiency is the answer to India’s twin challenge of energy universalization and climate mitigation. Provision of secure, adequate, low-cost energy of quality and convenience in an environmentally benign manner is core to energy efficiency which influences choice of fuels, choice of end use devices, and conservation practices. These are critical aspects of the India’s energy future considering the challenges to universalize energy services and at the same time cut down on emissions.

Also, the importance of energy efficiency stems from its complexity, and interlinking nature. Any inadequacy or incompleteness in the diffusion of energy efficient technologies at any stage of energy system makes the final users deprived from the service. India’s electricity in rural area is an example in this regard, where the absence of electric connection to households deprives people from electricity for lighting and other appliance use. Though close to 80% of the Indian villages are electrified (as on March 2006); only 55% of the rural households have electricity connections. The current energy infrastructure in India is grossly inadequate from both energy universalization and low carbon point of views. It necessitates immediate attention not only to add new infrastructure but also to modernize and improve the systems for bringing about efficiency in production, processing, transmission and distribution and reduce the gap between supply and demand.

Energy efficiency improvements have multiple advantages such as the efficiency of utilisation of natural resources, reducing air pollution levels, and lower spending by the consumer on energy related expenditure. Despite these significant benefits, the government and the utilities are not integrating efficiency programmes into their planning process. From the consumers’ perspective several barriers prevent them from investing in cost-effective energy technologies. The reasons include (1) lack of initial investment for efficient technologies and (2) lack of sufficient perceived incentives to pursue energy efficiency investments. As a result, the country is missing out on opportunities to save both in terms of energy and the environment. The study shows that EE approach, which suits developing countries, will lead to win-win opportunities both for the environment and the economy. To achieve this goal, the paper identifies specific (groups of) actors, study their specific situations, analyse the constraints and discusses opportunities for EE improvements. This can be referred to “actor-oriented” analysis in which we understand how various actors of the energy system are making the system work, and what incentives and constraints each of these actors is experiencing. It analyses actor linkages and their impact on energy and climate policies. The study recommends that the development interventions should include actor-oriented tools in planning, implementation, monitoring and evaluation of energy and climate policies.

[1] In 2005, among fossil fuels, coal accounted for less than 57% of energy needs, whereas its CO<sub>2</sub> share is more than 67% (IEA, 2007).

### **Framing Water: A case study of small river-based hydro energy development conflict in Turkey**

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The Turkish government is seeking to intensify the development of renewable energy, particularly hydro energy, for which it has stated that “*Hydroelectric power plants are an environment-friendly, clean, renewable, lasting and efficient*

*domestic resource with low operational costs and no fuel cost, which is not externally dependent and also serve as a fuse for energy prices. We aim at utilizing all hydroelectric potential in electricity generation that is technically and economically viable by the year 2023*" (The Ministry of Energy and Natural Resources, 2010). The hydro energy policy has been implemented by facilitating private sector investment in energy generation. This increased the number of private sector license applications for small river-based hydroelectric power plants (HEPs) less than 50MW. As of March 2011, 763 licenses are in effect and another 108 licenses have been approved.

As HEPs are spreading all over Turkey, one factor can potentially be a barrier to utilizing all hydroelectric potential: public opposition. A diverse group of national and local non-governmental organizations have challenged these projects as being "environment-friendly, clean, renewable, and lasting" energy source in Turkey. According to Omer San, the spokesperson of the Platform of Brotherhood of Rivers, eighty-three public interest litigations have been filed to halt these projects, and forty-one of them were finalized. Out of forty-one, district courts decided to halt the execution of the projects for thirty-nine of them (Anadolu Agency, September 24 2010). The main reason why the court decided to halt them is related the fact that environmental impacts assessment reports approved by the Turkish ministry of environment and forestry were found inadequate to minimize adverse livelihoods and ecological impacts and thus in conflict with sustainable development principle of the Turkish environmental law (Rize Court Decision, 2010). This paper examines the nature of the conflict over HEPs. It explores how different actors perceive and try to influence the use of river basins.

This study contributes to the limited literature about citizen activism focused on renewable energy, specifically HEPs which are considered problem free. In addition, a number of features of HEPs bring new aspects to the debates on public opposition. First, HEPs tend to be smaller in scale and in energy density. This increases the number of siting decisions and, therefore, their relative impact tends to be decentralized. Second, emphasis on energy independence and the development of renewable energy, specifically hydropower, are restructuring water supply and demand in Turkey. The amount of available water is estimated to be less than 1000 m<sup>3</sup> per capita per year in 2023 which is one-fourth of the world average (Turkey Water Report 2009). This will certainly increase the number of conflicts in the future. Therefore, from a policy perspective, understanding opposition is crucial as it can help resolve or avoid such conflicts in the future. This analysis also contributes to the water governance policies to better accommodate the necessary reallocation of water to address several risk issues.

We combine insights from political ecology and frame analysis in order to explain the nature of the HEPs conflict. The core of the conflict is about commodification and privatization of water as a common natural resource. Three frames emerge on the issue of water and its management as a resource: Energy security, livelihood security, and ecological security. It is claimed that Turkey will face serious energy, livelihood, and ecological risks in the long run, if current water management policies remain in place. These debates signal an alternative energy policy approach beyond the narrowly defined practices of regulatory agencies. They also signal the need for public participation processes that go far beyond conventional public hearings.

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## **Arsenic poisoning from drinking groundwater in South and Southeast Asia: Constraints on the sustainability of different mitigation options in Bangladesh and Vietnam**

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Elevated levels of arsenic (As) in shallow tubewells were first unambiguously linked to skin lesions and other diseases in the mid-1980s in the Indian state of West Bengal. It took a decade for international organizations that originally promoted the installation of tubewells to reduce exposure to microbial pathogens contained in surface water to recognize that the As problem extended over a much larger area into neighboring Bangladesh. High As concentrations have since also been reported in shallow groundwater pumped from floodplains draining the Himalayas in Pakistan, Myanmar, Cambodia, Vietnam, and China. Before mitigation efforts started in earnest a decade ago, an estimated rural population of over 100 million drinking groundwater was exposed to levels of As that have been linked to cardiovascular disease and various cancers in adults and inhibition of mental development in children. One reason As mitigation has been relatively slow may be a mismatch between the scale of the resources and coordination needed to tackle a vast problem relative to the scale of where an intervention needs to play out, which is at the level of the individual household. In Bangladesh

(pop. 160 million), for instance, there are on the other of 10 million shallow (<100 m deep) tubewells. Most of these have been installed privately, typically by a few neighboring households pooling their resources. The large number of wells combined with a very patchy distribution of As in the subsurface, both laterally and vertically, has two implications – one negative and the other positive: (1) predicting the As level of a particular well is often impossible and every well needs to be tested, (2) many households live within walking distance of a low-As well and, if not, could drill a deeper well to reach an aquifer that is low in As. Because of spatial variability in the composition of groundwater, the most effective form of As mitigation sponsored by international organizations and the government of Bangladesh to date has been the testing in 2000-05 almost 5 million wells using a simple kit in the field. Contrary to some expectations, this has resulted in 30-50% of households with a high-As well to switch their consumption to a neighboring well that is low in As. The lesson from this experience is that As testing should be made widely available at the local scale. Unfortunately, this hasn't happened and least one third of wells in Bangladesh are presently untested because they have been installed after 2005.

The next most effective form of reducing exposure in Bangladesh has been the installation of over 100,000 more expensive low-As wells >200 m deep by the government and NGOs. The limited monitoring data that are available, as well as some field experiments and basin-scale simulations, indicate that low-As groundwater can be pumped sustainably from such wells provided withdrawals are limited to hand-pumps. Instead, the government of West Bengal, for instance, supported a switch to mechanized pumping from a smaller number of high-volume wells for domestic use as well as irrigation. There is evidence that this shift, as well as large-volume pumping around the city of Hanoi, has led already to widespread contamination of deeper aquifers that were originally low in As by the downward intrusion of shallow groundwater that is high in As. The attractiveness of large projects to funding organizations and governments appears to dominate over consideration of the sustainability of centralized solutions.

Another approach to reducing exposure that has often been touted is treatment of high-As groundwater at the household level. Even though thousands of As removal systems of various types have been deployed in Bangladesh, their impact in terms of exposure reduction has been dwarfed relative to that of well switching after testing or the installation of deep wells. The main difficulty in Bangladesh is that distribution of groundwater is not only variable in terms of As but also with respect to other constituents, like phosphate, that either limit the capacity of a removal system (or others that can increase the removal efficiency, such as iron). It is therefore essentially impossible to predict when the capacity of an As removal system in Bangladesh other than by regular monitoring of the As content of treated water. It is hard enough for a new well to be tested in Bangladesh; periodic monitoring of a treatment system is currently unachievable. The situation in Bangladesh with respect to treatment is worth contrasting with a very different one in Vietnam where, thankfully, phosphate and iron levels in groundwater are typically low and high enough, respectively, for iron oxidation by simple aeration to be sufficient to significantly lower the As content of groundwater. Because there is no need for consumable filtration media or reagent additions in Vietnam, treatment by aeration alone has probably significantly reduced exposure throughout the country.

In summary, future efforts to reduce As exposure in South and South Asia on any scale should start from the realization that conditions are highly variable at the local scale. Higher priority should be placed on the promotion of periodic well testing (shallow private wells, deeper community wells, or household-level treatment systems), through a government network or perhaps even by commercial testers, provided sufficient quality control can be provided. Vast resources are clearly still needed to reduce the exposure to As contained in groundwater. However, these resources should be applied less on large centralized projects that are unsustainable but instead in small doses at the household- to village-level. The potential of mobile phones to transmit such resources and information could help overcome the complex logistics of such an effort and is currently unexploited.

## Posters

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### **Assessment of groundwater contamination around solid waste disposal site in Kano, Nigeria**

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Open dumping and uncontrolled landfilling of solid wastes are the most widely practiced waste disposal methods in many cities of the less developed regions, especially those in sub Saharan Africa. These practices are totally unsustainable and pose a major threat to the quality of the life supporting environment and public health. Of particular concern is the leachate produced at the waste disposal sites, which contains a large amount of biological and chemical

substances that are very likely to contaminate the soil, surface and groundwater sources in the near environs. The effects of leachate percolation on the quality of groundwater sources is particularly of great concern in sub Saharan Africa, where untreated self supply groundwater options represents a major source of water supply for many of the region's inhabitants. Thus, the importance of evaluating the impacts of such activities on the quality of local groundwater sources cannot be overemphasised.

Against that background, this study was conducted to examine the physicochemical characteristics of groundwater samples collected from hand dug wells around a major waste disposal site; Gyadi-gyadi dumpsite in Kano metropolis of Nigeria. This urban centre is one of the most populated metropolises not only in Nigeria, but also in the entire sub Saharan African region. Accordingly, two sets of groundwater samples were collected from the four geographical directions around the dumpsite in May 2009 and May 2010. The samples were analysed for physico-chemical characteristics that include: pH, Turbidity, Total Dissolved Solids, Electrical Conductivity, Total Alkalinity, Total Hardness, Calcium, Magnesium, Sodium, Potassium, Nitrates, Sulphates, Chlorides, Copper (II), Iron (II) and Manganese (II).

The results of this investigation revealed a significantly high concentrations of most of the parameters analysed, often above the WHO recommended thresholds. Concentrations of Nitrates, Total alkalinity and Total dissolved solids were especially very high, which suggest that the groundwater sources around the dumpsite may have been contaminated as a result of the effect of anthropogenic activities. Accordingly, some strategies were developed in order to mitigate the effects towards achieving sustainable development in the area and beyond.

## Twenty years of sustainable development

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I believe that the world needs to come up with new ideas to push forward the environmental agenda for Rio+20. I have been a sustainable development activist for 20 years in Bolivia. Thanks to the dissemination of the ideas of the NGO[1] in which I work the first Ministry of Sustainable Development in the world has been established in 1993 under the premises of the Agenda 21. I participated in the Rio Summit with great expectations and worked for sustainable development till I realized that sustainable development is no longer possible under climate change conditions.

*What happened after the Rio Conference?*

To make a long story short I should mention a few facts:

- No country has consistently adopted sustainable development.
- No country has implemented the Agenda 21.
- The Rio Conventions have served to waste resources in thousands of conferences and meetings, and to increase the carbon footprint of the UN's bureaucrats and government's officials, but no meaningful achievements in the ground.
- CO<sub>2</sub> concentration in the atmosphere increased from 356 ppm (1992) to 390 ppm (2011)
- Since Rio the average surface temperature has increased in almost 0,5 degrees C.
- The abundant commercial fish in the past, like sardines and tuna are exhausted.
- More contaminating sources of energy are being employed such as tar sands
- The last pristine areas are being occupied for oil drilling and mining.
- Population has increased in about 2 billion.
- Unsustainable patterns of production and consumptions have been expanding all over.

These facts show how the world has changed since the Earth Summit, therefore it is needed a review and change of the basic assumptions and ideas that were valid 20 years ago.

We should recognize that the wonderful discourse of sustainable development is not feasible in global warming conditions, since for sustainability (a long lasting process) we need stable conditions that no longer exist. In our warming world, ecosystems are changing in ways that we cannot predict, therefore the use of natural resources at the rate that they can regenerate is no longer possible.

The Brundtland idea that sustainable development «meets the needs of the present without compromising the ability of future generations to meet their own needs» has lost ground with the rapid melting of the Arctic. The needs of the present generation are already compromised with floods killing thousands of people and wiping out the livelihoods of millions in Pakistan, or thousands in Australia, Colombia, Venezuela and Brazil.

Can we meet the needs of the present generations when droughts are causing increasing food and water shortages?  
When food prices are soaring?

Can the needs of future generations are going to be meet when the melting glaciers are depriving of water and electricity



to many cities? When the oceans are depleted and acidifying? When massive deaths of birds are occurring and bees are disappearing?

Therefore to continue with the discourse of sustainability is going to lead us nowhere. Instead we have to be prepared to face increasing environmental disruptions. That is why a shift from the stress on sustainability to the stress on resiliency is needed. It has become common to speak about climate resilience, however environmental and social resilience is also needed, and therefore instead of sustainable development, we need resilient development.

The idea of sustainability has come from biological systems, the idea of resilience too. Resilience is a response to environmental disruptions, climate change is a global environmental disruption. In this sense, resilient development is the daughter of sustainable development. Development should be resilient to maintain the social and economic advances achieved to date, and shouldn't discard the great conceptual advances that the sustainability science has generated.

As the Rio+20 Summit is approaching we need new ideas that go beyond the UN bureaucratic discourses crafted to maintain the state of affairs. To achieve meaningful outcomes, and avoid further deterioration of human and natural living systems it is necessary a transformational change in the UN's 800 bodies that deal with environmental issues, and to replace them with a Global Environment Organization. Another important issue is to update the Rio Declaration to have a better global legal environmental framework, and an International Court for Environmental Justice is needed to ensure law compliance.

Rio+20 may be the last opportunity to agree upon sound bases for global environmental governance. As the impacts of climate change increase in their intensity and frequency, and erode the livelihoods of more people, it is going to be more difficult to reach agreements. In times of peace and prosperity it is easy to reach agreements, but in times of war and scarcity the opposite is true. A globalized world requires global institutions and global rules to deal with global threats.

[1] Association for Defense of Nature (PRODENA)

### **Assessment of possible Impact of Industrial Activities and the Use of Agrochemicals on the levels of Toxic Chemicals in the Natural Environment**

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The boom in some of chemical industries and the wide excessive uncontrolled long term use of enormous varieties of agrochemicals, especially in Libyan coastal areas drove us to carry out an extensive study to assess the possible impact of those uncontrolled notorious human activities on the levels of some toxic chemicals in the natural environment.

Therefore, an enormous number of environmental samples known to be especially subject to possible rain and air born contamination, were carefully analyzed for some the most common chemical pollutants relevant to the industrial and agrochemical activities in the area around Tripoli city.

Special emphasis was given to the analytical methodology such as sampling, sample preparation and evaluation of the analytical data such as reproducibility, recovery and linearity.

The important role of chemical research and science policy to monitor the environmental samples is briefly discussed in this paper.

### **Sustainable Management of River Landscape in a Mediterranean City: The Case Study Antalya-Bogacay**

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In simple term, water is life. All the living creatures need water to sustain their lives. And rivers are the symbolic keys about water to understand cultural processes in community in most cases. They have powerful meaning about fresh water that to help understand the role and function of water for the community. For example, irrigation is a keyword in agricultural production on the other hand recreation and leisure times are important issues in the developed countries.

According to Woohl (2004), rivers reflect land's and people's history. The river itself records the most recent changes

on it and around it. The physical forms of rivers and river ecosystems are our historical archives, yet these archives are challenging to interpret. The form or physical appearance of a river can be readily perceived. People commonly expect a “healthy” river to be “pretty” – to have clear water, stable banks and bed and perhaps an edge of trees along its sides or fish in its pools. These expectations of a healthy river’s appearance may be misleading in that they ignore loss of function. We must think that a healthy river connected to everything around it; people, soil, air, water, etc., but in real world to sustain a healthy connectivity between river and its components seen not possible. In order to these conditions we need to create a new way of living because of the global warming and other environmental problems. Because of them rivers are the key factors for the living creatures.

Successful integrative river management requires an understanding of links between natural and cultural landscapes, ensuring that institutional and community values are meaningfully incorporated in the process of environmental repair (Harris, 2006; Hillman et al., 2008). A connected approach to integrative river management aims for a dialogue between scientific understanding, political understanding, sustain economic development, conception of local needs and community values.

The current operational practices on rivers negatively impact environment and river function due to uncontrolled land use, floodplain protection and other problems associated with rivers in developing countries. Dams and reservoirs helps to flood protection but density housing, transit-roads, mining activities and mass production of building materials in watershed areas thread the rivers. One of the most important question that occupy city officials is how to river and riverbanks in the middle of the City. The problem may be more serious in Mediterranean cities due to high land prices caused by touristic activities. Forexample, Bogaçay river of Antalya City is located near the world famous Konyaaltı beach. Since watershed ecosystems are more sensitive to environmental changes, the impact of waterbodies is likely to be more severe on this ecosystem.

In many countries, river restoration or river rehabilitation has become an industry, an province, with nonprofit groups, government agencies and consulting firms. But in Turkey ecological river management and river ecological restoration is new concepts. We are now in the begining of this process. On the other hand, Turkey have still big construciton project to change the srtructure and form of the rivers.

The present study consists of three steps. The first step is to collect detailed information of Antalya-Bogacay River, its watershed and surrounding environment. The second step is to investigate management status of river in local, national and international platforms. The last step is to determine the holistic approaches in the case of Antalya Bogacay river for rehabilitation-restoration opportunity efforts with a SWOT analysis. This paper evaluates some state agencies and organizations such as city municipalities, General Directorate State of Hydraulic Works, Ministry of Environment and Forestry, Ministry of Agriculture and Rural Development, local forest institutes, related department in universities, nongovernmental organizations and public stakeholders and their efforts on rehabilitation of river. The river management model proposed in this study for Antalya City could also be applied to cities that have similar facilities in the Meditranean region. Managing water services to provide access to everyone is a complex task by the factors that environmental sustainability, maintaining and developing water infrastructure, legal framework, and water scarcity.

### **Shifts in the diet and trophic position of the parrotfish (*Scarus dimidiatus* Bleeker 1859) resulting from recreational feeding as determined by $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ analyses**

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Feeding reef fishes with bread or other food materials which are not part of the fishes’ natural diet has become a popular tourism activity in marine sanctuaries and is encouraged by tour operators to enhance human-fish interactions (Hemery and McClanahan 2005). As a recreational activity, it has gained wide acceptance among resource managers and promoters of reef tourism because of its non-extractive use of the reef fishes and its potential to provide alternative income source to coastal communities. However, the sustainability of this practice has been in question for more than a decade now and studies by Ilarri et al. (2008) and Hemery and McClanahan (2005) have reported on the changes in the reef community structure as well as in the behavior of the reef fishes resulting from such activity. In this study, stable carbon and nitrogen isotope analyses were used to determine how the feeding of bread to an important herbivore in the coral reef, such as the yellowbarred parrotfish (*Scarus dimidiatus*), would alter its diet and its trophic position in the reef ecosystem.

To carry out the study, juvenile male *S. dimidiatus* were collected from the reef around Canigao Island, Leyte, Philippines (10o14·30”N, 124o44·45”E) and were randomly assigned into control (n=7) and treatment (n=15) groups. The treatment group was reared in a 5x5x3 m floating cage located 150m southwest of the same island and was fed twice daily for 43 days with 150 g of white bread during each feeding schedule. Samples in the control group were processed immediately after collection while those in the treatment group were processed after the 43-day feeding period. The fish muscle

tissues and the bread samples were dried in a convection oven at 60°C and ground to powder form. The liver samples were initially dried in a vacuum oven and additional freeze drying was done at SIRFER, University of Utah. All samples were analyzed for their stable carbon and nitrogen isotope ratios at SIRFER using continuous flow isotope ratio mass spectrometry (EA-IRMS). Stable isotope ratios were compared between tissue types and between treatment and control groups using Student's T-test. Contribution of bread to dietary carbon intake of *S. dimidiatus* in the treatment group was determined using the two-source mixing model while changes in the trophic position of *S. dimidiatus* resulting from bread feeding was determined from the estimated trophic position following the equations in McCutchan et al. (2003).

The *S. dimidiatus* was found to naturally undergo shifts in its short-term and long-term dietary sources as revealed by the significant differences ( $P < 0.01$ ) in the mean isotope ratios between the liver ( $\delta^{13}\text{C} = -16.50\text{‰} \pm 2.51$ ;  $\delta^{15}\text{N} = 4.39\text{‰} \pm 0.57$ ) and the muscle ( $\delta^{13}\text{C} = -11.68\text{‰} \pm 1.77$ ;  $\delta^{15}\text{N} = 5.90\text{‰} \pm 0.84$ ) in the control group. Comparing the isotopic ratios of tissues between groups, lower mean  $\delta^{13}\text{C}$  values were measured in the liver ( $-22.83\text{‰} \pm 2.09$ ) and in the muscle ( $-13.39\text{‰} \pm 1.51$ ) of the treatment group than in the control group. However, only the liver samples were found to be significantly different ( $P < 0.01$ ) in  $\delta^{13}\text{C}$  between groups. The liver of the treatment group was also found to be similar in  $\delta^{13}\text{C}$  value as that of the bread ( $-22.95\text{‰} \pm 0.15$ ), with bread contributing 98.48% to its short-term dietary carbon source. These imply that in the 43-day bread feeding period, the *S. dimidiatus* had become completely dependent on bread as its short-term dietary carbon source. This supports the observations of Hemery and McClanahan (2005) and Illari et al. (2008) on the dependence of the fed fishes on food provisions by humans. Further, the estimated trophic level ( $\lambda$ ) of the bread-fed *S. dimidiatus* (2.6 to 3.2) was greater than that of the control group (2.2 to 2.8) which suggests that bread-fed *S. dimidiatus* would shift away from an herbivorous to an omnivorous feeding habit.

It was concluded that feeding the *S. dimidiatus* with white bread until satiety as is commonly practiced in reef tourism sites could alter its short-term and, potentially, long-term diet sources with bread replacing its major diet. Also, bread feeding resulted to a shift in the trophic position of the *S. dimidiatus* from herbivory to omnivory. Since a parrotfish play an important role as an herbivore in the reef ecosystem, there is a need to examine further how the change in role of the *S. dimidiatus* will affect the dynamics of the reef ecosystem.

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## Effect of a Low-Level Radioactive Wastes Storage Facility on The Geochemistry of Natural Waters

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Radioactive waste disposal practices have changed substantially over the last twenty years, but every positive experience is worthy of consideration. Since 1988, Electrochemical Plant (Krasnoyarsk region, Russia) produces low-enriched uranium (LEU) for the nuclear power plants. The used technology extracts uranium (VI) by nitric acid solutions. The residual pulp after neutralization by slaked lime  $\text{Ca}(\text{OH})_2$  is settled for the deposition of nitrate as  $\text{Ca}(\text{NO}_3)_2$  and also of the residual uranium as insoluble calcium uranate or double oxides of calcium and uranium. Then neutralized pulp is transferred to the long-term storage facility, arranged as a special slurry tank of liquid radioactive waste. The solid residue accumulates on the bottom again, and purified solution from the slurry tank flows through the rock and soil to get to the aquifer. In the pulp solution there is uranium without the elements of decay. Previous ecogeochemical study of these waste storage facility environment revealed that a series of natural geochemical barriers, through which the filtered industrial water drain before getting into the swamp and the river reduces uranium concentrations to the background values (Kovalev et al., 1996). The purpose of this study is to identify changes that have occurred over the past 15 years, and to give them a quantitative explanation on the results of thermodynamic calculations. The second is of fundamental importance for studying the radionuclide migration and their transport from permanent repositories to the biosphere.

The area under study is characterized by acutely continental climate with short summer, long winter and temperature variations from  $-55$  to  $+36^\circ\text{C}$ . The average annual rainfall is 465 mm. Geological section of the site is a complex of Quaternary deluvial sediments, namely a sandy loam and clay with lenses of sand. The maximum thickness of sediments is 15 meters. In sampled soils located near the slurry tank, the concentration of uranium is in the range of 2 to 4.5 g/t. Total low U concentration is adequate to the regional background (up to 7.9 g/t).

The slurry tank of neutralized pulp consists of two ponds, they are located at the watershed of the Khan and Syrgil Rivers, 60 meters above the River Khan and 35 meters above the valley of the Syrgil River. Hydrodynamic calculations have

shown that 96% of water flows to the Syrgil River. Its floodplain is composed of low-lying swampy peat up to 5 meters in height. The groundwater table beneath a top of watershed is located at a depth of 9-14 meters and depends on the seasonal and total rainfall of the year. The upper aquifer is free-flow and is recharged through infiltration of precipitation; a technological recharge to ground water by ponds drainage is significant. The thickness of water-bearing horizon is a few meters. The chemical composition of natural waters is bicarbonate calcium-magnesium with near neutral pH and low mineralization of 350-250 mg/L. The concentration of dissolved metals is caused by the water-rock interaction and is specific for the region background, varying in the order: Fe (0.02-0.73 mg/l) > Mn (0.06-0.15 mg/l), Sr > Ba > Cu > Zn.

Ground-, swamp- and river waters near the Electrochemical Plant storage facility were collected during 2 different seasons: 2008 autumn and 2009 spring. This double-sampling was performed to evidence possible seasonal differences in dissolved salts. The total dissolved solids (TDS), electrical conductivity and pH were measured at the site. Anion species in solution were determined by the ion chromatography. Metals were analyzed by the ICP MS and ICP-AES. Thermodynamic simulation at 25°C and 1 bar total pressure was performed by the "HCh" computer code and the UNITHERM database using a Gibbs free energy minimization algorithm (Shvarov, 1999). The equilibrium in heterophase 20-component system H-O-C- I-N-S-Al-Si-Na-Ca-Mg-Mn-Fe-U- o-Ni-Mo-Cu-Ba-Sr was modeled. The U(IV) and U(VI) species were incorporated into the model using the reference data (Hummel et al., 2002). Activity coefficients were calculated with the third approximation of the Debye-Huckel equation, which is valid for the ionic strength  $I < 0.5$  mol/l.

In the neutralized pulp with a pH of 8.98 the main anions are NO<sub>3</sub><sup>-</sup> (2 g/l) and SO<sub>4</sub><sup>2-</sup> (1.2 g/l) and cation is Ca<sup>2+</sup> (18 g/l). Maximum concentration of uranium is 0.477 mg/l. The base-induced dissolution of host rocks is resulted in high content of NO<sub>3</sub><sup>-</sup> (1.7-3.4 g/l) and SO<sub>4</sub><sup>2-</sup> (0.054-0.13 g/l) in water of the nearest drill hole C-4. It has a neutral pH 6.9 and distinct increasing concentration of Na, Mg, Fe, Mn and Sr in comparison with the background. Vice-versa, the concentration of uranium is 1.2 µg/l - 23.6 µg/l. It is lower than water-quality standards established by the World Health Organization (WHO). There are differences between chemical composition of ground waters moving down the slope (C-3 and C-4 holes). The pH and electrical conductivity as well as total dissolved solids show a decrease in their values. Nevertheless, the behavior of magnesium differs from other ions. Its concentration increases, remaining high enough in the vadose and marsh waters (461-349 mg/l). This intriguing phenomenon is not properly understood. The distribution pattern of the Sr indicates that the wastewater (13.4 mg/l) penetrates to the groundwater and moves down the slope (13.77-8.43 µg/l in C-4 and 9 mg/l in the C-3 holes) to the vadose zone and the swamp water (11.07-8.18 mg/l). Background concentration of strontium is within 0.64-0.16 mg/l.

## **What African Countries Perceive to be Key Adaptation Priorities: Results From 20 Countries in the Africa Adaptation Programme**

Mihoko Kumamoto

Adaptation encompasses a wide range of measures that cut across numerous scientific and socio-economic disciplines. Governments face a considerable challenge in prioritizing measures, and in forging multi-disciplinary links to ensure that their adaptation strategies complement existing national development/sectoral strategies. Adaptation involves different: sectors (e.g. agriculture, water, coastal, health, tourism, etc.); types (e.g. policy, institutional, technical, financial, behavioural); scales (e.g. global, regional, national, sub-national, local); levels of flexibility (e.g. hard- or soft-type); and levels of possible benefits regardless of the extent to which climate change occurs (e.g. low or no-regret options). The plethora of options available for adaptation can create a problem of 'spoilt for choice' and make prioritizing difficult. This is arguably the case for many African countries where adaptation to date has largely been implemented on an ad hoc basis, without systematic prioritizing according to trade offs and benefits across sectors. This paper addresses this issue by reviewing the priority adaptation options identified within the Africa Adaptation Programme (AAP). The AAP implemented by the United Nations Development Programme (UNDP) started in December 2008 and is supporting 20 countries across the African continent to adjust their national development processes to incorporate climate change risks and opportunities. Under this 3-year programme, all participating countries spent the first 3 to 6 months on studying existing adaptation strategies/policies/actions/interventions, identifying gaps, and formulating priority adaptation measures to address such gaps in a highly consultative manner. Here we review these priority adaptation measures and assess/categorise them with regard to inter alia a) types; b) priority sectors; c) scale; d) soft versus hard-interventions; e) measures focused solely on adaptation benefits versus low or no-regret measures; f) complementarity with existing national framework for development/climate change; and g) extent to which the measures are based on ecosystem management and/or promotion of sustainable rural livelihoods.

## **Participatory Approaches for Natural Resources Management: A Critical Evaluation of Joint Forest Development in Tamil Nadu, India**

N. Muthu Kumar

The main purpose of this paper is to critically evaluate the impact of participatory approach and community involvement in joint forest development in Tamil Nadu with the help of an ongoing PhD programme carried out by the researcher.

Participation and involvement of the local communities in natural resource management has emerged and now accepted as the best approach for sustainable management of natural resources. This is described as involvement of the local communities right from the conception and planning stage to implementation, monitoring and evaluation of the programme or interventions. The optimum approach is one in which the local communities come together to conceive, plan, implement monitor and evaluate natural resource management activities, with government departments and other agencies functioning as facilitators.

Participatory approaches refer to the absolute involvement of local communities in any specific programme, beginning from appraisal to planning, implementation, monitoring, evaluation, sustainable operation and maintenance. Participation of local communities is essential because of the following reasons:

1. For need based and village specific planning and implementation of natural resource management interventions.
2. For sustainability of interventions after withdrawal of support from state governments and agencies external to the rural environment.
3. The communities have a stake in the success and optimum development/ management of the interventions.
4. To instill a sense of ownership of the interventions amongst the local community.
5. For operation and maintenance of interventions over a long term.

Participatory natural resource management like forest development leading to better livelihood opportunities is one of the most viable options for the local community as it helps them in enhancing their socio-economic status. Livelihood opportunities linked to participatory natural resource management may be:

- a. Forest-based cottage industries.
- b. Para professionals like para vets etc.
- c. Income-generating activities for women and marginalized groups.

It is in this context, this researcher has discussed about the Joint Forest Management and its impact on environmental protection with a case study of Thiruvallur District in Tamil Nadu, India.

The Joint Forest Management (JFM ) programme in the country was reviewed by Government of India from time to time in consultation with State Governments, NGOs and other stakeholders in view of several emerging issues. In order to further strengthen the programme, the State Governments may take action on the following suggested lines. The community groups in many places in Orissa, Bihar, Gujarat, Andhra Pradesh and Karnataka and Tamil Nadu are performing the essential functions of forest protection and regeneration.

The JFM strategy in India ,especially in Tamil Nadu is built around the notion that local communities can regenerate and protect degraded forests if they are suitably compensated for their costs In a typical JFM set up, the local forest management body, the Village Forest Committee (VFC), works with the Forest Department (FD) on the protection and management of designated forests and receives in return, sustainable benefits that arise out of these restored forests. Thus the basic thrust of the JFM program and the dominant philosophy that has guided its implementation so far has been the provision of forest products - such as fodder, fuel, and non-timber forest products (NTFP) - to local communities in return for services rendered as part of JFM.

Taking in to consideration of the immense potential and genuine need for women's participation in JFM programme, following suggestion for ensuring meaningful participation of women in JFM.

## **A pilot investigation into the use of roof-harvested rainwater for groundwater recharge of a domestic well in Ibadan, Nigeria**

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Rainwater harvesting (RwH) has proven through the ages to be a major contributor for resolving potable water shortage problems but, since the advent of municipal water supply systems, RwH seems to be widely neglected. However, large centralised supplies are not available for all the communities of many developing countries, who remain reliant on extracting their potable water supplies from domestic wells. Unfortunately, extremities in seasonal climate mean that groundwater well supplies are often exhausted during the dry season. To address this issue, this work presents preliminary insights of utilizing rooftop rainwater for groundwater replenishment of a domestic household well in Ibadan, Nigeria. Rooftop rainwater was collected in a RwH storage tank (filled with sand and gravel layers) and the filtered water directed to an adjacent well to replenish the groundwater supplies. Changes in down-well water levels and the bio-chemical quality of the water were measured in the recharged well and, for control purposes, also in a nearby well. Results reveal that water supplies were sustained in the recharged well throughout the study period, while the control well dried-up. Moreover, despite the initial water quality of the well not according to WHO standards, the addition of RwH filtered water to the well appears to have diluted the severity of the bio-chemical concentrations and notably improved the quality of the water in the well. For many nations this approach would not be deemed acceptable but for others, this indicates that using rooftop-harvested rainwater to recharge a domestic household well can replenish groundwater supplies sufficiently to proffer a potable water source during the dry season and can reduce potential public health risks. It is recognised that these preliminary findings are limited; however, the approach outlined in this work does illustrate that RwH offers a wealth of promising possibilities for addressing the water shortage challenges of developing countries.

### **The Mau Forests Complex**

Alfredo Molinas

The Mau Forests Complex (MFC) is Kenya's largest water catchment area. Recently, due to deforestation, over-cultivation, and illegal encroachment, the size of the MFC has been reduced by a third. The author identifies a tragedy of the commons scenario in the MFC. However, it differs from the traditional example because the importance of the MFC transcends local interests since the MFC confers benefits on a national level. Cordoning off the MFC from the Kenyan population, however, is not the best strategy to overcome the tragedy. Instead, if incentives are properly aligned and controlled it becomes more efficient to decentralize management of forest lands, promote education regarding the importance of forest conservation, and privatize parts of the forest land. This last part should be carried out with caution, and this is where the Ogiek and the Masai, two local communities in the MFC, play an important role. Local communities with knowledge of the forest should be included in resolving the tragedies of the commons and in restructuring human relationships with natural resources.

### **Indoor Carbon Monoxide Emission and Particulates Produced from Combustion of Carbon Based Fuels and Their Health Implications on Rural Households of Manyatta Division, Embu District, Kenya**

Linus Kariuki Njeru

Over eighty percent of rural households in developing countries use biomass fuels (wood, dung and crop residues) for cooking and heating. This is done in open fires or simple stoves, mostly indoors, and rarely with adequate ventilation or chimneys. The study examined the fuel and stove types used by the households; ventilation conditions of the cooking areas; some indoor air pollutants emitted from smoke namely carbon monoxide and total suspended particulates and awareness on the associated health implications in the rural households of Manyatta Division of Embu District. Household and health facilities questionnaires were used to answer research questions on the stove and fuel types used and the level of awareness on the health implication of the indoor smoke. Carbon monoxide load was determined quantitatively through volumetric methods and total suspended particulates by use of filter paper traps. Percentages, averages, analysis of variance within and between groups and significance testing were done to test the differences in the groups. Results from the study show that, seventy percent of the households use wood fuel for their cooking either in form of charcoal or fire wood of which eighty six percent of these household use firewood which is not dried. These are burnt in inefficient stoves in the form of earthen or metal jikos in kitchens which are poorly ventilated. The pollutant load from the households using alternative fuels (biogas or kerosene) was lower compared to those using wood fuel (firewood or charcoal). The total Suspended particulates and carbon monoxide load in mg/m<sup>3</sup> was low for the well ventilated households as compared to poorly ventilated households. e.g. Total suspended particulates load in well ventilated conditions from households using firewood, charcoal, kerosene and biogas was 0.11, 0.04, 0.04 and 0.002 mg/m<sup>3</sup> respectively as compared to 0.14, 0.12, 0.05 and 0.02 mg/m<sup>3</sup> from poorly ventilated condition. Children under

the age of five, the aged (>60 years) and women especially expectant mothers were found to be the most vulnerable to health risks associated with indoor smoke at thirty seven percent, eighteen percent and fourteen percent respectively. Seventy three percent of the households sampled were not aware of the health hazards associated with exposure to indoor air pollutants resulting from smoke. The study findings call for greater action oriented research, policy attention and commitment to provide effective indoor air pollution mitigation strategies to the rural households.

## **Moving towards a Sustainable Future in the Nigerian Oil and Gas Sector: Challenges and Opportunities**

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The Nigerian society has undergone substantial changes in the last 5 decades. Income from oil and gas industry has resulted in a considerable increase in living standards, favorable economic position and consumption levels. At the same time oil and gas production and consumption has been the cause of the increase in Nigeria's carbon dioxide emissions. Nigeria is rated as number ONE for the top twenty gas flaring countries of the World. Oil and gas production has also been the major cause of unrest, militancy, conflict and environmental degradation in the Niger Delta. This paper examines the need to transit to a sustainable future oil and gas production and consumption in Nigeria: challenges and opportunities. The challenges include; how to convince the Nigeria government and the oil and gas operating in Nigeria about the harmful effects of global warming and the rising costs of business resulting from climate change, the need for fiscal reforms that shifts the burden of taxation from jobs, income and savings to waste of resources resource depletion and environmental degradation, the need for sound monitoring and accounting systems. Opportunities for Flare Reduction technologies and new growth poles that are aimed at addressing the interdependence of human and natural ecosystems are also examined.

## **Adapting the Water Sector in Nigeria to Climate Change**

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An area experiences water stress when annual water supplies fall below 1,700 cubic meters per person, water scarcity when annual water supplies fall below 1,000 cubic meters per person, and absolute scarcity when annual water supplies fall below 500 cubic meters per person (UN 2010). Population growth, urbanization, and over-abstraction by sectors like the agricultural sector are among a few factors that contribute to water stress across the world, and a country is considered vulnerable to this phenomenon when annual water supplies are between 1,700 and 2,500 cubic meters per person. Water scarcity or stress may stem from variable supply patterns caused by different factors, including climate change. According to the International Panel on Climate Change (IPCC), climate change is expected to exacerbate current stresses on water resources, and experts believe that the negative impacts of climate change on freshwater systems outweigh the benefits (IPCC 2007). The negative impacts of climate change will be experienced immediately at lower latitudes, where most developing countries are located (Evans 2009); in Africa alone, between 75-250 million and 350-600 million people are projected to be exposed to increased water stress by the 2020s and 2050s, respectively (IPCC 2007).

Nigeria is a developing country in Africa located at low latitudes (10° north of the equator) and its water resources are not only vulnerable to climate change but also to the effects of increased population. The population growth rate from 2010 to 2015 (2.12%) is projected to be almost twice that of the world (1.11%). The country is currently vulnerable to water stress (UN 2010), and climate change will only aggravate the problem. Seventy percent (2007 est.) of the population in Nigeria is below the poverty line, approximately half the population lacks access to improved drinking water sources, and 43% (2003 est.) of the country is malnourished (stunted) (CIA 2011; WHO 2009). It is relevant to cite such data, because in a developing country with such dire statistics, climate change can easily be overlooked even though it could have a significant impact on the economy. As of 2006, only 47% of people in Nigeria had access to improved drinking water sources, leaving approximately 77 million people without access (JMP 2008). According to the Water and Sanitation Monitoring Platform (WSMP), Nigeria is currently not on track to meet the Millennium Development Goal (MDG) of halving the number of people without access to improved drinking water sources by 2015 (WSMP 2008). Climate change could potentially slow the progress in Nigeria in the long run, so the water resources and infrastructure need to be adapted to climate change to reduce the vulnerability of the country's water sector to climate change.

According to the IPCC fourth assessment report, the projected sea level rise will have significant impacts on coastal megacities, and Lagos, Nigeria's economic hub and most populous city, is a coastal city that is vulnerable to sea level

rise, and will probably be affected (IPCC 2007). Lagos currently has a population of approximately 10.6 million people (2010 estimate) and a significant portion of these people could be affected by sea level rise and some may even be displaced (UNPD 2010). Additionally, sea level rise will increase salinization of groundwater resources which will limit the use of groundwater resources for domestic purposes. Desalinization of saline water may not be an option because it is expensive, especially for a developing country. Also, regional information presented in the IPCC fourth assessment report projects that extreme wet events (which include intense precipitation/floods) will increase in West Africa. Nigeria's First National Communication under the United Nations Framework Convention on Climate Change also projects an increase in rainfall variability which would result in increased floods. Water infrastructure can be adapted to increased floods by different methods. One of these is raising tube wells above flood levels, a strategy that has been successful in Bangladesh. Water resources are susceptible to increased contamination with more frequent and more intense flooding events. Good drainage systems are needed to prevent or at least minimize such contamination as well as ensuring waste disposal is managed properly and sited away from water resources. Another effect of increased variability of rainfall caused by climate change would be reduced precipitation in the northern regions of Nigeria. This would result in more frequent droughts in a region that is already dry and susceptible to droughts and desertification. In periods of rainfall, certain practices like rainwater harvesting will need to be employed to reduce the country's vulnerability to drought. These and more adaptation measures, along with policies that should be employed by the government need to be adopted so that Nigeria is fully prepared for the effects of climate change, effects that are believed to be currently experienced in the country.

This paper presents information on current water policy in Nigeria as well as how the policy incorporates climate change and its effects. Also, information on adapting water resources as well as water infrastructure is presented. A comprehensive literature review of national and international documents will be undertaken to perform this research.

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## **Sustainable E-Flows In The Ganga River: In the Perspectives of Livelihoods**

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River Ganga contributes to livelihoods in India. She is personified as Goddess and holds an important place, culturally, among Hindus. According to Hindu mythology, it is believed that bathing in the river erases sins and facilitates the attainment of salvation or nirvana. In addition, immersion of ashes of deceased ones in the river not only keeps the soul of the deceased in peace but places it in heaven. The River is also known for unique landscape and habitat for species which promote livelihoods. Over the time period, exploitation of river resources by the inhabitants has imbalanced the flow related livelihoods. Moreover, the river resources at certain stretches are at the verge of extinction. The proposed study focuses on the relationship between the river resources and livelihoods. The study provides suggestions on sustainable e-flows in the river to promote livelihoods. The primary survey has been carried out in Upper Ganga Stretch-UGS (Rishikesh-Haridwar), Middle Ganga Stretch-MGS (Narora-Kachhla Ghat – Bithoor – Kanpur) to analyze livelihood activities and recommend e-flow conditions. The Survey indicates that the present status in UGS is 'Maximum Sustainable Yield (MSY)'. Hence, the study suggests that MSY should be maintained in desirable state. The prevailing status in MGS is 'Livelihood activities are not economically feasible' so there is a need for improvement of flow conditions up to Maximum Sustainable Yield (MSY) in the desirable state in order to preserve ecosystem and in turn to promote livelihood activities. The study arrived at preliminary sustainable e-flow recommendations for drought and maintenance years (driest/wettest seasons) in the Ganga River.

The author expresses special thanks to World Wide Fund – India (WWF) for its support to carry out this project, and also thanks the Biodiversity, Geomorphology, Hydraulic, and Cultural groups of the program.



## Learning Organizations in the German Water Supply for the Strategy Conversion of Sustainable Development

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Utility services have experienced an increasing number of transformation pressures (e.g. deregulation, liberalization, privatization). In addition, the technologies of drinking water supply and their management systems are potentially vulnerable to climate change (Howard et al. 2010). In this context, the aim of this paper is to analyse the challenges and best practice solutions for sustainable economies as part of the national sustainable strategy by water supply companies in the German Water Sector. It is investigated to what extent water supply companies act like structural political actors as a part by Sustainable Learning (e.g. decentralized supply structures, high eco-efficiency, reduction of ecological footprint etc.) and how sustainability management tools (e.g. ISO 14001, ISO 9001, Balanced Scorecard etc.) are implemented.

The value-added processes of water supply companies (e.g. water collection, treatment, storage and distribution) require a high energy impact. Excessive use of non-renewable resources, low level of energy efficiency and high levels of carbon dioxide emissions are some of the main challenges that need to be addressed. Sustainability performance of water companies therefore demands in particular a greater use of renewables in the production process along the value chain of drinking water. For the strategic procurement in particular high requirements at an eco-efficient energy procurement results from that. High levels of energy and resource consumption in the value chain of drinking water are the leading indicators for procurement of renewables regarding sustainability and sustainable supply chain management. Energy Supply Enterprises (ESE) have a high degree of entrepreneurial responsibility in the context of sustainability. Their performance also has implications for the companies in the water industry and its procurement management. The responsibility by ESE can be seen next to ecological indicators (percentage part of renewables in the electricity mix, energy efficiency) and social requirements (price structure, compliance with social standards), demanded to pursue process innovations within the framework of sustainability-oriented competition strategies and to achieve a comprehensive contribution simultaneously within the general climate debate – through reduction of the negative environmental effects. Sustainable management in water supply companies must be mentioned regarding corporate responsibility and sustainability generally. The challenge for water supply companies in this context deals with three goals:

- Reducing external costs: The contribution is based on eco-efficient energy procurement in the case of higher levels of renewable energy and higher eco-efficiency in production processes.
- Sustainable energy procurement as part of strategic management.
- In the current debate and to achieve more success in sustainable solutions in the supply sector (reducing the environmental externalities), sustainable economies as a learning process should be more implemented: Therefore a paradigm change from cost efficiency into sustainable performance is essential to realize higher sustainable level in the water supply sector.

Learning and development capability is a key factor for the competitiveness and innovative capacity of firms (see Siebenhüner and Arnold 2006, 319-340). Organizational learning, however, requires relatively open and transparent operational communication and cooperation structures that make it possible to create internal space for dialogue for learning. Bruch and Vogel (2005, 155ff.) emphasize in this context the importance of organizational power in a company and the realization of collective commitment that is founded in a proactive use of actors (change agents, intrapreneurs) for sustainable business goals. This is particularly true for conceptual approaches to understanding and systematization of environmental learning processes (Brentel et al 2003, Cramer 2005, Pfriem and Schwarzer 1996; cited in Siebenhüner et al 2006, 27) or Sustainability Management (Fichter 1998). Organizational learning also enables companies to implement sustainable innovations (Pfriem et al. 2006, Rüegg-Stürm 2001). Steinmann and Schreyögg (2005) understand learning as a change and see the idea of a learning organization in the context of an ongoing organizational change (Steinmann and Schreyögg 2005, 506). Learning as a change in the knowledge base from this perspective means that an organization learns, «...if its self-referential action and expectation patterns, or more generally, their knowledge base changes (Luhmann and Schorr, 1979, 86). Restructuring of action theories can - and this is crucial - both in a reactive sense, i.e. experiential. And in the proactive sense, i.e. based on events that are supposedly occur in the future - therefore expected oriented - are conceptualized» (Steinmann and Schreyögg 2005, 509). Thommen and Achleitner (2004, 976) share Organizational Learning (OL) in direct relation to knowledge management and define OL as a process of change of organizational value and knowledge base to enhance the problem-solving and capacity building (and to change the framework of an organization). The main focus is based on building a company-specific knowledge

base, i.e. construction of knowledge that is shared by all company members. For this purpose, the knowledge base using the dimensions is divided individual / collective and documented / mental knowledge (in the internal organizational context and environment of the organization, see Wahren 1996, 98).

As a first overview, Table 1 outlines the scientific discourse on organizational learning[2] and sustainability. This is particularly clear that sustainability-related learning processes in the literature have been processed rudimentary (see Siebenhüner et al. 2006, 27).

In the research field of network systems such as water supply, the issue of organizational learning plays in correlation to lasting learning (still) a minor role. First approaches in this field of study provides a stakeholder analysis of the water supply industry (Tilmann 2001). Rothenberger (2003) describes specific configurations of actors as integrated micro-systems of care and shows the dynamics of the design of transformation processes of a network of sustainable supply (see also Berndtsson and Jinno 2008). Organizational sustainable learning processes in ecological and social topics (especially eco-efficiency and corporate social responsibility) are in the water supply rather rudimentary at present. (Mayer Spohn 2004, Pieper 2008).

Under the primacy of sustainable organizational learning the institutionalization of organizational sustainability in the areas of water needs and power supply were investigated. The network infrastructures and sectors of the supply systems are changing and therefore those areas represent in context to climate change an ecological key challenge for sustainable development processes.

As an example for sustainable economies a case study described the German energy supply nationwide, water supply companies and their positioning in terms of sustainable energy. It was to be shown to what extent the diffusion of renewables played already a role in the procurement management of the water supply enterprises or not. High levels of energy and resource consumption in the value chain of drinking water are the leading indicators for procurement of more renewables. Therefore the contribution aimed to show the enormous ecological and social responsibility of water supply enterprises and to describe action recommendations for a lasting energy procurement management in context to sustainable water management and water services.

In addition it was investigated to what extent water supply companies act like structural-political actors as a part by Sustainable Learning (e.g. decentralized supply structures, high eco-efficiency, reduction of ecological footprint etc.) and how sustainability management tools (e.g. ISO 14001, ISO 9001, Balanced Scorecard etc.) were implemented. A crucial topic in this study was anticipation in Sustainable Learning in supply utilities induced through sustainable innovation processes (see Porter and van der Linde 1995).

The research aimed at understanding the transformation processes currently taking shape in utility sectors, at identifying potential future paths, at evaluating their environmental, economic and social consequences and at developing new strategies for action. In order to accomplish this goal this study draws on theories, methods and data from the social sciences – in particular institutional Economics, Ecological Economics and Governance Studies. In this context the transformation processes were being analyzed both at a macro-level (emphasizing sectoral level transitions and national policies supporting these transitions), at a meso-level (developing regional level institutions of governance for these transitions), analyzing innovation networks and heterogeneous actor networks) as well as at a micro-level (e.g. new forms of innovation management and strategic planning at the level of individual utilities).

To reflect in-house learning and change processes of water supply enterprises, we first analyzed the organizational conditions for sustainability-oriented corporate policies. They were processed conceptually and empirically analyzed in a second step in business case studies. To describe the change and sustainable organizational learning particularly the sustainability policy and -performance of the companies was investigated. To this end, various approaches were highlighted (adapted from Behrens et al. 2005, 13:

- Evolutionary Organizational Economics
- Organizational (sustainable) learning
- Sociological Neo-Institutionalism
- Sustainability Management
- Strategic Management
- Innovation Management

Due to the sustainability challenges to the companies in this context we had to identify whether an institutional learning capacity exists in water utilities (see, systemic approach, Senge 1990, 6; culture-based approach, Argyris and Schön 1978), i.e. the «learning organization» is directed by a pro-active process of ex ante learning (see also knowledge-based approach, Duncan and White 1979). Preliminary results we could identify like following:

- Triggers for a sustainable supply chain (avoiding and minimising risks in purchasing energy, ensure environmental standards by energy suppliers) are practised marginally.
- Green energy purchases by water utilities is still low spread.
- Only a small part of the water utilities uses sustainability management as a part of strategic management.
- Lasting sustainable energy procurement is anchored only by few water utilities in the strategic management. Procurement management was not been identified as a success factor in sense of sustainability oriented competition strategies.
- Organizational sustainable learning processes in ecological and social topics (especially eco-efficiency and corporate social responsibility) in the water supply are rather rudimentary.

Regarding the target of greening the value chain of water supply enterprises (wse), sustainable procurement can be considered as an important factor. Another topic in context of sustainability management and sustainable supply chain management deals therefore with the enormous ecological and social responsibility of the water supply enterprises within the general climate debate by reducing the negative environmental impact.

Objective and task of this case study was to show how sustainable energy procurement in strategic management was anchored and green procurement management as a success in terms of competition-oriented sustainability strategies has been identified by the water supply enterprises. The degree of implementation of strategic management systems (e.g. Sustainability Balanced Scorecard) was found at a low level. In accordance with the requirements of sustainability sustainable learning should be stronger implemented by water supply enterprises and therefore be an strategic factor.

- [1] The scientific concept of 'learning', originally results from a behavioral research tradition in which it was addressed as part of the stimulus-response scheme (SR-paradigm). March and Olsen (1979, 12ff.) were among the first to have this learning approach applied to organizations. (see Steinmann and Schreyögg 2005, 506; see also Klimecki et al 1999, 7f.). According to Argyris and Schön (1974, 1996) manifests itself, therefore the knowledge of an organization primarily in the form of organization-specific theories of action («Theories of Action»). Here, the authors differentiate between those subjects name the members of the organization to justify their actions («espoused theory») and those who - often unwittingly - in fact, are the actions on («theory in use», see Steinmann and Schreyögg 2005, 509) . Sustainable Development as social learning see further Parson and Clark (1995).
- [2] The range of organizational learning is reflected by Klimecki et al. (1999, 12) because of the effect they leave in the organizational areas. Common distinction is made between incremental and fundamental learning differentiated (Miner and Mezas 1996), is particularly common on Argyris and Schön (1978) declining terms» single-loop learning «and double-loop learning». Based on their concept «theories of action», the difference between these two forms of learning are illustrated (sustainability-related learning processes in companies in particular see Siebenhüner et al. 2006, 29ff.).

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## Environmental Degradation, A Threat To Health And National Food Security

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The study was aimed at assessing the hydrochemistry and pollution status of Lagos waters and its implications on health and the fishing activities / food production. The population growth is seriously damaging the natural resources base and generating major environmental liabilities. Anthropogenic activities and land use have greatly increased the pollution status of our aquatic environment, becoming a threat to the National Food Security as well as the human health. This assessment of hydrochemistry and pollution status of Lagos aquatic environments (marine and lagoon) was carried out between 2008 and May 2010. Result showed that the physical and chemical characteristics of the study areas are significantly different from one another, seasonal dependant and are greatly influenced by the economic activities within the area. Marine debris, oil spillage / pollution, untreated sewage and effluents from industries (among others), have increased the pollution of the water bodies and decrease in fish production. Survey of living resources in Nigerian coastal waters carried out in 2009 (where ¾ of the haulage was marine debris) showed about 20% reduction in fish catch. That of the Lagoon survey also showed that major sources of pollution from land-based activities was constituted by untreated sewage discharge, oil spills, effluent from industries, litters, solid wastes, plastics and other marine debris which threatens marine life, human health, reduced fish production, and degrades the visual amenities of marine and coastal areas. Most fisher men had taken to dredging as an alternative to fishing. The growing world population is now a driving force in the global economy, and in achieving national food security, unprecedented rate of poverty reduction (among others) and meeting up with the Millennium Development Goal (MDG), much need to be desired.

## Cadmium in water and its effect on crab

Dasari Sreeramulu, PhD

Visakhapatnam is one of the largest city in India, with large coastline. It is anciently built with good natural port which is surrounded by several industries which are agrochemicals, pesticide, petroleum refinery, tannery and battery etc. These industries are major source of income and employment. These industries are contributing pollution in the coastal environment by adding industrial waste into the sea, due to the rapid and sustainable industrialization. In this study we used acid digest method for seasonal changes of heavy metals in water and crab tissue. In this study cadmium concentration in marine water shows seasonal variation; Post-monsoon  $0.034 \pm 0.005$  > Monsoon  $0.024 \pm 0.004$  > Pre-monsoon  $0.008 \pm 0.004$ . Similarly, cadmium concentration was found in marine crab showing Post-monsoon  $0.102 \pm 0.017$  > Monsoon  $0.078 \pm 0.016$  > Pre-monsoon  $0.028 \pm 0.009$ . Lastly in this study cadmium concentration in marine water and crab was found to be high  $0.047 \pm 0.003$ ,  $0.138 \pm 0.018$  respectively in MPS site during Post-monsoon. This high cadmium concentration was due to several untreated urban and industrial effluents and solid waste materials being drained in to the Visakhapatnam coastal water. Proper measurements to reduce these pollutants of the sea water may lead to health marine environment.

## Sustainable Tourism and Biodiversity Conservation in National Parks in Malaysia: A Need for Integration in the Management and Planning Activities

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Tourism industry has widened its scope from traditional tourism to a more sustainable one in the recent decades. Sustainable tourism, ecotourism or green tourism has been the latest jargon used by the industry to attract tourists to be

more sustainable and enjoy their holiday in nature. If sustainable development refers to meeting the needs of the present without compromising the ability of future generations to meet their own needs, sustainable tourism would denote tourism which respect and conserve, as well as not to harm biodiversity and socio-cultural balance. The greatest task to conserve the remaining biodiversity however may come down to some developing countries. They are now confronted with the real challenges to create sustainable community while coping with their rapid economic growth. Malaysia for instance has gazetted several national parks but those areas are exposed to illegal loggings and deforestation which will have great impact on its biodiversity. The remaining forests in Malaysia should be considered as a protected area as it plays a vital role in achieving specific conservation objectives. They are the sources of water supply, forest produce for human and animals as well as for recreational purposes and sustainable tourism activities. For that matter, under the National Physical Plan (NPP) of 2006, the protected Areas in peninsular Malaysia shall include all gazetted national and state parks, wildlife reserve or sanctuaries, marine parks, protected forests and other areas designated for statutory protection. It is the intention of this paper to highlight the policies designed for the conservation of Malaysian biodiversity. In particular, the paper will highlight the management and planning policies in the National Park and to assess its effectiveness in conserving its biodiversity. The paper conclude that the management and planning activities in the National Park must be integrated in order to ensure a proper and systematic usage of the biodiversity and for a successful and sustainable tourism activities.

### **Is energy a prerequisite for development? A perspective for sustainable development in Latin-America and the Caribbean**

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The conventional pursuit of development understood as high levels of per capita GDP and living standards jeopardizes sustainability by compromising the limited capacity of the natural system and the capability of the poor to consume more. Having a special consideration for the developing world's need for development, this study presents their unique challenges for sustainable development[1] (SD) given that increasing energy demands for development should moderate its environmental impact.

Developing countries has been opposed to seek targets for climate change mitigation under the United Nations Framework Convention on Climate Change and its Kyoto Protocol[2] similar to historic polluters targets as it limits developing countries' aim for development. The latest United Nations Climate Change Conference has showed little progress on developing countries strategies to cut future carbon emissions[3], thus, special guidelines on SD for their particular context are critically needed.

Based on the relation between energy and development in Latin-America and the Caribbean region context, this study presents the outlook for SD in the region from a demographic, economical, technical and environmental perspective.

In recent years, Latin-America and the Caribbean region has achieved remarkable progress in terms of living standards lead by economic growth, nevertheless, those indicators could be misleading. The aggravation of poverty and inequality, the polarization of income distribution and the deterioration of the environment remain widespread. Despite the fact that Latin-America and the Caribbean represent the second least polluting region in terms of world carbon emissions; its per capita emissions reach 9.86 tons surpasses the total global emissions in per capita terms average 6.82 tons[4]. Moreover, regional aggregated carbon emissions have been growing rapidly.

Latin-America and the Caribbean region should steer its development towards a strategy that pursues a low-carbon path while supporting SD. The region is however an important player in the world energy field; particularly a key producer and exporter of oil[5] which continues to be the most important source for producing energy.

Although some empirical evidence suggests that energy consumption is gradually decoupling from per capita GDP, the current "development model" in the region still demands large amounts of energy. In fact, during the period 1980-2008 regional levels of aggregated energy consumption rose by 12% as aggregate energy intensity remained constant. The varying levels of energy intensity across countries, however, highlight energy intensity efforts as a potential tool for transitioning to less carbon-intensive economies in the region.

The research question becomes evident: is Latin-America and the Caribbean region able to develop with the least energy consumption and carbon emissions? This study applies the IPAT approach[6] to the specific context of 21 countries in the region based on CO<sub>2</sub> emissions as the single variable measure of environmental impact. By presenting the interrelation amongst population (P), affluence (A) and technology (T) the most relevant findings reveals that population is expected to grow and per capita GDP is likely to increase. Given increases in population and affluence, the T term of

the IPAT equation becomes an essential counterweight to P and A; and requires energy efficiency[7] and environmental governance to moderate CO<sub>2</sub> emissions and establish guidelines for SD. Finally, this study contributes to demonstrate that there are ways of reducing undesirable effects. High levels of energy and carbon emissions are not necessarily a prerequisite for development.

- [1] Sustainable development has been widely understood as the development that meets the "...needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, Our common future, 1987: 2: 43)
- [2] UNFCCC (1992, 1997) Note that commitments are not binding and some industrialised countries, e.g. the US, Japan, Norway and Canada, greenhouse gas emissions continue to grow.
- [3] The conference took place in Cancun, Mexico, from 29 November to 10 December 2010. Developing countries propose to reduce emissions 1.3 GtCO<sub>2</sub>e below the reference scenario in 2020 plus an additional 1 GtCO<sub>2</sub>e in 2020 by reducing deforestation as unilateral action. GtCO<sub>2</sub>e reduction is conditional on external financing.
- [4] United Nations Economic Commission for Latin America and the Caribbean (ECLAC) Economics of Climate Change in Latin-America and the Caribbean, 2010 Report, December. P. 91
- [5] The region's highest demand of energy comes from oil products (42%). Only 23.1% of the energy produced in the region, comes from renewable sources, primarily water, sustainable fuel wood and sugarcane products.
- [6] The IPAT identity introduced by Ehrlich and Holdren (1971) and has been widely discussed in analyses of energy-related carbon dioxide CO<sub>2</sub> emissions.
- [7] Energy efficiency is measured as the reduction of environmental impact per unit of economic activity.

## The Human dimension of climate change and its effect on the socio-economic system in Mongolia

Batjargal Zamba

Mass movement of people, regional conflicts, devastating famine, collapse of empires, raise of nations, and many other societal catastrophes and shocking events have occurred during the long history of the humankind due to climate fluctuations. The researchers suggested that the climate change had significant effects on changes in the position of agriculture–grazing transitional zones in most parts of the world, particularly, in Asia.

Mongolia, as one of the deep continental countries in Asia, is facing multiple challenges in relation to the current and expected climate conditions. Human activities are making an increasing contribution to the destabilization of ecosystems in Mongolia, having associated feedback on socio-economic systems. In fact, Mongolia is struggling to find a way toward more accelerated development in its path of history as a nation during the last several decades. It seems Mongolia may not be able to avoid failures experienced by many other so-called "resource rich" developing countries who tend to "enjoy" an easy way to development relying on their natural wealth rather than their human capacity. Such kind of development policy as a rule appeared to be unsustainable in terms of economic growth due to price volatility at the international market and other similar factors. This policy has proved to have considerable side effects, including negative environmental impact. Moreover, there is a prerequisite of social tension attributed to the emerging disparity in access to available mineral resources and thus increased income polarization in society. In terms of ecological footprint, Mongolia at present is "burning" more natural resources for every component of Human Development Index (HDI) than many other countries in Asia.

Climate change studies, conducted in Mongolia so far, particularly, in respect to the expected climate conditions in the future, were mostly based on the outputs of global climate models (GCM) resulting in a very important message that the present global warming will in the long run lead to a *shift of climate zones* with dominance of arid and desert areas in this country. The series impact and risk analyses studies have been undertaken in respect of different ecosystems and economy sectors, including agriculture with a special focus on the livestock sector.

However, despite the fact that the emission scenarios used by the IPCC are sophisticated and relatively realistic, they missed certain important factors like the impact of climate on carbon cycle, changes in ozone precursors, long-term changes in solar activity, unpredictable but possible volcanic eruptions (like, for instance, eruption of [Eyjafjallajökull](#) in April 2010 in Iceland, ash cloud from which spanned big enough area). The principal instruments in climate change studies, such as the current GCMs, did not capture all intrinsic components in the driving factors, like the full range of aerosol impact and possible imperative non-linear feedback effects, related to land cover change (due to extensive land use, deforestation etc.), interaction with changing ocean (sea ice coverage, ocean current alteration due to water density variation), changes in cloud patterns (due to increased evapotranspiration and aerosol population as cloud condensation nuclei) and other associated factors.

In addition to that, the interpretation of projections was based mostly on the "domino effect" like linear approach rather than the cascade type transaction covering full range of economic and environmental aspects of the problem with a clear target on sustainable livelihood of people. The leading experts on climate change in Mongolia recognized that the vulnerability and adaptation assessments of climate change for different natural zones and rangeland in this country are defined, so far, by

judgments of experts rather than the quantitative estimation and integrated analyses. In this regard the certain outcomes of studies, particularly those related to future scenarios, can be considered in *optional terms* but not in categorical ones.

An extended survey and comparative examination, which have been undertaken within this study, have resulted in certain conclusions. More detailed discussion in this paper addressed the livestock sector as the most essential way to use natural resources in Mongolia, which had further lead to the list of emerging challenges for this country, including development paradigms (natural resource or human capacity based) and dilemmas faced, particularly, in respect of traditional pastoralism.

Looking back at the history, an assumption is made that sedentary and nomadic civilizations were responding to climate change in very different ways, with non identical impacts on themselves as society and on the environment. Even simple superposition of reconstructed trends of climate parameters, particularly, the temperature trend at global and regional scale and Mongolia's historical timeline could give an impression that certain commonly accepted perceptions about nomadic tribes can be revised. Most scholars, for instance, concluded that Mongols and their ancestors were migrating with war and attacks at their neighbors due to the worsening climate conditions (cool and dry phases of the regional climate trend). Nevertheless, a detailed analysis can provide differing evidence including opposing views.

*Sedentary civilizations*, as a rule, transferred their own risk to the ecosystems ( as an additional burden) using more and more material and energy resources for shelter, heating, cooling and other necessities, as well as for producing surplus, in addition to Basic Human Needs (BHN). It was, to some extent, causing double stress on the ecosystem. Such overloading on ecosystems had intensified since the Industrial Revolution (18th century) leading to the modern day's worldwide ecosystem degradation and global climate destabilization.

Nomadic civilizations, on the contrary, took the risk upon themselves accepting it as one's dues. They were able to reduce burden on the given ecosystem by moving to other places with adequate carrying capacity, in some ways unloading the stress from the ecosystems. Nomads were forced to live relying on limited resources, which in most cases had a negative impact on the growth of their population. Nomadic lifestyle was created as a way of life for human beings to survive in the unstable harsh climate conditions with added stresses due to prolonged cooling and dry periods. When severity of climate conditions were exceeding their survival threshold, this could lead to diminishing capacity of communities to sustain life, resulting in shrinking of their population. It can be assumed that expansion and migration were possible only when the climate conditions shifted to their positive phase (more warm periods with increased or regular rainfalls), supporting the capacity building to expand their area of inhabitation and to maintain their other capabilities. Conflicts or clashes with neighbors, in most cases, probably were occurring for the life style, but not for the life space. In this respect, one can say that the Chinese Great White Wall served neither in preventing sporadic attacks from the nomadic tribes of north, nor in preventing them from moving to the south due to worsening weather conditions in their lands. In fact, the wall stands almost like the border line between the nomadic and settled life styles preventing mass migration from both sides. Apparently, this unprecedented endeavor of human beings had benefited more those whom the Wall was intended to stop. Nomadic tribes, obviously, due to their tiny size of population in comparison with those who were settled inside the Walls might not have been able to avoid or withstand the possible radical assimilation during the long period of history, unless the Wall shielded them from this very possible ill fate. Inferring from historians' estimations, the total population of Mongolia within its present territory increased no more than 3-4 times during the 800 years of its history since the 13th century. However, the population tripled during the last 80 years since 1920-ies, with much more accelerated rate since the time when certain elements of settled lifestyle have been introduced and expanded in Mongolia.

In the long history of human society, the ecosystem at the territory of Mongolia has been controlled by direct impacts of global climate system through its regional patterns. Only in the second half of the twentieth century Mongolia began to experience certain interference impact on its ecosystems due to global warming induced climate patterns, regional economic integration exercises( cooperation arrangement within the former COMECON) , and its open door policy towards the globalizing world (period of transition to market economy). Mongolia has been increasingly intervening in the natural order and regularity, with a notable change, in the ecosystem structure, which in the future might aggravate the effect of forcing generated by the global climate system in a different direction, resulting in negative and positive outcomes, in terms of benefits for the ecosystem functions and for the society.

Migration, including nomadism and pastoralism, in modern days, can in fact be classified as one of the robust forms of human mobility utilized in order to cope with the periodically changing living environment. Human mobility in a form of migration was the only way for human beings to survive in the early history of the mankind. At present, migration still serves humans in their quest for survival (refugee migration due to regional conflicts or ecological reasons such as prolonged drought, devastating floods caused by storm surges and other extreme weather events) and in their desire to improve life (for generation of income, education, etc.) And enjoy life (pleasure, tourism). Therefore, migration is considered as a human development factor and not just as a survival option.

Mongolia has certain advantages compared to others, since it can benefit from its ecosystem services thanks to the dominance of natural and semi-natural ecosystems in the country and its people's unique lifestyle based on human mobility in the form of classical pastoralism. Traditional pastoralism, enriched by the advancement of modern technology and knowledge and diversified, involving cropping, ecological tourism, and other income source related activities in complementary and environmentally sound manners, can be the best possible option in the adaptation to climate change strategy in order to minimize the stress on society caused by the global warming.

Traditional way of livestock husbandry or pastoralism in Mongolia can be threatened by multitude of factors such as global warming caused cold waves with heavy snow storms, an early establishment of long lasting and fixed snow coverage of the territory in winter and etc. These factors in combination with increased soil moisture deficit, due to possible decrease in summer rainfalls and intensified evapotranspiration, can prevail as pressures on livestock, with heat stress ( as it was emphasized in a number of previous studies) no longer being the single stress factor for the animals.

Increased incidents of “white” and “iron” dzud[1] situations in winter seasons will have serious negative impacts on livestock as an economy sector and on the livelihood of the local communities with limited options for income sources for life. A complete change of the infrastructure development concept, which was based, so far, on the past climate background and norms, might be required. Improved concept should cover the full range of transport, telecommunication and energy supply networks, including road construction standards, energy grid, with autonomous backups based on local and renewable energy sources, wireless and satellite communications, rehabilitation of air services with access to the remote areas. Adequate government policy would be needed to deliver the distance medical and educational systems in rural areas using the advancements of modern ICT in order to provide equal access for everyone to a high or at least acceptable standard services.

Traditional way of life in Mongolia associated with pastoralism is considered as the less harmful and more feasible option in response to climate change, thanks to the high adaptive capacities of communities to the rapid changing living environment. On the other hand, the concerns are raised in relation with globalization impacts from the possible overturned effects of high tolerance of “nomads” to non native, but more disturbing and life changing “cultural” elements. Therefore, globalization induced changes in society need to be harmonized with natural capital and traditional cultural values to help avoid possible “shocks”, in combination with climate change attributed stresses, that might trigger negative “domino effect”, like consequences on local ecosystems and correspondingly increasing vulnerability in society.

Science based policy is needed in respect to a development paradigm of the country in order to prevent any collapse level degradation in ecosystems due to the interference effect of human and natural systems, which might lead to a significant pressure on the national economy and the livelihood of people.

In respect to the methodological approach, there is a need to highlight a pattern behavior of climate system, mosaic peculiarity of land cover, and a mixed structure of ecosystem with an aggressive intervention of man managed ecosystems, where mismanaged mining activities, steadily growing crop cultivation along with extensive animal husbandry are playing key roles. It is important to further update the results of the past studies by involving new data and upgrading them in terms of the spatial scale. In the downscaling exercise, there is a need to shift the focus from macro scale *frontal type alteration* to meso scale *pattern change and evaluate the after-effect of interaction* of the climate and human systems at a local level.

In terms of the adaptation strategy timeframe a high priority has to be given to the near and midterm incremental changes, adding certain long term and low probability but high impact changes, such as the continued and increased aridity in some parts of Mongolia, rapid and deep alteration in moisture supply regime and related adaptation options, and as well as, possible livelihood alternatives for local communities.

In practical terms, a special focus has to be made on the negative impact events, such as change in precipitation patterns with the increase of its winter proportion and lesser frequency but higher intensity rains in summer, leading to aggravated deficit of water for livelihood and production activities.

In the long term plan, some uncertain or low probability but high impact events should be kept in the field of vision, i.e., a complete shift of climate zones with intensified rate of desertification, which result in dramatic social consequences, such as mass displacement of people within and beyond their national borders, including flow of people in both directions as ecological refugees.

In the near term, scientific research activities need to be aimed at establishing well coordinated climate and ecosystem monitoring networks, identifying key indicators to track and analyze major changes, while developing relevant data bases. International cooperation is needed to identify the “tipping points” in relation with the aerosol impact on regional climate system, which in some areas could reach a level that may counteract with the warming effect of the GHG, due



to intensified land use change. In some parts of Mongolia, focus of the study should be made on the role of the so called black carbon or other albedo effective aerosols in acceleration of glacier melting and its matching rate with possible above 'normal' accumulation of snow in winter season.

Finally, certain conceptual issues have been broached in respect of the ecosystem restoration practices, with a focus on the ecosystem service based solutions, particularly, the "life point" approach. Concluding remarks covered a broad list of recommendations resulted from the analysis undertaken within this study.

- [1] The word "dzud" is a Mongolian term used to describe the natural hazards or extreme weather events like heavy snow fall with longstanding snow coverage (white dzud), lack of snow which leads to diminishing of sources of water for animals (black dzud), continued cold wave or stagnation of air mass with low temperature (freezing dzud), covering of pasture field with snow by ice layer due to thawing of its surface (hoof or iron dzud). The term "dzud" is used when these above mentioned events lead to damage of property and significant loss of livestock, severely deteriorating livelihoods of the local communities, becoming disasters from natural hazards.

# Stresses on socioeconomic systems

Annapurna Vancheswaran & Elke Weber

## Oral Presentations

### An Integrated Approach to Sustainable, Locally Driven Urban Development

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Uncontrolled urbanization is a growing, seemingly unquantifiable phenomenon characterizing today's planet, occurring at a rate most scholars and scientists would call unsustainable. Climate change impacts on the countryside -- increased and less predictable drought, flooding, failed harvests -- have exacerbated the more traditional migratory pressures, arising from the lure of improved economic opportunity or flight from conflict, to engender unknowable, virtually ungovernable cities. Across the developing world, and particularly across sub-Saharan Africa, such metropolises might more aptly be described as sprawling, improvised amalgamations, invariably located in poorly equipped, unhealthy settings, formed of multiple and diverse constituencies, all with credible claims to recognition and entitlement to fundamental services, fundamental entitlements.

The stresses of this apparently ceaseless in-migration on civil infrastructure and the public health are palpable, but difficult to measure. Indeed, data in underserved municipalities are in hard to come by in any event, even more so in such rapidly changing environments; by the time any telling indicator has been reviewed and understood, it is out of date.

Yet without such information, policymakers cannot begin to prioritize, plan and budget to address their cities' profound challenges. If local and national government are to be held accountable for the effective delivery of public services, they must begin with reliable information indicating the extent of the gaps in service delivery, the costs of filling these gaps, and technical and financing strategies for doing so. With this information, synergies between sectors can be readily identified, and cost-effective, multi-sectoral planning can take place. In this way, hidden deficits in one arena will no longer inhibit promising advances in another -- as evidenced in the simple example of the absence of private girls' latrines discouraging otherwise eager and ambitious girls from attending school.

Such is the task that the Millennium Cities Initiative (MCI), a project of The Earth Institute, Columbia University, has set out for itself. MCI works to help cities across sub-Saharan Africa achieve the Millennium Development Goals (MDGs), by: 1) ascertaining, through careful research and policy analysis, just how far off each city is from attaining each MDG target and informing citizens accordingly; 2) assisting stakeholders in determining their top development priorities; 3) providing technical support as the city designs an integrated development strategy predicated on realizing those priorities; and 4) identifying, inventing and piloting successful, replicable models to address some of these priorities, models that can then be brought to scale across the Millennium City and beyond.

This holistic orientation differs from the more silo-ed, sectoral approach still generally taken by the traditional donor community. However valuable any particular water or urban transport project, if it is not also linked to affordable access to proper drainage, sanitation, health care, education and lines of credit, it is not itself likely to substantially reduce the poverty levels of the affected population. It is only when the community itself, as the nexus of urban life, is considered as an organic whole -- its under-5 children, playing in the markets in uncovered sewage; its youth, too poor to afford schooling, standing on street corners with no jobs in sight; its hard-working women, longing for their own education and job-training, but whose days are consumed with water-gathering, food preparation and childcare; the physical space itself, its crowded, unhealthy conditions, completing land claims, topographical and other civil infrastructure challenges -- that the integrated nature of the problematic can be fully appreciated and comprehensively addressed in ways that can materially improve the lives of ordinary urban residents.

MCI's methodology embraces this more integrated approach. The presentation will show how our own sector-specific research -- our MDG-based needs assessments, costing exercises and poverty-related household surveys -- leads to interdisciplinary development planning, and how cross-cutting interventions are then identified to address more than one critical MDG-related deficit at a time. Examples include: 1) a community-based solution in Mekelle, Ethiopia, to provide readier access to water, thereby improving child health and increasing by several hours per day women's and girls time

for other activities; 2) training teachers to organize and lead Girls' Clubs in public schools, thereby strengthening girls' literacy, creative work and interest in science, math and technology, their connections (via the Internet) with Girls' Clubs in other Millennium Cities and countries and ultimately, their desire to stay in school -- all steps which, in turn, can delay their starting families, improve their earning potential and empower women's voices in public life; 3) training medical staff and health lay people in essential neonatal resuscitation and infant care, thereby saving newborn lives and substantially improving child and family health.

To address the monumental challenges facing the vast coastal city of Accra, Ghana's capital and a key West African hub, MCI has forged a successful multidisciplinary partnership with an array of Earth Institute and Columbia institutions – the Urban Design Lab, Center for Sustainable Urban Development, School of International and Public Affairs, School of Engineering and Applied Sciences; Center for International Earth Science Information Network, Mailman School of Public Health – as well as with international development agencies, corporations and non-profits, leading local academic institutions and local NGOs. Through seminars, studios and summer research, MCI has led this consortium to carry out an unprecedented GIS mapping of downtown slum areas, an urban transport study, research on waste-to-energy options, including a solid waste composition analysis and documentation of a composting project for youth, and papers documenting the state of the public health and land tenure systems. More than 30 Columbia architects and designers are currently working in the same slum areas to build upon this work and arrive at innovative solutions that preserve historic architecture and cultural traditions and enhance livelihood opportunities, while improving public safety, health and infrastructure.

Policymakers and donors view these research trajectories as valuable and useful. But a more systemic approach is needed if Accra's fundamental challenges are to be addressed. Fronting the Gulf of Guinea, with its debilitating coastal erosion, dysfunctional road, water and waste disposal systems and its vital fishing and tourism industries, ecology and public safety at stake, Accra is ill-prepared in every conceivable way to confront the potentially devastating impacts of climate change and its effects. To better understand, prepare for and hopefully prevent some of the worst predicted outcomes, MCI will carry out a comprehensive GIS mapping of the Greater Accra Metropolitan Area and will convene and rely on a trained task force drawn from local and regional government and civil society, whose mandate will be to help create and maintain this innovative, interactive tool. Existing infrastructure, including access and evacuation routes, health facilities and communications, will all be identified and plotted, enabling upgrades to be made on an as-needed basis. This project, and its potential as a replicable, real-time reporting instrument for coastal cities worldwide, will be a lasting contribution by MCI to urban preparedness and urban development strategies, and will figure in the presentation among MCI's multi-sectoral, cross-cutting initiatives.

In the regional capitals, interventions predicated on strengthening the emergency referral system and the capacity for maternal and child health care delivery; training teachers in early childhood education, uses of the Internet and how specifically to support girls in school; exploring improved mass transit, non-motorized transport and waste-to-energy options; and encouraging the planning and construction of downtown green and community spaces, all play important roles in the MCI agenda: to help create viable, sustainable cities, led by responsive and accountable local governments capable of supporting their populations by delivering on the promise of decent and reliable public goods and services.

If these regional capitals can in fact attain these objectives, which are readily translated into quantifiable, trackable targets known as the Millennium Development Goals, then those forced from the countryside (for any one of a number of reasons) can find respectable living conditions and economic opportunities in these so-called "Millennium Cities," thereby compelling fewer former smallholder farmers and urban residents alike to migrate to the already stressed, polluted and increasingly sclerotic national capitals. This decompression of the tensions afflicting Africa's major cities can only help to improve the socio-economic conditions there, together with the prospects for attaining the MDGs in these densely populated, vibrant centers of cultural and civic life.

## **Prevalence of Diseases and their Unsustainable Determinants: A Case study of Urban Slums of Bahawalpur**

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According to Rio Declaration and Agenda 21, 1992, human health is considered as the fundamental aspect of sustainable development. Health will become of increasing relevance in relation to the key challenges to sustainable development: rising poverty and inequalities, globalization, environmental degradation, mismanagement of natural resources, and unhealthy consumption patterns and lifestyles(von Schirnding 2002).Therefore, the relationship

between human health and the environment is complex. People experience the environment in which they live as a combination of physical, chemical, biological, social, cultural, and economic conditions that differ according to the local geography, infrastructure, season, time of day, and activity undertaken. The different environmental health threats can be divided into “traditional hazards, which are associated with lack of development, and the “modern hazards,” which are associated with unsustainable development (Corvalán, Kjellström et al. 1999). Thus, the link between environment, socio economic conditions and human health is a major cause of public concern about the sustainability. People in the poorest countries tend to be most at risk from household-related environmental quality problems, which impose the largest environmental disease burden on humanity (Smith, Corvalán et al. 1999). For example, in Pakistan, the environmental degradation creating fetal health impacts in the form of water born, vector born diseases and infections. Most of these environmental health threats are related to poverty (32.2% population of Pakistan is below poverty line), and insufficient development hence such poor communities need to address first. Therefore, the main objective of this case study is to analyze the geographical prevalence of disease in the slums of Bahawalpur City, and the identification of its relation with the unsustainable environment and socio economic determinants. It also discusses the appropriate management suggestions for better and healthy living conditions for slum population as a step to sustainable development. First the paper explains the methodological framework which was comprises on data collection, data analysis and its presentation. Field survey and interviews with the local residence were carried out to get information about demographical distribution of diseases, housing condition, income level, nutrition intake and sanitation condition, while laboratory analysis of water quality and disease statistics from local health centers were collected to interpret the results. Next to it, the paper addresses the detail analysis of the data which reveals the occurrence of different diseases and their demographic distribution. Infection diseases dominate among children, like Malaria (33%), typhoid fever (15%), Diarrhea (13%) and Cholera (12%), reason of which is the low of immunity, lack of sanitation and because children are the favorable hosts for the prevalence of communicable diseases. Hypertension is the primary disease found in 44 percent of adult population along with 21 percent Cardiovascular, 10.1 percent Hepatitis, and 8 percent diabetes. While Tuberculosis and diabetes found to be the main diseases of aged. Almost half of the total slum population finds to be anemic due to low nutrition level. Furthermore, the paper give the detail account on the relationship of these diseases with the several socio-economic and environment conditions prevailing in the study area. Poor housing condition, high dependency rate, low income level, improper sewerage, low income level, low nutrition intake, poor drinking water quality are the prime determinants responsible for adverse health condition of people living in these slums. In addition, illiteracy is another factor, among the poor communities, who are ignorant of the fact that most of the health problems are due to the degraded environment. Moreover, the health Care Services and Facilities are inaccessible and unaffordable for these Slums dwellers. That’s why people do not know about their diseases, they also did not know about health precautions and medical monitoring which is also accelerating the spread of diseases. Finally the paper discusses the need of integrated action at all levels and implementation of long-term program by the government directed at controlling the driving forces that generate the environmental health problems in slums. Only this approach can achieve sustained health benefits and environmental protection in accord with the principles of sustainable development. To implement successfully proactive preventive approaches, development policies and planning need a long time horizon. In addition, health and environment concerns must become an integral part of the planning within the framework of sustainable development (Corvalán, Kjellström et al. 1999).

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## **Social networks repaired: Positive externalities of a depression-based intervention in Southwestern Uganda**

Annie Marie Feighery

The Millennium Development Goals have drawn international attention to the need for further research on the subject of improved retention and dissemination of interventions in international humanitarian aid. From 2001 to 2011, funded by World Vision International, researchers from Columbia and Johns Hopkins Universities adapted and evaluated Group Interpersonal Psychotherapy (IPT-G), a group treatment intervention for depression, in the Rakai and Masaka districts of southwestern Uganda. Over the past three decades, successive insults of civil war and the HIV/AIDS epidemic resulted in a destroyed sense of community and widespread depression. Researchers in 2001 discovered local depression prevalence rates of 21%. In a 2003 evaluation, the original treatment program was found to be highly successful at treating depression. Following the initial study, the treatment intervention was disseminated to a wider population by World Vision, International. In a qualitative summative analysis of the disseminated intervention in 2010, the authors

investigated the impact of the IPT-G treatment at the community-level. Through ethnographic key informant interviews, the authors found positive externalities of the intervention on the community level beyond the reduced incidence of clinical depression on the individual level. Interventions created by NGOs on unrelated subjects, including education, sanitation, and agriculture, were determined to be more effective following the 16-week IPT-G by NGO staff, IPT-G leaders, IPT-G participants, and unrelated members of the communities. The authors have created a theoretical model that explains the improved success of development-based interventions was due to the IPT-G intervention, which repaired the social networks previously destroyed by civil war and the HIV/AIDS epidemic--resulting in a production of Granovetter's "weak ties." The result was an increased diffusion of innovations as described in Rogers' social network theory. New innovations introduced for the sake of increasing the communities' level of development were more easily shared by and accepted among members of the communities who, after the IPT-G intervention, consisted of a greater number of weak ties. Based on early data and the created model, the authors are now quantitatively and qualitatively investigating the mechanisms that are responsible for this improvement and how they might be translated to further scenarios in developing communities. The results will inform an increase in the transfer of technologies and the retention of aid investments in the effort to achieve the Millennium Development Goals.

### **Climate change threats to population health and socio-economic systems: challenges for creating a sustainable future**

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The emerging human-induced change in global climate is now a well-recognised threat to many aspects of human social and economic development. Ongoing changes in the climate vary between regions of the world, and the future will bring different types and levels of climate-related threats at local level. Overall, and considering too the equity issue, these local threats to the achievement of a sustainable future for most people pose major challenges. The climate system has many and fundamental influences on the processes and conditions of the natural world upon which human safety, wellbeing, health and survival depend.

These threats from climate change include: extreme weather events; reduced water supply and food production; the undermining of physiologically acceptable and healthy climate conditions that allow work and daily activities to be maintained; increased risks of certain vector-borne and infectious diseases; and sea level rise that will flood coastal areas and low lying island states destroying homes and livelihood opportunities. Each of these has serious health and economic consequences.

To promote and support a sustainable future will involve targeted health protection programs using interventions that already exist. The unarguable 'primary prevention' task is to reduce greenhouse gas emissions – a task that can be motivated via research and risk assessment that yields a more comprehensive understanding of the threats to sustainability from climate change, coupled with more effective research-policy engagements.

Climate change is not an isolated source of threat to sustainability. It is part of a wider, often interacting, set of global environmental changes now emerging as a result of excessive and unprecedented human pressures on the environment at regional and global levels. The links between climate change related heat exposure, physiological and health effects, work capacity and the economics and well-being of communities bring the three components of sustainability together: environmental, social and economic factors.

A clear example of this complex suite of potentially adverse impacts on sustainable futures concerns food sufficiency and attendant mal-distribution of food insecurity. Future food security is vulnerable to a combination of stresses: growing population size, urbanized consumer demands for 'high-end' (especially animal-source) foods, loss of biodiversity (e.g. pollinating species), heightened extremes (heat, infectious agent exposures, etc.) in agricultural workplace conditions that impede worker health and productivity, and footloose corporate supply chains relocating from one location to another undermining stable income streams for producer communities.

Belatedly, the health of global and local food and agricultural systems is being recognized as a determinant of population health, and vice versa. One research task is to identify factors for measuring the co-dependency of the two systems; and to this end the DPSEEA framework which articulates the relationship between population health and environmental health is a useful research-policy analysis tool (see Figure). This framework was developed in collaboration with WHO and is used to better describe the underlying factors behind the climate related health impacts and to analyze the role of different interventions to protect population health.

The local variation in ongoing and future climate change is significant and this creates challenges and opportunities for local action both to mitigate and to adapt to the local climate change. Our analysis shows that urban populations at low income levels will be particularly vulnerable.

One approach to local interventions would be to build upon the idea of 'citizen scientists' and the important role they can make in connecting the local and global levels in areas such as species loss, urban ecology resilience, and sustainable consumption. In Australia, citizen scientists collect and report data on local water catchment conditions, bird flocks in distinctive habitats, mosquito populations, and biodiversity of pollinators in community gardens. They bridge knowledge gaps in the variability of specific local conditions, which are often overlooked in global assessments.

Increasing the scope and breadth of expertise in scientific networks has long been interpreted as meaning that different disciplines should be represented on research teams and /or that researchers should engage with policy makers. The task of adapting to, and mitigating, climate change is so profound however that it makes sense to build linkages between science and everyday life through supporting citizen science inputs, particularly on matters such as sustainable food systems. This is particularly relevant within a context of calls for consumers to act more sustainably, as well as the realization that many consumers are confused as to how to act. Context specific knowledge is required of what environmental, economic and cultural conditions make sustainable consumption possible and whether the trade-offs that consumers practice in trying to be more sustainable undermines or advances resource use and depletion.

A global action research strategy focused on climate change must in our opinion be multi-pronged; and in this paper we focus on two prongs. The first is the production of indicators that incorporate a human health dimension and which can be applied globally and nationally. The second is the creation of extended scientific networks which employ citizens collecting, reporting and making sense of local environmental health data. This second prong is an essential element if citizen cynicism and 'crisis fatigue' is to be overcome in the face of the highly contested nature of global climate change science.

Our research has involved field studies in several countries with very hot seasons, which highlight the impacts of increasing heat exposures on daily life, work and economic activities. As an example, in urban areas of South-East Asia people carrying out heavy labor, already in 1975, lost approximately 7 % of their annual work hours due to extreme heat. This had increased to 9 % in the year 2000 and is likely to increase to 20 % in 2050 assuming that cooling systems cannot be applied in these workplaces. The studies also demonstrate local community approaches to reduce the negative effects on health, food production and economic development. Examples will be presented from Australia, India, Thailand, South Africa, Cameroon and Central America.

### **Social capital, social capacity and social carrying capacity: exploring the social basics of a sustainable development**

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This paper aims to develop a coherent theory for the practical implementation of sustainable development in the social context. Therefore, it analysis - based on an in-depth literature review - the terms "social capital", "social capacity" and "social carrying capacity" in the framework of 3-D Sustainability (Mauerhofer, 2008, 2010). In particular, the assessment concentrates on 1. the relationship between social capital and human capital, 2. the relationship between social capital and social capacity, 3. the overlap between the social capacity approach and capability approaches of Sen (1987, 1999) and Nussbaum (2000) as well as 4. the meaning and application of social carrying capacity in research and in practice.

'Human capital' and 'social capital' are terms that originated within the fields of economics and other social science respectively. Social capital and human capital were terminologically introduced by economists and other social scientists, partly to parallel their own field of sciences with other disciplines. The paper first provides representative overviews of the use of these two terms and of their range and meaning in the scientific literature. Then the analysis shows first regarding the existing relationship between social capital and human capital that clear and wide overlaps exist.

Afterwards the paper provides new definitions for social capital and human capital focusing on the stock function of these terms and suggests an integration of the latter term into the former one within the more interdisciplinary discussion on sustainability. Firstly, the word 'capital' - in its most basic sense - can be understood as 'an asset capable of creating future benefit for at least one individual'. This definition reduces Lachmann's (1978, cited after Ostrom, 2009) definition in which capital - in its most basic sense - is understood as a set of assets capable of generating future benefits for at least some individuals. Then, social capital (including human capital) should be defined as a social asset with the character of either stock/source or sink at a certain time and quantitatively as well as qualitatively characterized through an adequate number of humans or a human being alone and through already genetically predetermined and/or in another way capacitated characteristics (such as, measurements, skills, interests). Within this definition social capital consists of multiple, namely two or more units of human capital.

Concerning the second part, the relationship between social capital and social capacity, the paper first provides a comprehensive definition on the term social capacity. Social capacity can be therefore be defined as 'growth or development of each hierarchical level of human or social integration within a certain spatial range, shaped by unilateral, multilateral, reflexive and/or interdependent processes within an individual and between individuals or groups of individuals' (derived from del Monte-Luna et al., 2004). Afterwards the paper suggests for the future work on sustainability to introduce a clearer binomial distinction between social capital and social capacity whereas latter should concentrate on the flows from the capital.

The third part of the analysis indicates that the distinction gained in the second part appears to be widely congruent with Sen's capability approach. Sen (1987) supported the idea of development as economic growth and defined human development as the process of enlarging a person's functionings and capabilities to function, the range of things that a person could do and be in her life. Sen (1999) then formulated a framework that places freedom as the central feature of development. Comin (2008) criticizes the (too) individualistic direction of the capability approach, suggesting the 'de-individualization of the capability perspective' (p.644), and also Nussbaum (2000), takes a more ethical direction which affects social and environmental limits of sustainable development. Thus, the social capacity approach such as proposed in the second part of the paper appears to provide the advantage that it is less individualistic in comparison to the capability approach of Sen. In addition from the viewpoint of 3-D Sustainability it provides improvements on Sen's approach by more clearly distinguishing between stocks (capitals) and flows (capacities) as well as by including environmental and social thresholds via carrying capacities.

The analysis of the fourth part finds that the term "social carrying capacity" is hardly closer defined and/or used in sciences. Due to these findings a comprehensive definition is generated based on the social capacity definition developed within the second part. Hence, similar to the above-cited definition of ecological carrying capacity brought forward by Del Monte-Luna et al. (2004), social carrying capacity can be defined as 'the limit of growth or development of each hierarchical level of human or social integration within a certain spatial range, shaped by unilateral, multilateral, reflexive and/or interdependent processes within an individual and between individuals or groups of individuals.' The only modification in comparison to the definition of the social capacity noted in the second part of the paper is that the beginning term reading 'the limit of' is new.

Finally, the current and future potential research relevance of the term social carrying capacity within sustainable development is shown on examples regarding future limits to population growth, trade offs between population growth and per capita consumption, social riots with regard to equality issues (income and resource distribution etc...) and technical overload (and related resource questions) e.g., individual answer capacity to daily electronic correspondence as well as overwork in general (leading to e.g., burnouts and connected economic costs).

In summary, the analysis provides for each of the three assessed terms a sound definition and a variety of practical contributions to the further development of policy proposals and research priorities with regard to a social sustainability obeying the limits of the environmental carrying capacity such as described by 3-D Sustainability (Mauerhofer, 2008, 2010). This is of particular importance for socially initiated interdisciplinary discussions on sustainable development regarding limits of population growth, social riots, overwork and technical overload.

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## Economic potential of Brazil nut and rubber exploitation by local and traditional populations in extractive reserves in the Brazilian Amazon

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Brazil has approximately 524 million hectares of forests, covering 61.5% of its territory. Of this total, 98.7% (517 million hectares) are classified as natural forests and its greatest extent is in the Amazon region (356 million hectares) located in the states of Amapá, Acre, Pará, Roraima, Rondônia, Mato Grosso, Maranhão and Tocantins (IBGE, 2004). Forests are key elements in the maintenance and evolution of different species and the conservation of biological diversity but they are also a source of products with great economic importance as timber, fruits, oils and resins for local communities (Lele et al, 2000). Only 15% of natural forests in Brazil (77 million hectares) are protected by federal protected areas and the vast majority (61 million hectares) is located in the Amazon. The implementation of sustainable use practices for forest products extraction is imperative in order to reduce the degradation that causes many social and economic damages to the country. Many traditional and local populations in the Amazon are economically dependent on activities based on the extraction of forest products.

To ensure access of these populations to natural resources and control of the territory, a special category of protected area called Extractive Reserve (Resex) was established in Brazil in the 1990s. The Brazil nut and rubber are among the main products exploited in Amazonian extractive reserves but with activity below of its potential and not implemented in all areas. This fact limits the development of these communities and the economic contribution of this activity to the local and national economy. This work aims at evaluating the economic potential of the Brazil nut (*Bertholletia excelsa*) and rubber (*Hevea brasiliensis*) exploitation by local and traditional communities in extractive reserves in the Brazilian Amazon.

Estimates of annual production were done to the 41 existing extractive reserves in the Amazon, based on the information collected in the management plans and land use plans of the Resex that currently have extraction of these products. The economic potential of these products and the earnings per capita were established from the minimum prices set by the Brazilian government by the Guaranteed Minimum Price Policy.

The results have shown that 11 extractive reserves (4.1 million hectares) have potential for sustainable exploitation of rubber by local and traditional communities while others 17 Resex (6.6 million hectares) have potential for Brazil nut.

In the reserves with potential for rubber exploitation, the population living inside them and/or in the immediate surrounding areas with the right to exploit the resource is 22000 inhabitants. In this scenario the estimated annual production of rubber was 3.6 thousands of tons, with economic potential of US\$9.8 million per year (average price of \$2.68 per kg of rubber).

For the reserves with potential for exploitation of Brazil nut, the population inside them and/or in the immediate surrounding areas with the right to exploit the resource is 28000 inhabitants. In this scenario the estimated annual production of Brazil nut was 26.3 thousands of tons, with economic potential of US\$23.3 million per year (average price of US\$0.89 per kg of Brazil nut). Thus, the potential to be generated through the production of rubber and Brazil nut is US\$33.1 million per year.

The potential impact of these activities on the per capita income of the communities studied was estimated in US\$447.64 per year for rubber and US\$823.21 per year for Brazil nut. These values are higher than, for example, the US\$71 per year paid on average per person by the "Bolsa Floresta" Program of the Amazonas state government implemented in 2007. In this program, each family (with five people on average) living within a conservation unit receives R\$50. This value is an economic benefit provided to families to complement their incomes and stimulate the maintenance of the forest, which helps in reducing deforest.

Moreover, the estimated production of the areas studied here is almost the same as the average production observed for the entire Amazon biome between the years 2006 and 2008 according to official data - 3.8 thousands of tons of rubber and 29.6 thousands of tons of Brazil nut (IBGE, 2008). It should also be noted that the estimated potential may still increase, if:

- a. the inclusion of other federal extractive reserves that are also can be producers of rubber and Brazil nut, which may not have been identified, given the lack of information on official data;
- b. the inclusion of the extractive reserves managed by the states;



- c. the addition of other conservation units such as the Sustainable Development Reserves, National and State Forests, which also allow the extraction of rubber and Brazil-nut;
- d. encouraging the sale of products that increase the added value and improving the flow of production;
- e. an increase in efficiency in the process of rubber tapping and collection of the Brazil nut is achieved, bringing the average production per hectare.

These results demonstrate that a right policy, capable to promote access to areas with sustainable techniques of forest resource exploitation, can increase the production and ensure the economic sustainability of the communities depending on this activity.

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## **An exploration of individuals' attitudes and behavioral intentions of pressures on natural and socioeconomic systems caused by climate change, solid wastes, and increasing urban development in Costa Rica's fastest-growing population area**

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Most scenarios indicate that people in developing countries or in poor areas are highly vulnerable to the impacts triggered by climate change, yet they are less capable to adapt to the impacts (IPCC 2007). The World Bank (2009) recently reported that approximately 75 percent of the potential damage from climate change will be suffered by developing countries and predicts that about 80 million people will be highly threatened in Latin America and the Caribbean by the year 2020. Central America is considered one of the most vulnerable areas in the world due to its geographical location, which is subject to high incidence and intensity of extreme weather events (EuropeAid 2009). At the same time, climate change appears to maintain a low importance in many Central American policymakers' agendas considering that institutions in charge of research and disaster prevention are underfunded, which in turn might be a reflection on a lack of constituent pressure on politicians (Charveriat 2000).

Despite the vast accumulation of knowledge regarding the science of climate change, policy interventions still haven't found optimal ways to overcome environmental indifference and self-interest in individuals. Part of the reason is that decision-makers still lack sufficient detail on how people's behaviors interact with new economic policies, technologies, and institutional frameworks (e.g., Stage 2010, Van Vugt 2009, Brekke and Johansson-Stenman 2008). I consider Ajzen's (1991) theory of planned behavior, in which attitudes, subjective norms (social pressures), and perceived behavioral control influence intentions which in turn influence behavior. Lack of behavioral change around global problems such as climate change often occurs because people generally avoid tasks where they believe they cannot succeed (e.g., Ferguson and Branscombe 2010, Bandura 1989). Social norms, on the other hand, have been considered an important determinant to participate in pro-environmental social behaviors (e.g. Torgler et al. 2009, Pretty and Ward 2001). In order to assess these interactions, three major problems, considered to be nested in one another, are evaluated in this project. At the first level, there is the local problem produced by the lack of management dealing with ordinary solid wastes. This is a critical problem in Costa Rica, where only about 8 percent of total wastes are managed in some way (CYMA 2008). The second problem refers to the socio-environmental consequences of rapid and uncontrolled urbanization that many communities in Costa Rica are experiencing, particularly in coastal areas, which have been growing 3 times faster than 20 years ago (Programa Estado de la Nación 2007). At the third level, climate change was used as a global problem with consequences aided by each of the 2 other levels.

A structured interview was employed to collect the information analyzed in this study. Every house within each location was visited, although not all potential subjects were interviewed because either they were not present at the time of the visit or they refused to take the interview due to lack of time or interest. An informed consent was provided at the beginning of the interview assuring respondents their anonymity and clarifying how the data was intended to be used in the future. If community members verbally agreed to participate, a pair of interviewers proceeded with the interview

which usually lasted between 35 and 45 minutes and often took place inside respondents' homes. A total of 233 useful interviews were conducted during 2010 in 3 different towns in the central Pacific coast of Costa Rica. Once data was digitally coded, it was also audited by 2 other coders to minimize transcription errors. Excel and mostly JMP statistical software were used to run logistical regressions, contingency, and other non-parametric analyses. I expect to run some structural equation models in the near future using LISREL.

Preliminary analyses show that there is not a significant relationship between education level and environmental concern; however, I found a significant relationship between education level and whether or not individuals recycle (our proxy for behavior). Furthermore, based on the Ajzen's theory of planned behavior, there is support to the hypothesis that: a) level of familiarity plus b) attitudes toward urbanization problems, c) social norms, and d) behavioral control variables, influence people's behavioral intentions to mitigate the problems caused by rapid and uncontrolled urbanization. There is evidence that attitudes, social norms, and behavioral control also help explain a higher willingness to pay to lessen the negative impacts caused by the urbanization problem, but to a lesser extent their willingness to change their behavior (i.e. use more public transportation).

Furthermore, there is also evidence of a significant relationship between people's familiarity with climate change and how much they were willing to pay to combat its negative effects. Furthermore, when analyzing the perceptions of risk caused by trash problems toward different social groups, respondent's willingness to pay were significantly associated with most groups, including: other countries, their own country, their community, and their family; nevertheless, when climate change consequences were associated, their country, family and community were the groups at risk to which respondents are willing to pay to mitigate. Finally, I found some evidence that respondents are willing to pay differently across the 3 issues analyzed, i.e., trash, urbanization, and climate change. Specifically, people's average willingness to pay to solve the problems caused by trash was the highest, but only significantly higher than people's willingness to pay to solve the problems caused by the problem of rapid urbanization. Paying to solve problems associated with climate change was not significantly different of either issue assessed, suggesting that people's perceptions of problems associated with climate change are considered both local and global.

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## Assessing The Governance Context For Meeting The Water MDGs In Nigeria

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Despite what may seem like a distant target date (of 2015), it has reasonably been argued that yearly progress towards the achievement of the Millennium Development Goals (MDGs) is, and should be, an ever-pressing concern. In the particular case of the Goal No. 7 and Target 10- to halve the proportion of people without sustainable access to safe drinking water- the United Nations General Assembly Special Session of 2000 articulated this need for immediate action and the achievement of specific short-run targets. This declaration arose from the understanding that effective water

management plays a key role in economic growth and social development, and the achievement of several other MDGs in particular.

Like many African countries, Nigeria faces major challenges in reaching its water and sanitation MDGs. The immensity of this challenge is heightened by the country's huge population. Currently, Nigeria's annual population growth rate of 3.2% has been projected to result in the doubling of its current national population of over 140 million within 25 years. At the same time that water management is becoming more complex and challenging because of increasing water demand, food demand, urbanization and economic growth, there is also an emerging appreciation of the key role that governance plays in water resources management.

*Against this background, this paper critically assesses water governance in Nigeria in order to appraise the country's preparedness and efforts in meeting the MDGs. Specifically, the paper examines Nigeria's governance issues related to water development and management - those sets of complex issues related to politics and policies, power and authority, institutions, rules and regulations to examine to what extent they have brought about increasing water access and water use efficiency, water resources system performance, reducing vulnerability and developing resiliency against water related hazards, protecting ecosystem, promoting participatory management, ensuring equity and social justice.*

Using significant base of evidence from different parts of the country, the paper argues that there is a yawning gap between the reality on ground and the goal of achieving the water component of the MDGs in Nigeria. The paper ends with a highlight of the governance issues related to the policy, political and economical organizations, and institutions responsible for this problem.

## Posters

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### **Sustainable development: the way to state building in Southern Sudan**

Marietta Agathe

Sustainable development has grown from the environmental field but it has cut across the economic, social and political spheres. It focuses on putting people at the centre of development.

At the onset there seems to be no clear link between sustainable development and state building. Both concepts can mean different things within the field of academia. For the purpose of this study, sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. State building is the relationship among the state, the market, the environment, the society and the citizens; it is mostly about institutional development, and it is primarily a political process, mainly conducted by national political actors, but which international actors can both help or/and hinder, it should improve or sustain legitimacy and accountability as well as capacity and over the long term it requires economic growth and effective governance over the long haul.

Sustainable development is often considered as an end. This paper comes with the presupposition that it is a means, particularly in terms of state building in Southern Sudan. As southern Sudan will soon become an independent state, this paper seeks to analyse how sustainable development can contribute to the process of state building in the 'country-to-be.'

State building in the developing countries with weak institutions is considered the greatest challenge to fighting poverty, building peace and achieving sustainable development.

Many African countries are weak states. Southern Sudan is an opportunity for the international community, the African community and the Southern Sudanese to not repeat the same errors of state building in Africa. In many cases, the Africans did not own the process of state-building and many of the institutions that came with state building were foreign to them. There was no dialogue among the citizens prior to acceding to statehood. This partly explains why many African countries have been conflict-ridden and poverty stricken-for decades. In the case of Southern- Sudan sustainable development can help solve the problems of security, legitimacy, local ownership, accountability interplay with issues of cultural, religious and ethnic identities, all of which impinge on state building.

This presupposition is built on the key principles of sustainable development:

- i) Sustainable development is a holistic approach to development which encompasses the economic, social, political and environmental spheres. The integrated nature of sustainable development calls for comprehensive approaches and popular participation. However, institutions, national and international were established on the basis of narrow preoccupation and compartmentalised concerns. Institutions tend to be

- independent, fragmented, working on relatively narrow mandates with closed decisions processes. In the new Southern Sudanese, institutions must be founded on a more holistic approach which aims to see how institutions are interrelated.
- ii) Recognition of the interconnectedness between human beings and nature is at the core of sustainable development. Such interconnectedness exists between the state and the citizens. Just as individuals depend on nature to satisfy their basic needs, through social contract with the state, individuals give power to the state to take decisions on their behalf. The main function of the state is not to protect citizens, but to protect itself from the citizens. State protects itself from citizens by satisfying the needs of citizens so that social order prevails.
  - iii) By focusing on the ownership of the development process, sustainable development aim to make the process of development participatory and inclusive. The process of state building can only be successful if it is owned by citizens and not imposed from the outside. In the Southern Sudanese context, all the different ethnic groups should be embarked in the process of state-building and there must be dialogue among the different actors of Southern Sudanese society so that consensus can be reached in terms of how the natural resources will be managed, what economic activities will be undertaken and how to maintain the social cohesion of the society.

The key principles of sustainable development overlap with the core features of state building-building. Sustainable development can be the pathway to state building. For the purpose of this research, Max Weber ideal type was used. An ideal type of state building with the principles of sustainable development, the human rights and democratic principles was constructed. This ideal type was used as a unit of analysis to compare ten countries in Africa, namely: Sudan, the Democratic Republic of Congo, Mauritius, Zimbabwe, Ethiopia, Botswana, Rwanda, Burundi, Uganda and Nigeria and Southern Sudan in terms of there processes of state building.

### **Informal settlements and sustainable development: can upgrading initiatives contribute to a sustainable future**

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Sustainability is a topic widely discussed and its definitions may vary according to the area of knowledge. Nevertheless, there is a common perception that it must be based on three main pillars, namely environmental, social and economic sustainability. Natural resources must be preserved so that populations can benefit from it now and in the future, and societies can keep developing socially and economically. In a world where more than half of the population is living in urban areas and more than 800 million people are slum dwellers, sustainability also needs to be discussed from the informal settlements viewpoint. In Latin America, 23 out of 100 inhabitants live in favelas, tugurios or campamientos, a figure which is very similar to the Brazilian situation, where 25% of the population is living in informal settlements. These are places where social and economic conditions tend to be the worst, therefore hindering sustainability.

Being the best example of unplanned growth, slums are organic settlements. Streets, plots and open spaces are created according to people's immediate needs and perceptions and do not take into account aspects such as accessibility, safety or health conditions. Since the 1980's, there has been a tendency to avoid evictions and relocations of slum residents and upgrading initiatives have been welcome as a way to improve living conditions without breaking social bonds or displacing people from areas which, in some cases, are located near to public services and work places and, in most cases, are much cheaper than sites that would be much more adequate for housing purposes. These initiatives are based mostly in basic infrastructure and accessibility improvements, sometimes including leisure facilities and primary public services. Betterments in housing units are rarely considered and left for residents to decide how their houses should be improved. Up to date, most slums housing units are constructed with civil construction solid waste, turning informal settlements into alternative disposal sites. Materials which may be hazardous are used to construct shacks and precarious houses, putting people lives in danger. Latter, when housing units are improved, little or no attention is paid to typologies and insulation, ventilation and sanitation conditions.

This paper aims to analyse to which extent upgrading initiatives can contribute to ensure sustainability in informal settlements. The research adopted a case study approach, comparing two informal settlements, the first being located in the city of Recife, northeast of Brazil, and the second in Dar es Salaam, Tanzania. Both settlements were subject to urban upgrading initiatives. In the first case, local residents were moved to a nearby site and upgrading included basic infrastructure and accessibility improvement, with housing units being subject to betterments. In the second case, upgrade was done in the original site and only accessibility and basic infrastructure improvements were offered, housing units remaining unchanged.

Empirical findings show that where housing units were left out of upgrading initiatives, living conditions did not improve, as well as local economic development. Urban violence increased and infrastructure was poorly maintained. Moreover, social networks were broken due to real estate market pressures. When housing units were improved, although living conditions grew better, houses were not properly designed as to ensure adequate insulation and ventilation. Typologies were not adequate and unplanned annexes were constructed. Social networks were also affected since housing units' distribution did not take into account existing social relations among neighbours and families. Urban violence also increased, the economic situation of residents deteriorated and equipment maintenance was not adequate.

This paper argues that without an approach to informal settlements upgrading where environmental, social and economic aspects are considered, and where not only basic infrastructure and accessibility are taken into account, but urban design, construction materials and housing typologies are carefully studied, and social and economic networks are preserved, sustainability cannot be discussed.

## Health Status of Cane Workers in Ethiopia

Derese Bekele Belay

The objective of the study was to determine the health status of cane cutters and cane collectors who are exposed to suspended particulates from pre-harvesting sugar cane burning in Methara sugar factory. The design of the study was cross-sectional, 160 cane cutters from Awash, kikan and Abadir 2nd harvesting sites and 31 cane collectors from Chorrie site were surveyed against 89 control groups from Algae and Haro –Adi kebeles far away outside the sugar estate compound. A standardized questionnaire, Vicatest Spirometer, and Mini Wright peak flow meter were used to assess personal, occupational and lung function status of the study subjects.

The highest proportion of cane cutters 76 (47.5%) and 20 (64.5%) cane collectors were in an age category of 25-34 year while 41 (46%) control groups were of age category 15-24. The service year of cane cutters and cane collectors linearly increase with increasing age. 65 (40.62%) of cane cutters were once engaged in other dust and chemical related jobs. Lung function measurement results revealed that FVC, FEV1, PEFR and MMF of cane cutters significantly decreased with an increasing age (F and P) values of (5.16 , 0.002) , ( 6.42 , <0.01) , ( 3.42 , 0.019 ) and ( 3.06 ,0.03 ) respectively. Control groups also have significant mean difference with increasing age for PF, FVC, FEV1 and PEFR with F and P values of (3.07,

0.032) , ( 7.18 , <0.01) , ( 7.6 , <0.01 ) and ( 4.22 ,0.088 ) respectively . The 25-34 years age group cane cutters and cane collectors have significantly reduced ( $p < 0.05$ ) lung function parameters of PF, FVC, and FEV1 as compared to control groups. Parameter PF in an age category 15-24 and FVC, FEV1 of age category 35-44 year were also significantly lower ( $p < 0.05$ ) for cane cutters and cane collectors than control groups of the same age category . Cane cutters who were sprayers and workers of LPCD before recruited in the present cane cutting activity have significantly ( $P < 0.05$ ) reduced lung function measurement results of FVC and FEV1 than those who were directly employed in the cane cutting activity. Two tailed paired sample T- test shows that measured values of FVC and FEV1 both for cane cutters and cane collectors were significantly lower than respective predicted values. The mean percentage value of  $< 70\%$  of predicted FEV1 of 25-34 year age group cane cutters was  $51.71 \pm 12.59$  that represents 66 (86.84%) of cane cutters , whereas only 19 (67.85% ) of control groups of the same age category have mean value of  $< 70\%$  that is  $60.44 \pm 4.31$ . On the other hand only 8 (36.36 % ) cane cutters have mean value of  $\geq 70\%$  of predicted FEV1 values compared to 27 (65.85%) controls of the same age ( 15-24 ) category. Cane cutters and cane collectors collectively have 56% persistent cough and 72.9% wheezing on the chest and shortness of breath. Months of severe prevalent respiratory symptoms are during the cane burning seasons than non-cane burning seasons. Appropriate personal protective devices to mask nose and mouth which are the major routes of entry must be frequently supplied and strong regular medical checkups must be employed.

## Sustainable development and climate change management and adaptation strategies for European ultra-peripheral regions

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Sustainable development issues of concern to human welfare have focused on problems of economic progress, social equity, efficient resource usage and environment. Pressing concerns such as poverty eradication, health promotion and education have been high on the sustainable development agenda. Yet sustainable development policies to address these

issues are increasingly interlinked with the effects of climate change and adaptation and mitigation strategies at regional and local area levels. One of the key messages of the Stern Review on the Economics of Climate Change released for the British government in 2006 was that an overwhelming body of scientific evidence indicates that climate change is a serious and urgent issue for all countries and within them at regional and local levels. Unprecedented weather events are occurring across the globe at increasing rates. There has been increasing intensities of extreme weather events, such as storms, floods, droughts and heat waves in Africa, Asia, Australia, Europe, and North and South America.

In Europe, the impacts are magnified in the comparatively smaller and more insular peripheral and in particular the ultra-peripheral regions. Under ordinary weather based conditions, the peripheral regions of Europe are already experiencing a set of sustainable development challenges that place severe constraints upon their ability to demonstrate regional growth. The outer regions, such as for France, Guadeloupe, Martinique, Reunion, French Guiana and Saint Barthelemy; for Portugal, the Portuguese autonomous regions of Madeira and the Azores; for Spain, the autonomous community of the Canary Islands, and other European small island territories, face sustainable development issues that are compounded by their remoteness, insularity and fragility, small size, difficult topography and climate, and economic dependence on a few products. Sustainable development in the ultra peripheral regions is challenging as economic activity, capital stock and qualified human resources are concentrated within the core EU regions. The ultra-peripheral regions face significant economic pressures and social imperatives due to unequal development. Climate change impacts and the capacity to respond are significant issues that add to these concerns and furthermore can bring about significant environmental and social challenges in these regions. This paper provides an overview situation analysis of climate change adaptation and management profile in the European ultra-peripheral regions. This research reported examines the potential economic, social and environmental risks arising from climate change in these regions. Importantly, the paper considers the characteristics of adaptation and management strategies developed to provide solutions to climate change and related sustainable development problems. It explores the adequacy of existing local provisions of critical infrastructure for local communities to meet sustainable development objectives. To accomplish the main objective a European survey the agencies responsible by climate related issues in the ultra-peripheral regions will be carried out to ascertain: i) the degree of responsiveness, specifically in relation to climate change adaptation and management institutional strategies, practices and tools; ii) the level of climate change education and training; iii) the availability of climate change data and information and technological systems; iv) the state of climate change reporting (measurement and communication); v) the stakeholders' climate change cooperation practices; vi) the international, national, regional and local institutional assistance and cooperation within climate change issues. The paper proposes a set of recommendations and guidelines by which to deal with adaptation and management strategies for climate change issues in policies, plans and programs design and implementation of the ultra-peripheral European regions.

### **Socio-cultural adjustments, health and access to PHC services: a study of rural-to-urban migrants in Ulaanbaatar, Mongolia**

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Background: Mongolia is undergoing rapid economic development and urbanization. As of 2009, more than one million people, or 61.8 percent of country's total population reside in the capital city of Ulaanbaatar. Deepening urban-rural discrepancies and vulnerability of animal husbandry to natural calamities, force herder families to abandon their nomadic lifestyle and move to the suburbs of the capital city. Newly arrived migrants settle on the outskirts of the city, in ger (traditional felt housing) areas, which are expanded to hill slopes and lack basic amenities.

Objective: the study aimed to understand significant changes occurring in the lifestyles of rural-to-urban migrants: to explore rural-to-urban migrant's migration experiences and socio-cultural adjustments they undergo while adjusting to the urban life; factors that facilitate and/or affect it, with particular focus on access to PHC.

Design: an exploratory qualitative study of rural-to-urban households living in two sub-districts of Ulaanbaatar, Mongolia.

Methods: qualitative interviews with rural-to-urban migrant households living in two districts of Ulaanbaatar city were conducted between September-November 2010. In addition, previous studies and research focusing on internal migration and other related documents were reviewed.

Findings: various reasons, such as better job opportunities, ability to ensure better future for their children, improving livelihoods after losing their livestock due to severe winters, getting closer to children/relatives living in the city were mentioned by the migrants as the reasons for moving to the city. While adjusting to the urban life, rural-to-urban migrants face different problems in living conditions such as finding place to settle on, being not familiar with the city, having to

burn coal, having no money or job. Having other family members settled in the city and the presumed gains over losses after the migration to the city helps in easing the adjustment process. There seems to be insufficient assistance for the newly arrived migrants at the local administrative level.

Five factors were identified: (1) social networks play pivotal role migrant's adjustment to the urban life; (2) majority of rural-to-urban migrants experience decline in their living conditions since they find jobs in informal sector only due to lack of education and necessary skills; (3) the living conditions of ger areas present serious concerns for migrant's health and general well-being; (4) access to Primary health care services is limited due to remoteness, attitude of service providers, low quality of services provided, and insufficient information about entitlements, which prevents them to go to FGP clinic in case of illness (5) importance of information and support from local authorities and health professionals at FGP.

Implications for practice: the study findings would help urban health policy planners in developing appropriate measures to tackle growing health inequalities among different socio-economic groups in the city.

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## Public Policies, Social Organization and Sustainable Development in Brazil

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In the last decade, United Nations organizations endeavored to frame a new development standard for the twenty-first century, focused on environmental, social and economic sustainability. In Brazil, new dams have recently been constructed, affecting the lives of thousands of people, mainly those with lower ability to oppose or negotiate, usually from rural communities. In such context, we present the data of a research work which aimed at investigating how populations from areas flooded by the construction of the hydroelectric plant Presidente Juscelino Kubitschek (JK) evaluate the social and environmental actions carried out by the public energy company (Companhia Energética de Minas Gerais – CEMIG), to generate knowledge that will contribute for the understanding of the debate among families affected by this construction and representatives of the state of Minas Gerais, federal government and CEMIG. It is important to point out that the federal government signed an agreement (Termo de Ajustamento de Conduta (TAC)) with CEMIG, establishing social and environmental measures to be carried out by CEMIG as a condition for granting permission for the installation of the hydroelectric plant Presidente JK. It is known that there is no consensus about the fulfillment of the TAC after the completion of the work. It must be emphasized that the communities have distinct forms of social, cultural, economic and territorial relations that can hardly be replicated in another location. A very common problem in environmental licensing is the attempt to homogenize the socio-cultural characteristics of the communities that, somehow, are displaced due to the implantation of hydroelectric plants. The study involved 61 resettlers, mayors

and representatives of the residents' associations of the municipalities of Água Boa, Capelinha, Turmalina, Leme do Prado and José Gonçalves de Minas, in the state of Minas Gerais, Brazil, besides representatives of CEMIG and the union of rural workers of the state of Minas Gerais. Field work was carried out in the five locations. The instrument applied dealt with issues related to economy, society and environment to characterize the participants and their current life context. The organization of the responses of the resettlers allowed the construction of summary tables about each aspect investigated. As for the social sustainability, the suppression of the landscape, which resulted from the flooding of part of this region, suddenly imposed the dissipation of many different scenarios. The territory once inhabited was completely and irreversibly occupied by the reservoir waters, which undid the current dynamics and introduced a new and unknown territorial design of the region. In this process, parts of the local population were removed, social and cultural bonds were broken and material and immaterial cultural assets were destroyed. The construction of the dam Irapé represents the building of a technological cathedral, submerging forever the elements of life and symbolic expression of the populations that successively inhabited the area. The main complaints of the families affected refer to the infra-structure of the resettlements (lack of schools, health units, electricity and company water). According to the workers, 50% of the children from the families that lived on the riverbank have not attended school since January 2006, and there is no public or school transportation. It must be also emphasized that there are material and immaterial goods that represent symbolic invaluable assets. The religious and cultural festivals that took place in the original community, when the small properties favored the proximity between houses, no longer exist. Ties of kinships and friendship were weakened. As for environmental sustainability, we verified that 62,29% of the interviewees are not aware of the normative deliberations of the COPAM-MG. About 18,03% met the guidelines, and 16,40% met them only partially. On the other hand, 1,64% did not meet the determinations. The data revealed that family farmers have little knowledge about the environment, even after having experienced a long process of discussion and demands for new land to live and work. The environmental impacts caused to the region must also be stressed, the irrecoverable losses in fauna and flora, such as the absence of integrated regional policies for the appropriate application and management of the elements that booster the development and growth of the local economy.

### **National Parks and Society: Socioeconomic Analysis of Communities Surrounding the National Park of the Serra dos Órgãos (PARNASO)**

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The creation of protected areas in Brazil occurred at different times in its history. According to IUCN (2004) they can be defined as an area of land and / or sea especially dedicated to protecting the maintenance of biological diversity of natural and associated cultural resources, managed through appropriate legislation or other effective instruments. Among the currently existing typologies, the law 9.985/2000 established the National System of Conservation of Nature (SNUC), defining the criteria for creating, deploying and managing the various categories of conservation units (UCs).

This law was finally realized the ambition emerged in the late '70s to establish a single system that would set more objective criteria for the creation and management of some types and categories of protected areas that were previously scattered in different legal instruments (MEDEIROS , 2005). Data from the Chico Mendes Institute for Biodiversity Conservation (ICMbio, 2010) indicate that 8.2% of Brazil are already protected in the form of conservation units, equivalent to approximately 77 million hectares.

The strategic vision of SNUC possible that besides the conservation of ecosystems and biodiversity, the UC's contributing to income generation, employment, development and lead an effective improvement in quality of life of local people and the country as a whole. In this context, the National Parks have an important role, because although they are part of the group of protected areas, is encouraged and permitted the indirect use of its natural resources and its "public use." However, despite the undeniable increase in the number of UC's new in recent years, there are chronic problems regarding its implementation, as the ratio of units with the communities living inside and in the immediate surroundings.

The aim of this study was to examine what benefits the creation of a conservation area, specifically category National Park provides the neighborhood to its legal limits. For this, we analyzed the socioeconomic profile of the communities surrounding the National Park of the Serra dos Órgãos (PARNASO), the history of this park and population, and inclusion projects developed for this population.



This study was conducted in the National Park of the Organ Mountains, in the period March 2010 to March 2011. This important Brazilian Park was created on November 30, 1939, and currently has an area of 20,024 hectares. It is located in the central region of the state of Rio de Janeiro, southeastern Brazil, between parallels 22 ° 32 'and 22 ° 24' South and longitudes 43 ° 06 'and 42 ° 69' W. The PARNASO is inserted into the remaining forest block of the Central Highlands, one of the largest blocks of vegetation in good condition in the state, including the cities of Guapimirim, Petrópolis and Teresopolis, reaching 90 km from Rio de Janeiro.

To carry out this work was performed literature search on documents of governmental institutions, articles, books, theses, dissertations, and field studies. Socio-economic data, historical, cultural, families, health care, education, sanitation, housing, as well as instruments of inclusion promoted by the park for this population were analyzed to assess the accomplishment of its objectives, especially the development site.

This study covered the districts (or communities) in the towns of Petrópolis and Teresopolis, part of the immediate surroundings of PARNASO. The cities of Petrópolis (296,044 inhabitants) and Teresopolis (163,805 inhabitants) have part of their occupying the urban areas surrounding the Park, although most of these areas are part of the countryside. The region is an important tourist attraction and attracts thousands of tourists and vacationers, and also provide housing options for people who want to leave the big cities. In 2010, the Park received a record number of 132,140 visitors, a growth of over 7% from the year 2009, raising R \$ 690 thousand.

The region has ancient occupational origin, dating from 1788 in the first cartographic document produced for the area of Teresopolis. After creating the cities of Petrópolis in March 16, 1843 and in Teresopolis July 6, 1891 there was a strong regional development. With the assistance of the Management Plan and the Geographic Information System (GIS) of the Park, and topographical maps of Petrópolis and Teresopolis, nine neighborhoods. In Teresópolis: Granja Guarani, Inga / Cascata dos Amores, Quebra Frascos / Jardim Serrano and Petrópolis: Bonfim, Caxambu and Cascatinha.

Initial data indicate that the population of these districts is added about 20 000 inhabitants. The communities studied are highly differentiated from each other. There are typically rural and other inserted in an urban context, with high population density and strong industrial development. The composition of the population is also very different from each other in their constitution, socioeconomic status, history and culture. There are areas in need of goods and services and other wealthy, predominantly vacation residences, inns and lodges, which serve the local tourism or private. But in both cases there are risks of housing in locations such as on top of hills, slopes and banks of rivers.

The PARNASO already developing programs aimed at improving the relationship Community x Park. These projects follow the current trend of management, environmental policies with mixed instruments based on command and control (or direct regulation), economic (or market) and communication (May 2010). In the field of monitoring and surveillance are being developed, the Project Control and Prevention Spill and Fire Fighting. In relation to Environmental Education Projects for Environmental Awareness and Social Participation, including the Good Neighbor Project and Green Scenery.

Since 2003 PARNASO initiated the collection of entrance tickets with different prices (50% of total charge) for residents of your surroundings. This contributed to a significant increase in visitors from neighboring cities, registering 9% in 1993 and reaching 37% in 2006. In January 2010, the discount rose to 80% of the recruitment rate.

Thus, consensus is for many authors that the creation of protected areas is essential to the process of conservation of natural resources, especially in terms of habitat and genetic diversity and species (Fontana, 2004). However, although protected areas are not created with the objective of reducing poverty, the expectations related to its contribution to this end has increased during the discussion on the economic valuation of biodiversity (Mansourian et al., 2008).

Young & Lustosa (2003) assert that the environmental issue emerges as a new dimension of problems with interfaces like all others, where social exclusion is manifested in a concrete way from poor housing, health and other non-monetary indicators of quality of life.

In this sense, one of the assumptions of this research is consistent with the results of work performed by Valverde (2009), which associates the possible establishment of protected landscapes in the surroundings of these fully protected areas, combining thus the uses and strategies conservation into broader scales, developing studies considering the natural and social factors, through an integrated analysis, rather than dichotomous between them.

The harmonization between environment and orderly occupation of the territory can avoid repeating the tragic events, such as occurred in the mountainous region of the state of Rio de Janeiro, where more than 900 people died and thousands were left homeless as a result of heavy rains that fell in January this year.

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## Impact of Information Technology on the Socio-Economic Structure of Bangalore City

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The present decade is at the threshold of total digitalization made possible by Information Technology (IT). These digital technologies are bringing about immense changes in the way our societal systems function. It helps to do things faster and more thoroughly in a data based manner than in the past and has facilitated increased globalization. The convergence of IT with telecommunication has created the internet, a new kind of revolution. All types of information are available and are getting to be used in modern life. It can very well be a measure of the level of development in society. IT has pervaded every aspect of society leading to effects both positive and negative. So a thorough understanding of this impact is needed to enable interventions in society, and to avoid and forestall the possible negative manifestations.

Bangalore has over the years become a 'commercial, industrial, state administrative center and a location for premier educational institutions along with some of the largest IT and BT industries' in India. Bangalore's status as a hub for IT companies is often compared to the original Silicon Valley based in Santa Clara in California, a major locale for IT companies in the United States. This city has several advantages and strengths, which have made it an ideal location for IT industries. Thus it has entered into an era of knowledge based economy.

IT industry has brought about many and many types of changes within the city. It has led to commercial developments in several of its Suburban areas - old Airport road, Koramangala, Indiranagar, Jayanagar and Peripheral areas - Bellary road, Hosur road, Bannerghatta road, Whitefield area. Self contained high-rise apartments, low rise apartments, luxury apartments with all facilities like club house, gym, swimming pool and shopping centers have come up. Row houses, villas and Euro-American gated residential enclaves can be observed mainly concentrated towards the south-east. On the urban fringe luxurious club and golf courses have also been organized to cater to the new lifestyles of the relatively opulent. The escalating land prices coupled with rise in cost of living including construction has pushed the urban poor to reside in squatter settlements with hopelessly inadequate amenities and services.

The economy of Bangalore City has developed very fast during the last few years due to the quality of its work force, intrinsic as well as immigrating. The city has a satisfactory mix of skills and capabilities to provide world-class products and services.

IT has been changing the structure of as well as the mores society. The use of IT in different work sectors are directly and indirectly impacting on the lifestyles of people. As a whole, it is impacting on the socio-economic structure of the city. So Bangalore city has been taken as a case study and indicators are identified in order to measure the changes in the socio-economic structure due to IT industries. The study recognizes both the positive and negative impacts of the IT industry on the socio-economic features of the city. The development of IT industry has resulted in higher per capita cost for improvement and maintenance of facilities. Squeezing of population in congested areas, emergence of high-rise buildings in residential areas, indiscriminate destruction of greenery, haphazard and fast proliferation of urban sprawl, disorderly large-scale development of peripheral areas and pressure on infrastructure are some of the issues to be analyzed. Indicators have been population, family, culture, education, employment, income, health, entertainment, real estate, economy and manifestations of social responsibility of IT employees. The implications of this study are significant to government as well as respective authorities, while planning measures and formulating policies in the city. This paper seeks to highlight the positive and negative impact created on the socio-economic life of the city by the IT industry.

Proposals are made to overcome the negative impacts. The main idea is to promote positive impacts and to discourage the negative impact with proper use of IT in all fields of work and creating awareness among the general public about IT and its importance.

## **The Influence of Land Use Competition on the Expansion of Bioenergy Production: A Case Study of German Agriculture**

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In view of the increasing problem of global climate change, many countries are improving their policy framework to accelerate the energy production from renewable resources (renewables) (IPCC, 2010). In Germany, the economic conditions for the production of renewables have been improved by the implementation of the Renewable–Energy–Act (REA), which has similarly been adopted in many other European countries. This political measure provides a guaranteed purchase of the produced renewable energy for a period of 20 years, thus creating a strong incentive for investors. Since 2000, there has been widespread uptake of this scheme in the German agriculture which has led to a dynamic diffusion of renewables (Reiche and Bechberger, 2006). The anaerobic digestion of biomass (biogas production, BGP) has, compared to other forms of renewables (e.g. wind and photovoltaic), been gradually gaining importance on farms over the last decade. This is due to the fact that farms have the structural requisites (e.g. existing machinery) for this form of renewables and have a direct supply of biomass as raw material for the digestion process. As of the end of 2009, there were 4,960 biogas plants operating in Germany, almost all of which are located on farms.

In European agriculture farmers are being confronted with changing economic and structural conditions. For many farms, the high price volatilities, the limited value creation in primary production and the structural changes in the sector are great challenges. However, the production of renewables improves the opportunities for value creation in rural areas and is becoming a crucial importance for the mostly individual family owned farms to increase their farm income and hence ensure farm viability (Plieninger et al., 2006).

A closer examination of the recent biogas expansion indicates strong impacts on local agriculture. The demand for biomass is increasing, while the supply is re–stricted by limited arable farm land. Consequently, the energy and food producing farmers are in competition for farmland. Furthermore, competitive dis–tortions are induced by the policy due to an increased funding of renewables compared to food production. This will result in a higher ability to pay for production factors such as land which is accompanied by increasing land lease rates. Furthermore, the land use competition causes conflicts. These externalities may have an influence on farmers’ acceptance of BGP and may also affect their willingness to engage in BGP.

Without a sufficiently detailed knowledge of the agricultural investment behavior in the context of BGP, management and policy run the risk of under- or over–estimating market developments. Such misinterpretations have led to alternating boom and stagnation periods in the field of renewables in recent years. For policy makers it is difficult to forecast the investment volatility and therefore to assess the further expansion potential of BGP. For local stakeholders preparing biogas projects, the knowledge of specific agricultural decision-making structures has a high relevance because it gives them the opportunity to estimate farmers’ response- and investment-behavior more accurately.

The detailed research questions of this study are:

1. How do farmers perceive land use competition?
2. What determines farmers’ investment behavior (willingness to invest) in BGP?
3. How great is the impact of land use competition on farmers’ investment be–havior in BGP?

This investigation aims to analyze farmers’ investment behavior in BGP using a descriptive approach. Based on the model in a previous study (Willock et al., 1999) and information gathered in a literature review, con–structs were collected explaining the behavior in an extensive prior model. Our model consists of:

- Individual factors: ecological awareness, affinity for technology, willingness to take risks, knowledge about BGP, socio demographic characteristics
- Farm internal factors: economic situation, farm structure (soil quality, farm–land area, labor capacities)
- Farm external factors: perceived negative effects of BGP (level of competition between farmers), opinion of farmer’s social environment towards BGP

We validated our model using data from a survey we carried out with 160 farmers in northwest Germany. We de–veloped

statements basically on the hypothetical model and operationalized them in a questionnaire rated with a five point Likert scale. The farmers were personally interviewed in autumn 2009.

The starting point for the further analyses was the question whether farmers were invested in renewables or not. Hence, three groups of farmers can be separated by their investment decision a posteriori:

- Farmers who have already invested in BGP (Biogas-Investors) n=58
- Farmers who have invested in other renewables (Other-Renewables-Investors, mainly photovoltaic- and wind-energy) n=65
- Farmers who have invested neither in BGP nor other renewable technologies (Non-Investors) n=37

In the further analyses, the Other-Renewable-Investors were excluded because the focus of the study was on BGP. We compared the Biogas- and Non-Investors in terms of their attitudes and perceptions towards BGP, energy crop cultivation and their perceived level of land use competition as well by analyses of variance. The differences between Non-Investors who focus on food production and Biogas-Investors who produce renewable energy additionally are very highly significant. The F-statistics with regard to the statement "Biogas plants built in my area are bothering non biogas producing farmers" are very high ( $F=40.59$ ;  $p \leq 0.001$ ) between the Biogas-Investors who disagree (mean=-0.56) and Non-Investors who agree (mean=0.87) (rated from 2 "applies totally" to -2 "does not apply at all"). These groups differ in their positions which reflect a high polarization between food and energy producing farming. Furthermore, the results imply that land use competition has increased considerably, which means that conflicts are more likely occur between farmers.

The identification of determinants of farmers' investment behavior in BGP was based on an explorative factor analysis and a binary logit regression. The formed factors reflect most of the constructs from the a priori model (KMO=0.751;  $R^2=70.19\%$ ; Cronbach's Alpha: 0.457-0.848). However, as ecological awareness, affinity for technology and farm structural indicators did not emerge as factors. They were considered as co-variates in the further analysis. The model estimations outputs confirm that different factors have an influence on farmer's investment behavior and that the hypothetical model are highly validated ( $\chi^2=80.55$   $p<0.000$ ; Cox&Snell- $R^2=0.617$ , Nagelkerkes- $R^2=0.833$ ). Farmers' willingness to invest decreases considerably (exp. Beta=0.050;  $p=0.002$ ), if they perceive high negative effects of BGP (competition between farmers, land use conflicts). An explanation for this is obviously the high conflict potential. A higher level of competition leads to an increase in intensity of conflicts. Furthermore we found out that farmers' social networks, friends and local residents have a strong positive influence on the investment decision if they are well disposed towards BGP (exp. Beta=13.658;  $p=0.002$ ). The majority of respondents are not willing to invest in BGP, if they perceive land use competition and/or a negative opinion of local residents related to BGP, despite the high economic incentives. They prefer to avoid potential conflicts, so they rather refuse investments. Farmers who are satisfied with their economic situation on farm are more willing to invest in BGP (exp. Beta=5.583;  $p=0.006$ ). Individual factors such as ecological awareness, affinity to technology, knowledge and farm external factors such as farmland area and labor capacities have no significant influence on the willingness to invest.

The findings of this study help us to understand investment behavior at the farm level in the specific context of bioenergy production. The focused studies on BGP imply that the future expansion of bioenergy production in German agriculture is not only determined by the biological biomass potential, but rather by socioeconomic issues of land use competition. The future expansion of BGP and the biomass supply (energy crop production) are threatened by these externalities in a long run. German policy is directed towards a significant expansion of agricultural BGP. However, the capacity for BGP uptake is overestimated according to our findings, and thus this endeavor may fail. Our findings suggest that policy makers and local stakeholder would do well to consider socioeconomic patterns in forecast models. Therefore land use competition and farmers' acceptance towards BGP probably improve prognosis accuracy. Considering that many other European countries have adopted the REA after Germany, these findings could be transferred to these countries to identify latent land use competition. Furthermore, this study implies actions for conflict prevention to support a future sustainable agricultural BGP.

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## Linking dryland and climate change to poverty reduction in Uzbekistan

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Uzbekistan is a doubly landlocked country in Central Asia with large share of rural population whose income highly depends on agricultural production. After the collapse of the USSR Uzbekistan was left face to face with the hypertrophied economy aimed at cotton production with the agriculture unable to cover domestic needs in foodstuff. In order to diversify the agricultural production, ensure food security and avoid sharp decrease of the population's income the Government has undertaken market reforms in order to: (i) support private small agricultural producers (dehkan entities) which are currently playing the leading role in production of vegetables, fruits, meat, milk and other products; (ii) facilitate gradual transformation of collective farms into private farming entities to eventually ensure their support to modernization and increase efficiency of agricultural sector. At the same time Government continue to bear the main costs of maintaining large-scale but ineffective irrigation infrastructure established in the Soviet time.

Currently even the regions with low-quality land and suffering from water deficit provide relatively high foodstuff production contributing to food security of Uzbekistan. However, opportunities for poverty reduction based on the agricultural development model have some limitations related to the access to land and water as well as demographic growth. The situation also challenged by climate change issues that are related to Aral Sea catastrophe and global warming trends.

According to the estimates Uzbekistan's population is expected to reach 33.2 mln by 2025. If the area of agricultural land and labor productivity would remain unchanged, Uzbekistan will face 7 mln labor surplus in rural area by the same year. This will certainly lead to rapid decrease in rural households' income and increase in rural poverty rate[1].

In the long-run perspective of increasing population's wellbeing will depend on expansion of non-agricultural sectors, urban development and movement of rural population to cities/towns. In this regard national structural reforms and industrialization strategy were aimed first of all at speeding up the pace of economic growth and expending sustainable employment particularly in industry and service sector.

Being the most populated country in the CA region Uzbekistan has the largest territory. However only 4.1 mln. hectares (9.16% of the total territory) are used under crops including 3.3 mln. hectares (7,45%) of the irrigated land.[2] During the last 20-30 years the soil has been affected by salinization and erosion, polluted by heavy metals and agro-chemicals. Approximately 25% of the agricultural land is estimated as below average and low-quality while share of quality and high-quality lands constitutes only 27.3%. Based on the official data nearly 32% of the irrigated land are affected by the water and wind erosion. Salinization is another critical challenge. By 2008 50.2% of the irrigated land have been estimated as saline, including 7.3% as highly saline.

The other essential of sustainable agricultural production is water. Annual deficit of water from the surface sources varies from 4 billion cubic meters to 5.5 billion cubic metres depending on the year[3]. The growing deficit of water resources is caused by the natural reduction of flow due to climate change and increasing consumption of water to deal with the soil resalinization and maintain crop yield. The agricultural sector takes 53524.2 mln. cubic meters of water or 91.3% of the total water consumption[4]. If irrigated agriculture would continue to play the leading role in agricultural production, water deficit would likely to grow further. This will inevitably restrain development of the agricultural sector and cut down income of the rural population.

Aral Sea disaster entails the first evident of climate change incident which can be considered as a probable scenario for other countries and regions of the world. Since 1950-s the number of days with the air temperature over 40 °C in the Aral Sea region increased twofold, on average across the country – 1.5 times. Higher temperatures and longer summer lead to degradation and melting of the glaciers being sources of the rivers of the Aral Sea basin. Based on the estimates the area of the mountain glaciers has already decreased by over 30%. In the medium and long-term perspective this may entail tougher desertification, land degradation and salinization as well as drought and food security challenges.

Climate change entails health issues, especially for people suffering cardiovascular diseases and evokes the need to revise construction and communal service standards in the regions mostly affected by the temperature shocks. First of all this refers to heating/cooling, power and water consumption, etc.

Environment and its implications on poverty are underestimated due to lack of statistical and analytical information available. However, during the last decade the Government of Uzbekistan pays specific attention to water and land resources use and management, both in terms of national strategies for effective agricultural production and food security, and regional cooperation, to enhance joint efforts in environmental and economic security, as well as social stability in Central Asia.

Enhancement of environmental policies and measures should be implemented in line with policies on expansion of non-agricultural sectors, urban development and movement of rural population to cities/towns in order to mitigate negative implications of dryland and climate change on poverty.

*Short-term recommendations:* strengthen regional cooperation in Central Asia; enhance current and create new institutions to support small agricultural producers; realize more effective social security system in regions with higher environmental degradation.

*Long-term recommendations:* promote industrialization and urbanization; modernization of agricultural sector and infrastructure; climate change adaptation.

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### **Towards a New Measurement of Energy Poverty: A Cross-Community Analysis of Rural Pakistan**

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Most rural households in Pakistan remain in a state of energy poverty. They use a variety of non-conventional energy sources, including traditional biomass (firewood, animal and plant waste), kerosene and even LPG. A specially designed Energy Poverty Survey (EPS), carried out in rural Pakistan from December 2008 till January 2009, showed that rural households use different combinations of energy sources (the energy mix). This paper analyses the characteristics and consequences of the different energy mixes, used by richer and poorer rural households. Using data from the EPS, we develop a composite index to measure the degree of *Energy Poverty* among rural households. This index takes into account the inconvenience for the household associated with the use of different sources of energy, as well as its energy shortfall and takes household size into account. In our results, we found that 23.1% of rural households experience high degrees of energy inconveniences, spending ample amount of their time and effort in collecting or buying different energy sources. Next, using the standard conversion units to convert different energy sources into kilowatt hours, we found that 96.6% rural households experience severe energy shortfalls. Our new and inclusive measure of energy poverty which combines the energy inconveniences and the energy shortfalls, reveals that 91.7% of all rural households in Punjab province of Pakistan are in the state of severe energy poverty.

### **A study of SMEs activities on human health and the environment in Oyo State, Nigeria**

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Nigeria, since independence, has been spending huge amount of money for entrepreneurial and small business development programmes. Hence, the rapid proliferation of SMEs which incidentally are mainly located in the urban centres. SMEs are regarded as growth drivers that can make any nation a viable economy and they contribute immensely to the economic, industrial and social development of any nation. They bring about several benefits to the inhabitants of areas where they are located such as infrastructural facilities; improvement in the standard of living and stimulation of trading/economic activities. Ibadan is the capital of Oyo State in Nigeria and it is the largest city in Africa. Many SMEs are located in Ibadan due to infrastructural facilities. Despite the benefits associated with SMEs, they also pose great danger to the environment because pollution, for instance, emanating from SMEs are reported to cause visible damages to the environment. The environment is a global issue which should be of utmost concern to both individuals as well as corporate organizations.

A highly degraded environment can impact negatively on health and lead to pollution of different forms. The quest for economic development especially in Nigeria, seem to have push environmental matters to the background. The environment has been greatly devastated by social wastes, pollution, flooding, and the likes, especially in the urban centres where SMEs are highly concentrated. Since SMEs constitute majority of companies, they are bound to have the greatest environmental impact. However, the extent to which this happens may relate to the age of SMEs, qualification of

the workers in the SMEs; experience of the workforce, funding of SMEs; the organizational culture of the SMEs, training received by SMEs workforce, SMEs size and perhaps the state of SMEs infrastructure

This study is therefore carried out to reveal the hazards associated with SME activities, not only on their operational environment but also on human health. Hence the general objective of the study is to characterize the nature and types of environmental accounting and management activities in SMEs with a view to determining their effect on the health of SMEs operators, neighbours as well as the entire operating environment. The specific objective however, is to evaluate the environmental accounting factors that influence SMEs' activities within their operating environment.

The study which was restricted to Oyo State covered all SMEs and other major actors within the Environmental Management System (EMS) in the thirty three local government areas of the state. These major actors are the Ministries of Environment and Water Resources, Commerce and Industry, and people leaving within the areas where SMEs are located (SMEs neighbours).

The nature and types of environmental accounting and management activities of SMEs in Oyo state were determined by a group of operational variables such as the state of SMEs infrastructure, frequency of maintenance of such infrastructures, SMEs funding, degree of technical and human development, government policies guiding SMEs operations, types of operation undertaken by SMEs, and the nature of SMEs. To evaluate the environmental accounting factors influencing environmental management activities among SMEs, the following socio-economic variables were identified namely, the age of the SMEs (X1); experience of the workforce (X2); qualifications of the workforce (X3); degree of funding (X4); availability of infrastructural facilities (X5); training of the workforce (X6); size of SMEs (X7); organizational culture of SMEs (X8); public perception towards the quality of products of SMEs (X9); and the extent to which valuable accounting information in environmental management is obtained by SMEs (X10). To evaluate the environmental accounting factors (EAF) influencing SMEs activities (SMEA), the latter was modeled as a function of 10 identified relevant variables.

From the study, it was discovered that all the identified SMEs generated one type of waste or the other which invariably, may have the potential of not only polluting the environment but could also be hazardous to health. Again, most of the disposal techniques employed by the various SMEs only succeeded in recycling the generated waste. Even the ability to effectively handle complex process like waste management by SMEs is suspect, sequel to low capacity building or ill-equipped labour force and lack of adequate infrastructural facilities. Majority of the SME operators opined that the infrastructural facilities used for combating environmental hazards were grossly inadequate. It was revealed by the respondents that many of the equipment were in varying state of decay.

The inadequacy of infrastructural facilities may increase the inability of SMEs to address environmental pollution that may arise from solid, liquid and gaseous wastes generated by their activities, which implies that the environmental impact on the environment could indeed be very high. The study further revealed that the rates of indiscriminate and open burning of wastes, the degree of gaseous discharges, industrial effluents, organic wastes and domestic sewage to the environment by SMEs are very high. This implies that the activities of the SMEs potentates the danger faced by the inhabitants of such areas to air pollution and its attendant consequences. Other parameters such as emission from SME generators and noise emanating from SME operations were high.

Finally, we concluded that SMEs activities have tremendous impact on human health and the environment in which they operate. However, the extent of such impact largely depends on a variety of operational and socio-economic variables. Hence, we recommend that the SMEs' sector which is largely dominated by low-skilled manpower should undergo incessant training both locally and abroad. Secondly, we advocate that government at all levels should endeavour to address the issue of inadequate basic infrastructural facilities such as water, electricity and good roads. Inadequate infrastructural facilities in SMEs accounted for their sub- optimal performance because majority of the SMEs could not address environmental problems from solid, liquid and gaseous wastes generated by their activities. Litter bins could also be provided and supplied to every street in each of the 33 local governments of the State. Constant monitoring of all road sides for litter presence and removal should be carried out on daily basis. The quest for economic development should not lead to continuous degradation and destruction of our environment and human lives. New and improved technologies could be adopted by SMEs to minimize effusions from their activities on the environment.

### **Social Capital and Quality of Life: With Special Reference to Tehran (Iran)**

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This study attempts to study the relationship between social capital and quality of life in Tehran. It also aims to identify that whether level of quality of life differs according to level of social capital in different localities? It aims to identify optimum combination of social capital's cognitive and structural elements which have significant relationship with quality of life.

In order to conduct this research positivistic methodology and deductive logic of inquiry have been employed. Furthermore, survey method along with Geographical Information System (GIS) has been used to conduct the research. As material a Household Schedule Interview Form (HSIF) and a global position system (GPS) device have been used for collecting the subjective and spatial data respectively. To generate, analyze and obtain the operational model for social capital and quality of life, multiple regressions and a one-way between groups analysis of variance methods have been used.

As result multiple regressions indicated that there was a significant relationship between social capital and quality of life ( $p= 0.000$ ) and null hypothesis is rejected. In association with second aim, one-way between groups analysis of variance showed that there was a statistically significant difference at the  $p<0.05$  level in quality of life scores for the three levels of low, moderate, and high social capital [  $F(2, 11529)= 3405.2, p=0.01$ ]. Furthermore, the multiple regressions indicates that excluding communication, rest of the four indicators viz. view towards locality, social participation, social trust, and local solidarity are entered in the model as predictors of quality of life. In addition, 68% of the variances in quality of life scores is explained by included indicators of social capital indicators.

### **Genetically Modified Organism (GMO) and Substantial Equivalence Concept: The Adoption of Precautionary Principle for Stricter Labelling of GMO in Malaysia**

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Genetically Modified Organism (GMO) is an organism whose genetic material has been altered using the genetic engineering technique and is specially used and related in food production. A strict food labelling is required for the protection of consumer's health from any risk introduced either through the production process, nutritional implication and technological changes in the properties of the food. Sequentially, labelling in this sense empowers consumers to exercise precaution to protect their own health by being enabled to personally judge their own health risks from consuming a novel genetically modified food that may not have history of safe use. Nevertheless, most of the food industries have widely spread the use of GMO without noticing the consumers by embarking on the "substantial equivalence" concept, i.e. by declaring certain characteristic in GMO is substantially equivalent to its conventional item without further test and labelling. Such practise poses a major threat to consumer's safety and authorities are required to take proactive steps in ensuring strict labelling or certification. This is particular is monitored closely by the Malaysian authorities which is also active in promoting strict safety requirement through Halal Certification. It is argued that the Precautionary Principle, the well-established in Principle 15 of the Rio Declaration that allows States to set preventive measures of prohibiting certain activities to protect its environment and social health despite lack of scientific certainty, can be used to contest the use of "Substantial Equivalence" concept that dilute the GMO characteristic in food and escape the GMO testing and labelling. Although GMO may not be a major threat in local food production question arise as to the imported genetically modified food from overseas. This paper attempts to examine the applicability of the Precautionary Principle in prohibiting the Substantial Equivalence concept adopted by the food industries as a measure to control the use and labelling of GMO in Malaysia. In depth analyzation of the food safety standard and legislative framework in Malaysia will achieve the objectives of the study. The study concludes that Precautionary Principles is an appropriate mechanism in ensuring a stricter labelling the GMO in Malaysia.

### **Impact of Trade Liberalization on Environment in India: A case study**

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Human greed to live a sophisticated and luxurious life has led to climate change via environmental degradation. The climate change is the most complex environmental problem challenging the earth as a whole. Environmental scientist and researchers around the world are exploring the concepts of its vulnerability and its links to recent climate change. Apart from the linkage between climate change and economic growth, they focus mainly on sustainability and to preserve the nature for future generations. The trade-off between environmental degradation and economic growth can be compared to Pareto optimality. That is the over utilization of Mother Nature for the benefit of present generation should not deprive the same benefit or welfare for the future generations. In this regard Trade, economic growth and environment act as a vital role in attaining sustainable development. Trade liberalization is considered as an engine for economic growth. However critics of liberalization argue that openness of trade to international market have adverse effect on pollution level in developing economy like India, where environmental regulation are not as strict as in the developed economy.



The linkages between trade and environment can be assessed through the impact of economic growth on environment. Environmental Kuznets curve (EKC) is commonly applied to examine the impact of economic growth on environment as popularized by Grossman and Krueger (1993). Their studies indicate inverted 'U' relationship between economic growth and environment. The inverted U relationship postulates that deterioration in environment in the early stage of economic development shall improve as economy growth in to higher income level of development. However various researches have provided mixed empirical result in terms of pollutants like green house gas (GHG) emission such as carbon dioxide (CO<sub>2</sub>).

India has opened its economy in 1991, with introduction of economic reforms and it is the most preferred destination for foreign direct investment (FDI) in the world. Further India has emerged as a manufacturing hub for multinational corporations because of its cheap labour and weak environmental regulation. There are large numbers of cross countries studies on environmental issue, with India being included in the cross countries study. But there are only few studies on country specific nature. Cross countries estimate result may not be appropriate since countries differs in regulatory frame work and hence there is need to examine linkages between Trade, economic growth and environment based on country specific variables

The main objective of this paper is to investigate the impact of Trade liberalization on air pollution in India. Further to know whether Trade Liberalization has led to pollution heaven hypothesis or not. Johanson's Co-integration method has been applied to examine the objective, Trade intensity, Scale effect, composition effect and technique effect. Time series variables are tested through unit root test to check the non-stationary of the variables. Long run coefficient of co-integration of technical effect is negatively related to air pollution. Thus the scale effect of trade liberalization is detrimental to the environment. The error correction model reveals that openness and scale effect are negatively related to air pollution. White composition effect and Technique effect are positively related to air pollution. The positive relation of composition and technique effect confirms pollution haven hypothesis.

Variance decomposition of CO<sub>2</sub> reveal that opens in responsible for explain 7.29 percentage of variation of CO<sub>2</sub> after three time period, this percentage reaches to 10.63 percentage after six time period and goes up to 11.69 percentage after ten time period. Overall the findings of the study show that Trade liberalization is significantly related to air pollution. However the negative relationships also suggest that attempts are being made to go for cleaner technology to central pollution. The government should enforce the regulatory frame to central pollution to achieve sustainable development; otherwise, air pollution will affect the overall health of the citizen which will ultimately affect the productivity of the labour and the total factor productivity of the country.

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## **Pressure on Natural System with Special Reference to Keoladeo National Park Bharatpur: India**

Manju Lata Sharma

Purpose of this study is to find out the stress on natural system of KNP(Keoladeo National Park) and stress on socioeconomic system.

Keoladeo National Park Bharatpur consists of an area of 2873 hectare. Initially, it was a natural depression; and was flooded after the Ajan dam was constructed by Maharaja Suraj Mal .The bund was created at the confluence of two rivers, the Gambhir and Banganga.

Misuse of environment has a history as back as that of civilization. Of all the political, economic and social revolutions of the last century, none has so changed human values as the environmental revolution. Human society is using ecological resources faster than they can be restored. The park was a hunting ground for the maharajas of Bharatpur. In one shoot alone in 1938, over 4,273 birds were killed.

Keoladeo which earlier used to be flood prone is now dependent on rain, because one of the two rivers, Banganga, on which it was dependent, has long dried up and on the second river, Gambhir, a dam called the Panchana Dam has been built damming the river. The Annual Requirement of water to maintain the wetland character of the Keoladeo National Park is about 14 million cubic feet water.

Undomesticated cattle(feral) poses a management problem to the park. The other major problem being faced in the park is the invasive species growth of *Prosopis juliflora*, and this has adversely affected the habitat of woodland, grassland and lakes. KNP situated on highway so the all development like hotel and marriage homes, colonies are developed near the highway that is within the periphery of KNP and adversely affected the natural habitat of birds.

Pressure on socioeconomic systems imposed by continued development of Bharatpur and KNP. The local politicians of that area have not been allowing the water to be released from the dam for the National Park, as they want it for agricultural purposes. Prior to Keoladeo being declared a National Park(1972), cattle rearing and grazing became a major economic use of the Ghana(thickest forest). When the ban on grazing was imposed, a confrontation between the villagers and the police on this issue led to the deaths of six villagers.

### **Preliminary investigation of the NIMBY effects of senior citizens' welfare institutions in ageing society**

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In Taiwan, it is estimated that the percentage of aging population will reach 14% by the end of 2020, and by that time the number will meet the definition of aged country from WHO. As the aging population keeps increasing in Taiwan, the demand for medical treatments and health care facilities from elders and also the demand for caring and nursing organizations will keep rising. The regulation for "Establishment Standards of Senior Citizens' Welfare Institutions" mainly focuses on the facilities and the arrangement of personnel. The content does not properly regulate where the institutions should be located in the scale of community. However, previous studies indicated that lower living quality, community security issues and sanitation problems are main concerns for local residents avoiding to reside near caring and nursing institutions. Also previous researches related to senior citizens' welfare institutions mainly discussed about the internal design and the service qualities of institutions. Only few studies focused on location choice and the relationship between the institution and its external environment. In this study, we will choose Taipei city as the study area. In order to obtain the external effects on local community of senior citizens' welfare institutions; the history of establishments of senior citizens' welfare institutions in Taiwan, policies for senior citizen and previous research accomplishments will be reviewed in the first part. Secondly, based on analyzing the criteria such as scale of the institution, the number of beds served in one institution and current location of existing institutions in Taipei, we will classify all institutions into types and identify the issues encountered. Both qualitative and quantitative methods will be adopted to explore the possible external effects of certain institutions such as impacts on property price in the community, we will conclude the characteristics about the location of senior citizens' welfare institutions in one community in Taiwan and the relationship between the institution and its community.

### **Sustainable Heritage Tourism Case Study: Heritage Corridor in Medan City, Indonesia**

Shanty Silitonga

Tourism is a complex world but yet an inspiring world. It is a wheel of economic and an agent of change especially for developing countries. In contradiction tourism impact badly to the environment and social-culture life of surrounding community. Land degradation, waste, pollution, shock culture and social degradation are among those influences, that is why it is imperative for tourism industry to implement the concept of sustainable tourism. A balance must be found between limits and usage of tourism so that continuous changing, monitoring and planning ensure that tourism can be managed. Tourism will never be completely sustainable as every industry has impacts, but it can work towards becoming more sustainable. Economic, social and environmental aspects of sustainable development must include the interests of all stakeholders including indigenous people, local communities, visitors, industry and government.

This research took a study case in Malay-Colonial heritage corridor in Medan city; consist of three streets and a city square enriched with heritage buildings; Maimoon Palace, Javache Bank, Town Hall, Post Office and others. The objective of this study is to evaluate the physical, economic and socio-culture of existing condition and formulate sustainable heritage tourism formula for research area. This study carries out three principal tasks to explore these issues. First, the writer conducts field survey to evaluate the physical condition of existing condition. The field survey figured out how many heritage buildings left and the condition of place identity. Second, the writer issued questionnaire to conclude opinion from visitor and surrounding community about economic and social-culture condition in research area. And third, the study will compiles and analyzes formula for sustainable heritage tourism concept for research area. The study used descriptive research methodology; case study research methodology. Photo and video surveys of the whole study area are therefore carried out, focusing more on the recording of facts than on providing an interpretation of the places.

Based on its detailed data and analysis, the study found three important things and concluded a recommendation. First, the degradation place identity. Vanishing heritage building, abandon ones and lack of amenities for pedestrian eased of the place identity. Place identity is one of important key for successful tourism destination. Whether a space has a good image and identity is key to its success. Creating a positive image requires keeping a place clean and well-maintained, as well as fostering a sense of identity. This identity can originate in showcasing local assets. The writer concluded that place identity in research area must be preserved and re-build again. Government's involvement, law enforcement, physical treatment and tax relief are some of things to be done.

Second one found in this research is that there are not enough economic activities in this area, mostly covered by retail, office and most mainly by Chinese people. And third; which is associated with previous one, there is a lack of culture activities in this area. Having something to do gives people a reason to come to a place, avoid emptiness and they will return to the place again. In planning attractions and destinations, it is important to consider a wide range of activities for men and women; people of different ages; different times of day, week and year. Create an enticing path by linking together this variety of experiences. One answer which fit to the research area is utilize seasonal strategies, like holiday markets, parades and recreational activities to activate the street during all times of the year offers a unique, attractive experience and rich with 'culture flavor'.

### **Healthcare Professionals Training and Retention as a Contribution to Sustainable Development in the Horn of Africa**

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There are direct and indirect links between healthcare and sustainable economic development and entrepreneurial innovation in both developing and developed nations. The productivity of the economically active population depends on the quality of healthcare provision, outreach and governance. A good physical and mental development in human life is the best asset for societal well being and socio-economic prosperity of nations. The healthcare provision and governance in the Horn of African (HoA) nations is in a very precarious situation (World Bank, 2007; IMF, 2007). One of the main reasons for this is the massive exodus of qualified healthcare professionals to the affluent corners of the world. Unfortunately, healthcare was somewhat a neglected sector in the region due to inadequate resources allocation, poor governance and socio-economic and political problems. For several decades, Eritrea, Ethiopia, Somalia and the Sudan did not only produce huge numbers of refugees but also became legions of highly skilled emigrants particularly in the strategically vital sectors like health. During the past 10 years (1995-2005), more than 40% of those locally trained medical doctors, pharmacists, laboratory technicians and nurses left the region to work elsewhere (UN, 2006; UNHCR 2009). The availability of viable and modern health services are vital contributors to the sustainable developmental dynamics of nations. Unfortunately, this harsh brain drain reality has left the HoA nations with undeveloped, despaired and debilitated health sector with a limited outreach capacity. The detrimental impact of this on the development endeavours of the HoA nations is apparent. In fact, this situation has become one of the major impediments preventing the nations from making headway to attaining at least some of the United Nations declared Millennium Development Goals (MDG) by 2015 (UN, 2009). Currently, the region has over 95 million people of whom more than 40% are living below the poverty line (less than \$1 a day) (World Bank, 2009; UNDP, 2008).

As mentioned above, without nurturing healthy population, it is very difficult to achieve sustainable development as human ingenuity is the most important input in the process of wealth creation and productivity enhancement. We need effective and SMARTER (Specific, Measureable, Attainable, Realistic, Timely, Effective and Resourceful) strategies, schemes and vital action programs to curb the current massive brain drain of healthcare professionals from the HoA. To reverse this sombre situation and promote the ability of retaining healthcare professionals, the HoA nations should revisit and improve their current modus operandi in their macroeconomic management system. Otherwise the unfortunate vicious cycle of losing the best and the brightest will continue unabated. So far, this trend has forced the HoA nations to encounter arduous difficulties to pull themselves out of the quagmire poverty and misery. It has also aggravated their continued suffering from the undesired consequential effects of brain drain. Therefore my paper deals with: the root causes of massive brain drain of qualified health professionals in the HoA nations; the extent of the negative impacts of brain drain on the health sector and the magnitude of its detrimental contribution to the overall sustainable development efforts of the nations in the region; the WHYs and HOWs of the failure to reduce the continued mass exodus of qualified health professionals from the region; the reveal of the observed weaknesses and strength of the current strategies and action programs dealing with the problem; and the initiations of alternative strategies and action programs that can help to improve and streamline this grave situation?

My paper focuses on conceptual discourse supported by anecdotal facts, observational realities and figures. This has

helped to find out weaknesses of the current modus operandi focusing on retention of health professionals in the region. This helped to enriching the paper and proposes conceptual wise better strategies and action programs to improve the situation. I followed the exploratory and conceptual style in my methodology utilizing the thesis, antithesis and synthesis based holistic approach in my analysis and strategic considerations.

My rigorous literature survey in the area and comprehensive review of the findings of earlier studies and reports has helped me to propose potentially useful strategies, action programs and implementation modalities for consideration. The aim is to bring feasible alternatives more appropriate for implementation, and effective in resource utilization within the realm of brain drain curbing comprehensive endeavours. I believe that HoA nations need solid foundations of the new beginning for a better performance and outcome in the healthcare governance and provision as one of the vital inputs in their sustainable development core agendas. I hope that my recommendations will be valuable contribution towards achieving this noble objective. Brain drain problems stem from the failure to take decisive and savvy actions at the right time, of the right type, in the desired level and at various stages of developmental continuum. Stakeholders at a wider spectrum should realize that coping with the brain drain of healthcare professionals successfully is one of the principal contributing factors of enhancing sustainable development in the region. Nations need new ideas and full support to enhance their all out efforts to advance the viability and capacity of their healthcare system in order to be able to provide better and widely outreached health services to the society at large.

The strategies and action plans recommended in this paper are not absolute panacea by themselves but subject to further discussion and consideration by the stakeholders. The contents of my recommendations are based on the critical analysis approaches that require review, evidential argumentation, discussion and critical thinking. They are subject to an in depth evaluation and analysis in accordance with their potential usefulness for enhancing sustainable development in the region.

# Interaction of stresses

Upmanu Lall & Kua Harn Wei

## Oral Presentations

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### **Implications of hydroelectricity development projects for sustainability of rural livelihoods in Sikkim, India**

Thomas Chandy, University of Melbourne

Rodney J. Keenan, University of Melbourne

R. John Petheram, University of Melbourne

Peter Shepherd, Institute of Indigenous Tertiary Education

Mountain economies the world over are undergoing transformation from traditional agrarian to more industrial or service economies in response to forces of globalization and private investment. Such changes invariably have socio-economic impacts on communities residing in these areas leading to more profit-based or cash-income rather than subsistence-level livelihoods (Huston 2005; Ponte 2001; Thongmanivong & Fujita 2006). Social changes resulting from these developments are also common, including social fragmentation and depopulation of mountain villages. (GarciaRuiz et al. 1996; Huston 2005; Khanal & Watanabe 2006)

Sikkim, a State of India in the Eastern Himalayas, has an area of 7096 km<sup>2</sup> and a population of 0.54 million. It has recently embarked on a program of development that aims to generate 5000 megawatts of electricity by 2015, through construction of 22 mostly medium-sized hydroelectricity projects (Government of Sikkim 2009). This paper examines the current environmental and socio-economic impacts of these projects on nearby communities, and considers the implications for future sustainable livelihoods.

Two case-study village panchayat units (clusters of villages) were selected for this study. One panchayat, Shipgyer, is predominantly tribal and is located near Teesta Stage III hydroelectricity project in North Sikkim and the other, Chujachen, is located near Chujachen hydroelectricity project in East Sikkim. Both these projects are in an advanced stage of construction. According to the last official socio-economic data (Government of Sikkim 2006), the major occupation of villagers in both areas was farming. The impacts of these two hydroelectricity projects were studied using qualitative research methods including focus groups and in-depth interviews. Purposive sampling was employed to select participants to represent the range of ethnicity, age, gender and wealth status. Snowball sampling was subsequently used to select villagers who were affected in various ways from project implementation. Interview data were transcribed to word processor and continuously analysed in the field, by coding and constant comparison methods guided by grounded theory. Some secondary data were collected from different sources in the Government of Sikkim.

In both research sites construction of hydroelectricity projects has caused changes in land use, involving mainly conversion of agricultural lands to roads, tunnels, buildings or other components of the projects. Villagers were compensated for loss of their agricultural land, either by one-off payment, or through the provision of employment in regular or contract jobs in the hydroelectricity companies. Compensation for some unforeseen damage to property has also been made, as a one-off measure by the companies. However, indirect damage to property by landslides, wash of excavated earth onto arable lands, rolling of boulders and dust pollution has not been compensated for. Road construction work has caused a lot of deforestation and damage to trees in and around the villages. Village forests that people traditionally used for firewood and fodder collection have been destroyed by construction work. Water scarcity is also being experienced to varying degrees by villagers.

Hydroelectricity companies have been major employers of local people in the areas of project implementation, helping, temporarily, to address unemployment problems, especially for the younger generation of villagers. Employments take various forms, both fulltime skilled and unskilled, as well as casual. Some construction and materials-supply contracts are given to villagers and indirect benefits have accrued through business and trade.

Most of the jobs that local people work on pertain to the construction phase of the projects, and so are short-term. The attractiveness of a monthly salary which comes with much less toil than required for agriculture has enticed people to abandon farming. Abandonment of agricultural fields in mountain terrain leads to land degradation and their becoming

unfit for cultivation due to landslides, rill and sheet erosion (Khanal & Watanabe 2006). Evidence of serious degradation is not yet perceptible in the study villages.

Agriculture production in Himalayan areas, depends on a number of factors, including the use of livestock for draught and manure production, the maintenance of an adequate forest cover, availability of water for irrigation and the presence of an informal labour exchange system (Avasthe et al. 2005; Ives & Messerli 1989, pp. 44-5; Tiwari 2008). The current study shows that in Sikkim developmental activities have impacted on these factors in various ways. While the need for livestock keeping has declined due to reduced farming, forests and streams have been adversely affected by landslides, earth dumping, tunnelling and road construction. People's preference for company employment rather than farming has resulted in loss of the informal labour exchange system and its replacement with hired farm labour that is expensive and unaffordable to most villagers.

The results of our research also suggest that employment of villagers in the electricity development companies has diminished the social capital of the communities. Social networking that existed in the form of cooperative sharing of labour for agriculture has weakened. There is increased commoditization of labour and informal village-level networks to meet exigencies such as food or fuel shortages are losing importance. The outmigration of younger people to take up residence in nearby towns has caused social disintegration, leaving villages occupied mainly by the elderly who are unable to undertake agricultural activities. Young villagers who have been working in the companies have little or no knowledge of traditional agricultural systems that formed the basis of the village economy before the companies arrived.

The key findings of this study are that: (i) conversion of land from agriculture to uses associated with construction of large hydroelectricity projects has led to villagers abandoning agriculture - either because of sale of land to the project or because of the lack of time for farming; (ii) a major socio-economic impact of hydroelectricity project construction is that most villagers now prefer regular company employment and are moving towards urban lifestyles, thereby losing farming skills; (iii) these changes have implications for sustainability of livelihoods of the communities, since most company jobs are of short duration. The change in land use and livelihoods of large sections of the population of the two *panchayat units* studied represents a transformation from a proven sustainable (though in most cases subsistence) system to a short-term and unsustainable one.

Agricultural fields have provided livelihoods to the villagers for generations. The abandonment of agricultural land and the loss of traditional farming skills threaten to deprive the people of a sustainable livelihood option. It is argued that there is a need to revive land-based economic activities on abandoned agricultural lands, reclaim degraded lands and introduce new products and production methods. The hydroelectricity companies have taken some initiatives in this direction by facilitating the formation and training of self-help groups to work on diverse income generation activities. These measures need financial support, marketing and infrastructure to enable them to become successful and sustainable ventures. Apart from these steps, there may be potential for new areas of economic activity, such as floriculture, tourism and small-scale industries.

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## The Importance of Sustainable Urban Quality of Life and Housing in Enhancing Urban Competitiveness: An Empirical Study across 35 Chinese Cities

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Cities have been traditionally viewed as places with advantages of economic productivity, since people can find more job opportunities and earn more money there. However, nowadays' mobility and globalization of firms make it possible for people to choose their favorite working cities worldwide. Glaeser found that cities with high urban quality of life (UQOL) grew faster because they can attract more talents to work in. But with more and more immigration into high UQOL cities, the housing demand increased so rapidly that urban rents may rise up faster than wages. When the living cost increased by the housing prices offset the UQOL differences, it would reach a dynamic equilibrium which let the mobility of labor terminate. Even worse, if the urban housing prices rose higher and higher, urban dwellers would have to move to lower UQOL cities where they could afford housing cost (Glaeser 2001). Therefore, the pattern of urban competitiveness is changing dramatically from traditional sole economic driven mode and turns to a kind of sustainable attractiveness of UQOL, housing prices, as well as the income level.

Quality of life is a multi-faceted, complex concept. People from economics, political science, planning, geography, sociology, psychology, medicine, marketing and management are joining in the discussion of QOL. More than 100 definitions of QOL have been made from different perspectives. Those definitions are also including some cognates such as good life, subjective well-being, happiness, life satisfaction, and amenities (Cheng 1988; Diener 1984; Rice 1984; Roback 1988). Through an extensive review on previous study, UQOL for our research can be defined as follows.

*Urban Quality of Life is the product of the interplay among the external conditions in society, environment, economics, politics, healthcare, education and housing which affect both individual development and sense of well-being in the urban.*

Following this definition, 44 customized indicators which are divided into 8 domains (including economics, education, environment, transportation, telecommunication & culture service, healthcare, housing conditions and safety) are given for the measurement of UQOL in Chinese cities.

Based on the pioneer study of the dynamic equilibrium among housing prices, income and UQOL, this research aims at revealing their quantitative relationship which may inspire the government to realize the importance of sustainable UQOL development and learn key points on how to improve urban competitiveness. So borrowing from the compensation theory that the differences between housing prices and income can be fully compensated by UQOL across cities (Blomquist 1988; Roback 1982; Rosen 1979), a basic equilibrium model is given.

$$\ln P_{it} = \alpha + \beta \ln W_{it} + \sum_{j=1}^n \gamma_j Q_{it}^j + \varepsilon_t$$

Here  $P_{it}$  presents the housing prices at city  $i$  in year  $t$ ;

$W_{it}$  is the wage at city  $i$  in year  $t$ ;

$Q_{it}^j$  is the value of the UQOL index  $j$  at city  $i$  in year  $t$ ;

$\alpha$  is a constant for other factors;

$\beta$  is the regression coefficient for the log of wage;

$\gamma_j$  is the regression coefficient for the UQOL factors;

$\varepsilon_t$  is the error term, which captures other factors that influence the dependent variable other than the regressors.

Then 35 main Chinese cities' yearly data of average commercial housing prices, average wages of urban workers and 44 UQOL indicators among 1997-2007 is taken to do an empirical test. At the beginning, the coefficients of totally 22 significant UQOL factors ( $p$ -value < 0.2) are firstly gained through the regression on the equilibrium model. This group of coefficients is the base for the calculation of total value of UQOL ( $\sum$ UQOL) and value of UQOL classified by domains (UQOLD). Then a series of hypotheses are tested in order to verify possible connections among them.

The results show that both income and UQOL can greatly explain the variation of housing prices across cities. As the impact coefficient of UQOL is a little higher, it can be seen as the willingness to spend more in living in a desirable place greater than the willingness to earn more. We also found that the UQOL premium is increasing more quickly than income premium during the observation period. This means UQOL plays a more and more important role in raising housing prices. That shows high UQOL usually goes with high housing prices though high UQOL is welcoming migration and high housing prices are impeding migration. As the convergence process towards the equilibrium will lead to the continued growth of housing prices, the excessive growth of housing prices may break the equilibrium which will cause the drain of talents. So the governments are better to keep sustainable high UQOL as well as to control the excessive high housing prices when needed. Through a regression between the price-to-income ratio (PIR) and the total value of UQOL, several inflection points are collected to find the cordon of PIR. This can give a reference for the government as a sign when the housing prices are excessively high.

All these results have strong implications on the importance of sustainable UQOL and housing for local governments to enhance urban competitiveness. Besides, the important UQOL indicators affecting immigration significantly and the signs when the housing prices are needed to be controlled are suggested based on the different regression results.

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## **Economic Policy for Sustainable Development and its Impact on the Market Competitiveness**

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There is an extensive discussion about the relationship between the sustainable development and the competitiveness at macro and micro economic level. Some experts argue that the environmentally friendly growth is affordable for highly developed economies only and that higher ecological criteria and standards lead to lower price competitiveness. On the contrary, we share the understanding that sustainability and competitiveness can be mutually supportive. Certainly, this is possible if we manage to combine the power of the “free market” forces with an adequate regulative mechanism, consisting of economic and non-economic incentives. Some of these incentives are based on direct and indirect subsidization of the development and the implementation of so called alternative energy sources and renewable raw materials. The financial resources for such pro-sustainable fiscal policy are generated by environmental fees, fines, taxes and such sources like the revenues from the market for emission tradable permits (ETP).

The European Union (EU) ETP scheme is quite illustrative in this respect. It grants companies allowances that authorize companies to emit certain amounts of preliminary specified greenhouse gases. If the actual emissions for a given business unit are below these allowances, than it can sale it to a company(s) where emissions are still above the permitted level of pollution. Therefore, companies with advanced, eco-friendly technologies are awarded with additional financial stimuli on expense of the companies which are late with the technological innovation. This mechanism has an important advantage – it is “budget neutral”, i.e. it does not engage tax payers’ money and therefore does not harm the budget balance. This advantage is very valuable especially for periods of financial turmoil and economic recession when public finances are under pressure. Thus inter-company burden transfer remains at a micro level and sharpens the competitiveness while the macroeconomic system remains intact. Certainly, this effect can be amplified by applying non-market instruments like the technical environmental standards that establish limits to the overall volume of hazardous pollution. Such limits may lead to downsize of the production of even to shut-down of enterprises unable to meet standards or to buy emission permits.

In 2008, the EU green-house gas emissions (GHG) reached their lowest level since 1990. The Union is one of the world’s least emission intensive economies - 473 g carbon dioxide per euro of GDP.[1] The following factors played an important role for this success: (1) Technological innovation in the energy sector, including implementation of state of the art purifying technologies in the coal-fired thermal electrical plants, large-scaled introduction of alternative energy sources (wind, solar and bio-fuels); (2) Further economic restructuring in favour of the widening service sector and, respectively,



shrinking industrial share in the GDP; (3) Positive business respond to the incentives for clean and more efficient energy consumption; (4) Rising public awareness about the environmental dimension of production and consumption.

The abatement cost of the Kyoto Protocol targets distorts the relative prices in favour of exporters from countries like China, India and the USA which did not join yet the Protocol. It explains why there is an increasing pressure from the Protocol signatories for justified competitive environment. Certainly, such demand make sense because the price advantage of the Chinese steel exporters over the Swedish steel exporters is based on the compromised environmental standards in the emerging Asian economy allowing lower production cost. Therefore, such instruments like an additional import duty would help for the eradication of such market distortions. At the same time, the combination of fair competitiveness with cleaner technologies will make possible the fulfilment of the criteria for sustainable development. The so called indicator 'ecological footprint', proposed by Rees and Wackernagel (1996)[2], must be taken into account in the process of improvement of the rules for foreign trade both on bilateral and multilateral levels.

In 2008, the French President Sarkozy warned: "...if large economies of the world do not engage in binding commitments to reduce emissions, European industry will have incentives to relocate to such countries...The introduction of a parallel mechanism for border compensation against imports from countries that refuse to commit to binding reductions therefore appears essential, whether in the form of a tax adjustment or an obligation to buy permits by importers." [3] This warning, based on the understanding for fair trade and transparent competitiveness, was mirrored in an amendment of the EU Directive 2003/87/EC, where the legislators have determined that "Energy-intensive industries which are determined to be exposed to significant risk of carbon leakage could receive a higher amount of free allocation or an effective carbon equalization system could be introduced with a view to putting EU and non-EU producers on a comparable footing. Such a system could apply to importers of goods requirements similar to those applicable to installations within the EU, by requiring the surrender of allowances." [4]

By my perspective, such policy does not have an alternative because otherwise current foreign trade rules favour pollutants (less cost of production) and punish environmentally friendly producers and countries which spend billions of Euros to fight the global warming and its unpredictable impact on the economic development. The gap is caused not only by the price distortions but also through the relocation of industries from the developed into the developing countries or through shrinking production in the developed countries and respectively increasing output in the less developed economies. We witness in both cases the so called "carbon leakage" of emissions where lower emissions in the EU, US or Japan are replaced by much higher emissions per unit of GDP in countries with lower productivity because of the outdated technologies and/or lose environmental standards. Frankel (2008) has strong arguments when insisting that the World Trade Organization must work for the implementation of the import carbon tax and/or alternative instruments like quotas or obligation to buy emission tradable permits from the importing country.[5]

The sustainable development, viewed by Gechev (2005)[6] as development which is environmentally friendly and socially justified, demands adequate policy changes at a company's level. For instance, the American corporation General Electric has launched "Ecomagination" program- a set of clean technologies serving the energy, transportation, water treatment and consumer product sectors. Revenues from this program reached \$8.5 billion in 2005, and induced additional orders for nearly \$17 billion. In this respect, Lash and Wellington (2007) argued that the risk of climate change may generate new competitive advantage. They recommend four steps for the mitigation of this challenge: (a) quantification of the direct and indirect gas emissions or the company's "carbon footprint"; (b) assessment of the risk of these emissions (charges, fees, taxes, production downsize, ethical problems, etc.); (c) adaptation of the company's business to the new conditions and (d) acting ahead of the other rivals.[7] Michael Porter argues that the environmentally friendly production may and have to lead to better competitiveness if properly organized and regulated.[8]

Honda and Toyota are another example of such policy. These companies first commercialized the energy efficient hybrid engines. Currently, BMW produces about 50 car models with EU5/6 emissions norm and another 20 models with low carbon emissions. It puts the company on the lowest tax group in Germany and few other EU states and therefore wins some "negative tax" eco-bonus which increases its competitive advantage. The company is trying to globalize the financial feedback on its environmental achievements and it is indicative that BMW shares were registered on the Dow Sustainability Group Index i.e. has an international recognition which gives some additional positive impact on the company's brand image. As Packard and Reinhardt (2000) pointed out, forward-looking companies are seeking ways to mitigate the effects of the global warming on their business activities, shape regulatory regime and communicating with the society about their appropriate respond to the new challenges.[9] We argue that the companies with 'green technologies' and clean products will strengthen their competitive advantage.

[1] European Environment Agency, Greenhouse gas emission trends and projections in Europe 2009: Tracking progress towards Kyoto targets, EEA report No.9, 2009, p.19.

[2] Rees, W. and Wackernagel, M.(1996). Our Ecological Footprint –Reducing Human Impact on the Earth, British Columbia, Canada: New Society Publishers

- [3] Letter to EU Commission President Jose Manuel Barroso, January 2008.
- [4] Paragraph 13, Directive of the European Parliament & of the Council amending Directive 2003/87/EC so as to improve and extend the EU greenhouse gas emissions allowance trading system; Brussels, Jan. 2008.
- [5] Frankel, J., Addressing the Leakage/Competitiveness Issue in Climate Change Policy Proposals, July 2008, pp.8-12, accessible at: <http://www.hks.harvard.edu/fs/jfranke/LeakageBrookgsWeditsAug.pdf>
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## Potential links between emergence of zoonotic pathogens and stresses on natural and socioeconomic systems: ecohealth and sustainable development

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Infectious disease is one of the major plights of man or beast, ancient or modern. In recent memory, the world has seen the emergence of HIV, ebola, SARS, H1N1 and others. What all of these infectious diseases have in common is that they are pathogens that originated in animals. Of 335 emerging infectious disease (EID) events between 1940 and 2004, 60.3% were zoonoses, and of these approximately 71.8% originated in wildlife (1). The economic cost of an outbreak event can figure in the thousands and millions of dollars such as the annual costs of preparing for the influenza season, but can explode to the several billions per year spent on malaria, tuberculosis, and HIV. It has also been known for some time that wildlife EIDs threaten domestic animal and human health, and may be a threat to conservation of biodiversity (2). With this study, we aim to link research on infectious disease with sustainable development because of this potential threat to world health, ecosystems, and economies.

Recent work suggests that anthropogenic stresses on natural systems may increase risk of disease emergence (3, 4), and that EID outbreaks or events can have significant impacts on socioeconomic systems (5). Some of the drivers for disease emergence include anthropogenic land use changes, climate and weather changes, deforestation, agricultural industry changes, breakdown of public health measure, and human demographics and behavior changes (6). These drivers are inextricably linked with development and sustainability. Our study will investigate emerging infectious diseases and the potential relationship with multiple variables measured in natural and socioeconomic systems.

However, as an initial, first-stab exploration of these relationships, it is beyond the scope of this paper to make much larger statements about the implications for sustainable development and related issues. It may serve as a valuable exercise to develop and direct future research and discussions, specifically in regards to how ecology and health (ecohealth sensu J. Lebel) research may be linked to sustainable development research.

We are examining the relationships between zoonotic pathogens and several natural and socioeconomic factors in a country-scale global analysis. We are using a generalized linear regression to find the best-fit model; the variables include EID pathogens, World Health Organization (WHO) health statistics, agricultural land area, forest area, meat consumption, and CO<sub>2</sub> emissions. We are using the EID database compiled by Jones et al. (1), broken down by number and type of pathogens by country.

Health statistics that are included cover a range of healthcare investment and expenses, such as density of health workforce and hospital beds, percent immunization, and ratio of health expenditure. These variables serve as an approximate evaluation of a country's readiness or capacity to deal with health emergencies. We are using change in percent land area for agricultural land and forest over a set period of time to evaluate stress on natural systems due to human encroachment and activity. Change in meat consumption by humans also places stress on natural systems and agricultural systems by increasing pressure to produce more volume from finite resources. Annual CO<sub>2</sub> emissions per capita from fossil fuel burning and change over time may serve as an indication of pressure on natural systems as well as stage and rate of development.

We have found that countries with the highest proportions of EIDs as a group had statistically significant higher proportion of countries whose percent agricultural land area decreased and percent forest land area increased than when compared with all countries and total countries with EIDs (See Table below). This suggests that changes in agricultural and forest land area may be an indicator for identifying countries where there should be more in-depth investigation of drivers for land use change and emergence of EIDs, and potentially the need for higher surveillance for future EIDs. Thus, in the next stage of our study, we are analyzing by pathogen type, specific drivers of emergence, and socioeconomic

variables such as human population. Results from this preliminary analysis may provide insight into what interactions might be significant between EIDs and natural and socioeconomic systems.

This type of analysis of ecohealth, natural, and socioeconomic variables may lead to a more accurate picture of the global system. The challenge lies in gaining access to or creating more comprehensive global datasets, and effectively analyzing them. Though, an opportunity is gained when such analyses are stronger and lead to greater understanding of how EIDs interact with representative variables in natural and socioeconomic systems. In light of this, we hope to build upon this study by including different variables such as land use, resource consumption, and global trade and tourism, and also by improving the resolution of datasets to be able to run the analysis at finer scale for individual countries with the goal of informing and advising policymakers.

We address here something that is not just a health issue, nor solely an environmental one. It is both things and more than what we can currently understand. EIDs present a danger to ecosystem, wildlife, and human health, but also to biodiversity conservation and globally connected economies. It is for these reasons that we hope to build upon current work and to innovate by engaging sustainable development research. Although sustainable development is an interdisciplinary field still taking shape, it has been largely dominated by engineers and policy analysts in topics centered on the built environment and consumption industries. The expanding field of ecohealth is an incredible opportunity for research and surveillance programs to connect human and wildlife ecology, but also is another pathway of research to work towards a sustainable future that involves a new range of possibilities.

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## **Toward Assessing the Sustainability of Geological CO<sub>2</sub> Sequestration: An Integrated Economic and Geological Framework**

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The mitigation and reduction of atmospheric carbon dioxide concentrations due to our continued global use of fossil fuel hydrocarbons remains one of the most challenging problems facing society today. Geological sequestration of CO<sub>2</sub> by injection and storage into sub-surface formations offers one important option for long-term climate mitigation. Potential geological storage sites differ in terms of technical capacity and formation characteristics, as well as in economic potential. Numerous studies have explored the technical aspects of geological CO<sub>2</sub> sequestration, and a myriad of scientific questions persist. For example, the effective size of many different reservoirs and the fate of produced/expelled fluids after CO<sub>2</sub> injection are largely unknown. Furthermore, the technologies required for post-injection monitoring and the necessary surveillance frequency are poorly constrained and will remain so, until we gain considerably more field experience. This technological and scientific uncertainty translates into economic uncertainty with respect to quantifying the long-term costs and benefits of different storage sites. Nevertheless, the regulatory and economic infrastructure that will be needed to implement carbon mitigation options must accommodate a number of economic and social policy concerns, and these can be addressed now, in parallel with scientific and technical research. Where are best (considering economic and technical perspectives) options for geological carbon storage at appropriate volumes? What are the relative merits of onshore versus offshore reservoirs from legal, regulatory, and public perspectives? How should the scientific community provide input to policy makers to evaluate onshore versus offshore options and related technical issues?

One area requiring attention is incorporating risk and uncertainty into technical and economic assessments of geological sequestration choices, and in particular, concerning oceanic versus continental storage sites. In addition, there has been little systematic analysis of the economic costs and the risk to the environment for long-term storage options. In this paper, we develop an integrated economic-geological framework for comparing the long-term viability and the long-term expected costs of specific geological reservoirs. To do this, we draw upon the economic theory and methods for determining the optimal extraction for a non-renewable resource stock under conditions of uncertainty in stock size, considering geological formations (pore space) as a non-renewable resource. We modify the established theory

to incorporate the expected damages from potential leakages of CO<sub>2</sub> after injection and reflect these damages in the shadow prices of the stock. For example, at a low level of pore space utilization, injected CO<sub>2</sub> can in effect be stored permanently at a site, without causing substantial environmental damage; however, if more and more CO<sub>2</sub> is injected into the reservoir and occupies (utilizes) a greater amount of pore space, the potential for damages to neighboring environments due to leakage has higher probability. In this sense certain storage reservoirs may be less “permanent” than others. Thus, we are able to link the amount of the pore space that is utilized within a given reservoir and the expected damages. Furthermore, a critical determinant of the best storage sites will be the relationship between the volume of injected CO<sub>2</sub> in a given reservoir and the transport and movement of CO<sub>2</sub> within the subsurface. Using a dynamic framework, we develop the necessary and sufficient conditions for optimal use of a geological reservoir and address how injection constraints, geological trapping potential, and the expected environmental damages may affect the quality, capacity, and long-term economic costs at a given storage site.

A shadow price that accounts for the marginal environmental cost associated with a given level of injection should be reflected in the long-term economic and environmental costs of each sequestration option. *Ceteris paribus*, a higher marginal environmental cost makes a particular CO<sub>2</sub> storage reservoir less favorable. The marginal environmental cost may also be considered as a reciprocal of the value of the trapping capability for each storage site. In this work, we focus on the case of geological CO<sub>2</sub> storage in oceanic settings and provide an initial assessment of the long-term economic and regulatory costs relative to other continental geological storage options. We incorporate the potential costs and damages with respect to CO<sub>2</sub> leakage from oceanic storage sites (e.g., leakage back to the atmosphere, migration of CO<sub>2</sub> into other environments). Because sub-seafloor formations provide unique and significant advantages, such as reduced risks of post-injection leakage and minimization of potential damages and regulatory concerns, the marginal environmental damage of a subseafloor site may be much lower than in continental formations, offering a significant cost advantage for long-term decision making. We simulate the marginal costs for specific sites and provide some preliminary comparisons between continental and sub-seafloor CO<sub>2</sub> storage options. Using simulations, we also estimate the shadow costs associated with various subseafloor sites based on an integration of assumed site-specific characteristics and reservoir storage capacities.

Because geological carbon sequestration programs are often at the leading edge of interactions between social policy and scientific research for climate change mitigation, resources should be prioritized to develop integration among these related efforts as much as possible.

Long-term storage of CO<sub>2</sub> emissions from fossil fuel hydrocarbons requires careful attention to both the short-term costs of CO<sub>2</sub> capture and transport to a storage reservoir as well as the long-term environmental costs at each site. Responsible public policy also requires attention to the uncertainty and risk, and future investments should be directed toward the solutions that are most effective and efficient. This research demonstrates an effective framework to quantify the temporal and spatial tradeoffs among alternative storage reservoirs in order to assess the broad viability of geological CO<sub>2</sub> sequestration in a structured and integrated manner.

## **The Climate Change and Security Nexus**

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In recent years the security implications following climate change have received increased attention by policymakers and researchers. Climate change is now in the field of security often described as a ‘threat multiplier’, i.e. a factor exacerbating already existing problems such as water scarcity and food insecurity by making them more difficult to deal with than would be the situation without climate change. However, there is also increasing agreement that non-climate factors such as level of poverty, governance, presence of mechanisms for conflict management, regional diplomacy etc. will largely determine whether and how climate change moves from being a development challenge to a security threat. Accordingly, one must ask to what extent climate change poses security concerns and what differences there might be depending on the climate change effects in focus, but also what kind of security concern that is raised, i.e. when, how and for whom?

This paper is based on a systematising and categorising of the vast amount of studies addressing the nexus climate change and security. The analysis lies as background to perspectives and reflections on this highly complex and politicised field. Furthermore, the analysis is used to discuss the importance of articulating the approaches taken and how the framing of climate change and security is linked to the policy approach.

The analysis focuses on peer reviewed articles published during the period 2000 to 2010 dealing with security implications from climate change. The articles include all kinds of methodological and theoretical approaches and include case studies, statistical studies and discursive analysis. The articles are selected through searching in data bases

using key words relating to 'climate change and security'. The selection made is, hence, based on the authors' own classifications. Clearly, there might therefore be articles overlooked due to that the authors' have not categorised them as climate change and security-related.

The categorisation of the articles focused on five elements.

- *Definitions of climate change*: whether the studies refer to e.g. temperature, precipitation, sea-level rise or extreme weather events.
- *Time periods*: whether the studies are based on e.g. historical data or future orientated scenarios, as well as the time horizon used (5/20/50/100 years).
- *Applied methods*: e.g. empirical studies, review studies, discursive studies, statistical studies, semi-quantitative studies.
- *Security paradigm*: the security approach adopted, e.g. human security, state-based security or international security.
- *Effects of climate change on security*: the types of effects in focus, e.g. humanitarian catastrophes, migration, conflicts.

The analysis recognises three main problems in this growing field of research. Firstly, many studies provide overly simplistic causal connections between climate change and its potential security implications. Climate change is generally treated rather uncritically assuming that certain types of effects and responses will be generated automatically due to climate change. A second problem puts emphasis on the importance of the premises adopted for the analysis, i.e. how the premises affect the interpretation made concerning whether, how and to what extent climate change is considered having security implications. The third problem is related to the previous one but focuses on the methodological foundations and their implications on the analysis' results.

The findings from this analysis are discussed emphasising the need for scrutinizing the security approach taken and acknowledging how different approaches shape the analysis. Climate change evidently has security concerns, but depending on the security approach different effects become more prominent than other. As such, different perspectives need to be adopted in order to give a coherent understanding. Moreover, the shifting character of security, which has lately increasingly moved from state-based security to human security, is also likely to lead to very different social impacts depending on the security framework applied.

The analysis recognises that the explicit articulation of what kind of security one considers has major implications for the policy response developed. Considering that the human security approach stresses issues of vulnerability, adaptation and justice it provides a broader and more encompassing notion of climate security than e.g. the state-based approach. Moreover, since its emphasis lies on the effects on people and their situation it can better merge with the approaches vital in the discourse of sustainable development.

## **Sustainable and efficient organizations: The case of hand-crafts micro-business in Southern San Sebastian**

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In this paper it is analyzed the organizations' sustainability and efficiency which are committed to the exploitation' activities of tule *Thypha* spp at the Zapotlán's Lake taking into consideration the socioeconomic and environmental impact in the municipalities of Gómez Farías and Zapotlán el Grande. The initial hypothesis departs from the consideration of the scarce social capital of organizations that limits development's sustainability

The research method employed is the ethnographic complemented with field work supported by informal interviews, documental and bibliographic research.

This methodology puts in evidence that there is not equilibrium between organization's sustainability and economic efficiency of handcraft micro-business involved in the exploitation of the *tule Thypha* in Southern San Sebastian due to scarce social capital, environmental sustainability and economic development. The hypothesis of this research is proved empirically and confirms similar findings by the research conducted on the mainstream theory of social capital and its implications on economic development. The main contribution of this paper is that it also considers the scarcity of natural resources to achieve equilibrium between economic efficiency and sustainable development.

The outcomes of the application demonstrate that the drama of economic efficiency and sustainable development of micro-business is tied to constrain of social capital. This finding has implications for the design and implementation of economic and social policies oriented towards the improvement of economic growth and sustainable development.

### **Emerging Vulnerabilities in India's Irrigated Agroecosystems: Role of Technological Lock-ins, Poverty, and Debt Traps**

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Recent satellite based estimates of groundwater depletion in the northern belt of the Indian subcontinent show that groundwater levels fell an average of 4 centimeters per year between 2002 and 2008. These estimates show a much faster rate of depletion than previous official estimates and have raised fears about an imminent water crisis in the one of the most intensively irrigated regions of the world that supports 600 million people. Long term ecological data from the region shows evidence of declining soil depth and rising pesticide resistance levels.

In this paper we use the robustness-vulnerability framework to examine the suite of ecological and socio-economic vulnerabilities that have emerged in irrigated agroecosystems in semi-arid regions of India since the diffusion of Green Revolution technologies in the early 1970s. Socio-economic data from the successive rounds of the National Sample Survey coupled with time series data on rainfall patterns, soil fertility, groundwater tables, and pesticide resistance levels are used to characterize the vulnerabilities and the associated tradeoffs along the different development trajectories. Our analysis helps understand the conditions under which technological lock-ins and debt traps often get linked in poor societies and how these may lead to unsustainable pathways by restricting the choice set of farmers and subduing the self-corrective mechanisms within the social-ecological system. We also discuss some emergent market and institutional responses at the local and regional level and their implications for robustness of the system.

Our examination of these linkages points to the need to devise policies that explicitly recognize the systemic and chronic nature of this problem. Thus, piecemeal approaches that deal with say, increasing subsidies for particular inputs or forgiving part of the debt may provide some temporary relief but are not likely to make any significant difference over the long term. In the long term, there is need to work simultaneously on several fronts –such as crop diversification, improving small farmers' access to credit and crop insurance, groundwater regulation, extending the reach of agricultural extension services, improvements in rural infrastructure and regulation of marketing of seeds, pesticides and other inputs. At a deeper level, this suggests that it may more be more useful to see development as an open ended and unpredictable process which calls for the need of more reflexive rather than deterministic planning. The reflexive mode emphasizes experimentation and learning at all levels as opposed to a top-down control and one size fits all solutions derived from a linear mode of thinking based on simple cause and effect relationships.

### **Long run relationship and Short run Dynamic: An analysis of Energy, Socioeconomic Development and Economic Growth in Colombia**

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This research describes the causal relationships between development, economic growth and energy use in Colombia. Using time-series methodologies, we find that economic growth and development drive total energy consumption. The results regarding the relationship among poverty, inequality and energy indicate that increases in gross domestic product and per capita energy supply contribute to decrease poverty. Inequality and indigence have a direct relationship with poverty trends. The results also confirm that access to modern energy services helps to decrease poverty. Moreover, the improvements in energy efficiency and decreases in CO<sub>2</sub> emissions have contributed to development and growth. These results showed the importance of the formulation and adoption of good policies and strategies that encourage sustainable energy use to improve growth and development, especially in developing countries.

We have divided the analysis into three parts: (I) Output - energy relationship. (II) Productivity analysis, where we focus on the relationship between the energy use per unit of labour and the output per unit of labour. (III) The relationship between poverty and energy is analysed with the aim of determining the effects of energy consumption on poverty.

In this study, we use time-series methodologies that involved the following steps: (I) Test the stationarity of each series, we first apply the unit root test with the following techniques: the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), Bartlett and Portmanteau white noise tests. (II) Cointegration tests to determine if there exists a long- run relationship among all test variables. This test is designed to find the stationary linear combinations of vector time series, and in this test a number of cointegrating factors must be determined. (III) Causality tests using the Granger approach with first-differenced VARs for each of the two pairs. (IV) We estimate the casual relationship among development, economic

growth, poverty and energy, controlling for changes in capital, labour, human capital, exports, standards of living and other energy features. We select the structural Vector Auto Regression (VAR) model for estimating the regression model, which provides certain advantages in this study. First, this model is flexible, easy to estimate, and it usually gives a good fit in the analysis of multivariate time series. Second, this model takes into account the endogeneity and simultaneity of variables by allowing the error term to be contemporaneously correlated across equations combining of long-run and short-run information in the data by exploiting the cointegration property. Third, this model allows to analysis the dynamic impact of random disturbances on the system of variables

The results of output energy model show that growth in human capital, exports, energy supply per capita and industrial energy consumption significantly affect economic growth and development. Moreover, the results also show that an improvement in energy efficiency and a decrease of CO<sub>2</sub> emissions could affect economic growth and development. The results of human capital show positive and significant affects output growth. Therefore, the increase in human capital is an important driver of economic growth and development (Erumban, 2008; Gutierrez, 2005). The poverty and GINI variables have a negative effect on output indicating the importance of these variables in economic growth and development. Energy supply per capita positively affects economic growth. The variable of energy intensity shows a negative and significant impact as expected, indicating that improvements in technology and energy efficiency increase the output.

The estimated productivity model shows that the capital-labour ratio and exports-labour ratio are determinants of productivity. Energy, electricity and natural gas consumption used per worker also significantly contributes to productivity. Poverty and GINI variables show a negative effect on productivity. The increase in CO<sub>2</sub> emissions and energy intensity are significant and negatively affect productivity. The increase in the industrial sector positively affects productivity.

The estimated results of the model for poverty and energy show that GDP and the per capita energy supply are key variables decreasing poverty because better access to sustainable energy services is necessary for economic growth and for the development of businesses and income-generating activities and because a reliable and affordable supply of energy services is pivotal in improving productivity in rural and urban communities (European Commission, 2006).

The biomass consumption variable has a positive influence on poverty. This means that increases in firewood or charcoal consumption contribute to higher poverty. These results concur with the fact that lack of an adequate energy services exacerbates poverty and contributes to its perpetuation, as it precludes most industrial activities and the jobs they create. The relationship between poverty and CO<sub>2</sub> emissions is positive, indicating the close relationship between poverty and sustainable development.

From the above analysis, we can see that energy is a critical determinant of economic growth and development, and the results also confirm the trend of decoupling between the behaviour of GDP and energy consumption. In order to achieve high economic growth and development, multidimensional policies are required and these policies should not ignore the energy sector and sustainable development. Moreover, we can see that energy is a determinant of poverty. Designing, adopting and implementing policies focused on providing affordable, clean and reliable energy acts to meet the needs of the poor and reach the goal of poverty reduction because access to energy services facilitates economic development, generates incomes and employment and can help to achieve a more sustainable use of natural resources. It can also reduce emissions, thus protecting both the local and global environments (World Bank, 2006).

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## **Implementation of Local Sustainability with Regard to Climate Change – Hungarian Case Study**

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These days, there is an increased interest in the topics of both sustainability and climate change (EU SDS 2006, SEG 2007). The most diverse views, facts and ideas are published related to these two terms, an endeavor and a phenomenon, respectively, which require the harmonization of viewpoints, co-operation and common thinking (Sneddon

et. al. 2006). Like sustainability, climate change is also more and more often in the focus of attention and discussions. Despite the fact that the causes connected with climate change are still debated, as well as the phenomenon of global climate change, the examinations have shown that in accordance with the principle of precaution, action is needed on behalf of local citizens towards prevention and mitigation of damages or towards the adaptation to climate change emphasizing related synergic effects. From the viewpoint of both sustainability and climate change, a holistic approach is needed to be able to examine interactions and to find possible solutions.

The significance and relevance of sustainability is not to be contested, as it is clear that the anomalies in natural cycles and the reproduction of goods endanger human existence. The examinations suggest that among the dimensions and levels of sustainability, it is likely that on a local level, progress is easier, as it can be assumed that in a small region or community, the practical implementation of sustainability is a vital challenge to those living there. The use of local-level assessments is pivotal to better grasp local reality (Naess et. al. 2006). Furthermore, there is a lack of information on how local knowledge can encourage local mitigation and adaptation strategies. This is why we have chosen the micro-regional, settlement level, trying to find out how sustainability can be implemented and enforced in a region rich in natural values taking into consideration the possible effects of climate change. As contained also in the Fourth and Fifth Assessment Reports of IPCC (Intergovernmental Panel on Climate Change, AR4 2007, AR5 2010) one of the greatest threats to implementing sustainability is climate change.

We are investigating the contribution of development to sustainability, taking into account the local connections and interactions between sustainability and climate change. Prognoses show that climate change will have a serious effect on Hungary. Considerable warming, drying (decreased mean annual precipitation) and an increased frequency, intensity, duration and damage of extreme weather conditions can be expected. (VAHAVA Report, 2010) Weather conditions of recent years and months have proven that this is a real threat. A survey was carried out among local municipalities in a special area of Hungary. 7 main topics were covered by the 26-page questionnaire: general data (5 main questions); natural environment, resources and their utilization (31 questions); general, social and economic characteristics of the settlement (21 questions); institutional, organizational background (5 questions); main barriers of development (8 questions); climate change and weather conditions (32 questions); views on a livable countryside and settlement (in accordance with the New Hungary Development Programme).

The subject of the analysis was the Lake Tisza region in Hungary and the 73 settlements in the Regional Development Council of Lake Tisza. This region has been selected because it is rich in environmental values (protected, Ramsar sites, Natura 2000 areas, Lake Tisza, Tisza), coupled with economical and social problems and a significant Romani population, making it suitable for the complex evaluation of the interdependences. One focal point of this examination was climate change on the local level especially dealing with the opinion of local stakeholders. Lake Tisza is an important tourism destination with a unique natural environment, where it is possible to satisfy the demand of visitors searching for sports-, conference-, eco-, adventure and other kinds of tourism. The artificial lake (Kisköre aquifer, 1970) is the second largest lake in Hungary, having a very important role in flood protection, water storage, water quality protection, recreation, farming systems and in the conservation of biodiversity. Another specialty of this 2 262 km<sup>2</sup> area is that one third of it belongs to two different National Parks. What the result of these special circumstances and facilities are in reality is another matter. This depends on the local population of the affected 73 settlements.

The research mainly focused on how sustainability can be implemented for a livable settlement, environment and countryside. Determining the answer is complicated by the fact that the analyzed region is an especially disadvantaged area of Hungary (Lake Tisza region) and a holiday resort of exceptional significance. Among the dimensions of sustainability related to climate change, the preservation of natural values and resources is of the utmost importance. This realization may be controversial in the eyes of the public struggling with day-to-day problems.

In the interest of preparing for climate change it is expedient to develop an action plan to help preparation, prevention, alleviation and reconstruction so that possible courses of action will be clear to all. Inherently Local Agenda 21 (LA21) processes include aims concerning mitigation (e.g. transport and energy related emission-decreasing tools etc.). However LA21 has not been as successful as initially expected. Empirical evidence underpins the fact that it is not so easy to implement LA21 due to regional differences and the lack of cooperation and common thinking among local stakeholders in Hungary. Thus, another type of local model has been developed that can handle both sustainability and climate change at the same time considering the statistical data and local views about environmental and socio-economic circumstances. Our examinations showed that the practical implementation of local sustainability could be encouraged more effectively through climate-related activities especially focusing on synergies (F r, Csete 2010).

Developing local measures for saving energy, increasing efficiency and using alternative energy sources is equally important in preparation and decreasing living costs, with special emphasis on investments and development. (Csete, Torok 2009) Human health, the security of food and water supplies are critical among the effects of climate change. Water is especially important since the study shows that people in the region are extremely optimistic about water supply



and quality perspectives. The existence of Lake Tisza and natural values justifies reviewing the status of and making suggestions for the future of water resources, water protection, alternative solutions and the rational use of groundwater, thermal water and irrigation. The results are summarized into a local model that can foster the practical implementation in the research area. This model has a significant role in putting climate change in a broad societal context regarding all dimensions of sustainable development, and putting together information on local mitigation and adaptation options that can fit recent policy instruments and structures of municipalities.

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## Acknowledgements

This work is connected to the scientific program of the "Development of quality-oriented and harmonized R+D+I strategy and functional model at CUB, and BME" project. These projects are supported by the New Hungary Development Plan (Project ID: TÁMOP-4.2.1/B-09/1/KMR-2010-0005 and TÁMOP-4.2.1/B 09/1/KMR-2010-0002)

## Keeping Sustainability Afloat in Rising Disaster

ShenukaMayani De Sylva

This paper focuses on post-disaster reconstruction endeavours in South Asia and strategies for rebuilding resilience amongst rural poor. It highlights the complexities of attempting to implement sustainable housing development practices in economically disadvantaged nations and discusses the benefits of strategic planning that begins long before disaster strikes to ensure sustainable reconstruction.

The urgency for shelter in post disaster situations demand quick solutions—at such times 'sustainability' is a distant thought, an unreasonable and excessive ask especially in most economically disadvantaged nations. Yet as natural and man inflicted disasters spread steadily across the world, post-disaster reconstruction often takes the form of a second wave of disaster, inflicting adverse socio-cultural, environmental and economic damage; its impact at times, more detrimental and far reaching than the destruction caused by the first. The solution to such damaging outcomes is 'sustainable reconstruction'. Sustainable reconstruction is ideally an endeavour that seeks to bring society, local community, environment and technology together; recognising each as interlocking parameters essential in dictating the nature and types of efforts that would make reconstruction sustainable in the short-term and the long-term. Successful implementation of such an approach requires strategic research and planning—commencing long before a disaster strikes.

A pressing problem in post-disaster environments in developing nations that has received little attention and consideration in post disaster reconstruction is traditional architectural practices. Although traditional construction systems and materials are ideally suited for rapid short to medium term low cost post-disaster responses and satisfy sustainable principles, they are generally overlooked or dismissed in shelter design and construction. When considering local conditions traditional systems of construction are appropriate socio-culturally, suitable eco-environmentally and feasible economically; however the principals and practices of traditional architecture rarely inform local reconstruction initiatives and the efforts of global disaster response agencies. This paper identifies this as a problem in mass housing for rural communities and as the primary factor contributing to 'reconstruction disasters'. To illustrate this aspect of post disaster reconstruction an ongoing research project based in post-tsunami Sri Lanka and focused on the revival of traditional and sustainable construction techniques destroyed by modernisation and post disaster rebuilding processes will be used. Case studies from other Asian nations will be used to elaborate on some of the issues being discussed.

Revival and repositioning of traditional vernacular systems of construction and materials within the contemporary context of a developing nation poses further challenges. While developments in construction techniques and cutting edge technological advancements can be utilised to add value to these ancient building traditions and extend the lifespan of bio-materials and the robustness of geo-construction systems, modern day socio-cultural influences and assumptions hinder individuals and communities from re-embracing such traditionally sustainable practices. This situation poses yet another challenge when thinking sustainable reconstruction. In view of this a significant facet of strategic planning and research would involve the need for branding and marketing of this form of architecture in order to obtain acceptance amongst stakeholders. It would also involve the education of rural communities on the value and urgent need to maintain and continue with traditional building and living practices that are sustainable while adapting only modernising practices that benefit such a way of life. As such the development of sustainable housing for Asia's rural poor and rebuilding resilient communities involves collaboration between various stakeholders. The benefits of a collaborative development cannot be underestimated or ignored particularly in reconstruction following large scale disaster for such endeavours are perceived by economically disadvantaged nations as opportunities for rapid development.

A successful reconstruction endeavour satisfies sustainability in the three principal aspects of socio-cultural, eco-environmental and economic. This paper presents the multiple dimensions that need consideration and negotiation for the implementation of a successful reconstruction endeavour in rural South Asia and in particular Sri Lanka.

### **The Path to Resilience: Research directions toward optimizing the mutual impacts of Cities and Climate Change**

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As the earth is being more and more urbanized, the concerns related to the impact of human settlement patterns on the habitat is growing. Since 2008 more than half of the world's population has been urban and this population is anticipated to increase up to 70% by 2050. Since the mid-20th century most of the observed increase in global average temperatures is very likely due to the observed increase in anthropogenic greenhouse gases (GHG) concentrations (Solomon, et al. 2007).

The future of human life on the planet will be increasingly concerned with the changes in global climate since the past two decades. Besides the natural roots for climate change, human activities like burning fossil fuels, deforestation, and developing land for farms, cities, and roads have contributed to climate change by releasing greenhouse gases into the atmosphere (EPA 2010). Cities are the chief causes of and solutions to global warming (Mills 2007; Grimm, et al. 2008; Ewing, Bartholomew, et al. 2008a & Grimmond 2007). The direct impact of urbanization on global climate stands through production of anthropogenic emissions of carbon dioxide, and biologically homogenizing environments that leads to diminishing biodiversity (Mills 2007).

Although urban areas only cover a small fraction on the Earth's surface, the GHG emissions from cities are huge and growing. Cities play dual functions with respect to GHG, both by direct contribution to emissions and by reducing natural sinks (Grimmond 2007). From the emissions perspective, in the worldwide scale, transportation stands for 14.3%, residential and commercial buildings produce 16.5%, and land use changes account for 12.2% of CO<sub>2</sub> emissions, cumulatively generating 43% of the global CO<sub>2</sub> emissions in 2005 (World Resources Institute 2009). Analogous statistics from U.S. national inventory of greenhouse gases illustrates that urban areas are directly involved in at least 51% of the U.S. GHG emissions in 2008.

Researchers argue that the emissions corresponding to transportation are highly correlated with land use policies; in that, the effect of land use is stronger than the effects that economic or population growth can have on CO<sub>2</sub> emissions triggered by transportation (Bart 2010). Recent studies demonstrate that achieving long term reduction goals in CO<sub>2</sub> production is not promising only through current vehicle and fuel technology considerations. Instead, it requires a strong shift towards low impact development policies that can sharply reduce the growth in VMT across the sprawling urban areas (Ewing, et al. 2008, Kooshian and Winkelman 2011). Energy use in buildings is also an important factor in contribution of urban areas to climate change. It has been cited that while the most GHG emissions are produced from transportation, the most energy usage comes from building operations (Norman, MacLean and Kennedy 2006).

Despite the uncertainties in future climate predictions, scientists have proven that changes such as sea level rise, increases in temperature, variations in precipitation, and other expected fluctuations in climate events are inevitable (Climate Impacts Group 2009). Adaptation to climate impacts will be more crucial when these impacts may be self-amplified by the increases in GHG emission. It is also vital to consider increases in the risk of natural hazards. One may imagine the consequences of sea level rise, where almost one-quarter of the world's population lives within a boundary of 100 km from the coastlines and around 13% live in elevations less than 10m above the sea level (Seto and Shepherd 2009) to be hazardous.

Nevertheless, climate change for urbanites has been inundated by remarkable changes in the local environment (Grimm, et al. 2008); and for this reason, less attention has been directed to study the impact of urbanization patterns on global climate change, relative to the local environmental issues. At the global level there is no published research that seeks to identify the contributions of individual cities to the anthropogenic concentration of GHG (Mills 2007). While there is an increasing need for institutional capacities in establishing interdisciplinary practices, there is no inclusive practical urban climatology that embraces clear guidelines for future implementation.

It is critical that cities and the drivers of urbanization are central to global environmental research; however, despite such importance, current climate mitigation policies have not prioritized land policies in national and international climate mitigation frameworks (B. J. Stone 2009). Barriers to implement climate change policies at a local scale are: lack of political will, discounting the impact of local action, perceived lack of peer communities in the region, lack of resources and options, and lack of appropriate climate science for planners (Carter and Culp 2010). Despite the importance of cities in climate change, local and regional planning authorities do not have access to appropriate planning tools to measure the associations of anticipated urbanization patterns on climate; that necessitates the diffusion of urban climate knowledge to planning and policy sectors.

Addressing the challenges of global warming in near future, it is crucial to envision and create the foundations for prospective researches on the impacts of the changing built-environment patterns on climate change. Toward this goal, as recent emerging studies have shed light on, urban growth patterns are the determining factors that manipulate the magnitude and extents to which urban emissions are produced by transportation, land use changes energy consumption in buildings. Here, I propose key factors that need to be addressed in an interdisciplinary setting, as the future research frameworks on the mutual impacts of urbanization and global climate change:

1. In responding to climate change, it is essential to address both adaptation and mitigation strategies, especially when climate impacts are unavoidable.
2. Transportation emissions are highly correlated with urban growth patterns (i.e. urban sprawl, compact development, etc.). Additionally, the extent to which land cover is converted from natural to built-up area is also dependent on the intensity of sprawling growth patterns.
3. Urban growth patterns are shaped by the spread of houses and jobs, determining considerable amount of daily travels. The spread of housing and employment locations is a function of urban economy; however, individual choices are similarly important in shaping different urban forms (i.e. the complexities in formation of suburbanization besides the economic motives).
4. Individual choices encompass consumption patterns, and accordingly use of energy and automobiles in the urban areas.
5. And finally, public perception is a determining factor in individual choices that can be highly improved through educational processes.

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## The Ecology of Cooking: a Cross-Sectoral Study on Sustainability Aspects of Cooking at Six Sites in Sub-Saharan Africa

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Cooking serves as an entry point to examine multiple dimensions of sustainability within households in the Millennium Villages Project (MVP), specifically their nutritional consumption, their energy consumption patterns, and their interface with the environment. The MVP is a network of 14 villages in 10 countries in sub-Saharan Africa designed to test various integrated development interventions with the aim of scaling successful practices to national levels. This cross-disciplinary investigation documents environmental, economic and social aspects of cooking practices in 6 of the MVP sites: Potou - Senegal, Ruhira - Uganda, Mbola - Tanzania, Pampaida -Nigeria, Tiby - Mali, and Koraro - Ethiopia. There are major gaps in knowledge of cooking practices; how they vary across country or region and how they are changing over the duration of the MVP or other development projects. However, as one of the fundamental activities that a household undertakes to sustain itself, this study shows that cooking is an important lens through which we can identify the interaction of stresses on the household and help to inform decisions about what avenues are appropriate to address these.

Household survey data from 300 households at each site, landscape-level biophysical survey data, and anthropometric measurements are combined with qualitative data to characterize the cooking system at each site and to conduct a cross-site comparison of the interaction of environmental, economic, health and social aspects of cooking practices. The 6 MVP sites represent a diversity of agroecological zones, varying staple crops and dishes.

As in much of sub-Saharan Africa, cooking across the sites is largely a low-tech process, done on three-stone fires with biomass fuels gathered by household. Women and children are the main source of labor, both for cooking and gathering fuelwood.

With precipitation ranging from 250mm to 1200mm per year, different levels of forest cover, and a variety of land management strategies, a wide range of ecosystem services are available across these 6 sites. The availability of these services impact cooking practices themselves, the burden that these practices place on households, or alternatively, different cooking practices, such as a preference for certain species for fuelwood reconfigures the landscape. Indicators of the availability of these services include precipitation, proportion of fuelwood versus crop residue, and level of woody vegetation.

Cooking and fuelwood collection are a substantial time-labor burden for the household, in particular women and girls. Sites differ in the distance traveled and time spent in order to collect fuel wood and the presence of a market for fuelwood for domestic cooking (in sites like Potou and Tiby). Sites also differ in fuelwood availability and ease of collection by season, and this can contribute to seasonal market demand for fuelwood. Across the different sites, major food crops are mostly produced by the household itself, while for certain ingredients, like cooking oil, sugar and salt, households are dependent on access to local markets. Additionally, the economic responsibilities for food are frequently divided by gender; in Tiby, for example, men are responsible for producing the staple crops while women are frequently responsible for purchasing accompanying food. For some, particularly women, cooking provides a source of income by selling processed food on markets, and in the example of Tiby, this income helps women purchase the accompaniments for family meals

The introduction of improved cookstoves in Ruhira, Pampaida, Tiby and Koraro has reduced biomass consumption of cooking by up to 45%, reducing the time-labor burden of fuel collection, and freeing women and children's time for other uses. Improved cookstoves range in price from \$2 (Tiby) to \$16 (Pampaida), depending on variety and households' ability/willingness to pay, but have potential in the future for carbon-based subsidy through carbon financing programs.

Cooking practices are linked to a variety of social aspects including nutrition and health, gender and culture. At the start of the MVP, levels of chronic undernutrition among children under two years in age were very high varying from 31% to 63% across the 6 sites. Over the course of the MVP, dietary patterns changed towards more diversified diets and levels of chronic undernutrition also reduced. On average, the West African sites (Tiby, Pampaida, Potou) showed higher levels of diet diversity than the East African sites (Mbola, Uganda, Koraro), paired with differences in culinary practices. Also, the different methods of cooking have an impact on the availability of vitamins and minerals in foods and potential to improve nutritional security through improved cooking practices can be identified.

Different methods of cooking also impact health risks associated with cooking. The inefficient or incomplete combustion of biomass, particularly when cooking is done in poorly ventilated structures, produces indoor concentrations of health-

damaging pollutants associated with acute lower respiratory infections, chronic obstructive pulmonary disease, and lung cancer, and contributes to negative health outcomes. However, while the outcomes of indoor air pollution (IAP) on long-term health can be difficult to measure, investigations into different cooking practices capture potential risks by geography, and lend insight into where further IAP studies should be conducted. Among those risk factors measured in the study are: location of cooking event, length of cooking time required for staple dishes, location of cook in relation to pot during the cooking event and the intensity of stirring required for staple dishes.

This study documents different aspects of cooking across a diverse sample of sites in Sub-Saharan Africa and describes cooking as a cross-cutting theme of sustainable development. Improved knowledge of cooking practices through in-depth, cross-sectoral investigations opens collaboration opportunities between sectors and informs sustainable development solutions with the ability to address multiple stresses simultaneously.

### **Climate Change, Natural Disasters and Migration: An Empirical Approach according to the Educational Level, the Gender and the Geographical Position**

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The aim of this paper is to assess the relationship between natural disasters caused by climate change and migration by interesting in the migration rates, the education level, the gender and the geographical position of the countries. Many studies such as the Stern report (2006) or the Intergovernmental Panel on Climate Change (IPCC, 2007) predict an intensification of climate change for the following years. Thus, climate change has taken an important place in the world governance. But the partial failure of the Copenhagen Conference (2009) show that it is difficult for the states to agree on the strategy to adopt in order to reduce their impact on the environment. Indeed, developed countries are responsible for an important part of the pollution and greenhouse gas emission compared to developing countries which bear the effect of this environmental degradation and are more affected because of their economic vulnerability and their lack of means due to poverty. This environmental decline can induce natural disasters among other problems. One of the solutions, for the population of those countries to confront this is to migrate. The management of supplementary migratory flows due to environmental degradation make more complicated for developed countries the issues about migration coming from developing countries. The relationship between climate change, natural disasters and migration is thus fundamental. The environmental migrations are often at the origin of displacement of population which can affect the stability of the hosting areas by many ways. It can induce some conflicts with local populations by making a pressure on employment and local wages, trade and natural resources such as water, above all if these regions are already poor.

We investigate this relationship through simple econometric models by using panel data from developing countries. In order to see the effect of the natural disasters on global migration rates, according to the geographical position, the educational level and the gender, we take as dependent variables, the net migration rates between 1950 and 2010, representing the difference between the total number of emigrants and immigrants and made available by the UN Population Division and the Panel Data on International Migration of F. Docquier, M. Schiff and M.C Sjoblom (World Bank Databases), which measures international skilled migration from 1975 to 2000.

We also use the emigration rates provided by level of schooling and gender for 195 countries in 1990 and 2000 of F. Docquier, L. Lowell and A. Marfouk. With regards to the climate change indicators which represent our variables of interest, we use the CRED data (2010) from 1900 to 2010. We first take the total number of natural disasters in a country in a five years period. Then we disaggregate our natural disaster indicator into three subgroups: the climatological measure which include the number of disasters caused by extreme temperature, drought and wildfire; the hydrological measure which group together the number of events caused by flood and mass movement wet and a meteorological measure which consider the number of events caused by storms. All the four objectives already discussed are estimated by using country and year fixed effects estimator through an accurate econometric model. We also check the robustness of our results by using General Methods of Moments (GMM) estimator.

The results obtained from fixed effects estimator show that natural disasters have a significant and positive effect on net migration rates. But this effect is different according to the disaster type. The climatological disasters has a lagged effect of one period on migration, unlike the others disasters type which have contemporaneous significant impact on migration. We also find that the effect is not the same for the different education level. Natural disasters have an effect only on the migration of people with high education level. This is confirmed by the impact of natural disasters on the

migration of skilled workers. With regards to the gender, men with a high level education migrate as soon as have they are victims of natural disasters whereas women only migrate with one period delay. Finally concerning the impact of natural disasters on migration according to the geographical position, we find some differences in migration behavior in European Central Asia, MENA and South Asia regions.

### **Taps and Trekkers: Water Management and Adaptation along the Annapurna Circuit Trek of Manang District, Nepal**

Hannah Perls

Climate change is predicted to dramatically affect the Himalayan region via shifts in seasonality and rainfall, as well as increased glacial melting. The purpose of this research was to qualify the ability of mountain communities in Nepal to adapt to this change, specifically decreasing water availability from glacial melting. Very little field research has been conducted in this area on the potential influence of specific cultural practices, religious beliefs and even current development plans on a community's adaptive capacity. A series of interviews were conducted in May 2010 along the Annapurna Circuit Trek (ACT) in Manang District, Nepal with hotel owners, farmers, and village development coordinators. These interviews discussed water seasonality and availability, agricultural practices, water infrastructure, domestic uses, and income sources. When faced with water scarcity in the past, village residents living along the ACT required liquid wealth, reliable taps and irrigation and community organization in order to purchase additional food, pay for maintenance and repairs and/or invest in further infrastructure. As the single greatest source of liquid wealth and profitable employment, tourism has the greatest influence on a village's adaptive capacity by providing money and attracting men and youth to stay in the villages rather than migrate to Kathmandu for employment. The current development plan for Manang District ignores this crucial link between tourism and climate change adaptation, financing the construction of a road that will bypass many villages along the ACT, abolishing the community's greatest source of income while increasing unemployment and environmental degradation. This construction will greatly inhibit the adaptive capacity of these communities to respond to the predicted decrease in water levels caused by climate change.

### **Dynamics of Slash-and-Burn Agriculture in Madagascar: A better understanding integrating local community's perspectives**

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90% of primary forests in Madagascar were lost due to two main drivers: the predominant practice of slash-and-burn agriculture over the years, coupled with the rapid population growth. Additionally, Madagascar's forest cover decreased from 11 million ha to 9 million ha from 1990 to 2010 while the population practically doubled to reach 20 million people (Freudenberger, K. USAID 2010). Most importantly, Madagascar's population is expected to double again in the next 20 years if its average growth rate of 3% which is amongst the highest in the world, is maintained. This alarming situation raises critical issues on sustainability. For instance, how to deal with the inevitable land pressure for food security and what will happen to the remaining forest given that its 2/3 is composed of protected areas.

In fact, the traditional slash-and-burn agriculture has become unsustainable in Madagascar due to the limited land and the rapid population growth (Styger et al. 2007). This unsustainable practice is still persistent in the country despite attempts by the government and NGOs to reduce it, noting that 80% of the population lives from subsistence agriculture. Indeed, adopted strategies have focused mainly on introducing alternatives to this farming practice and on promoting development projects for poverty alleviation. However, these strategies failed to tackle this issue in two ways: (1) the structure of unsustainable farming practice has not been fully investigated in Madagascar and (2) farmers are not given any direct incentives to abandon this unsustainable practice.

Consequently, an innovative approach is essential to devise an effective and sustainable solution. This research aims to contribute to this direction by trying first, to gain a better understanding of the root causes of this unsustainable slash-and-burn practice as well as their interlinkages and then, by investigating the use of payment for ecosystems services as a possible and innovative tool to support development as well as a sustainable land use practice.

Indeed, payment for ecosystems services is still at its nascent phase in African countries (Ferraro, 2009), however, it is considered as a more cost-effective way of meeting rural needs around protected area compared to traditional and indirect conservation policy tools (Ferraro, 2001; Wendland, K.J., et al., 2009; Wunder, 2005; Pagiola et al., 2005). Through the sale of environmental services, it changes the incentives of forest managers and/or to generate resources to finance conservation efforts (Pagiola et al., 2002) and it will reduce the costs of managing protected areas by

strengthening the links between local communities 'well-being, their actions and habitat conservation (Dudley N. and Stolton S., 2003, Ferraro, 2001).

This research focuses on the peripheral zone of the Ranomafana National Park in Madagascar as a case study. This park is not only a World Heritage Site, home to a very rich biodiversity, but represents also the most important watershed of the southeastern part of Madagascar. Its surrounding communities increase their pressures through their unsustainable agricultural practice (Ferraro, 2002) which is exacerbated by constraining natural factors such as the narrowness of existing valleys (Peters, 1999) and very low soil fertility (Johnson, 2002). These complex interactions between the national park and threats from the surrounding communities make it an interesting case study.

Data used in this research are obtained from officials and NGOs, and collected also through direct interviews of 91 heads of households. The survey was conducted from September to mid-October 2010 by using a semi-structured questionnaire which covered agro-environmental and socio-economic variables. But most importantly, this study distinguished itself from other studies in Madagascar through the integration of the villagers' perspectives on the importance of forests and their opinions on the development of a payment for watershed-based services as an incentive to forego slash-and-burn agriculture. The collected data were subsequently used to depict a causal-loop diagram of slash-and-burn practice so as to understand its dynamics in this specific site, then, we used a statistical analysis to assess the potential of payment for watershed-based services as a possible solution and the significant factors affecting the villagers' decision to accept it or not.

Based on the villagers' perspectives, frequent burnings from slash-and-burn practice mainly have technical drivers such as a secure productivity and easiness of land clearing. However, a vicious circle of frequent burnings is created when the villagers' motives are coupled with the naturally low soil fertility and the loss of productivity from the burnings. In addition, the high population growth exacerbates the land pressure to ensure subsistence by cultivating other crops as a substitute to rice. In fact, the results showed that their yearly rice production is consumed after only 3 months on average; 90% of the sample still produces rice in a traditional way which means that the farmers do not adopt any specific technique, nor use any fertilizers due to poverty. Besides, the low productivity and limited cropland will inevitably lead to agricultural land expansion in the national park, if no sustainable and long term solutions are implemented.

In addition, the negative feedback between frequent burnings on hydrological systems and future crop production has been overlooked over the years. However, this might constitute an opportunity for future changes since 87.91% of the sample recognized the importance of water functions of forests. The analysis of the villagers' perspectives on a payment for watershed-based services to value this feedback loop revealed that the villagers are willing to forego slash-and-burn practice under such innovative approach, noting that 89.01% of the sample has never heard about this payment mechanism before the interview. Finally, the survey allows also the identification of the significant factors that influence this decision to change from this unsustainable farming practice.

In conclusion, this research showed the importance of analyzing the persistent use of slash-and-burn practice in Madagascar, as a system by determining how it works and how changes in certain conditions will affect outcomes. The use of a causal-loop diagram certainly gives a holistic view of this issue, and develops a better understanding that allows the definition of innovative and effective strategies in a more structured way, for instance, the development of a payment for watershed-based mechanism in this particular setting. This causal-loop diagram can also be used by policy makers or conservationists to track conflicts of interests with the villagers' perspectives.

Understanding the villagers' perspectives on this persistent issue on slash-and-burn agriculture and on any proposed strategy is a crucial approach since they are the first agents for change. In our case, their willingness to change under a payment mechanism is just a starting point for sustainability but other challenges such as their technical capacity, the legal and institutional framework and the source of payment to support the payment mechanism still need to be addressed.

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## **Interlinkage between Ecological Risks and Food and Health Security in a Fast-Growing Environment – A Case-Study of the Laguna Lake Region, Philippines**

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Development impact to the Earth's natural and socioeconomic systems is broadly known. However, how it contributes to this end, which factors are involved and up which extent it does so remains unclear. Moving towards a sustainable future is therefore having various challenges. This study focusing on the interlinkage between ecological risks and food and health security in a fast-growing environment conducted in the Laguna Lake Region, Philippines, aims to understand how growth and development affect natural and socioeconomic systems and also how the latter in turn impedes sustainable development efforts.

The Laguna Lake Basin is one of the most important and dynamic land and water formations in the Philippines. Its water body encompasses the whole of Laguna and Rizal provinces including parts of Metro Manila, Batangas, Cavite, and Quezon, reported to be among the fastest growing economic zones in the country. Economic activities, population increase, industrialization and rapid urbanization have been occurring in the region leading to another dimension of vulnerability of the natural and socioeconomic system. The region is heavily populated and in 2000, its population represented about 9 percent of the total population of the country. An important social inflow of population into the Laguna Lake region is observed and is characterized by a strong expansion of informal settlers, a phenomenon that further increases local vulnerabilities and related impacts.

In addition, due to deforestation, increased human settlements, agricultural activities, and industrial development, ecological risks have caused significant impacts on agricultural, food and water supply on which public health heavily depends. Food and health risks, which result from both inadequate supply as well as poor quality of food, and water, are contributing significantly to the public health conditions. This problem is worsened by reported impacts of a changing climate felt directly by farmers, rural and urban dwellers, often characterized by increased flooding, landslides and drought.

With regards to the health issues, the Millennium Ecosystem Assessment Sub-Global Assessment conducted in 2005 stated that heavy metals such as lead (Pb), chromium (Cr), cadmium (Cd), copper (Cu), arsenic (As), and mercury (Hg) have been found in the lake. The implications of the presence of heavy metals and other toxic substances on water, lake sediment, and biota are of concern to human health, particularly among consumers of seafood, fish and other local products. However, there remains a gap in the current knowledge about the status of the Laguna de Bay ecosystem and its relationship to health risks, indirectly through food consumption or directly through water contamination. Furthermore, while heavy metals are a concern, the bulk of the pollutants also belong to human waste. In this light, the realm of infectious diseases, particularly that which causes water-borne illnesses is of great importance. A holistic view is therefore warranted to look at the linkages between environmental pollutants and conditions, health status, health systems, health-seeking behavior and practices, access to health services, perception of health in relation to environment, water and sanitation, food and nutrition, and food security.

To address the above issues, this study tries to develop a methodology on how ecological risks and food and health security are interlinked and through a field-based approach, investigate how growth and development affect natural and socioeconomic systems and also how the latter in turn impedes sustainable development efforts. For data collection, household surveys, focused group discussions as well as key informant interviews are conducted in addition to secondary data reviews. Laboratory analyses are conducted with soil, water, biomaterial and fish samples to identify ecological risks at upper, middle and lower watersheds. Data analysis is conducted by using statistical and geographical information system tools. Outcomes from this study, funded by the Research Institute for Humanity and Nature, Japan, is expected to help clarifying the interlinkage between ecological risks and food and health security in a fast-growing environment in the Laguna Lake Region, and at the same time to serve as a tool and new inputs for local and national policy making as far as food, water and health security in a context of changing climate and environment are concerned.



## Spatial analysis of the socio-economic and natural hazards vulnerability for Haiti, using GIS and Remote Sensing

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The Caribbean Basin is among the most vulnerable regions to future natural disasters and climate change. Haiti has the combined challenges of a severely degraded environment (e.g. only 3% tree cover remaining), extreme poverty, limited institutional capacity and repeated occurrence of natural disasters; however, these are not distributed evenly across the country. Therefore, in order to implement meaningful interventions toward encouraging sustainable development leading the country out of the vicious circle of natural hazards to poverty, the interaction between socio-economic and natural hazard vulnerability needs to be better understood spatially.

We propose an assessment of vulnerability to these multi-hazards using existing natural disaster mapping produced by the World Bank, socio-economic data from a nationwide census in 2003 including high-resolution population data produced by the US Census Bureau, medium to high resolution imagery to assess land-use changes from 2000 to 2007, and a proxy for local institutional capacity using a measure of distance and quality of roads from Port-au-Prince. Environmental degradation will be modelled using change in forest cover and cultivation of steep slopes. The national demand for charcoal and increased cultivation of steep slopes due to reduced soil fertility will be highlighted as key drivers of this degradation. We predict that vulnerability will be greatest among the most physically remote communities from Port-au-Prince and those with little vegetation coverage. Finally, we will make recommendations regarding strategies for sustainable development that respond to the needs of the population and the physical, economic and cultural constraints of the environment.

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## Climate Change and Human Security: Facing Future Challenges

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The beginning of the year 2011 was marked by climate related disasters with serious implications for human wellbeing: In Queensland in Australia, floods surged through the region, setting Brisbane, Australia's third largest city, under water, and killing at least 19 people. In Brazil, more than 500 people perished when mudslides caused by heavy rain covered and destroyed their homes, making it the worst natural disaster since several decades. Observed climate change is a fact, with scientists linking observations in sea-level rise and global mean temperatures to increasing CO<sub>2</sub> emissions. Whereas the science on anthropogenic climate change has advanced quickly, the impacts for human wellbeing are lacking behind. In order to fill this gap in the literature, this paper examines the impact of climate change on water and human health, and discusses its relevance for human security.

Water is essential for all aspects of life, especially when people depend on it for sustaining their livelihood. Water is a source of economic activity, crops cannot thrive without it, but it can also contain bacteria, protozoa, viruses and parasites causing water-borne diseases, such as cholera, bilharzia and typhoid fever. The impact of health on the domestic economy is particularly relevant for development countries. With climate-sensitive economies, facing multiple stresses, including inequality, poverty, and civil warfare, developing countries are highly vulnerable to changes in the climate system. Moreover, with low incomes, the capacity to adapt to predicted changes is low. Climate change is estimated to affect human health in various ways. One is that temperature increase will increase the range of water-borne infectious disease. On parallel, climate change may bring stronger and destructive weather events, such as flooding and tropical cyclones, thereby increasing the risk of post-disaster waterborne disease.

Moreover, strategies to mitigate climate change, such as the production of biofuels or nuclear energy, will have unintended consequences, affecting food security or nuclear safety. This notion has been under-researched, and will play an important role if societies decide to reduce emissions drastically.

## Evaluating Urban Ecological Modernization in China: A Case Study of Wuhan City

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Ecological Modernization Theory (EMT) is a positive discourse that developed in European countries, namely Germany and the Netherlands, to address the contradiction between the environment and the development in the late 1980s. From the birth date, the evolution of this theory can be categorized into three stage according to its characteristics. The first stage was from the 1970s to the mid-1980s which characterized by a heavy emphasis on the role of technological innovation in environmental reform, especially in the sphere of industrial production (Huber, 2000; Jänicke, 1986; Mol & Sonnenfeld, 2000). Studies in the second stage from the mid-1980s to the mid-1990s witnessed a decreasing emphasis on the role of technological innovation as the only driving force in environmental reform. The ecological modernization theorists developed a more balanced view of the respective roles of the state and market during this period. In addition, they emphasized on institutional dimension and cultural dynamics (Hajer, 1995; Spaargaren & Mol, 1992; Christoff, 1996; Dryzek, 1997; Andrew Gouldson & Murphy, 1996; Cohen, 1997). EMT broadened in its theoretical and geographical scope from the mid-1990s onwards, Scholars began to investigate the EMT's applicability during this period. Jackson, Roberts, Gibbs and Lundqvist employed EMT as a tool to analyze the changes of environmental policy

As analyzed above, EMT studies focus on environment-informed social and institutional changes, especially changes in technology, institutions, culture, and behavior. The core themes of EMT are grouped by Mol and Sonnenfeld ((Mol & Sonnenfeld, 2000)) into five clusters: 1) Changing role of science and technology in environmental deterioration and reform; 2) Increasing importance of economic and market dynamics and economic agents; 3) Changing role of the nation-state in environmental reform; 4) Modifications in the position, role and ideology of social movements; 5) Changing discursive practices and emerging new ideologies in political and societal arenas

Relatively lagging behind the research of western countries, the EMT research in China started from the mid-1990s and can be reviewed from two aspects.

From the theoretical perspective, the Journal "Environment and Society" first published "Industrial Society and Beyond: Ecological Modernization", systematically introduced western research on EMT. Yu interpreted EM as a discourse based on the value of post-modernization, which focused on the social restructure and benign environmental development, he also suggested that ecological recovery and ecological restructuring be conducted simultaneously in the EM framework (Yu, 1999). Fang argued that although EM was originated from ecological area, the transformation it brought should cover the various aspects of the society instead of only being restrained within the scope of the ecological area, he also believed the EM transformation would eventually spread to the sphere of politics, governance, economy, institute, management, education and culture (Fang, 2004). Shen conceptualized EM from four aspects: 1) EM was the modernization been ecologicalized, it emphasized the ecological conscious in developing countries and the ecological restructure in developed countries, 2) EMT was an optimistic environmental ideology, it considered environmental problems as opportunities, in another word, it was possible to achieve economic growth, social development and environment protection simultaneously, 3) EM was a comprehensive ideology, and should be the combination of economic modernization, social modernization, 4) EM was the introspection for the past and the monitoring for the future (Shen, 2005).

From the empirical perspective, He and Wu investigated the relationship between EMT and current environmental policies in China, they considered government policies on industrial restructure as the key point to implement EM in China. As they argued, the realization of EM in China could only be achieved through the reform of institute, technology and economy (J. He & Wu, 2001). Chen and Li emphasized the importance of government macro control and public movements, they argued the EM could be achieved through advanced scientific and technological approaches (Chen & Li, 2004). The research conducted by CAS showed that China was undergoing the period of industrialization. Accordingly, the environmental pressure arising from industrial modernization and the environmental protection required for ecological modernization formed dual challenges to China's modernization. Facing the challenges, there were three roads, the first was to repeat the old road passed by the developed industrial countries, meaning pollution first, control second and transformation last, the second was to directly adopt the current approach of the developed industrial countries, meaning ecological transformation required for comprehensive ecological modernization, the third was to adopt the principle of integrated ecological modernization, meaning that green industrialization, green urbanization and ecological modernization should advance in a coordinated manner. In light of the international and domestic conditions, researchers of CAS believed that integrated ecological modernization is a rational path. If this path is taken, China's ecological modernization is expected to reach the world's middle level around 2050 (C. HE, 2007).

It could be found that western academics have made great achievements on EMT research both from theoretical and empirical perspectives. Despite some scholars have noticed the importance of EM in China (some did not use the term directly) (Chen & Li, 2004; Fang, 2004; J. He & Wu, 2001; Shen, 2005) and there have been a few studies on EM

applications in regional or urban context (Barrett, 2005; A. Gouldson, Hills, & Welford, 2008; Keil & Desfor, 2003; Schlosberg & Rinfret, 2008), the role of EM in urban context and its functions still remain unexplored. What is Urban Ecological Modernization (UEM)? How to realize UEM in Chinese context? Is it possible to assess the level of UEM for a city?

Facing these gaps, the study: 1) reviewed and analyzed the EM process in a Chinese context, 2) developed an evaluation framework to assess the performance of EM in China at the urban level, -both qualitative and quantitative approaches were used in the evaluation, 3) explored and discussed the theoretical framework of Urban Ecological Modernization (UEM) which includes basic concepts, essential connotations, basic principles and motivational mechanisms.

In the study, Wuhan was selected as a case city to help demonstrate the effectiveness of UEM in China. Five core themes were employed to conduct the evaluation according to which grouped by Mol and Sonnenfeld.

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## Policy conflict and the feasibility of water pollution trading programs in China

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Water pollution trading (WPT) is considered to be a cost-effective policy instrument for water pollution control. Since the late 1990s, Chinese governments pilot different level WPT programs for water pollution control. However, the implementation of WPT programs is slow-paced and do not achieve expected results. Policy interleaving or conflict is considered to be one of main factors which block the WPT in China. This research takes the pilot program of WPT in Tai Lake Basin as case to address the policy conflict and explore the feasibility of WPT programs in China. The water pollution control system in Tai Lake Basin, regulation and practices of WPT Tai Lake pilot program are reviewed and analyzed. The results showed that the WPT in Tai Lake Basin has great conflict with other environmental regulations, such as environmental impact assessment system, five-year plan target, et al., and the prospect of WPT is not optimistic. Finally, suggestions on perfecting China's WPT mechanism are also outlined to smooth the conflict.

# Exhaustible and/or overused resources and their supply chains

Martina Keitsch & Stefan Seuring

## Oral Presentations

### Promoting sustainable development in the minerals industry: the phosphate project in Saudi Arabia

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The Kingdom of Saudi Arabia is largely considered to be a single-commodity economy, in that the oil sector is the most important pillar of the national economy, while the non-oil sectors play a relatively weak role. National economic diversification is considered a strategic goal for the Saudi Arabian government. The minerals sector in Saudi Arabia is one of the economic activities which has already started to achieve this strategic goal of diversification away from oil-related activities as the main source of national income. Saudi Arabia has strategic industrial minerals such as phosphate, bauxite, high-grade silica and gypsum as well as industrial raw materials that can be used in the domestic, regional and overseas markets. The industrial minerals sector in Saudi Arabia recognises sustainable development as a vital objective for society and readily acknowledges its responsibility for helping to achieve this critical aim. This paper examines the phosphate project which is considering one of the industrial minerals important to the economy of the Kingdom of Saudi Arabia, focusing on its production, the structure of its industry and the effects of government policies and planning efforts.

### The Context of Climate Change and Development in the Wooded Savannah of Nigeria

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The savannah is the major food-crop producing zone of Nigeria and it is very important for food security in the country. Large scale commercial farming and irrigation agriculture are few. Low-input small-holder rain-fed agriculture which typically relies on seasonal variations in rainfall and local climate positives supports the production system. However, substantial change in climate is expected in the Savannah in the near future. Although temperature may not increase substantially, reduction in rainfall is expected to be significant. The present and future patterns of rainfall and temperature anomalies show that the distribution of stressors across space is non-uniform. This also means different adaptation strategies may be necessary for different clusters of communities and social groups to maintain food production systems. A description of aggregate vulnerabilities which combine environmental and social dimensions of climate change at local level is important for determining and designing appropriate, place and context specific, people-focused and participatory climate mitigation and adaptation strategies. In such environment dominated by small-holder farmers, pastoralists, small scale commercial fire-wood gatherers, leave collectors, and other economically marginalized populations that depend on land resources, restored and well managed, but climate-sensitive natural resource systems can become human shock absorbers and targets for climate change mitigation, and fulcrum for climate adaptation and development. This study demonstrates the nexus between the local climate system and development. It presents evidence to support how a degree of localized eco-geographical factors which control the local climate, create eco-climatic complexes which vary across space and time and exert long term controls on the ecosystems and human livelihoods in the semi-dry wooded savannah of Nigeria.

Daily rainfall and maximum temperature data and their downscaled values were analyzed for present and future climatologies. This data was combined with local eco-geographic variables (elevation, slope, aspect, NDVI, soil potential for agric, protected areas, population density, etc) to build suitability maps integrated with Markov probabilities from satellite-derived land-cover maps to simulate future land-cover (2006 to 2046) under present and future (2046-2065) climate scenarios using Idrisi's dynamic Cellular Automata\_Markov land change model. The eco-geographic variables were also statistically analyzed using principal component analysis (PCA). The result was profiled to determine spatial and

temporal behavior of the principal controlling factors of local climate systems and the eco-climatic complexes they create under present and future climate scenarios.

Rainfall generally determines the rhythm of human activities in the Nigerian savannah and its erratic distribution in space and time could be a strong index of climate variability and change. Although present climate trend in the wooded savannah shows little warming (0.0580C/month/decade) for maximum temperature and no clear trend for rainfall, future climate scenario suggests a significant decline in rainfall (about 4mm/month/decade), the collapse of the bi-modal rainfall pattern, but with a kind of elongated rainy season, and a rise (0.020C/month/decade) in mean monthly maximum temperature that is lower than present. The local climate system is driven mainly by the coupling between terrain, rainfall and temperature in all seasons. This climate-orographic complex predominates and produces climate positives around the southeast-northwest corridor in all seasons except June-July-August when the system spatially reverses to the southeast-northeast corridor across the Niger. Although this local system pattern is projected to continue in future scenario, its spatial influence will be weakened with rainfall becoming less significant.

The western axis presently constitutes the most agriculturally productive areas as suggested by the climate positives and the concomitant eco-climatic complexes which support agriculture for most seasons. The large footprint of small-holder rain-fed agriculture also appears to support this. More rural settlements may emerge around here in the near future under present climate scenario. However, this climate advantage will likely weaken under future climate scenario. The central area currently has the highest density of rural communities and with a number of designated protected areas. The climate positives and attendant eco-climatic complex may shift to this area under future climate scenario and present settlements are expected to expand rapidly. The eastern axis presently has large coverage of woodlands and forested areas. However, these woodlands and forests are projected to become more disturbed and transition to shrub/grassland is projected to become more rapid under both present and future climate scenario. In general, under future climate scenario, galleria forest – a signature of the drier savannahs - is projected to dominate the wooded savannah, and the evidence supports a strong feedback between the local climate and the ecosystems with concomitant effect on human livelihoods. Serious decline in the eco-climatic complexes created by the local climate systems will likely lead to decline or total collapse of the rural livelihood systems, increase food and human insecurity, and undermine development. A vicious cycle is also expected between declining rainfall and the canopy ecosystems that are critical to propagating the eco-climatic complexes and associated climate-positives. The study area also doubles as the headwaters of major rivers that support urban and agricultural water use in south-western Nigeria. Hence, unmitigated climate change effect around the area has the potentials to also undermine development in the entire area.

Aggressive vegetation and albedo enhancement strategies as primary form of climate change mitigation appear to hold much promise in the area. This may include incentive for community managed forest and woodland, as well as eco-tourism. A well packaged canopy enhancement and natural forest management under the Reduced Emission from Deforestation and land Degradation, Clean Development Mechanism, and Carbon Trading (CT) frameworks will likely be attractive in maintaining the current local climate and also ecosystems balance and guarantee local livelihoods.

### **Forest Transition - When, Where and for How Long**

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Forest transition has been defined as the change from contraction to expansion of national forest area (Mather and Needle, 1998). The drivers of forest transition include urbanization, the intensification of agricultural production responding to the concentration of farming practices to fertile lands, yields improvement based on expanding irrigation, fertilization and plant breeding, and thus abandonment of marginal land. Abandoned land then becomes available to reforestation through natural regeneration or planting. Changing forestry practices can contribute to improving timber yield thus reducing land demands for growing industrial wood (Kauppi et al. 2010). In some places economic development creates non-farm jobs to pull farmers off of the land. Old agricultural lands thus become spontaneously reforested. In other places a growing interest to make forest products prompts governments and landowners to plant trees on open lands (Rudel et al. 2005).

This presentation addresses the following questions: Which nations have reached forest transition? Will all nations eventually reach forest transition? Is there going to be a global forest transition, in other words, when will the global forest area cease to shrink and start to expand? And when will the last nation experience forest transition?

There are a number of uncertainties, thus answers to these important questions will be incomplete. The indirect and direct drivers of forest transition are analyzed based on national case studies and international compilations. The accuracy and precision of the historical data are discussed. Cases of inverse forest transition are presented, and land use trends and impacts of climatic changes are discussed. A change of the global forests from a net source to a net sink of carbon dioxide might not coincide with a global forest transition. The latest evidence suggests that such a change has occurred even though the forested area of the world is still shrinking. International trade of agricultural and forest products has increasingly affected national patterns of land use (Meyfroidt et al. 2010).

Technological and social innovations, adoption of efficient land use policies and practices, changes in how people consume, and how goods and commodities are traded affect the future supply of and demand for land resources and farm products. A global restoration of forests must be perceived from a systems perspective. Noting the competition for productive land between different land uses, a global forest transition will require major policy and technological innovations, and shifts in demands for fiber, fuel, and food. The market economy mechanisms must be combined with strong national and international policies in order to reach forest transition at the global level.

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## Participation and Success in Environmental Governance: Lessons from Woodfuel Policy in Chad

Julia Kennedy

The Republic of Chad is at one of the far ends of the spectrum of human development, and as such it is an illustrative case study for the global effort to improve standards of living for billions of people while remaining within the carrying capacity of our local and global ecosystems. A close analysis of the successes and failures in Chad's policy framework can provide greater insight into achieving sustainable development in diverse contexts around the globe. This article argues that the success of Chad's controversial woodfuel policy is indicative of the flaws in democratic decentralization theories of resource management, and provides support for an approach that combines the strengths of central and decentralized management regimes. This approach is particularly relevant to the many countries like Chad where building democratic institutions and local capacity to manage natural resources will require long-term investment.

Chad's sustainable development is fundamentally related to energy issues. Chad is an oil-producing country, yet because it is landlocked, import taxes on hydrocarbon products render them too expensive for the majority of the population. Fuel costs are among a variety of factors that make electricity-generation inconsistent and hugely expensive. As a result of these and other factors, Chad's population is largely reliant on woodfuels (firewood and charcoal) for its relatively small domestic energy demand. Woodfuels are a globally significant topic in environmental governance because of their widespread use, and their impacts on forests, biodiversity, soil degradation, climate change, and public health. Throughout 2008, the government of Chad adopted a series of progressively stricter policies on forestry resources and the woodfuels market, referred to collectively here as the woodfuel activity ban. These policies include a ban on the felling of live trees and a ban on producing and transporting charcoal. They were enacted in response to deforestation rates in the "urban woodshed"[1] of N'Djamena (Chad's capitol, NDJ) reaching alleged crisis proportions, and they have succeeded in dramatically reducing deforestation in this zone. What would be a victory is tainted by disquieting tradeoffs, for these gains came at the cost of increased authoritarian policy-making and alleged human rights violations. This uncomfortable meeting of environmental gains and social losses goes to the heart of another major discussion in global environmental governance: democratic decentralization and local management of natural resources. This study collects the disparate threads of this discussion, including democracy, authoritarianism, development, participation, and natural resources management under an umbrella concept termed "participation and success". This phrase refers to their shared questioning of the extent to which increased participation in decision-making on the national and local scales results in better social or environmental outcomes.

The dominant view in current development practice is that increasing participation in and decentralization of decision-making power over natural resources achieves better environment and livelihoods outcomes through higher levels of efficiency in resource management, equity in benefits distribution, and sustainability through the incentive to perpetuate these benefits. A cornerstone of this theory is that decentralized resource management is preferable to centralized resource management emanating from the State because the latter fails to achieve sustainable development outcomes through inefficiency and high transaction costs. The woodfuel policy in Chad indicates that this is not always true. The

Chad woodfuel policy demonstrates that a centralized environmental policy emanating from an authoritarian government is capable of achieving specific environmental outcomes in targeted zones. It is an instructive example of how the State can respond to increasing demand for resource management capacity while representative, accountable, and empowered local organizations are in a nascent stage of development.

The first section of the article describes the evolution of woodfuel policy in Chad up to the 2008 ban, and how that history helped form the current policy. The second section describes the multi-layered theoretical framework surrounding and illuminated by the Chad woodfuel policy. The third section provides some detail on the methodology used to evaluate the impact of the woodfuel policy and the findings of that evaluation. The final section returns to how this case study highlights the strengths and weaknesses of the participation and success framework and new directions suggested by these findings.

The empirical analysis for this study is based on data collected through both quantitative and qualitative methodologies. The quantitative measures include Food and Agriculture Organization (FAO) survey data on changes in household energy practices and budgets, data on the use of energy substitutes, and World Bank-sponsored forest assessment data from 2001. Qualitative measures include contextual analysis to establish how the ban was implemented and received by the beneficiaries, historical interviews to establish a reliable baseline of policy conditions before the intervention, focus groups, and a limited forest assessment. The analysis indicates that while many of the policy's objectives have been either fully or partially achieved, that quality of life for most beneficiaries has been negatively impacted. Despite these impacts, public acceptance of the policy has grown over the past 2 years. The sustainability of this intervention depends on the government's ability to improve access to affordable energy substitutes for charcoal and maintain the stringent enforcement of the woodfuel activity ban, particularly for large-scale commercial producers, without violating human rights.

The Chad woodfuel policy demonstrates a case where an authoritarian centralized policy has effectively achieved its intended outcomes. The durability of the policy reflects both positive and negative indicators and requires more time for evaluation. These conclusions serve less to imply that proponents of democratic decentralization in natural resource management are wrong than to highlight the flaws in this somewhat idealistic perspective and suggest policy paths for environmental management in areas lacking in institutional capacity. These policies can accompany decentralization efforts to preserve environmental resources and respect civil and human rights while the long process towards building representative, accountable, and empowered local institutions unfolds.

[1] The Food and Agriculture Organization defines an urban woodshed as "the potential sustainable woodfuel supply zones of major cities"; an ecological concept similar to a watershed. («WISDOM for Cities». FAO. 2008. <http://www.fao.org/fileadmin/templates/FCIT/PDF/WISDOM.pdf>.

## **Sustainable Food, Energy and Water (FEW) Development: the FEW Security Model**

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This paper investigates the sustainable development of basic needs of food, energy and water (FEW).

The most critical challenges facing nations in the next decades involve securing fresh water, food and alternative energy supplies. The basic needs of people are: water to drink, food to eat, and energy to boil water, cook food and keep warm. Meeting these needs is crucial for the survival of the citizens. There is no nation without citizens. That is why countries strive for securing the sustainable supply of food, energy and water.

Why should food, energy and water be national issues? Shouldn't they be solved both locally and globally at the same time? In a fair world this would be a reasonable expectation. Everyone should have enough nourishing food, clean water and cheap energy at their disposal. Our current world is not fair, though. Nations fight over food, water and energy. What a researcher can do in this situation is to help leaders and citizens to understand the interdependent nature of food, energy and water need fulfillment between nations. A country that solves its food, energy or water needs at the expense of others will have to pay for it sooner or later. Since climate change accelerates the speed of environmental changes leading to socio-cultural and economic crises with exponentially growing numbers of climate refugees, that day will come sooner rather than later. It is understandable that nations wish to survive and prosper and, therefore, secure their food, energy and water supplies – as long as this can be done without compromising the similar efforts of others.

In some situations, food, energy and water needs can be met parallel. The solution of one need may even enhance the solution of another need. In other situations, conflicts arise from trying to meet food, energy and water needs simultaneously: a solution to one need may harm or destroy the supplies of another.

Food and water needs conflict in (a) irrigation: use of rainfall and groundwater to irrigate fields where food crops are grown; (b) meat production: indirect water consumption to grow feed for cattle in sheds or to prepare fields for

grazing livestock and direct water usage on farms and ranches; and (c) processed food manufacturing: continuous 24/7 processes of food industry. Organic farming, subsistence farming and hunting are the least water-intensive food production methods.

If water is used for producing food for exports, local people may suffer a triple blow: they turn their fields into monoculture, which destroys soil fertility; they have to sell their harvest at dumped export prices to greedy middlemen so that their own families go hungry; and concentrated monoculture farming by all farmers in the area and multinational food processing industry established next to these monocultures in low-salary, low health, safety and environmental (HSE) concern areas dry up the groundwater sources so that local people go thirsty. The capitalist solution to these problems is to sell imported foodstuffs and bottled water to the impoverished local inhabitants.

Multinationals also build beverages factories in many dry, population-rich market areas, and monopolize the groundwater, resulting in local farmers losing their subsistence crops and locals losing their drinking water. The families start using water from streams polluted by wastewaters from factories.

Post-modern famine caused by mono-crops for exports and death from diarrhea and other diseases caused by polluted drinking and washing water take place publicly among populations of well-nourished and healthy people, not privately in isolated villages.

(a) Food crops are increasingly burned as bioenergy or refined into biofuels in overproducing developed countries. Many say food should not be used for fuel. The greatest problem arises in poor countries: if food crops are put into car tanks instead of human mouths, famine becomes permanent. Local food production by small-scale farmers is essential for the survival of not only families but also communities, which otherwise forget traditional, ecologically sustainable farming skills.

(b) Bio-oils are refined from plant oils. Palm oil usage is criticized by non-governmental organizations for causing severe ecological and socio-cultural problems, but it does not greatly contribute to food loss. Other plant oils used for biofuels are more important foodstuffs since they are essential ingredients of healthy diets. There is a market niche for mass production of biofuels from animal fat, which is unhealthy to humans, like sugarcane from which Brazil has refined biofuels for decades.

(c) Producing biogas fuels from field residues, sludge, dung and human excrement are the most sustainable options.

Energy is needed to plough/sow/harvest/transport/process food. In traditional societies human and animal energy is used for this purpose, but development has meant heavy investments in machinery running on unrenovable oil-based fuels, multiplying the ecological footprint of food production.

Hydropower has been used for thousands of years. Micro-scale hydropower can be sustainable. Largescale dams manipulating natural water levels and flow have major ecologically and socio-culturally malignant impacts. Power-generation through natural water phenomena without disrupting them is more sustainable.

Energy boils water and makes even somewhat polluted water acceptable for drinking or for household use. Of the renewable energies, waterpower is an indirect way of boiling water like wind power while solar and biomass energy are direct methods. Solar power is the most sustainable way of boiling water. Many unrenovable methods, such as nuclear power, oil refining and coal production, need huge amounts of water in their processes and in their uranium/oil/coal production. Their wastewaters are hazardous waste that should be cleaned before discharging, or rather not be discharged at all.

Food, energy and water issues are interrelated in many ways, and sometimes create a tangle, causing further ecological, social and economic problems.

This paper introduces a Food, Energy and Water (FEW) security model built theoretically and tested empirically in four countries. With the FEW security model countries can assess their current state and future developmental needs of FEW security based on globally sustainable development.

## **Reconfiguring for Sustainability: Challenges at Suncor Energy Purpose of the Research**

Connie Alexandra van der Byl

North America's conventional oil reserves are in decline while governments identify a need for security of local energy supply. Alberta's oil sands represent a significant resource in filling that need. With 80% of the oil sands located too deep beneath the earth's surface for extraction through conventional surface mining techniques, companies are looking at new technologies to tap into those reserves.



Suncor Energy, located in Calgary, Alberta and Canada's largest integrated energy corporation, is one such company. In 2004, Suncor officially opened its Firebag in situ oil sands facility located 65km northeast of Fort McMurray and almost 800km north of Calgary. In situ facilities use various technologies to extract deep oil sands reserves through drilling techniques. Suncor uses steam assisted gravity drainage (SAGD) which injects steam into the reservoir to loosen bitumen so that it can be pumped to the surface and upgraded into oil. This process has environmental benefits over mining as the associated impact to land and water usage is much less and there is the potential, through technology improvements, to reduce associated CO<sub>2</sub> emissions.

In the sustainability strategy literature, some scholars project corporate sustainability will be achieved through continuous improvement and greening efforts (Vito et al, 2009). Others see a need for creative destruction and competency destroying technological advancements (Hart and Milstein, 1999). In reality, there are many uncertainties and barriers associated with radical innovation (Hall and Vredenburg, 2003). Some companies have been successful by combining traditional approaches with new technology (Vredenburg and Westley, 1997). These companies rely on and extend existing capabilities. Suncor's move into the in situ business occurred while mining operations continued. Capabilities developed in the mining business were redeployed to the new in situ business with varying degrees of success.

The dynamic capabilities framework extends the resource based view of the firm which has been used in sustainability strategy since the 1990s (Hart 1995; Russo & Fouts 1997; Sharma & Vredenburg 1998). Dynamic capabilities theory goes beyond the resource based view in focusing not only on the static, internal capabilities of a firm but on the dynamic or changing nature of those capabilities as well as the external business environment. Opportunities in the business environment are internally sensed, seized and, where necessary, existing capabilities are reconfigured to take advantage of that opportunity (Teece, 2007).

In recent dynamic capabilities literature, effort is made to differentiate content analysis that focuses on „what constitutes a dynamic capability from the organizational and managerial processes that reveal „how dynamic capabilities are born (Peteraf and Maritan, (2007). These processes are defined by Teece (2007) as micro foundations. This research extends dynamic capabilities theory by using empirical data to identify how the dynamic capability for reconfiguration was executed at Suncor. Micro foundations of a dynamic capability for reconfiguration are explicated by defining the managerial and operational processes that both existed and were lacking at Suncor.

In April of 2009, Suncor was fined a record \$675,000 for two environmental offenses. Pursuant to the order, a creative sentencing project was established to facilitate a regulatory compliance research project. The creative sentence project has provided a unique opportunity to conduct an in depth case study and to obtain candid observations of Suncor employees and external stakeholders. As a senior executive with Suncor commented, it's unusual not to worry about being candid for fear of legal action because in this case the legal action has already taken place.

The project data set includes both primary and secondary data. From September 2009 to December 2010, a total of 67 interviews were conducted, 46 within the company and 21 interviews with external stakeholders. Most of the interviews were conducted in person in Calgary using a semi-structured approach and lasted between 60 and 90 minutes. A handful of interviews were conducted at the project site located 65km northeast of Fort McMurray, Alberta. The site was reached by vehicle so the project team could get a sense of the remoteness of the location. The journey took over two hours from Fort McMurray because of road conditions and industrial traffic headed to projects in the area owned by other companies. Participants from Suncor ranged in position from senior executive management to front line employees. All interviews were recorded, transcribed, polished and sent to participants for their review. Once verified by participants the transcripts were included in the final data set for coding. Secondary data includes government, non-government, court, media, industry and company provided documents.

Given the court ordered creative sentence, interviews have been focused on root causes of the environmental infraction and current compliance initiatives. The authors of this paper proposal, however, have approached analysis of the data with a priori constructs from dynamic capabilities theory. Specifically, coding for themes related to the dynamic capability for reconfiguration and associated contingency variables.

Suncor was reputed to have a proactive sustainability strategy (Hall and Vredenburg, 2003). Interview and historical data also indicate the company was entrepreneurial in nature. These capabilities allowed them to sense the opportunity in SAGD technology for both its potential economic and environmental returns. Suncor's financial and resource position, coupled with their entrepreneurial, action oriented logic prompted them to take action to seize the opportunity. The empirical evidence shows, however, that the strategic dynamic capability for reconfiguration was undergirded by a lack of formalized operational and compliance processes. In addition, both negative transfer (Finkelstein and Halebian, 2002) and non transfer of capabilities occurred. As a result, Suncor faced challenges in the actual implementation of the strategy.

Our research contributes to dynamic capabilities theory by using empirical data from this in-depth case study to define the processes underlying Suncor's reconfiguration into a new, more sustainable technology. Our findings challenge assertions that processes and a centralized structure stifle technological responsiveness (Teece, 2007). We also extend the literature on reconfiguration by applying the negative transfer concept from the acquisitions literature. Our strongest contribution is in responding to a call to substantiate content analysis in dynamic capabilities literature with process research.

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## What do European Citizens Think of Mineral Depletion?

Fanny Verrax

Resource scarcity, and specifically mineral depletion, is not a very discussed issue in the political agenda of European countries, especially compared to climate change related topics. Although various experts (economists, geologists, etc.) have been sharing their views on the subject for several decades, very few studies have been conducted about laypersons' perception and opinions about mineral depletion. The project I will tell you about, called «Sustainable Scenarios», is a web-based survey focusing on European citizens' beliefs and values towards three economic scenarios to be considered in the future in order to cope with mineral depletion: green growth, de-coupling, and de-growth. Although these scenarios reflect crucial and on-going debates among economists, each scenario is presented in a very simple form, so that it can be easily understood by every participant.

The Green Growth scenario focuses on three paths of action: 1) Increase the exploration process in order to find more deposits. 2) Every time it is possible, respect the “Natural Resources Hierarchy” by substituting long life reserve resources to scarce ones. 3) Fund more research in order to enhance the mineral recovery (mining, benefaction, smelting), and in order to find totally new solutions which would make us less dependent of the Earth natural resources.

The De-Coupling scenario proposes three main initiatives: 1) Improvement of recycling rates and processes (both technological and institutional change). 2) Reduction of consumption of raw materials by more efficient use and application, 3) A shift in consumption paradigm: consume art and culture instead of travels and hamburgers...

As for the Green-Growth scenario, it promotes these three actions : 1) In industrialized countries, decrease the production and consumption rate tremendously, so that we don't need new raw materials but have enough with the recycled ones. 2) In developed countries, make a shift from human productivity (produce more with less human workers) to material productivity (keep the same level of production with more human workers but much less materials use). 3) Encourage growth and productivity increase though in the developing countries, by letting them extract new ores, but with a strong regulation which ensures the profits will indeed benefit the local populations, until they reach a certain level of prosperity.

The survey, which will be running from mid-February to mid-April, asks participants to vote on the likeliness and desirability of each scenario, depending on a set of values, such as personal freedom, equity, comfort and welfare, and of course curtailment of mineral depletion. Participants will also be able to share their opinion more freely in a Forum, in which they can for instance write their own ideal scenario to cope with the mineral depletion issue, or express their concerns towards broader environmental topics. The recruitment strategy aims at having very diverse people participating, but more specifically 1) people from the mining industry, 2) people from alternative political and economic movements, such as de-growth supporters, 3) people from environmental organizations.

Once the survey is closed, a discourse analysis method will be applied in order to identify several imagined communities and have a specific insight about their values and beliefs, and therefore have a more precise idea of how they would react towards different environmental policies. Hopefully, these empirical findings will then provide a precious insight into the social acceptability of future political decisions trying to cope with the issue of resource scarcity.

This project is a part of my PhD, untitled “Ethical and Social aspects of Mineral Depletion: a European perspective”, supported by the University of Versailles Saint-Quentin (France), the University of Bergen (Norway) and the 7th Framework Programme of the European Commission.

## Posters

### **Integrated Paradigm for sustainable development: A Panel data Study**

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In the developing world, there is a clear trade-off between economic growth and environmental security. In the early stages of development, sustainability is difficult to maintain as countries try to achieve capital accumulation, with basic human needs being prioritized over environmental protection. Later, as development is attained, human capital, wealth and strong institutions mean the industrial processes are likely to use fewer natural resources and produce less pollution. Following the approach of Costantini and Monni (2008), this research considers this relationship between natural resource availability, economic growth, and the environment, using an integrative paradigm. This combines the Resource Curse Hypothesis model (RCH), which focuses on the impact of resource abundance on economic growth, with the Environmental Kuznets Curve (EKC), which considers the effect of economic growth on environment. The RCH literature is based on the empirical model proposed by Sachs and Warner (1997). This model was based on endogenous growth theory with a Dutch disease feature. Sachs and Warner (1997) stressed on the idea that a negative relationship between natural resource abundance and economic growth imposed a conceptual puzzle, as it was expected that resource abundance should increase investment and thereby the growth rates. However, what was noticed was that resource-poor economies were the world's star performers like, for example, Korea, Taiwan, Hong Kong, while many resource-rich economies underwent adverse reaction in growth during the 1970's and 1980's. Other authors built on this model by adding or altering different independent variables and different econometric methodologies. Therefore, RCH model structure is growth rate of per capita income as a dependent variable and independent variables such as initial per capita, trade policy, government efficiency, and investment rates. While, Environmental Kuznets Curve (EKC) model is an empirical relationship between per capita income and indicators of environmental degradation such as air pollutants, river quality, carbon emissions, and deforestation. Different studies did not find the hypothesized inverted U-shaped relationship for all kinds of indicators. EKC takes the shape of an inverted U-shaped curve relating economic growth to environmental degradation. It resembles the hypothesized relationship between economic growth and income inequality (Kuznets, 1955). Costantini and Monni (2008) were the first to adopt a three stage least squares method of estimation using three equations of growth, institution quality, and EKC. Exploring the relationship between these three variables is a new field, an identified as an integrated paradigm for sustainable development. Thereby, this research focuses on developing an empirical framework following the approach of Costantini and Monni (2008) to further study RCH and EKC models simultaneously. The main addition is that panel data are used to investigate this interlocking relationship. This setting has several advantages over cross sectional data (Greene, 2008; Hsiao, 2003).

First, the method of principle component analysis and composite indicators are adopted to construct an overall sustainable development index and resource intensity measure using Millennium Development Goals (MDG) and World Development Indicator Data. Second, this research applies an integrated paradigm to investigate the relationship between natural resource availability, economic growth, and the environment using a panel of countries over the period 1990-2007. Simultaneous equations with error components are then used to provide parameter estimates, with various dummy variables used to capture the effect of regional factors.

This research will be shedding the light on the literature review of both RCH and EKC. Then, the study will extend the work of Costantini and Monni (2008) to relate the three dimensions using panel data framework. This empirical result will provide further means of recognizing the interrelation between natural resources, economic growth, and the environment and the importance of understanding these links for sustainable development. It provides an input into policy debates over sustainable development paths that satisfy countries' needs while preserving the environment for future generations.

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## **A Simulation-Based Approach To Studying The Interaction Of Market Structure With Water Efficiency Policies: Monopoly And Microirrigation In Gujarat Water Markets**

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Agricultural areas around the world are facing severely depleted groundwater resources, which farmers rely on to increase productivity through irrigation. In many areas this situation is likely to be exacerbated by climate change as farmers draw on aquifers to buffer against increasingly variable precipitation and surface flows. If groundwater in these areas is to be sustainably utilized, total withdrawals must be diminished from their current levels, possibly leading to a welfare loss on the part of farmers and their communities.

Policies to bring about sustainable water use may take many forms, including direct and indirect rationing, direct and indirect marginal pricing, tradable water rights (TWR), and subsidizing water efficient technologies such as microirrigation (MI). Depending on the local environment in which they are implemented, these policies vary widely in terms of cost, effectiveness, and political feasibility, and may also interact in unexpected ways that synergistically or antagonistically affect societal goals. It is therefore important to understand the net effect of policy interaction on the outcomes of interest to planners and stakeholders.

This research contributes to a policy debate motivated by the situation in North Gujarat, India, where a mix of recently enacted policies has somewhat helped to improve the groundwater situation, but in an inefficient and inequitable manner. As private (and in many cases monopolistic) groundwater markets are abundant in North Gujarat, we consider the situation in which water markets already exist, and a policy is needed to reduce village-level water use to sustainable levels, asking:

- 1) What are the marginal efficiency and equity effects of moving to tradable water rights from monopoly?
- 2) What are the efficiency and equity impacts of MI subsidies?
- 3) How do each of the above policies interact, and how are they contingent on rationing regimes and initial buyer-seller network characteristics?

Methods and novelty statement: These questions are addressed using a simulation framework in which a population of smallholder agents buy and sell water in competitive and monopolistic water markets. In the current (but flexible) model setup, agents are modeled as producing one of two crops: a water inefficient low revenue crop, and a water efficient crop with higher revenues that also requires capital investment to bring into production. This framework is able to represent the choice between field crops versus horticulture, or flood irrigation versus microirrigation. Individual agents are defined by their land holdings, effective water endowment (based on pumping capacity derived from electricity rations), and capital budget. Additionally, for each population considered, we define a buyer-seller network that maps which water-buying farmers can buy from which water-endowed farmers (relevant only under monopoly).

All farmers are assumed to maximize profits under quadratic production in water, subject to water prices which may be determined by policy or endogenous water markets, and subject to capital constraints on their ability to adopt, which are in turn affected by subsidy and loan policy for the water efficient technology. While the individual agent-level model is somewhat simplistic, a systematic and wide exploration of market outcomes across many model parameters allows us to study quantitative outcomes and characterize qualitative relationships that arise from the simultaneous interaction of many different policies, under many different population types -- our analysis includes many thousands of model runs, each representing a specific policy, population and water use scenario. In the model, sustainability is therefore taken as a constraint, and we examine efficiency and equity outcomes by considering total agricultural production, total profits summed across the population, and incomes among the water-buying population, among others.

Besides the results that emerge from the current model, this framework and toolkit should be of interest for the potential to facilitate future economic policy analysis of important yet intractable agricultural problems. The mathematical and computer model developed provides a modular structure that can be used as a groundwork upon which to analyze other situations by supplying the model with locally relevant data or enhancing different model components as needed to address specific research questions. In addition to modules for utility, production and cost functions (with a utility-specific solution module), the model includes separate solution procedures for competitive and monopolistic water markets, both

of which account for technology-induced discontinuities in individual and aggregated demand curves. So long as solution procedures are compatible with functional forms, the model and code may be used to examine other problems with minimal change to the computational infrastructure. Nearer term extensions include richer crop portfolios and the impact of risk aversion, interaction of irrigation technology with other inputs to production, and incorporating land use decisions on the extensive margin.

Early results suggest the impacts of transitioning from monopolistic to competitive markets vary heavily according to the structure of the buyer-seller network and the magnitude of water restrictions required to make extraction sustainable. Additionally, we find that, as one would expect, increasing microirrigation subsidies under competitive conditions leads to increasing welfare for both water buyers and sellers. However, under monopoly conditions, welfare measures exhibit positive concavity as a function of the MI subsidy level. This is likely due to the dynamic wherein small subsidies differentially tip larger and wealthier (and therefore well-owning) farmers toward adoption, resulting in a higher value of marginal productivity on water for well-owners, while the demand curve of water buyers is unchanged. At higher subsidy levels, more people have adopted, reducing the scarcity of water and lowering the overall water price.

While further exploration of parameter dependencies and social benefit-cost ratios will be conducted, these initial results are useful in highlighting the contingencies under which policies may be worthwhile. They suggest that, while establishing tradable water rights and microirrigation subsidies can bring many benefits to smallholders, neither is guaranteed to do so and any ex ante assessments of such transitions must consider details of the local agro-ecology and other farming-related policies.

### **Managing Water Quality Sustainably for Food and Health Security in the Philippines' Lake Laguna Watershed**

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Many studies have demonstrated that rapid economic development, land-use changes, and urbanization have resulted in soil erosion, mine drainage, industrial effluents, and household discharges that pollute the watersheds in the Philippines. Scholars, practitioners, and community leaders recognize that the sustainable management of water quality is necessary to reduce risks that threaten the country's food and health security. They have also attempted different approaches to improving the water quality but these approaches have been generally unsuccessful to date. Our case study in the Lake Laguna watershed explores that an integration of these approaches, including new components could help address the issue much more effectively. Drastic changes in the pollution pressure over the past ten years have contributed to water pollution in the case study area. The polluted water not only contributed to an outbreak of water-borne diseases such as diarrhea and cholera among people living in the region, but also contaminated aquatic food resources such as plants, fish, shells, and ducks, causing a public health threat manifested as miscarriages and premature deaths in the community and raising social and medical costs. In order to improve the water quality, the Laguna Lake Development Authority (LLDA) introduced market-based instruments in the form of an Environmental Users Fee System (EUFS) involving commercial establishments, agro-based industries, clustered dwellings, and domestic households. EUFS follows the "polluter pays principle," requiring the polluter to obtain a discharge permit from LLDA. In 2001, EUFS was also enfolded into the environmental management program when it combined the command and control approaches. Although this decreased the discharge of the pollutants, it did not resolve the issues of water quality, diseases, and public health. Those approaches can be classified into two: market-based instruments and non-market-based instruments. Our study explored that additional market-based instruments such as water treatment plants, and tourism and non-market based instruments such as developing institutional arrangements involving stakeholders and a combination of the approaches could substantially improve water quality management and food and health security in the Lake Laguna watershed area.

## **Deforestation and Seigniorage in Developing Countries: Tight macroeconomic policy versus the environment**

J.-L. Combes

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The forest still covers an important share of land area in many developing countries and represents an important source of revenue for governments. Another major contribution to government revenues in developing countries comes from printing money, namely the seigniorage. Using a simple theoretical model, we show the existence of a substitution effect between seigniorage and deforestation revenues. Regressions based on a panel of developing countries confirm the existence of a non-negligible substitution effect between seigniorage and deforestation revenues. Consequently, a tighter monetary policy (that fights inflation as recommended by the IMF, for example) may hasten deforestation. To address this problem, we extend the theoretical model and show that international transfers dedicated to rainforest protection may upturn the positive link between tighter monetary policies and deforestation, providing some additional support for REDD's advocates.

# Food production/sustainable agriculture

Peter de Ruitter & Pedro Sanchez

## Oral Presentations

### Integrated Farming for Sustainable Life and Environment

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Nowadays, around 60% poverty in Indonesia was located in rural areas, and more than 70% of rural poverty was linked to agriculture. Agriculture is a way of life and source of life for most people in our community, but people still have an old paradigm which views agriculture as only a matter of cultivation which merely produce commodity for self-consumption. Agriculture must be developed by eliminating sectoral egoism so that it must be developed harmoniously with the other land use for forest, plantation, horticulture, settlement, living environment, mining, infrastructure, industry or tourism as well as other sectors.

Integrated agriculture is a system which combines all related agriculture activities in one land that it is expected becomes an alternative solution to the improvement of land productivity, development programme and environmental conservation as well as the development of villages as an integration. While tropical soil is considered old soil and lack of nutrient, but, due to the high number and distribution of water fall, air temperature, soil temperature, humidity, soil moisture regime and the supporting of the high activities of soil microorganism and the fastness of organic closed cycles, the site productivity of the tropical land is relatively high. The utilisation of land harmoniously by considering all composing elements is expected to provide the most optimum advantages for the life of all human beings living on it (Agus, 2006). By employing appropriate strategies, technologies and management, tropical areas should be managed to have very high productivities and economic values as well as very high biomass production.

Agricultural activities around the world are relatively able to make production well and sustainable if only there is big energy as input which sometimes has to compromise economically rather than for the purpose of ecosystem sustainability (Chan, 2006). Integrated farming based agribusiness model was developed by KP4 UGM through ICM (Integrated Crop Management), INM (Integrated Nutrient Management), IMM (Integrated Soil Moisture Management) and IPM (Integrated Pest Management). The system have multifunction and multi-product (Food, Feed, Fuel, Fiber, Fertilizer, Pharmacy, Edutainment, Eco-tourism etc) with technological strategy of 7R (Reduce, Reuse, Recycle, Refill, Replace, Repair and Replant). The system should collaborate and develop networking system between ABCG (Academic, Business, Community and Government) with economical, environmental and socio-cultural approach as a characteristic of Education for Sustainable Development (Agus, 2010). This model facilitates the learning needed to maintain and improve our quality of life and the quality of life for generations to come. It is about equipping individuals, communities, groups, businesses and government to live and act sustainably; as well as giving them an understanding of the environmental, social and economic issues involved. Integrated farming could support for better sustainable life and environment.

*Integrated Bio-cycle Farming System (IBFS)* is an alternative system of agriculture which harmoniously combines agricultural sectors, such as agriculture, horticulture, plantation, animal husbandry, fisheries, forestry with non-agricultural aspects, such as settlements, agro-industry, tourism, industry which are managed based on landscape ecological management under one integrated area. The drastic and significant innovation of IBFS is the introduction of digester and basin as well as pre-biotic organism in the process of organic compost waste treatment.

The key characteristics of IBFS developed in UGM University Farm are (i) an integration of agriculture and non agriculture sector, (ii) value of environment, esthetics and economics, (iii) rotation and diversity of plants, (iv) artificial and functional bio-technology, nanotechnology, pro-biotik, (v) management of closed organic cycle and integration in an integrated area among ICM, IPM, IMM, INM, IVM, (vi) management of integrated bio-protection and ecosystem health management,

(vii) landscape ecological management, agropolitan concept, (viii) specific management of plant and (ix) holistic and integrated system (Agus, 2010).

We developed an Integrated Farming based Agribusiness that consist of Teak (500 tress/ha) and Sorghum (5 kg seed/ha), producing grain for food at 4-5 ton/ha, producing shoot for fuel at 30 – 50 ton/ha and leaf for feed at 20 – 40 ton/ha. At commercial units of 20,000 ha, this agribusiness can produce grain for food about 80.000 – 100.000 ton, produce shoot for about 600,000 – 1,000,000 ton that equivalent for ethanol production for fuel at 1.000 l/day, and produce leaf for feed about 400,000 – 800,000 ton (Figure 1). Teak plantation after 7-10 year-old, producing wood 0.2 – 0.56 m<sup>3</sup>/tree could be used for housing and handicraft for export and local consumption.

An upscaling model for a 20,000 ha of integrated farming may produce ethanol at 1,000 lt/day and compost-fertilizer 11 ton/day. The cattle of 1.100 cows producing meat for export and local consumption, besides producing dung for organic fertilizer and biogas. The level of economic, environment and social culture in this region could be increased drastically. Uddin (2006) also found that integrated farming in Bangladesh is also important not only for employment creation but also for promoting for the overall economic condition.

The application of IFS in some country was also give a good results. Channabasavanna and Biradar (2007) reported that Integrated farming system in India recorded higher system productivity (15,555 kg/ha/year) and net returns (Rs. 48,603/ha/year), over conventional rice-rice system (6667 kg/ha/year and Rs. 21,599/ha/year, respectively). The productivity per day was 2.3 folds higher (42.6 kg/ha/day) in IFS over conventional system (18.2 kg/ha/day). The IFS also recoded the highest water use productivity (43.2 kg/ha.cm) and labour use efficiency (25.17 kg/ha/labour).

The sustenance of increased productivity must emphasize on the development of strategies aimed at maintaining improved yields without depleting natural resources or destabilizing the environment. Ugwumbaet al., (2010) found that net farm income realized by farmers who maintained crop-livestock-fish integration was the highest. Implying that farmers who want to achieve full integration and thus earn more income and escape from poverty will target the combination of more enterprises including crops, livestock, fisheries, processing and even biogas. Farm cash income was positively influenced by age, level of education, years of experience and type of integration. It was, however, negatively influenced by household size, cost of farm inputs and gender of farmer. Farm cash income can be improved by directing policy towards measures that will reduce cost of inputs and increase farmers knowledge and technical skills.

An integrated farming system is probably the most benign agricultural production system from the environmental perspective, where crop and livestock production are in balance with nature. Okselet al. (2004) found that integrated farming in Malaysia effected Langgas River water quality but in the value is still within the acceptable limit and categorized as free from organic contamination. Even, introducing several improved legumes and grasses into these grassland improved soil fertility, pasture and animal productivity with subsequent increase in food (milk) production and income in Uganda (Sabiiti et al., 2004)

The drastic and significant innovation of IBFS is their integration of multi-sector (consist of Agriculture, Horticulture, Plantation, Forestry, Animal Husbandry, Fishery etc) for multifunction and multi-product (Food, Feed, Fuel, Fertilizer, Pharmacy, Edutainment, Eco-tourism etc). In the collaboration with technological strategy of 7R (Reuse, Reduce, Recycle, Refill, Replace, Repair and Replant) and networking system between ABCG (Academic, Business, Community and Government) at economical, environmental and socio-cultural, this method can be approaches a characteristic of Education for Sustainable Development (ESD). Integrated farming could support for better sustainable life and environment.

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## Species Diversity, Fishing Induced Change In Carrying Capacity And Sustainable Fisheries Management

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It is well established in the fisheries management literature that marine ecosystems are complex and marine species depend on one another. As a result, it is important to account for species diversity to ensure sustainable management. In addition, recent research published in the marine sciences literature has provided unequivocal evidence that fishing activities destroy habitats and inhibit production of planktons. This paper illustrates that if a conventional bioeconomic model is employed, an optimum effort policy as opposed to quota appears to result in sustainable management even if fishing impacts carrying capacity. However, the so-called optimum effort may collapse the stock if species diversity is not accounted for. Conversely, if species diversity and the impact of fishing on carrying capacity are considered, neither the equilibrium quota nor effort may guarantee sustainable yield.

In this paper we extend the work of Akpalu (2009) by incorporating the impact of fishing on carrying capacity in fisheries management. Thus, like Akpalu, we account for phenotypic diversity in our bioeconomic model to determine an equilibrium yield. Moreover, following recent developments in the literature, we relax the assumption of constant carrying capacity and surmise that the capacity depends on harvest. For the conventional bioeconomic model that neglects species diversity, our simulated results show that if fishing impacts carrying capacity, setting an “equilibrium/optimum” quota may collapse the stock but an “equilibrium/optimum” fishing effort policy appears not to do so. However, if the impact of fishing on the carrying capacity is severe and species diversity is not accounted for, the optimum fishing effort may also collapse the stock.

The descriptive statistics of the catch and effort data on the three tuna species within the exclusive economic zone of Ghana, used to estimate the yield function. The data collected for the three major tuna species in Ghana (of economic value): Bigeye (*Thunnus obesus*), Skipjack (*Katsuwonus pelamis*), and Yellowfin (*Thunnus albacares*) tuna. These three species are carnivorous species preying on other fish and therefore belong to the same functional group. Although tuna fishing efforts have intensified, total annual landings of the industry increased sharply in the late 1990's through 2001 reaching 88,000 tons in 2001 but dropped to 63,000 tons by 2006. The lax effort and catch limiting policies may result in biological overfishing and depletions. The average catch within the period is 49, 280 metric tons with a relatively lower standard deviation. The minimum catch was recorded in 1992 when the FADs were introduced and the highest was recorded in 2001. The number of standardized fishing days is used as a proxy for fishing effort. The mean standardized fishing days within a year for the tuna fleet is 2263 and annual mean catch per standardized trip is 22.16 metric tons.

The t-statistics indicate coefficients are statistically significant at 99 percent confidence level and have the expected signs. Moreover the curvature of the yield function is strictly concave. Using the estimated parameter values, the estimated maximum sustainable yield and effort levels are 80,716 metric tons and 5,054 fishing days within a year, respectively. Clearly, the maximum catch of over 88,000 metric tons which occurred in 2001 exceeded the MSY. Note that the MSY depends on the carrying capacity, the corresponding effort does not. Adopting an intrinsic growth rate and a catchability coefficient from Bortier-Verstraaten (2002), we estimate a value for the carrying capacity and the index of the severity of fishing on carrying capacity.

Studies have established that phenotypic diversity within fish populations has serious implications for reproductive capacity of fish stocks, and neglecting this situation could overestimate yield and catch potentials and collapse fish stocks. Moreover, technology/gears used in fishing may also affect marine ecology, and consequently, the carrying capacity of fish stocks. We have shown that, if examined within conventional bioeconomic model, effort regulation (but not fishing quota) appears to guarantee sustainable harvest irrespective of whether the fishing impact carrying capacity or not. However, neither effort nor catch restriction may ensure sustainability if the impact of fishing on the ecosystem is severe but neglected. Thus, it is imperative that fisheries managers account for both situations in their modeling process and in setting fishing regulations to avoid stock collapse.

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## **Mainstreaming Organic Farming in the Banana Industry Value Chain – The Experience of Agrarian Reform Beneficiaries and Indigenous Peoples in the Davao Region, Southern Philippines**

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This paper describes the initiatives jointly undertaken by the Foundation for Agrarian Reform Cooperatives in Mindanao, Inc., Agrarian Reform Beneficiaries and Indigenous Peoples in the Davao Region with regard to undertaking alternatives to the massive use of petrochemical-based products in banana production. It discusses about their gains and challenges and the extent to which they have mainstreamed a sustainable agriculture system and showcased a model of integrated, ecologically sound and economically viable banana organic farming within the fruit industry in the region.

Banana is the second most important agricultural export in the Philippines, next to coconut. This is evidenced in the value of banana exports. From US\$114.18 million in 1980, it grew to US\$326.42 million in 2004. From its 5th rank in 2000, the country became the 3rd largest producer in the world in 2007, next only to India and China.

Production of export Cavendish banana is concentrated in the Davao Region where large scale banana plantations are located. Estimates put more than 70,000 farm workers and employees directly dependent on the banana industry.

The landmark passage of the Comprehensive Agrarian Reform Law has turned banana plantation workers of multinational companies into owners of vast tracks of banana plantations. As new owners, the former plantation workers and employees organized themselves into agrarian reform cooperatives to control, manage and make profitable their business operations.

Cavendish banana is produced as a mono-crop utilizing high chemical-based farming technology. Having been known only this kind of technology, the agrarian reform beneficiaries continued to use the same farming system that is highly dependent on synthetic fertilizers and chemicals introduced by the multinational corporations, along with the short- and long-term risks on people and the environment. These risks are generally recognized worldwide. Benefits conferred by petrochemical-based farming system and the risks of using them while recognizing their dreadful effects on human lives and the general environment have put the agrarian reform beneficiaries into a quandary. The spiraling costs production inputs brought about by the volatile oil prices in the world market caused endless increases in the domestic prices of synthetic fertilizer and pesticides, which in turn, staved off much of the farmer cooperatives' income to production expenses. The farmer cooperatives are also aware of the increasing trend in the global market for preference for organic products, the premium price these organic products command in the market, and questions about protecting and preserving the environment.

Aware of the long-term sustainability of chemical-based banana industry, the leaders of the agrarian reform beneficiaries cooperatives looked for alternative technology and farming models that could answer to their predicament. They found organic farming as the alternative answer to the conventional, chemical-based farming method. Organic farming is their answer to the problem brought about by the onslaught of ever-increasing production costs, which eroded the profitability of their economic endeavor and decreased substantially their household incomes.

One service organization in the Davao region that took up the challenge to enable the ARBs to shift to organic banana farming is a non-government organization named the Foundation for Agrarian Reform Cooperatives in Mindanao, Inc. Popularly known in the country as Farmcoop, it espouses cooperativism and social justice. It envisions a sound and ecologically sustainable agriculture in a society where economic freedom, political empowerment, social responsibility, holistic life, and gender equality prospers. It has developed a modified template of intervention, i.e. organic highland and low-chemical banana production, coupled with provisions like market access, technical and organizational assistance, and other capacity-enhancing services.

The shift from conventional to alternative farming system, however, is not an easy task. It cannot be done overnight—the skills needed, farming technology to be applied, the degraded soil and environmental condition obtaining in the banana farms, resources to be mobilized to rehabilitate these farms—all of these pose barriers to the desire of the banana farmers to shift to organic farming. Moreso, the shift necessitates the unlearning of acquired ways of thinking and doing things.

Emboldened by their current status as new owners of the banana plantations and the realization that now is the appropriate time to let-go of the unsustainable farming system they “inherited” from the former owners of the banana plantations, the agrarian reform beneficiaries cooperatives in the lowland banana plantations started the arduous task to shift towards organic farming. Farmcoop serves as the lead push of this shift and it proposes for a gradual shifting.

The first step is the reduction of dosage of petrochemical-based inputs. In 2005, Farmcoop started to produce organic compost and foliar fertilizers for application on the banana farms of partner-cooperatives. Under the guidance of

Farmcoop, partner-cooperatives in the lowland banana plantations set up laboratory farms/trial plots and subjected to different parameters in terms of volume/content of organic inputs and frequency of applications. However, such experiments were not continued because most partner-cooperatives decided to adopt individual farming scheme of management. Note that right after the agrarian reform beneficiaries cooperatives got the ownership, control and management of the banana plantations, they adopted the corporate scheme used by the previous owners, the multinational companies. However, they encountered numerous problems, among them was the decline in production, which prompted them to look for a new system of management. With the help of Farmcoop, partner-cooperatives innovated a scheme of management known as Individual Farming System, which turned out to be more beneficial to the cooperatives and their members as it led to the development of an “entrepreneurial mind-set” among the agrarian reform beneficiaries. This new farming system has been credited for the improved productivity in the farms.

Nonetheless, hands-on training of partner-cooperatives on how to produce vermin-compost for their own use were continued. Samples of microbes produced in the defunct trial plots were sent to a university soil laboratory for analysis, the results of which revealed the samples to have contained important elements necessary for organic inputs.

Results of the year-long experiment became the bases for designing modules on standard farm operating procedures on “low-chemical” banana production. The modules present a step-by-step process on how to pursue the “low chemical” approach by applying mix of organic inputs, biocides and foliar fertilizers, together with the application of some chemicals for fruit and plant care purposes. This “low chemical” approach technology is suitable only to the banana farms that are situated within the lowland areas straddled by plantations operated by multinational companies using high-chemical approach. Purely organic approach could not thrive in an environment where contagious vast plantation areas are into conventional farming.

Marketing of low-chemical banana, which bears the brand name Calinan Crest, is being undertaken by the Organic Producers and Exporters Corporation. In 2009, a Europe-based certifying body, the Ecocert, certified the Calinan Crest bananas.

While there is difficulty in shifting to organic agriculture among partner cooperative in the lowland it is rather a different matter in the upland areas where two cooperatives composed of Indigenous Peoples and agrarian reform beneficiaries ventured into a diversified and organic banana farm project. It is heartening to note that two upland banana cooperatives have chosen to produce bananas organically and in the cooperative way. In doing so, they not only prevented the incursion of multinational companies engaged in chemical-based banana plantations into the uplands but as well in protecting the watersheds of Davao. They adopted Farmcoop’s highland organic banana technology. They grow and maintain only the prescribed Cavendish variety, use only organic fertilizers, botanical inputs and non-chemically treated materials, follow the procedures prescribed for the procurement of labor subsidy and material inputs and in the proper utilization of facilities, equipment and tools.

It becomes inevitable that, in 2005, Farmcoop has to establish the Bio-Organic Fertilizer and Pesticide Complex to start the production of organic fertilizers and biocides to address the needs of highland organic banana farms. The Complex produces compost, liquid fertilizers foliar and vermi-compost fertilizers to provide the nutritional requirements and to control pests and diseases of highland organic bananas.

Farmcoop also facilitated the cooperatives’ access of their products to the international market through the Organic Producers and Exporters Corporation. In 2009, the banana they produced has been awarded an organic certification from the Japanese Agricultural System. This certification has led to higher price of their produce in the international market.

The experience of Farmcoop and its partner-cooperatives has shown that it is possible to mainstream organic farming practices in the production of exportable bananas.

Business World, July 27, 2006.

Brochure of Farmcoop on its Vision-Mission Statement

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## Coffee-Forest Matrix: Conservation Strategy for Sustainable Agriculture

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Agriculture and conservation are often viewed as opposing forces, each competing for land use and management rights. This is particularly true in tropical regions of the world that host both high levels of biodiversity and human poverty (Fisher and Treg 2007). While preserving tropical forests is a necessity for biological conservation, this must be coupled with other conservation strategies. Forest reserves are often isolated, expensive to manage, and alone are not a practical or sustainable solution in many parts of the world (DeClerck et al. 2010, Perfecto and Vandermeer 2008). Recently conservation strategies have begun to focus on a broader, landscape approach (Perfecto and Vandermeer 2008) in which dynamics of land uses within a region are taken into account. Agroforestry, defined as “intentional management of shade trees within agricultural crops” (Bhagwat et al. 2008), plays an important role in this landscape matrix as studies have shown that it has the potential to maximize biodiversity, minimize environmental degradation, and provide wildlife habitat and environmental services (Harvey and Villalobos 2007, Schroth and Harvey 2007).

Coffee is an agroforestry crop that shows promise to enhance habitat value and ecosystem services, while increasing profit margins for the farmers. Coffee is the second most traded commodity in the world after oil and in many developing countries, the primary export (Taylor 2007). The way in which coffee is grown has a significant influence on the level of biodiversity that a landscape matrix can support and the environmental benefits that it may provide.

Traditionally, coffee is grown within native forest, an approach that provides wildlife habitat, fosters ecosystem services, and protects biodiversity. Over the past four decades, there has been a trend to move away from the traditional “rustic” coffee and towards either a monoculture of coffee plants (Perfecto et al. 2005) or the replacement of native forest with non-native tree species. The latter has been the case in India, the fifth largest producer of coffee in the world.

Market-based approaches to conservation are a viable way to both protect wildlife habitat and provide financial incentives to coffee farmers. Several coffee certifications currently on the market provide a guarantee that coffee is grown in an environmentally sustainable, socially conscious manner, and/or promote protection of biodiversity and wildlife habitat. Those whose farms are certified not only receive a higher premium for their coffee, but also improved health conditions with the reduction in agrochemicals that most certifications require.

Research has shown that coffee agroforestry may produce valuable habitat for various wildlife species. Most studies have focused on bird and insect diversity (Gordon et al. 2007, Perfecto et al. 2003, Perfecto et al. 2005, Pineda et al. 2005) with few studies published that address the mammals living in and around coffee farms (Daily et al. 2003, Gallina et al. 1996, Husband et al. 2007, 2009). More research is needed on biodiversity and habitat, as it relates to coffee-dominated landscapes, to guide and inform certification requirements to ensure that biodiversity and habitat are better protected, particularly for those species such as small mammals that have not been widely studied.

We investigated the effects of non-native tree species on the diversity and abundance of small mammals in coffee farms from February to June 2010 in Kodagu, India. The Kodagu Region is divided into three ecological zones: moist evergreen forest, intermediate rainfall region, and dry deciduous forest which corresponds to the rainfall zones high, transition, and low, respectively. Twenty farms, each with two 50- x 50-m trap grids, were sampled throughout the 3 rainfall zones, yielding 40 independent sampling units. Each site contained varying degrees of non-native tree species. The sites were surveyed for 5 nights each with the exception of 2 sites that were surveyed for 4 nights; this yielded a total of 14,256 trap nights. The small mammals were trapped with Sherman traps and released after determining the species and taking standard measurements. Additionally, each of the 20 farms had one grid with indirect sampling methods which consisted of 2 track plates, 2 hair traps, and 2 digital camera traps, one with flash and the other with infrared photography.

During the four-month study period, there were 146 overall captures (1.02% trap success rate) and 129 individual captures (0.90%) for the Sherman traps. Capture rates per site were low as compared to rates in coffee farms in other tropical areas, but consistent with those in coffee farms in India. Of the 6 species captured, only one is endemic to the Kodagu region. Preliminary analysis shows that small mammal abundance and biodiversity is dependent on the rainfall zone in which the site is located, but may not be strongly dependent on the amount of non-native trees present. Further analysis will be conducted on the effect of other habitat parameters on small mammal biodiversity in the Kodagu region of India. It is suspected that landscape scale parameters such as distance to native forests or riverine corridors may have significant influence on the mammal populations that an area can support. Our research will help explain the dynamics of coffee-forest landscapes and assist in finding a balance between conservation of biodiversity, maintenance of ecosystem health, and production of sustainable income for farmers. Additionally, our research will inform a set of best management

practices that will not only benefit coffee farmers, but also help conserve and improve wildlife habitat. Our results may offer another layer of conservation strategies for agriculture-forest landscape that would benefit both the biodiversity and economics of a region.

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## **Creating a Climate SMART Agriculture within the Sahel Millennium Villages Projects for Sustainable Food Security and Environmental resilience**

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The Sahel is one of the poorest regions in the world that has long been plagued by drought and desertification. These extremes of climatic variability has caused the deaths of not only many people but also hampered the production systems. However, over the past three decades, the Sahel is experiencing an environmental renaissance, in terms of the development of vegetation and improvement of production systems. Experts link this phenomenon not only to an increase in rainfall but also to changes in land and tree use legislation which have incentivised farmers to plant and maintain trees in their farmlands. Hundreds of thousands of farmers have transformed large swaths of the region's arid landscape into productive agricultural land, improving food security and livelihoods of millions of people. Sahelian farmers achieved their success by ingeniously modifying traditional agroforestry, water, and soil management practices. This optimistic transformation resulted from a combination of incentive changes in government policy combined with village-level institutional innovations in managing land, along with successful changes in farmer practices. These experiences deserve careful attention as a basis for developing regional and national initiatives that could possibly result in a new era of transformative change across the Sahelian landscape. Lessons from success stories and case studies models in implementing the Sustainable Land Management practices have not been adequately synthesized to spearhead further expansion of the practices throughout the Sahel. This article reviews these experiences, and their broader implications for sustainable food security within the Millennium Villages Projects in the Sahel, as manifestations of Climate SMART Agriculture, a fresh approach to achieving food security and environmental resilience through agricultural systems that increases productivity while enhancing adaptation and mitigation.

## Assessing the efficiency and sustainability of high- and low-cost fertilizer inputs for maize in sub-Saharan Africa by large-scale modeling

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Sub-Saharan Africa (SSA) is a region with extremely low yields for staple food crops due partly to exhausted, nutrient-poor soils. For decades, crops have been grown in many parts without replacement of the exported nutrients (Rosegrant et al., 2005). There are many experimental studies focusing on measures to increase agricultural outputs by different types of inputs. On the one hand, a “Green Revolution for Africa” is advocated, relying on inorganic fertilizer application (Denning et al., 2009). On the other hand, there are efforts to improve agricultural production by low-cost measures like green manure (leguminoses), ecological sanitation, and soil conservation methods. Although experimental findings from field trials are available from several regions (e.g. Sileshi et al., 2010), no assessment of their suitability across the whole sub-continent has been carried out, yet. Our study aims at assessing several of these options regarding their efficiency to increase yields today and under changing climate. This is done by large-scale agricultural modeling using a GIS-based EPIC model (Liu, 2009).

In order to achieve a good representation of agricultural systems in SSA, we adjusted the model by simulating prolonged cultivation for 24 years with residue removal, which leads to soil degradation through nutrient mining and erosion. Thereby, yields decrease from about 2.5 t ha<sup>-1</sup> to about 1.5 t ha<sup>-1</sup>, which is slightly above the reported average. We used the virtually degraded soils as well as native soil data as baselines and business as usual scenarios. Starting from there, three methods for increasing agricultural outputs by nutrient replenishment were simulated: (1) sufficient supply of inorganic N fertilizer, (2) planting of *Sesbania sp.* as a cover crop, and (3) planting of *Vicia faba* as a cover crop outside the growing season. In order to assess the sustainability of the methods under climate change in terms of maintaining agricultural yields, we ran all simulations additionally for the 2040s using data from the global circulation model HadCM3 with the SRES scenario A2 and an atmospheric CO<sub>2</sub> concentration of 490 ppm. In order to prevent a bias of results due to inter-annual climate variability, the results are presented as an average of the last seven simulation years.

When looking at the whole sub-continent with degraded soils and current climate, yields are highest with sufficient N fertilizer supply (3.2 t ha<sup>-1</sup>), followed by planting *Sesbania* (2.3 t ha<sup>-1</sup>), *Vicia* (2.0 t ha<sup>-1</sup>), and business as usual (1.8 t ha<sup>-1</sup>). On fresh soils, the average yield with business as usual is at about 2.4 t ha<sup>-1</sup>. With sufficient fertilizer supply, yields are quite stable at 3.2 t ha<sup>-1</sup>, closely followed by *Sesbania* cover with 3.0 t ha<sup>-1</sup>, and *Vicia* with 2.9 t ha<sup>-1</sup>. Over all, sufficient N fertilizer seems therefore to be the best solution, especially on exhausted soils. But on fresh soils, the legumes are also capable of keeping the soil N content at a nearly sufficient level throughout the simulation period.

Regarding the spatial distribution of yields, there are significant regional differences. On native soils, the highest increases with inorganic N fertilizer can be found in the Sudano-Sahelian belt, Eastern Angola, Southern Mozambique, and the Madagascan coastlines. When comparing *Sesbania* planting to fertilizer application, higher yield increases can be found especially in Southern D.R. Congo, Northern Angola, Southern Namibia, and the lower Volta basin. Nearly equal results are found in most of East Africa. In the Sudano-Sahelian belt the effect is lower. The impact of *Vicia* is almost everywhere lower than that of mineral fertilizer or *Sesbania*, except for few grid cells in Southern Africa with low minimum temperatures. *Vicia* has a lower energy to biomass conversion rate and lower optimum temperature than *Sesbania*. But as it also has a lower minimum temperature, it is more suitable in humid mountainous regions. On exhausted soils, inorganic fertilizer application leads to similar spatial patterns of yield increases as on native soils, but with a stronger relative effect. The impact of *Sesbania* is always lower than that of N fertilizer, but at least nearly equal in parts of Eastern and Southern Africa. Also in this scenario, *Vicia* has over all the lowest effect.

With future climate data, yields are over all slightly lower than under current observed climate. On degraded soils they are with business as usual management quite similar as under current climate with 1.7 t ha<sup>-1</sup>. This can mainly be attributed to the dominating nutrient deficit, which dominates plant growth limitations and hence renders changes in temperature and precipitation less important. With N replenishment, yields are at about 3.0 t ha<sup>-1</sup> with N fertilizer, 2.3 t ha<sup>-1</sup> with *Sesbania* fallow, and 1.9 t ha<sup>-1</sup> with *Vicia*. Without biomass removal, yields are at 2.2 t ha<sup>-1</sup> with business as usual, 3.0 t ha<sup>-1</sup> with N fertilizer, 2.9 t ha<sup>-1</sup> with *Sesbania*, and 2.7 t ha<sup>-1</sup> with *Vicia*. In general, projected yield changes under climate change have to be treated with caution and it will be necessary to simulate the different management scenarios with an ensemble of GCMs in order to obtain robust results.

Spatially disaggregated, simulated yields on exhausted soils as well as native soils with business as usual increase in most parts of West Africa and East Africa, except for the Sudano-Sahelian belt and the Horn of Africa. In Southern Africa,

yields can rather be expected to decrease, and in Central Africa increases and decreases depend strongly on the local environment. Vicia has also with the climate projection data weaker effects than the other two measures. Sesbania is the most effective method for N replenishment in Angola, Namibia, and parts of D.R. Congo. On degraded soils in (semi-) arid regions of West Africa it is also more efficient than inorganic fertilizer. This might be due to changes in the water household of the soils because of organic carbon input and covering of soils outside the growing season. Inorganic fertilizer has the highest relative effect on degraded soils in Madagascar, Angola, D.R. Congo, and Nigeria.

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## **Integration of Transgenic Plants into Alternative Cover Crop Mulch Systems Illustrates a Paradigm and a Platform for Sustainable Agriculture**

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Food demands of the growing world population pose a challenging problem, particularly when farming lands are shrinking, crop yields have stagnated and water shortages are increasing. Understandably, agricultural production and food security are high on the list of global concerns. Conventional breeding strategies in concert with fertilizer use and integrated pest management led to increased crop production in the last century but, unfortunately, this production increase was achieved at the cost of high usage of non-renewable resources which have impacted ecosystems, reduced soil fertility, raised concerns for human and animal health, and increased reliance on chemical inputs and heavy machinery driven by fossil fuels (1). Preservation of yield and attractiveness, particularly for fruits and vegetables, continues to rely heavily on the use of pesticides. From several environmental considerations such as contamination of fresh-water resources, soil erosion, global warming, loss of biodiversity and wildlife habitat, and degradation of soil quality, no-tillage agriculture seems superior over tillage-based agriculture (2). Integrated cropping systems including legume-based systems have been shown to produce higher yields while providing ecosystem services and reducing adverse environmental impacts. We have developed a sustainable reduced-till system that is based on the use of legume cover crops as mulches that offers a biological alternative to commercial fertilizer; reduces runoff, soil erosion and loss of nutrients; diversifies soil microbial communities; and suppresses weeds and pests while increasing crop yields and economic returns (1, 3). Adoption of transgenic technology that integrates adapted genetic modification of crops with ecologically based soil management systems could enhance our potential for achieving a sustainable agriculture.

We pursued the compatibility of genetically engineered tomato genotypes carrying novel value-added traits with sustainable production systems that utilized reduced-till N-fixing or non-N fixing cover crops. We surmised that if the transgenic plants performed well in a cover crop-based alternative agriculture system, such an integrative approach could combine the features of sustainability, productivity and quality. Moreover, such an integrative model holds the promise of value addition to crops, while providing ecosystem services as well as reducing economic burden on the farmer. Also, such studies are vital for designing strategies to add nutritional value for consumer health. We have conducted integrative studies consisting of a comparison of both conventional black polyethylene (BP) and the alternative, cover crop-based [leguminous hairy vetch (*Vicia villosa*, HV) or non-legume rye (*Secale cereale*)] production systems in defining their effects on the agronomic characteristics, metabolome and gene expression of non-transgenic and five novel transgenic tomato genotypes. Our studies conducted for three years (2004, 2006 and 2007) show modulation of metabolome as well as expression of specific indicator genes that stress the need to carry out extensive field studies along with analysis at the macromolecular levels. In general, most of the transgenic lines performed equally well in both HV and rye mulches compared to BP. Fruit set, size and yield of HV and rye grown transgenic plants were equivalent to, or higher than, those grown on BP except for one hybrid transgenic line. These data also demonstrated

that the agronomic characteristics of a genotype grown in a particular mulch system are a function of the presence and expression of the transgene while also emphasizing 'environment (cover crop mulches) X genotype (tomato)' interactions in both transgenic and non-transgenic tomato plants. Specific genotype (G) X mulch (E) interactions were exemplified by differential metabolic profiles, and expression patterns of the indicator genes including transgenes fused to either constitutive 35S or regulatable E8 promoters. It was clear that upregulation or downregulation of genes in the fruit were a function of the mulch in which the plants were grown and the genotype tested. Conspicuously, a high level of synergism was apparent between HV mulch and some transgenic tomato lines in regulating nitrogen (N):carbon (C) indicator genes (4) and other regulatory and signaling genes.

Similar results were obtained in a controlled experiment in which non-transgenic tomato plants were grown to fruit harvest outdoors in pots containing either bare soil or soil amended [supplemented] with a known amount of HV mulch in the absence and presence of varying amounts of external N (0-200 kg/ha equivalent). HV supplementation increased fruit yield and above-ground biomass of tomato which were accompanied with higher expression of N assimilating genes NR and NiR, N:C indicator gene ICDH, and asp aminotransferase (ASAT), defense gene osmotin, cytokinin receptor kinase CKR, and the key gene in secondary metabolite production, PAL, in the leaf tissue. Interaction of HV with exogenously added N was revealed by increased expression of glucose-6-phosphate dehydrogenase, NR, NiR, N:C indicator gene PEPC, osmotin, and glutamine synthetase 2 (GS2/GLU2) genes and decreased expression of CKR, PAL and ASAT. Addition of N to bare soil led to higher levels of NiR, ICDH, PEPC (at 200kg/ha N), osmotin, CKR and PAL genes, and decreased levels of GS2/GLU2. These data confirm our previous observations (5, 6) and further indicate that, in addition to responses to exogenous N, specific HV X N interactions impact the type and quantity of select class of genes.

Our studies demonstrate compatibility between on-farm produced, cover crop based inputs and field production of genetically engineered, value-added crops such as tomatoes. It will be of interest to determine if similar compatibility exists between other nutritionally enhanced crops, including fruits and vegetables. This study is relevant in the context of the current concerns to achieve agricultural sustainability in an eco-friendly and economical manner to meet the demands of a growing world population. Integrating genetically modified crops with sustainable agricultural practices could mitigate the impact of intensive practices on the environment, and simultaneously enhance crop productivity, protection and quality. Our study suggests a new paradigm for sustainable agriculture that is consistent with the sustainable paradigm proposed for soil management (7, 8), but relies on genotypes (germplasm), built with novel transgenes, adaptable to sustainably managed soil conditions, enhanced soil biological activity, and efficient use of nutrient cycling.

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## **Climate change and sustainable animal agriculture in sub-Saharan Africa: methane emission, abatement options and adaptation scenarios**

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The objective of this paper is to report some data on enteric methane emission from tropical livestock production system and largely to discuss on possible abatement scenarios in the transition to sustainable agriculture. Baseline methane emission data



was generated using cattle experiment conducted in Head Box respiration chamber at the International Livestock Research Institute in Ethiopia in 2005. Methane emission (g/day) and Methane conversion rate (MCR) (MJ of methane produced per 100 MJ of gross energy intake) of experimental animals range from 185.7 to 124.1 ( $\pm 13.6$ ) and 12.6 to 6.8 ( $\pm 0.84$ ), respectively depending on the type of feed used during the experiment. This was generally considered high and had implications of productivity of animals in this region as well as opportunities for abatement mechanisms. We therefore selectively review practical mitigation options such as nutritional management, production intensification or alternative adaptation scenarios in view of addressing the increasing challenges of climate change and livelihood issues in this part of the world.

### **The influence of globalization to the transformation of Chinese rural industrial pattern**

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As the environment changes, rural industry pattern of the mainland China should also change accordingly, and so does the farmland, the former use of which is only in production. These transformation make agriculture operators must face the change from original domestic grain safety pressure to international competition and challenges. Because these changes have quite influence to China's future rural industry pattern, so how to increase the competitive advantage rural industry will be the critical factor of future China's rural industry transformation.

The main purpose of present study is to analyze the impact of rural industry transformation on agriculture operators in China under the shock of globalization, and tries to put forward some relevant coping strategies and suggestions. In this study, we focus on gathering the relative information, combined with objective points to narrate plainly about its development situation and results, in order to compare the vicissitudes of past and present agriculture industry and agriculture.

In the threshold of the 21st century, the agriculture of future China must promote industry structure function. And the development direction of agriculture should be "the industrialization of agricultural production", "the modernization of agricultural life" and "the natural of agricultural ecology", which will be the common target of the nation.

### **Bio-fertilizers and bio-energy from agricultural waste in Egypt's Nile Delta**

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Some of the main challenges facing Egypt today are arable land scarcity, poverty, food insecurity, land degradation, water scarcity, ENERGY and pollution and demographic centralization. The main interrelated goals of our project are poverty eradication, food security and climate change mitigation to form a unified strategy for "sustainable development agriculture". Egypt contributes less than one 1% of the world's CO<sub>2</sub> emissions, but is expected to experience some of the worst impacts of climate change. That could result in the migration of millions because of potential global-warming-induced sea rise, which could flood the Nile River delta.

That, in turn, will affect Egypt's food output, since areas surrounding the Egyptian river provide most of the nation's arable and residential land. In total, more than 80 million Egyptians are living on less than 5% of its total area. Agriculture is critical to the country's economy, providing 15% of Egypt's GDP and using 83% of the country's water supplies.

About 40% of Egypt's population lives below the poverty line, the majority of which are located in Upper Egypt. Stark geographical disparities exist between the region of Upper Egypt, desert areas in Sinai and the Red Sea- which are some of the country's poorest areas with high levels of food insecurity and malnutrition; and between the more developed Lower Egypt region, where Egypt's manufacturing, construction and trading take place. The demand of water has increased to a level that reaches the limits of the available supply.

The vision at is very simple: to build sustainable farming communities where waste is utilized and re-injected to build zero waste eco villages the supply cycle; where energy production and consumption is based on Renewable Energy sources; as in solar energy and recycling agro waste for organic fertilizers that are cheaper than chemical fertilizers less depleting to the soil and uses less water where the farming process is done using organic components and methodologically used to save water; a very valuable and scarce resource. In brief, Ramsco advocates the adoption of a circular economy- rather than a linear one- holding true to 3 principles "Recycle, Reduce, Reuse." How can this be accomplished?

Ramsco implements clean technologies for sustainable agriculture. The company develops innovative solutions for fighting poverty while mitigating climate changes in the Middle East and North Africa region. In Egypt, our mission is to face future inundation of the Delta with reclamation and valorization of desert lands and development of eco-villages in the desert to counterbalance the overpopulation of Greater Cairo and urban areas through rural development and recycling (agro waste in Egypt totals 36 million tons and only 8 are recycled). The starting point is the initiation of productive activities that create employment and generate incomes, particularly for the poor. In order to meet the

increasing demand for food and reduce the burden on low-income families, Rawya directs her efforts towards promoting sustainable agriculture that reduces water consumption, increases productivity and yields, uses organic fertilizers and pesticides thus reducing soil degradation and contamination of the food chain; supporting small and medium sized related industries such as composting, producing soil enhancement products as biochar, packaging, canning, converting municipal waste into energy (2nd generation biomass), recycling of used water and sewage, desalination of sea water, and promoting investment in renewable energy (especially solar energy) that also uses solar panels to change brackish water and desalinates sea water for both drinkable water and irrigation; Remediation of both soil and water; and lastly supporting low cost eco housing that conserves and reduces the use of water, energy and waste, particularly for the poor and homeless. In the Hassan Fatehy vaulted style.

Ramsco contributes to sustainable development in Egypt by mobilizing resources to transform agricultural residues into fertilizers and soil amendments, and stimulating conventional and organic farming specially after the rise in fuel prices and high cost of urea reaching up to \$280 per ton in Egypt causing farmers to stop farming if compared to organic 45 \$ thus we started our own research center in Ismailia to increase efficiency of organic fertilizers so as to increase profits for small farmers Creation of sustainable agricultural communities and creation of supply chain for cash crops . Creation of permaculture plantation of alfalfa which is cheapest way of fighting anemia for children and for livestock for animals increasing dairy products

Targeting areas with high temperatures, Ramsco has set up pilot sites in New Kalabsha specifically to test whether the new mechanisms of agriculture would work. WE have bought French technology for conventional farming for France for super vegetable gardens I The results, so far, have been extremely encouraging: Water used in agriculture has been saved by up to 60%; and productivity increased productivity increased by 50 percent and above 50 percent Celsius , each acre can have either 32 gardens or 48 gardens each garden is consisting of 4 plots per garden The aim for the future is to give farmers the know how the kits and seeds than create a supply chain for both conventional and organic cash crops market the products for fair trading

Ramsco suggests micro-financing with low interest rates (6%) empowering the small farmers by giving them partial property ownership of the project on which they work. By establishing stock market companies owned by the technology owner (in this case, Ramsco), the private investors and the farmers, it's a win-win situation for all. Ramsco's objectives are 3-pronged.

Economic:

- Increase incomes-production all year round and increased yields.
- Reduce production costs-> higher profits.
- Using idle capacities (unused land).
- Creation of branding and a franchise.
- Reduce rural to urban migration.
- Creation of new market niches.

Social:

- Promote community development in rural and desert areas.
- Create new job opportunities.
- Empowering women and the underprivileged.
- Increase literacy and awareness of farmers.

Environmental:

- Efficient use of water.
- Improve soil erosion.
- Increase soil fertility.
- Improve health due to safe and high for ourselves, our children and our children's children. Preserve the environment through forestation

I have created our own research center to improve the French conventional technology in Ismailia close to Cairo where we are using our own soil enhancers and bio-polymers, we are in process of having three patents for soil enhancers and a biochar machine patent. Our results were quite successful where one acre can produce 58 tons of conventional farming and saving a lot of water almost up to 60%.

The results for organic quantities are still not ready yet but looks almost same in organic lettuce to the conventional produce

The cost per garden is almost 200\$ and we are working on decreasing the cost. I hope that the day will come, when my project of eco-villages will give a better living and eradicate poverty in my country.

## Poultry Production and Outbreak Risk of Avian Influenza: Lessons from Japan and Implications for Healthy Eco-Food System

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Since 1990s, animal epidemics like highly pathogenic avian influenza (HPAI), foot and mouth disease (FMD), or classical swine fever (CSF) are becoming a serious menace to livestock industry all over the world. These livestock epidemics were already discovered by veterinary medicine in the late of 19th century and L-Office international des epizooties or International Epizootic Office (OIE) was established in 1924 to guarantee the transparency of animal disease status world-wide. However, it is recently recognized that outbreaks of contagious livestock diseases damage the livestock industry and its regional economy. This phenomenon would not be unrelated to today's industrialized livestock farming. The cage system and clustered livestock farms raise the outbreak risk of animal disease and its amount of economic losses when infected. At the same time, as Delgado et al. (1999) named "Livestock Revolution", income increases among the emerging economies shift their diets to livestock food products (e.g. meat, eggs, daily products) and the livestock sector is expanding rapidly and industrializing drastically. In the case of poultry production, its world stock increased 4.4 times from 4.5 billion heads in 1961-65 to 20.0 billion heads in 2006-09. Especially during the last two decades, 1991-2009, the emerging economies increased their shares of poultry production such as China (27.9% to 28.1%), Brazil (5.1% to 5.8%), India (2.4% to 3.0%), and Rest of Asia (15.0% to 16.7%). Thus, the risk of livestock epidemics is getting higher and expanded. Under the circumstances, we study some cases of HPAI outbreak occurred in Japan and examine and discuss future-oriented livestock and food system pursuing both economic efficiency and animal health, which also affects human health.

This paper has three objectives. The first one is to arrange economic losses caused by HPAI epidemics from recent cases. Since last fall, several low and highly pathogenic AI epidemics have been reported in Japan and on Jan. 31, 2011, 142 thousand and 40 thousand broilers were slaughtered in Aichi and Miyazaki Prefectures, respectively. Following Meuwissen, et al. (1999) and van Asseldonk, et al. (2005), the economic losses are distinguished into direct losses and consequential losses. Furthermore, the consequential losses are divided into five categories; i) Business interruption, ii) Losses related to established movement restriction zones, iii) Reproduction of the farm, iv) Losses from emergency vaccination, and v) Price effects. Using published data and interviewing the stakeholders, the economic losses are estimated for each case and the differences of poultry farming system are discussed. Through these case studies we learn some lessons how to avoid and control HPAI outbreak. Secondly, a conceptual livestock farming model with a risk of HPAI outbreak is built with the estimates of economic losses. Reviewing Hardaker, et al. (1997), we examine the risk of HPAI to poultry farming. Lastly, we introduce a concept of Healthy Eco-Food System and propose its promotion for sustainable agriculture. Through food chain, healthy livestock leads to human health. Livestock health is secured by healthy ecological system with disease-free wild lives. Regarding livestock farming considering animal welfare, Allender and Richards (2011) estimated California egg consumers' willingness to pay (WTP) for cage-free eggs and their findings suggest that higher production costs result in a net welfare loss to consumers. The outbreak risk of HPAI tells us that the ecology or natural environment surrounding food production system is the key to sustainable agriculture. As a trend, global food demand is increasing in the long run and for instance, Masuda and Goldsmith (2010) project that China's meat consumption double from 62.6 million metric tons in 1999/01 to 136.3 million metric tons in 2030. Now we need to consider not only increased production of foods but also WTP for healthy ecological system to secure our food and health.

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## Sustainable Consumption Initiatives in a Communal Context: The Responsible Consumption Cooperatives

Eleni Papaoikonomou

A growing interest on the environmental and social implications of consumption has been observed over the last two decades. Academics and the society in general place more attention on how individuals can lead sustainable lifestyles as consumers and new consumer movements with such concerns, like the ethical simplifiers (Shaw & Newholm, 2002), appear with more intensity. The present paper describes the phenomenon of Responsible Consumption Cooperatives that has been gaining increasing popularity in Spain during the last ten years according to the findings of the empirical study.

The research objectives of this study are to:

- 1) To present these sustainable collective initiatives and the type of projects carried out within these collectives.
- 2) To examine how individuals can lead sustainable lifestyles at a communal context by participating in ethically oriented consumer communities.
- 3) To check whether the members of these communities feel more empowered by participating in such communities than trying to lead individually sustainable lifestyles.

This study has taken a qualitative approach aiming at more richness and depth of data. The unit of analysis is the collective project of the responsible cooperative, but the units of observation of this study are the members of the ethical consumer communities. The fieldwork took place in the northeastern Spanish region of Catalonia, where these cooperatives have become increasingly popular.

To ensure the validity of qualitative research, methodological triangulation is necessary (Hall and Rist 1999). Using the 'qualitative tool kit' as suggested by Hall and Rist (1999, 295), three data-collection techniques are combined in this study; observation, interviews (including focus groups) and document analysis.

Fieldwork began with observation, which permitted an initial contextualization of the ethical community and allowed the researchers to establish rapport and proceed with the other techniques. Different types of observational strategies were employed. Besides traditional observation in physical settings, online observation was also used, since the ethical consumers of the communities meet both in physical and computer-mediated environments. In traditional observation, a field notebook was kept during the observational process. In online observation, information was sourced through subscription to mailing lists of two groups resulting in 178 mails for the first group and 85 mails for the second one.

Interviews and focus groups provided an in-depth insight into consumers' experience of the project. Four focus groups were conducted with 32 participants in total. Sessions lasted from 90 to 120 minutes. Nine in-depth informal interviews followed with duration of 40 to 120 minutes. All sessions were tape-recorded and videotaped. Then, they were transcribed verbatim with silences, pauses and laughs noted.

Document analysis facilitated a broader understanding of how the ethical consumers construct their reality through means of expression not co-produced with the researchers (Patton 2002). In specific, an online magazine written and published by the members of the collectivities was identified and analyzed. Fifteen, 20-page extension issues were downloaded representing a five year period (2003-2008).

The Responsible Consumption Cooperatives are neighborhood based (so geographically limited) collectivities whose main project is the collective purchase of products according to ethical criteria decided by the collectivity. The criteria adopted by these coops prioritize:

- 1) The preference of smaller and local producers.
- 2) The avoidance of intermediation and big commercial chains and the establishment of direct relationship with the producer.
- 3) The purchase of natural, ecological products.
- 4) The use of fair labor conditions in the production process.

The collectivities have set the aforementioned criteria as their bottom line for purchase of products. The products have to comply with the established criteria, otherwise they are rejected by the cooperative members because they are seen as unfit with the philosophy of the cooperative. For instance, they will reject an ecological product that comes from far away because they also take into account the ecological footprint of the product's transport. A wide range of products are involved; from vegetables and fruits to detergents and cosmetics. The variety of products depends on the level of organization of each cooperative. Therefore, the main project of the cooperatives is of boycotting nature in favor of more sustainable production-consumption cycles.

Nevertheless, besides the group purchase of products, cooperatives are also involved in other activities. For instance, waste minimization is one principle that permeates the whole function of the cooperative. For instance, the cooperatives try to achieve a lean process without extra packaging. When the weekly purchase takes place, each member has his own wooden box which he/she reuses or other forms such as a shopping cart, a backpack, a bag are used to transport the products. This is a widely accepted practice among the members of the cooperatives and it is encouraged through mails sent to the members.

Silvia (mail about upcoming delivery of products, Cooperative Environmental Hope): You should have in mind that in the case of bread and muffins, so that we don't generate waste, they will not be packed and when you come to pick them up you have to bring your tupperware or a bag or what you prefer.

The cooperatives not only practice ethical consumption, but also they actively try to promote. Towards that aim, they organize seminars (e.g. about ecology or household waste minimization), they participate in campaigns (e.g. they actively participated in a recent campaign against genetically modified products) and they write and publish online a magazine that as they say intends to 'be the vehicle of the ideas, news and activities of the groups in Barcelona in everything related to consumption, ecology and social movements'.

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## Nutrient-Based Design

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Both rural Japan and rural America are caught in a web of interrelated ailments: air, water and soil pollution; biodiversity and habitat loss; rural flight and poverty. That such dissimilar cultures, climates and locations could suffer the same ills implies that the problem is systemic. Securing sustainable water and food sources for the world population is an issue that transcends socioeconomic strata; geophysical, racial and political boundaries; and certainly conventional applications of planning and design.

My research seeks to answer this question: can design professionals broaden their perspective to encompass the rural environment and orchestrate holistic solutions to re-balance the rural landscape? Currently, my research pursues a more specific question: can we successfully appropriate the indigenous methods of Japan's pre-WWII satoyama for the reinvigoration and reinvention of Japan's own ailing rural landscape?

*Satoyama*. An historic form of socio-ecological production landscape, Japan's satoyama are valley communities characterized by their symbiotic relationship with the surrounding environment. Typically, they comprise these basic elements: mountain water sources, manicured woodlands, small reservoirs, semi-aquatic paddy fields, villages, and native flora and fauna. The satoyama model is a closed cycle of nutrient energy in which one process benefits another, which in turn benefits another, and so on until returning to complete the loop.

*Tane-bonchi*. Located in a valley in the northeastern region of Shiga Prefecture, are 13 communities in a 4 sq. km area collectively known as Tane. Through gappei (Japan's policy of consolidating local governments into larger cities and townships) they have fallen under the Nagahama City umbrella and have lost official capacity for self-governance. Typical of much of rural Japan, the valley's future social, economic and environmental viability is in question. The least populous village now has only 1 resident, while the largest has 450. In the western-most Tane village, Ikeoku, we find 24 houses where once stood twice that number. Six houses are vacant, and 40% of the villagers are over 65. There has not been a wedding in the community for over 20 years. Every family in the village owns farmland, but only one resident is farming.

*Biwa-ko*. The water source for the major cities of Kyoto and Otsu, Japan's great freshwater lake, Biwa, is a critical body of water, as illustrated by its nickname "Mother Lake". Biwa lies at the heart of Shiga Prefecture, is the collection point for all the waters that flow from the mountains ringing the territory, and has only one outflow. Pure and potable for centuries, Biwa's waters must now be treated for phosphorous and nitrate pollution as a result of the past 70 years' industrialization.

For the past 30 years, Shiga prefecture has levied exorbitant taxes on Tane residents for a pipeline which pumps Lake Biwa water to the community for irrigation purposes, while the original mountain streams which fed them have been confined to concrete sluice-ways and closed off from the fields. Initially an act of preservation and agricultural engineering, the system has only served to financially hamstring farmers, undermine natural filtration processes and dissociate the population from a natural element.

Ruralscape issues require an alternative design ethos: one which values appropriate technology over 'new' technology, contextualism over seriality, and resiliency through diversity rather than uniformity. Nutrient Based Planning is design which prioritizes nutrient energy exchange and seeks to strike a middle-ground between Environmental Protectionism and Economic Development. The goal is to formulate a nuanced, contemporary model of engaging the rural landscape by combining indigenous knowledge systems with a re-discovery of forgotten assets. At the foundation is an understanding that ultimately the health of the soil and its ability to produce food is what sustains not just people, but modern society in general. The three scales which Nutrient Based Planning spans are: "Micro", farms and farmer communities; "Midi", urban centers and academia; and "Macro", regional governments and watersheds.

*Micro.* The popular image of rural idyll does not include vast blankets of monoculture crops, aerial sprayers, e-coli outbreaks, concentrated animal farms, abandoned houses and nitrates in one's drinking water. Instead of writing off this vision as romantic riff or Luddite rejection of technology, why not translate this emotionally gratifying and socially responsible aesthetic paradigm into a feasible, contemporary, tangible model?

The current manifestation of Japan's paddy fields is an awkward combination of rigid geometry, human territoriality, embrace of the Western tractor and a misapplied regard for hydrology. No parcel of land is independent of the greater ecological systems of the area. Alternatively, no parcel of land is all-encompassing of an ecosystem. Yet, all landowners are beholden to, and dependent upon, the health of the local system. How can we change land ownership perception and representation so that this concept of collective ownership and collective dependency is understood? How can crucial technology like the tractor be incorporated into a system with a more nuanced, natural land division?

*Midi.* Just as the disparity between wealthy and poor grows ever larger, so does the Urban-Rural disconnect. How can we reacquaint these two equally significant landscapes? Cities survive via a consumptive, linear vector: nutrients and water from outlying sources come into the city, are used, and then either discharged as treated sewage or stored indefinitely in landfills. Instead of incinerating or sequestering the tremendous amount of organic waste created by cities, why not take advantage of the urban capacity to implement innovative infrastructure and return these nutrients to the field? Through such a relationship, cities can ensure their own future access to clean water, healthy food and green space by directly supporting agrarian practices which promote biodiversity.

*Macro.* The import of larger natural systems has been obfuscated by both our serial applications of infrastructure and our propensity to define space by economic boundaries rather than geophysical ones. What language and concepts can planners utilize to fulfill their role as custodians of natural systems which cut across political boundaries yet are subverted by man's infrastructural pursuits?

If Lake Biwa is truly recognized as a significant body of water worth preserving, and it is understood that what comprises Biwa is not just what is bounded by the shoreline, then protective measures must be implemented further upstream in valleys like Tane. Imposing protections on a place obviously presents issues, but by considering the farming lands around Lake Biwa as a new class, agrarian park, the prefecture of Shiga could arrive at a solution that supports the livelihoods of farming communities, while simultaneously ensuring prefecture-wide environmental and social health.

## **Assessment of Sustainability of Organic Farming in India using Analytical Hierarchy Process (AHP)**

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Several issues threaten the food security in India. The prominent among these are: increased food demand from agriculture by the rising population, reduced soil fertility, depleted ground water, contamination due to pesticide residues and vulnerability induced by climate change. While green revolution did serve a purpose of the needs of self sufficiency in Indian food supplies (in terms of substantial reduction in imports of food supplies) of 1970-80, the post green-revolution situation is not so certain. While recent biotechnology led GM crops increase the productivities and pest resistance [Matin Qaim, 2003], the consequences in the long run on the ecosystem and the human health are not yet clear [Wolfenbarger et al, 2000]. Following recommendations from FAO ([www.fao.org](http://www.fao.org)) address the non-sustainability of current methods of chemical and water intensive agriculture:

- o Governments need to reject the current model of energy and chemically intensive farming that characterizes industrial agriculture and replace it with farming that works both with nature and the needs of local communities.
- o Farmers need to be encouraged to use fewer fertilizers with more precision, and be given support to convert to modern, ecological farming methods. Measures must be adopted which enrich soil, such as using cover crops when fields are not in use, to stop it from being leached of all nutrients.

It is not surprising therefore that a wide section of scientific community and policy makers are confronted today with the complexities of choices to be made by farmers for agricultural practices. This paper reports results from a study that uses a multi criterion analysis tool called AHP (Analytical Hierarchical Process) [U. Subba Raju, et al, 1995] to assess options such as chemical farming (dominated by chemical use), organic farming and integrated farming in India. Chemical farming is one which is inspired by the green revolution and is characterized by farm mechanization, use of chemical fertilizers, pesticides, hybrid seed varieties, and monoculture. Organic farming is characterized by less mechanization, use of organic pesticides and fertilizers, indigenous varieties of seeds, multi-cropping [Roitte 1998], etc. Integrated farming is basically the combination of the two farming practices, viz., chemical and organic. It is an attempt to adapt the chemical and organic farming methods to maximize returns.

There is one important bottleneck in the adoption of organic farming by majority of the farmers in India, especially those conditioned to chemical farming, thanks to the green revolution. And this bottleneck is the initial low production output per hectare of organic farming, especially when practiced on a soil depleted of its fertility owing to excessive use of chemicals [David Tilman, 1998]. It is observed that, since organic farming substantially focuses on nourishing or feeding the soil [Peter Tompkins & Bird 1998, John Jeavons 1995], the production output per hectare increases with years of practice. For example, in the three cases of cultivation that were chosen to study, the production outputs per hectare for horticulture (mango), rice and sugarcane started stabilizing after 3, 4 and 4 years respectively. This is in agreement with [Andrew H. et al, 1997] the definition of sustainability, where time is an extremely important dimension. In view of above, the above three options for farming were assessed for: (i) horticulture (mango), (ii) rice and (iii) sugarcane. These three crops represent all the major categories of farm products, viz., rice is cereal providing staple food and sugarcane is a cash crop while horticulture deals with vegetables and fruits.

In the AHP study, both qualitative and quantitative attributes were considered under different perspectives. The qualitative attributes included soil health, local employment, occupation safety, social justice, etc. The quantitative attributes considered were – soil erosion, water requirement, water pollution, productivity, cost/benefit ratio, etc. The options were ranked from four different points of views (called perspectives), namely economic, technological, social and environmental. The ranking of alternatives in the AHP study indicated that from the economic and environmental perspectives, organic farming is the most suitable option, whereas from the technical and social perspectives, integrated farming is the most preferred. It may be difficult and impractical to shift all the farms to organic for reasons of inertia as well as anxiety expressed by farmers, etc. It was however evident from study that such a goal may be progressively attained. Prior experience [P. Bhattacharyya, 2005] of making wide-scale impact suggests that with clear scientific evidence, strong political will and institutional support it is possible to achieve the 'fully organic states' goal towards sustainable agriculture to meet the long term food and nutritional requirements in India. In this study, time series analysis was used based on the results of AHP to enable predictions of future rankings of the options from the four perspectives.

In conclusion, our two main contributions are: (i) ranking of three typical farming technologies from four perspectives using multiple qualitative and quantitative criteria and (ii) study of the effect of time on the ranking of technologies.

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## **Impact of Global Change on Soil Microbial Community in Agricultural Systems with Implications for Crop Production in Developing Countries**

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Soil microorganisms are considered to be critical determinants of crop responses to global change events as they are extremely sensitive to changes in soil nutrient and chemical composition, temperature, and moisture. In agricultural systems, soil microbes are responsible for nutrient cycling, residue decomposition, soil structure, nitrogen (N<sub>2</sub>) fixation, plant nutrition, pathogen balance, and mycorrhizal associations. This review surveys the impact of two specific

components to global change events – elevated atmospheric carbon dioxide (CO<sub>2</sub>) and changes in precipitation patterns – on three vital functions of soil microorganisms that govern nutrient cycling, soil structure and fertility in agricultural systems: (a) symbiotic N<sub>2</sub> fixation, (b) mycorrhizal associations, and (c) decomposition. The consequent outcome on crop production has been provided for the developing countries of Latin America, Africa and Asia. Human population in these three regions is greater than any other part of the world, and will continue to increase, thus putting stress on agricultural production. A lack of understanding of soil microbial diversity in agricultural systems, particularly in the developing countries, which house majority of the world's agricultural-dependent economies, exists due to technical difficulties in diversity quantification and influence of agrochemicals and mechanical tillage on soil microbial processes. According to the Intergovernmental Panel on Climate Change (IPCC), it has been projected that the developing nations will be more negatively affected by climate change than the temperate regions of mid-to-high latitudes. Comprehending the effects of global change on microbial communities in the agricultural soil types of the developing world will have broader implications for crop production, food security and population nutrition in these regions.

Among the global greenhouse gases (GHGs), carbon dioxide is the most important anthropogenic GHG with unprecedentedly high CO<sub>2</sub> concentration in the current atmosphere among all GHGs. Findings in this paper have been taken from chamber and Free Air Carbon dioxide Enrichment (FACE) experiments on field-grown crops found commonly in Asia, Africa and Latin America. Studies depict that elevated CO<sub>2</sub> will affect soil microbes indirectly through plant and root exudates. All studies showed increased symbiotic N<sub>2</sub> fixation activity and crop biomass due to either increased bacterial biomass, activity or genetic shifts in bacterial DNA that allowed better adaptability to a CO<sub>2</sub> rich environment. Fifty percent of the studies showed increased mycorrhizal biomass or activity with little effect on crop growth. The remaining studies found either increases in mycorrhizal activity, which led to higher crop biomass, or no effects on mycorrhizae. About 33% of the studies found increased microbial decomposition due to priming effects from root exudates and accelerated microbial activity with consequent increase in crop biomass. Reduced decomposition due to modified litter quality under elevated CO<sub>2</sub> was found in 50% of the studies, and 17% showed no effects on decomposition and crop growth.

Since 80% of the total global agricultural land is rain-fed, crop models project that changes in precipitation patterns will shape the direction and magnitude of the overall impact on crop growth. Changes in precipitation patterns can affect soil microbes directly by influencing soil moisture under droughts and floods, and indirectly through changes in plant evapotranspiration-to-precipitation ratio. All studies depicted a decrease in symbiotic N<sub>2</sub> fixation and crop biomass due to reduced nodule area or bacterial activity and disruption of root-bacterial associations under droughts, and denitrification under hypoxic conditions due to flooding. Mycorrhizal sensitivity to soil moisture was moderate compared to symbiotic N<sub>2</sub> fixing bacteria. Mycorrhizae colonization under droughts and floods increased in 83% of the studies leading to higher photosynthetic activity while 17% showed decreased root and fungi biomass under droughts. For decomposition, 50% of the studies showing an increase due to either higher carbon allocation to the root system under water stress (and reduced shoot growth), or greater crop-microbe contact and temperature buffering upon flooding. However, the remaining 50% showed decreased decomposition causing reduction in crop biomass due to mineral stress under flooding and high evapotranspiration-to-precipitation ratios under low rainfall.

Based on the findings of this review, recommendations for four main areas are addressed to counter the uncertainties in and the knowledge gap for impacts of global change on microbes in agricultural soils. First, microbial responses to global change events are plant-specific, microbial species-specific, site-specific and season-specific. Lack of information on soil microorganisms can be reduced by an interdisciplinary approach that integrates microbiology, microbial ecology, environmental genomics, and soil and plant science enabling better assessment of global change impacts on different microbial groups. Second, due to poor infrastructure, inadequate transportation, and high cost, many small and subsistence farmers rely on biological N<sub>2</sub> fixation and mycorrhizal associations for nutrient uptake instead of external chemical inputs. Therefore, it is crucial to employ sustainable crop management practices - such as conservation tillage, organic farming, agroforestry - that can impact soil productivity via aboveground plant and belowground soil responses to elevated CO<sub>2</sub>, temperature and moisture depending on the soil type. Further, crop and pasture models have poorly described the field crops and soil response to global change, especially elevated CO<sub>2</sub>, in these developing regions and contain many uncertainties. Incorporating soil microbial sensitivity (in terms of composition and function) into climate and crop models can reduce the uncertainties giving more accurate estimations. Finally, integrated national and international policy measures are essential for researching, effective data-sharing and monitoring impacts of global change on plant-soil microbial interactions, particularly in the poor regions as they lack the required funds. Agronomists, climatologists and modelers, and governments need to collaborate to 'dig deeper' into soil management, water resource availability and crop growth under changing climatic conditions for optimizing food production. While soil microorganisms in agricultural systems are out of sight, they certainly cannot be taken out of mind given the effects of global change on these microscopic creatures and the consequent outcome for crop production.



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## **Sustainable productivity increase of cattle ranching in Brazilian Pasturelands: Meeting land-use demands and sparing nature**

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Stemming from global population increase (FAO, 2008) and concomitant with per capita consumption, recent competition for land is likely to continue in the future, driven by further increase of demand for food and fuel on the one side and endeavours to protect pristine environments, on the other (Smith et al., 2010). Recent rapid growth in the demand for livestock products has been driven by rising income, urbanization, and preferences by the growing middle classes throughout the world for a diet that includes meat and other highly nutritious foods (FAO, 2007; Smith et al., 2010). In addition, rapidly growing biofuel market is expected to further increase contributing to competition for land (Tilman et al., 2001; Tilman et al., 2009).

Brazil is the greatest exporter of meat with cattle ranching being the major driver for deforestation and degradation of the Amazon forest and the Cerrado, the Brazilian savanna (World Bank, 2010). Brazil is also the biggest international producer of sugar cane bioethanol.

This research project was set up to investigate plausible answers to competition for land, historically leading to land-use change in Brazil (mainly deforestation). We analysed the potential increase of productivity of pasture lands in Brazil in order to meet future demand for food, timber and fuel until 2040. We investigated whether the improved land management of cultivated pasture lands results in the sustainable increase of pastures productivity, enough to meet future demand for meat and liberate enough land to fulfill demands for soybeans, maize, sugarcane (biofuels), and timber without converting any additional natural land.

This is the first study that includes estimates for the potential productivity of pasturelands, based on two different models, in order to conclusively analyse the potential for increased productivity in a spatially explicit way. The study was conducted within the ‘sustainable intensification’ concept (World Bank, 2006; Godfray, 2010), which focuses on production that makes the best use of nature’s services without damaging these assets in long term, which in our study was assumed to be 30 years. We also calculated cattle productivity for pasture land that could potentially be transformed into agropastoral and silvipastoral (agroforestry) systems and we modelled potential productivity for different regions under current and projected climate conditions.

Our results show that current pasture productivity in Brazil is well below the potential productivity. We also found that the land already used as pasture can produce enough commodities to satisfy future demand for food, timber and biofuels projected for at least the next three decades in Brazil, even when incorporating for future climate change. We produced maps identifying, for a number of scenarios, the distribution of potential land-uses and cattle ranching productivity that take into account climatic and biophysical constraints and meet all the projected future demands for the analysed commodities. We also present a simplified greenhouse gases balance estimates resulting from switching from Business-As-Usual to improved land management scenario.

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## Conservation Agriculture and its Impact on Land and Labor productivity in Central Ethiopia

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Ethiopian agriculture is characterized by low productivity attributed mainly to soil degradation and inefficient use of water resources. Soil and water resource use inefficiency is so significant that the country is unable to produce enough grains to feed its population even in years of good rainfall (Kassa, 2003). The domestic grain production is estimated to supply only about 70% of the total food requirement, and each year, 4 to 6 million people need food assistance despite the existence of potentially productive resources for food self sufficiency and even surplus production (EEA, 2006). Virtually all of the country’s crop farming is operated by smallholder farmers, practicing traditional plough-based activities. It is well documented that conventional farming with frequent ploughing gradually degrades the physical structure and chemical quality of tropical soils (Brady and Weil, 2001). The dire situation Ethiopia is facing has prompted the government and other actors in agriculture to identify and implement alternative farm-level practices that increase productivity without undermining the natural resources.

Conservation Agriculture, a package of activities initially promoted by FAO, was among one of the initiatives introduced in Ethiopian agricultural system to abate deterioration of soil and water resources. According to FAO (2001), conservation agriculture aims at making better use of agricultural resources through the integrated management of available soil, water and biological resources, combined with limited external inputs. Conservation agriculture promotes different conservation

practices, with permanent soil cover, minimal soil disturbance, and crop rotations always emphasized (FAO, 2001). The concept of conservation agriculture aggregates a number of soil and water management and conservation practices under a single banner for delivery to farmers (Garcia-Torres et al., 2003; Knowler and Bradshaw, 2007).

While soil conservation practices, including minimum or no tillage have long been practiced by farmers in Ethiopia, conservation agriculture best practice packages were introduced in 1998 by Sasakawa Global 2000 (SG 2000) on 77 maize plots (Matsumoto et al., 2004). Despite the decade old national effort to systematically disseminate conservation agriculture, no empirical evidence has been presented as to what extent the technology package is being adopted, or the extent to which farm yields are being influenced. Only a few studies (Kassie et al., 2009; Rockstrom et al., 2009; Wellelo et al., 2009; and Shames, 2006) have reported on the status and effects of conservation agriculture in the country. Further, these studies focused on northern Ethiopia where drought and soil degradation are the most important agricultural constraints. The few papers on conservation agriculture in Ethiopia (Kassie et al., 2009) or Africa (e.g., Mazvimavi and Twomlow, 2009; Haggblade and Tembo, 2003) in general, show that farmers tend to adopt only some of the components – usually the minimum plowing and higher quantity of herbicides at the initial stages. They hardly ever practice the whole conservation agriculture package. Use of the full conservation agriculture package is advised, however, to reap the full benefits of the new technology over conventional farming (FAO, 2001; Ito et al., 2007).

This study analyses the factors influencing the adoption of conservation agriculture in two districts in Ethiopia and assesses its impacts on land and labor productivity. The adoption of the different components of conservation agriculture was analyzed using a multivariate probit model and the impacts were estimated using generalized methods of moments and the control function approach to deal with the common problems of endogeneity and heterogeneity.

The results show that the initial decision to adopt the different components of conservation agriculture package is influenced by location, family size, access to extension, and formal education. Among the components, herbicide application was found to be significantly and strongly influencing land productivity. Other factors that influence land productivity are location, sex of the head of the household, livestock wealth, and human labor endowment. None of the components were found to be influencing labor productivity. Given the scarcity of land in Ethiopia, the contribution of herbicide application towards improving land productivity within conservation agriculture efforts should be investigated further at the policy level in view of achieving more efficient and sustainable land use. Also, efforts should be sustained to expand extension services so to generate greater awareness about the multiple benefits of conservation agriculture.

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### Optimizing Crop Water Productivity for Sustainable Agricultural Development in the Nile Delta, Egypt

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Increasing water productivity in agriculture will play a vital role in easing competition for scarce resources, prevention environmental degradation and provision of food security. The overall goal of the irrigation improvement project (IIP) is to improve the social and economic conditions of Egyptian farmers through development and use of improved irrigation water management and associated practices, which will increase crop production and, as a result, the farmers' income mainly by improving the irrigation infrastructure, facilitating a more equitable distribution of water and improving on-farm water management. This study is aimed at optimizing crop water productivity using genetic algorithms (GA) under the IIP and changing irrigation and cultural practices in the north Nile Delta. Therefore, two branch Canals (improved and unimproved) were selected on the Meet Yazid command area, Kafr El-Sheikh, Egypt, sample tertiary units were selected, six in each branch Canal, and distributed at head, middle and tail locations and were selected purposively to reflect different conditions. Six fields on each Mesqa were selected and distributed at head, middle and tail locations on the Mesqa. Two main summer crops (rice and cotton) and two main winter crops (Egyptian clover {Berseem} and wheat) were studied on each Mesqa. The effect of the IIP on six indicators of the physical and economical water productivity for selected crops were investigated and compared with the unimproved area. The field results revealed that average crop evapotranspiration ranged from 702-744 mm for rice, 476-517 mm for cotton, 293-316 mm for wheat, and 388-420 mm for Egyptian clover in both improved and unimproved areas, respectively. It can be concluded that the irrigation improvement increased yield by 9, 23, 6, and 45% and saved water by 20, 5, 44, and 7% for rice, cotton, wheat, and Egyptian clover compared to the unimproved area. Average values of crop water productivity were 1.01, 0.72, 1.54, and 10.46 kg m<sup>3</sup> in the improved area compared to 0.93, 0.47, 1.44, and 7.04 kg m<sup>3</sup> in the unimproved area at average crop evapotranspiration of 723, 497, 305, and 404 mm for rice, cotton, wheat, and Egyptian clover, respectively. It is also noted that applying deficit irrigation for cotton by 4% during the vegetative stage increased crop water productivity by 39% in the improved area. Genetic algorithms are uniquely suited to solving problems that have a large number of input parameters and have complex, discontinuous search spaces. So, the field data will be processed using GA to provide an algorithm to aid in the search for optimal crop water productivity as affected by the IIP.

### Partners' collaboration on biomass production: a source of renewable energy toward sustainable community development

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In general, the Philippines is faced with depressing realities, a matter for concern not only of government sector but also of all law-abiding citizens, individuals and groups, itemized as follows:

1. Unsanitary waste disposals from backyard livestock raising projects causing land, water and air contamination or environmental pollution;
2. The use of highly toxic chemicals to treat wastewaters from slaughterhouse and big-time livestock and poultry projects, land-water-and air-pollutants drained to catch basin;
3. Heavy use of toxic chemical, synthetic fertilizers and pesticides in agriculture farms (e.g. mango growers & fruit production) resulting in low productivity, health hazards and environmental degradation;
4. Continual use of commercial synthetic-based feed formula, additives and medicines for resulting in high production costs but lesser gain, and human health deterioration;
5. Women's deprivation from income generating, livelihood and socio-economic projects, resulting in low, if not, zero income.;
6. Less opportunities on or access to education, health services, and other basic resources resulting in low literacy rate and poor health condition of urban and rural poor sectors.

To promote partners' collaboration on the effective management of animal wastes (biomass) from slaughterhouse and livestock-raising (hogs/swine, cow and goat) projects as a source of renewable energy toward sustainable community development

1. To establish a model animal waste management facility, the Chinese-fixed dome type for the slaughterhouse combined with livestock production project that will showcase the use of the three system-outputs as inputs in various agricultural farm activities
2. To systematically involve local women, youth and men in the actual operations of the waste management facility, livestock production and other related socio-economic/livelihood projects
3. To organize potential partners to collaborate in handling different related activities and strategies in the implementation of the project after some consultations, having the following roles:

3.1 LGUs – local government unit, village-level

- 3.1.1 - Serves as regulatory and monitoring body on matters related to environmental protection and policy implementation, business activities
- 3.1.2 - Helps in the sourcing of financial budget especially on infrastructure aspect of the waste management facility and actual operations
- 3.1.3 - Supervises its own personnel in the actual maintenance of the slaughterhouse and upkeep

3.2 Participating NGOs (local, national, international)

3.2.1 - Local (CARATS): provides technical support on the construction of biogas digester system, facilitates planning and finance generation, develops environmental education curriculum, coordinates and assists LGU-assigned personnel in monitoring use of the system and implementing livelihood/socio-economic projects, promotion of biogas technology, and training of construction workers (mason) as manpower supply in the eventual mass replication program being part of its strategic plan, establishes pool of consultants & trainers, help design research studies related to environment, economic & social needs of the community

3.2.2 - Local and international development organizations: help provide financial budget for the project, for the infrastructure and daily operating costs, policy advocacy campaigns, promotional activities, and training of construction workers, seed capital for livestock production and other livelihood/socio-economic projects, data-gathering & research work

3.2.3 Other local/national NGOs – assist in implementation of livelihood projects by providing technical expertise and establish connections on production and marketing strategies, environmental education and health related activities, help organize other areas establish their own project on livestock production-cum-biogas system and coordinate policy advocacy campaigns

3.3 - Local business owners/entrepreneurs

Various other businesses may involve in the partnership and coordinate with marketing groups, either to avail of system-outputs for use in their operations and/or to join or sign-up for the market-matching agreement:

- 3.3.1 Lending companies/individual proprietors –to provide micro-financing
- 3.3.2 Market research groups-to conduct studies on potential market outlets
- 3.3.3 Agriculture-based production project owners:
  - 3.3.3.1 Raw brown sugar processing plant(s)
  - 3.3.3.2 Compost fertilizer & vermi-cast compost
  - 3.3.3.3 Biological pesticides & fertilizers (natural)
  - 3.3.3.4 Aquaculture/Inland fishing/fish processing
  - 3.3.3.5 Alternative feed formula processing
  - 3.3.3.6 Farm crops and fruit orchard/fruit candy processing
  - 3.3.3.7 Vegetable production
  - 3.3.3.8 Agro-forestry & seedling nursery
  - 3.3.3.9 Other local livestock and poultry meat processing
- 3.3.4 Technical service-providers: computer-related, bookkeeping, accounting & audit, civil engineering works, etc.

#### Strategies:

1. Collaboration between participating NGOs, governance & business sectors on all aspects of development partnerships
2. Establish a sustainable agriculture demonstration farm to showcase agricultural productivity on the how and when the 3 system-outputs are actually utilized in all relevant production projects
3. Livelihood development and transfer of agriculture-based technology to the community through trainings, workshops and hands-on application
4. Advocacy policy and implementation, information dissemination and education campaigns related to environmental protection, socio-economic project financing to help establish, strengthen and enhance community-centered economies
5. Capability building of the local organizations as well as all the participating NGOs, LGUs and Business sectors

#### Anticipated Results:

1. Environmental protection
  - 1.1 zero waste thrown into the open environment, coming from the slaughterhouse
  - 1.2 all farmer-members of the organization utilized organic farm/livestock & poultry inputs
  - 1.3 showcased how wastes are recycled as alternative source of energy and organic inputs.
2. Economic stability
  - 2.1 Women, youth, workers and farmers' organization shall have managed own socio-economic projects in the 2nd year of project implementation.
  - 2.2 Increased family income by 50% in the first year of project implementation by generating savings and income in terms of fuel and energy utilization (e.g. methane gas as substitute for LPG, lighting, incubating), generating income from sale of organic inputs from by-products of biogas system and have contributed to build-up of community-centered local economy
  - 2.3 Farmers' income increased if organic inputs are used at reasonably less costs
  - 2.4 Basic needs met: three full meals a day, family support on public education, adequate shelter, clothing, good health of family members.
3. Positive social impact
  - 3.1 Developed a strong support system among the women, youth, farm workers, farmers' organization and the organizations
  - 3.2 Each member has developed deeper sense of responsibility, cooperation and commitment to the organization.
  - 3.3 100% of organizations' members shall have actively participated in all activities at village, regional or national levels;
  - 3.4 Initiated projects/activities to respond to issues affecting them.

### **The Use of Indigenous Knowledge Systems as a Mechanism towards a more Sustainable Future: Challenges, Preconceptions and Solutions**

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Indigenous Knowledge Systems (IKS) are important to invest in for sustainable development and poverty alleviation; they have been developed over centuries and have been perfected by each generation who embrace this knowledge from their elders. IKS is the knowledge of local people embedded in society and used for survival in a particular environment and is continually and specifically adapted to the changing requirements of local people and conditions. It is created, tested and utilised in its own environment. Slikkerveer (1995) defines IKS as "...systems of knowledge and practice, developed over generations in a particular field of anthropological study, and as such unique to a specific culture or region" (p. 513).

Western knowledge, perceived as more modern and thus superior, is often more expensive and therefore less sustainable, requiring large amounts of external inputs. The idea behind this knowledge system came out of the Industrial Revolution and, with colonization, became replicated in the developing countries. However, this replication tends to ignore the poorest of the poor while the more elite benefit. The agriculture sector, for example, has been heavily invested in since the Green Revolution (GR) in the 1960s, however many poor farmers have not reaped the benefit.

There is a dualistic approach to agriculture in the south; on the one hand there is a small scale farming system (nomadic herding, compound farming and urban/peri-urban agriculture) with very little investment, and conversely there is a modern capitalist farming system (livestock ranching, mixed farming and large scale plantations) benefitting from high levels of investment. With continued neglect of interest in small scale farming, and thus IKS, a further rise in inequalities and a disempowerment of local people living in the south is probable.

For the purpose of this paper, sustainable development is defined as steps towards alleviating poverty and reducing inequality for the long-term. Nevertheless, with a continued neglect of investment in small scale farming, and thus IKS, a further rise in inequalities and a disempowerment of local people living in the south is probable. "Little is likely to be achieved without the precondition of scientific respect for indigenous knowledge" (Howes, 1980, p. 345). IKS and Western knowledge systems both use scientific methods as a base for development, and there is a need to recognise this so that they are both seen as equally valid knowledge systems.

Therefore further investment in IKS and the encouragement and facilitation of sharing IKS in the south could lead to economic growth, sustainable development and poverty alleviation (Technical Centre for Agricultural and Rural Cooperation, 1993; Slikkerveer, 1995). Furthermore, Chi-ang Lin (2007) insists that IKS is "...a unique intellectual knowledge system, which has been increasingly recognised as critical for sustainable development" (p. 554). Although techniques that work in some locations may not necessarily be transferable everywhere, the sharing of IKS is done with people who also value its importance and are dealing with similar problems, therefore it is invaluable to those who own it and use it.

This paper uses a case study of women farmer groups in Uganda based on a research trip taken there in the summer of 2008. In Uganda, 56% of the population lived below the poverty line in 1992, however the proportion declined substantially to 34% in 2000 (OECD, 2005). According to the Uganda National Household Survey, the proportion of Ugandans with income below the poverty line has grown from 1999/00 to 2002/03, both in urban and rural areas. Meanwhile, inequality, as measured by the Gini coefficient has risen (Government of Uganda, 2004/05-2007/08). This combined data shows poverty reduction is slowing down while inequality increases.

With a high proportion of women farmers living in rural areas, we decided to concentrate our research around them to find out why the percentage of Ugandans living in poverty began to increase and how this could be reversed. What do we need to invest in for sustainable development?

Our study focused on five women farmer groups in the rural parts of Mbarara, Uganda. These are women engaged, as a group, in the growing and selling of fruits and vegetables. These groups are crucial in promoting women's livelihood: they provide a platform for mutual support; a mentoring environment that facilitates sharing of business and market-related information; networking; and other value-added services (Stevenson and St.Onge, 2005).

The findings from this research will be used to assess and analyze the environment of women farmer groups and related agricultural trade activities. The recommendations will act as the platform for actions to address and identify opportunities, gaps, and challenges to consider strategic actions, as well as interventions that will foster growth of agriculture and trade within Uganda. More importantly, they will lead to better strategies in sustainable development and the eradication of poverty.

There are fundamental and overlapping questions that provided direction for the research group in linking the role of IKS, sustainable development, and poverty reduction in Uganda:

- 1) Who are the stakeholders?
- 2) What are the opportunities and challenges being faced by the stakeholders?
- 3) What factors have direct impacts on the success or failure of the women farmer groups?
- 4) What areas are identified for future research?

The research strategy involved the collection of primary and secondary data from stakeholders and the review of qualitative and quantitative information in both sets of data findings. We held interviews and focus group discussions with five women farmer groups, the Mbarara District Farmers Association, a District Commercial Officer, a Community Development Officer, and an officer from the National Agricultural Advisory Services.

This research found that all groups acknowledge the importance of IKS and how it has greatly empowered them by allowing them to share "free" knowledge among themselves and other farming groups. For instance, they do not have to rely on buying fertilizer because they have learned how to turn rotten fruits and vegetables into compost and combine it with manure from their animals to create fertilizer of their own. We also found that while this IKS exchange benefitted the groups involved by keeping them sustainable, its reach was limited, and the women farmers called for greater interaction with other indigenous groups.

It must be noted that neither IKS nor Western scientific knowledge system can guarantee poverty alleviation or sustainable development worldwide. Instead, both are a process and an improvisation that need to be experimented in different environments and should involve the local people who will be affected. These systems could be hybridised; but with particular sensitivity given to IKS so as not to create feelings of disempowerment amongst local people. If they are encouraged to participate in development projects and policy planning with clear communications in place, then they will be able to establish ownership over their new knowledge and skills; IKS could be distinguished as a platform from which to build upon.

This paper has touched upon findings and challenges, and applied field based evidence to support arguments for the use of IKS as a tool for a more sustainable development model. This model is based on communities, knowledge sharing, women's empowerment and the use of the local environment as both the solution and tool for development. Increasing the investment in IKS, in some cases hybridizing it with Western knowledge and increasing the south-south exchange of IKS will provide a platform for poverty alleviation by contributing to the increased economic opportunity, empowerment and security of low income communities.

Finally, strengthening assets such as access to land, services, markets, roads and credit will support and enhance IKS so that it can reach its potential and this should be done at a policy level. By encouraging south-south exchanges of IKS and networking between communities, districts and even countries, coping strategies have the ability to strengthen and improve which could result in sustainability and a reduction of poverty levels.

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### **Native Trees Forage, Alternative Protein Food For Cattle In Tropical Mexico**

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Livestock production systems as milk, meat and dual purpose, are important for the state of Veracruz, because of the supply of goods for human consumption (mainly meat and milk), employment, and contributions to the economy of Mexico. However, animal production based on cattle, has been under heavy criticism from the environmental point of view, due to its association with the degradation of ecosystems caused by deforestation for pasture establishment. As a result, there is a huge need to develop sustainable and economically competitive technologies attractive to the cattle producer. An important resource to achieve this, are the native herbaceous plant species that have the potential to grow in extremely affected areas, and eventually allow the recovery of soil fertility, a microclimate and a hydrological cycle similar to the original ones as well as the restoration of at least part of the flora and fauna still surviving in some places. In the agro-forestry development, trees may be associated with agricultural crops and pastures (agro-forestry system) as fodder banks that can be harvested under direct cutting or grazing, for animal supplementing, as live fences, in order to improve the soil physical conditions caused by mechanization and/or livestock continuous trampling, which constitutes a common occurrence in pastures of the Mexican tropic. Taking all this into consideration, and in order to provide cattle producers of northern Veracruz, Mexico an alternative to feed their cattle, this research mainly aims at knowing the nutrient content of native trees as a supplement food protein, and incorporating the forestry component in



traditional farming systems by increasing the productivity of soil resources. This research included the local knowledge of fodder tree species, which indicated the presence of 65 species used as poles, 80 species designated as hedge, 72 species used as shade, 21 used with medicine purposes, and 69 species used to feed the cattle. Six of the species mentioned above were selected for their adequate production of leaves, for their rapid growth and their high nutritional quality for livestock. They are *Leucaena* (*Leucaena leucocephala*), *Morera* (*Morus alba*), *Chacloco rubi* (*Hamelia patens*), *Guácima* (*Guásuma ulmifolia*), *Pichoco-bunting* (*Erythrina americana* Miller), *Cocuite* (*Gliricidia sepium*), native species from Mexican tropic. The plants were evaluated in the bud stage of senescence and flowering, restricting the fraction of mature foliage in the samples located at a height under 2 meters, and considering 5 plants per species, randomly selected in the study area. The nutrients evaluated through proximate analysis were: dry matter (DM), crude protein (CP), ether extract (EE), ash (C), crude fiber (CF) and total digestible nutrients (TDN). The neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined with the Van Soest technique. This study used a completely randomized design with five replicas. The chemical composition showed substantial variations among species ( $P < 0.05$ ) indicating that *Leucaena leucocephala*, *Morus alba* and *Gliricidia sepium* (20.0%, 23% and 21% respectively), show much higher PC content than the regional tropical pasture and in several cases also higher than commercial concentrates. In relation to the NDF and ADF, *Guásuma ulmifolia*, was the species with the lowest value (23.4%) compared to the other five species whose value exceeds 40%. In conclusion, it is feasible to use native foliage of fodder trees which provide acceptable nutritional quality and reduce large areas of degraded pastures, especially in the Mexican tropics.

## **The Pedagogy of Alternation as an instrument of the Brazilian Policy of Technical Assistance and Rural Extension: case studies in the North and Northeast of Brazil**

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Agriculture is considered one of the human activities that cause most impacts to the natural environment, but it is indispensable for survival of society. After the industrial revolution, big changes have occurred, including in agriculture, bringing a technological apparatus that revolutionized the way of producing. This intensive and mechanized agriculture has brought some benefits, but also caused many negative impacts on the environment, bringing in its wake several social consequences, such as the reduction of jobs in rural areas, as well as many environmental liabilities, such as the destruction of biomas, intensive use of water resources and biodiversity loss.

During the last years the society has been claiming for forms of production less harmful to the environment. Among these forms of production, can be cited the organic agriculture, permaculture and those grown on small farms, such as family farming. In Brazil, family farming was, for many years, relegated to the background, not being considered relevant in social and economic terms.

Only in recent decades that this segment began to receive more support for public policy development. Among these policies, we can mention the National Policy on technical assistance and rural extension (PNATER), established in 2003 and whose main objective is to contribute for a sustainable rural development in the country. The Technical Assistance and Rural Extension Service (ATER) was implemented in Brazil in 1940 and originated from the US model. For many years this model was heavily criticized because it was only focused on technology diffusion, not taking into account the social, environmental and cultural aspects of rural communities. In the late 1990's began a discussion to remodel the actions of the ATER, considering the wide debate on sustainable development, giving rise to this new policy. Among the new strategic direction of ATER, there is the strengthening of appropriate educational initiatives for family farmers, based on the Pedagogy of Alternation, and other educational experiences built on the reality of family farmers.

The Pedagogy of Alternation appeared firstly in France in 1935, with the rural family homes, proposing an alternative to teaching focused in urban activities, which forced the rural exodus. This pedagogy fundamentals itself in the principle of learning by doing, or, first execute and then theorize and reflect. In Brazil, this type of learning started in the 1960's in the state of Espírito Santo in the agricultural family schools. These schools are not public, but managed by associations of parents that through networking administrate public funds to maintain the schools, as well as the teachers and materials. The main objective of this paper is to present two cases of Ater services, based on the application of Pedagogy of Alternation. The paper starts with a theoretical discussion on ATER in the Brazilian and international contexts, in a historical trajectory until nowadays. Family farming will also be discussed, relating it to Brazilian law that defines this productive sector, its relevance and its present situation in diverse Brazilian regions. The first case studied is in the North of Brazil, in the Family School of Maracá. The second case is in the Family School of Santana in the Northeast of Brazil.

The two cases are presented and compared, in order to identify the different performance of the local actors in the articulation of the Pedagogy of Alternation with the local Ater activities. It is known that no single extension methodology is suitable for all situations and for all purposes, but while identifying the differences of performance among individual and institutional actors, it was possible to observe how training of technicians and young children of local farmers is enabling its attachment to the land. This paper contributes to research on sustainable rural development, more specifically related to initiatives undertaken by agricultural family schools that attend the premises of Pedagogy of Alternation within the Brazilian Policy of Technical Assistance and Rural Extension.

### **Production Of Freeze Dried Protein And Lactobacillus Casei Probiotic Biomass From Goat Milk Whey**

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In this communication, we document the technical feasibility of elaboration of two added value products from goat whey: (a) freeze-dried protein and (b) freeze-dried probiotic biomass of *Lactobacillus casei*. Results from goat milk whey ultrafiltration experiments are presented, from which high protein/lactose ratio protein is recovered. In its lyophilized form, this protein presents superior solubility characteristics with respect to analogous commercial products. The ultrafiltration permeate was utilized as growth culture medium for the probiotic microorganism *L. casei*. Results from batch and fed-batch fermentation experiments are reported. The growth kinetics of *L. casei* in de-proteinized goat milk whey is analyzed. From batch experiments, a kinetic characterization is conducted. A strong inhibition of biomass growth by lactic acid production is observed. Fed-batch strategies resulted in higher average productivities, lower residual substrate concentrations, and higher product viable counts than batch strategies.

### **Malawi starts the African Green Revolution, showing improved crop yields and increased drought resistance**

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Today, the African Green Revolution is starting with emphasis on overcoming soil nutrient depletion. Malawi presents a case of one country hit particularly hard by depleted soils—like many of its neighboring countries, it has faced widespread hunger in recent decades due to low crop production related to soil degradation. These soils are nitrogen limited. Small holder farmers produce 80% of Malawi's food, mainly maize. To address food insecurity, Malawi adopted a national agricultural subsidy program in 2005 that reaches almost 2/3 of all rural households. Each household receives vouchers redeemable for a discounted price on small amounts of nitrogen fertilizers, improved maize seed and legume seed. Since the subsidy began, national average crop yield estimates increased from 0.8 to 2.0 tons/ha.

At a well-studied field site, we have measured similar increases in maize yield with fertilization compared to areas where little or no fertilizer is not used. We use two remote sensing data sets (2000-2010) to study the impacts of fertilizer inputs on crop phenology (determined with MODIS Enhanced Vegetation Index time series) and interactions with rainfall patterns (measured by the Tropical Rainfall Monitoring Mission). We find a positive phenological response to nitrogen inputs and improved seed varieties. In the case of drought (2010), our analysis of the satellite data shows fertilizer inputs mitigated the impacts of the rainfall shortage and maintain crop yields. These findings are supported at the national scale by statistical data on crop yields. Quantitative assessment of this type is needed to assess crop fertilizer responses, develop best regional management practices and consider future programs supporting adaption to climate change and ensuring food security.

## Quality planting material production in cassava for sustainable food security in developing countries during challenging times

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Change in climate pattern has sent alarming signals to the global community to start working on alternative foods and food production to meet the inevitable food scarcity. Cassava (*Manihot esculenta* Crantz), a popular tuber crop has the capability to withstand adverse climatic conditions, holds great promise as a crop in times of temperature rise or drought condition. Studies have indicated that cassava can grow and yield under high temperatures, even to the extent of 45 to 48°C. It serves as a staple food for large numbers of people in the tropical and subtropical regions of the world. It is the fourth most important source of energy in the tropics. Cassava in general is a rainfed crop in nature, however; recent studies have revealed that manifold increase in tuber production could be obtained under irrigated condition. Another relevant characteristic of this crop is its potential to grow and yield even under low fertility condition. It has high carbohydrate production potential. Compared to cereals, the crop is a highly significant calorie yielder, estimated as 250,000 calories/ha/day compared to 176,000 from rice, 110,000 from wheat and 200,000 from maize. A number of value added and extruded food products are now available from cassava starch besides the traditional glucose syrup, dextrose, adhesives, dextrin etc. These have enhanced the food and nutritional value of the crop. Cassava is the most important subsidiary food crop in Kerala, a State in Southern India. The role of cassava in supplementing food grain production in the State of Kerala started since 1880. With the area under rice, the foremost cereal crop in India fast receding and the number of mouths to feed rapidly increasing, the demand for food will be tremendous and it will certainly be difficult to meet the requirement with the present food crops and strategy. The viable and cheap alternative is cassava.

The area under cultivation and production of cassava, however, is not increasing despite the tremendous potential of the crop as an alternative source of food to face the challenge of global warming and the inevitable famine. The major reason responsible for the impediment is the non-availability of quality planting material. Rate of multiplication in cassava is very low compared to cereals or pulses. While in cereals, the multiplication ratio is 1: 100 or above, in cassava it is only 1:10. Hence it takes pretty long time for quality planting materials of high yielding and hybrid varieties to reach farmers, if the traditional method of multiplication is followed. Studies conducted at the Central Tuber Crops Research Institute, India during 2003 to 2008, have evolved a farmer friendly method called “Minisett Technique”, by which it was proved that multiplication ratio in cassava could be significantly enhanced to 1:60 from the traditional 1:10. Second major problem hindering cassava cultivation is the rapid spread of cassava mosaic disease (CMD). Since cassava is clonally propagated, it facilitates easy and fast spread of this viral disease.

The minisett technique developed could successfully address the twin problems of low multiplication ratio and CMD. The study also opened a new avenue for enhancing productivity and production from a unit area of land significantly over the traditional method.

In the study, mother culture of the 3 varieties was indexed and sub cultured. Indexing technique developed at CTCRI ensured total freedom from viruses. The *in vitro* raised materials were then hardened in the specially made shade net nursery (35% shade) in small paper cups using vermiculite. Transplanting to nursery beds in the shade net house was done after three weeks. The spacing maintained was 30x30 cm. The plants were allowed to grow under protected environment, after which they were cut off from the base and made to minisetts for further multiplication. The mother stocks in the nursery bed were allowed for re-emergence as ratooned plants.

Disease free planting materials thus obtained were made in to one node, two node and three node minisetts and planted in nursery beds in shade net house at close spacing. The nursery bed comprised of sand and soil mixture in equal proportion. The nursery beds were irrigated when needed with micro sprinklers. The minisetts sprouts after a week and were closely monitored for incidence of mosaic symptoms, if any. Only healthy and disease free plants were maintained in the nursery. Growth parameters were noted after biometric observations in the nursery. They were transplanted to the main field before 30 days.

Virus free minisetts raised by the above process was then transplanted in the main field for field multiplication on ridges. Among the four spacings, used in the study, an increasing trend in tuber yield was distinctly seen with decrease in spacing. Closest spacing 45x45 cm resulted in significantly higher tuber yield of 35.7 t ha<sup>-1</sup>. Number of nodes and correspondingly the number of stems per hectare were the highest in 45x45 cm spacing. Second best result was obtained in the 60x60 cm space treatment. Experiments conducted on fertility management of minisetts revealed that the application of FYM @12.5 t ha<sup>-1</sup> at the time of field preparation along with 50 kg/ha of phosphorous fertilizer followed by N and K @ 100:100 kg ha<sup>-1</sup> after transplanting (N and K in two splits) was ideal for planting material production.

Harvesting of the crop was done on maturity. A closer spacing of transplanted minisetts (45 x45 cm) yielded 5.4 million nodes/ha or about 50,000 stems per hectare, which was significantly superior to wider spacings. In the traditional planting

only 15,000 stems could be expected. Apart from enhanced multiplication ratio, 36 t/ha of tuber was also obtained, which indicated high economic returns. Two node minisetts was found to be the ideal size for quality planting material production in cassava. The study indicated that multiplication ratio in cassava could be enhanced to 1:60 from the traditional 1:10, through two node minisetts. Further, the study revealed that planting material requirement in cassava could be reduced to 33% by using minisetts technique, compared to the traditional practice. Stems were carefully cut from the base and stored carefully without causing any harm to the buds. Stems were stored in a specially designed store house which had ample ventilation facility. The technique has thus opened new avenue for rapid production of quality planting materials in cassava and thereby inevitable increase in area under cultivation as well as sustainable productivity

### **WÉGOUBRI, the sahelian bocage: an integrate approach for environment preservation and social development in sahelian agriculture (Burkina Faso)**

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The NGO Terre Verte pursues the realisation of bocage perimeters (wégoubri in the mooré language) in Burkina Faso. They are an innovative concept of rural development that has been established in the 1990s in the experimental farm of Guiè and is now adopted in other experimental farms in Burkina Faso.

The deterioration of the rural landscape in the Sahel region has worsened in the last decades, endangering local populations. The creation of bocage perimeters in this rural landscape is a way to remediate problems linked to overly extensive agriculture.

Through a holistic approach to the problem, the experimental farm of Guiè has been able to integrate environmental preservation into the Sahel agriculture thanks to three axes of intervention: applied research, education and direct help to the peasants. An experimental farm relies on five technical teams, each supervised by a coordinator.

The concept is based on the creation of bocage perimeters in a mixed propriety regime, comprising individually owned plots and common grounds, managed by an association of beneficiaries. The result is a restored environment, in which agriculture is no longer tantamount to erosion and livestock farming to overgrazing, where trees and bushes are harmoniously integrated into the environment.

The increase in agricultural yields observed after a few years of soil restoration leads to the conclusion that those projects will be economically viable. A system of credits for farmers could allow the implementation of such a system, which represents the only solution for the millions of hectares of degraded soil in the Sahel region.

### **Promoting Consumption Of Sustainable Products: Attitudes Of Institutional Consumers In India**

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There has been an increasing concern with using sustainable development on account of widespread awareness on issues related to global warming and their impact on welfare of generations- both present and future. Promoting sustainable consumption is an equally important initiative in ensuring that sustainable development becomes self sustaining. It is expected that institutions in India could play a larger role in encouraging the consumption of sustainable products by exposing their employees, consumers and stakeholders to such products. Such exposure would help in introducing the sustainable products to many potential consumers simultaneously and may also lead to adoption of these products by other members of the family or extended family subsequently. At the same time, being bulk purchasers, the institutions could have a significant impact on suppliers through the size of their orders. The suppliers could be encouraged into marketing sustainable versions of products by the institutional consumers by removing some snags in adopting such products- a lack of sufficient demand and high prices. In the absence of demand, such products are likely to be expensive and therefore, out of reach of many customers.

It was decided to explore the attitudes of institutional consumers towards sustainable products in general and specifically, consumption of sustainable tea or coffee was selected. The two beverages are consumed in considerable quantities, but do not involve huge budget outlays in an organisation's allocation of funds. It was expected that the institutions would be more forthcoming in adopting sustainable products that did not require a large outlay. Moreover, either or both of the two beverages are consumed almost daily- in the office during working hours and also when employees socialise. In view of the time spent by working adults outside of home, at their workplaces, it is worthwhile to examine whether the institutions they work in can help in inducing the shift in consumption to sustainable versions of the two beverages. This paper examines the role of institutions in promoting the consumption of sustainable tea/coffee amongst their employees. It is

assumed that a demand generation would percolate to the growers of tea/coffee who would, seeing a rise in demand for the sustainable versions of the two beverages, make it more viable to use sustainable farming practices, reversing the cycle of unsustainable practices in the production and consumption of tea/coffee.

This paper examines whether selected institutions in India were aware of sustainable consumption in general and sustainable tea/coffee in particular; whether they saw any potential benefits in promoting use of the sustainable versions of the two beverages in office premises; whether they were willing to pay extra to purchase sustainable tea/coffee; whether they used other sustainable products and whether these organisations intended to initiate the use of the beverages if they were not already doing so and within what time frame. The paper also examines the problems the institutions expect to tackle in the process of adoption of sustainable products. It concludes that while institutions feel that they are socially responsible and may consider use of such products if they benefit employee health (and reduce absenteeism), in practice they do not yet have a timeframe within which they could see themselves as actually walking the talk. The paper concludes with recommendations for strategies to market sustainable products to institutional consumers.

The study was funded by Solidaridad and was conducted by the author on behalf of Partners- in-Change.

### **Analysis of Contract Farming on Maize for Sustainable Agricultural Development in Cambodia**

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The study is aimed at analyzing the present situation of informal contract farming (CF) on maize, which has been practiced in the North-west provinces of Cambodia, and trade and production of maize for the development of agricultural sector. The study has three main objectives as follows: 1) to investigate present CF practice and organization of production and cross-border trade of maize, 2) to explore the relationship between contract farmers and contractors by assessing the bargaining power of maize contract farmers with the contractors, and 3) to draw policy implication of the study findings to enhance economic impacts of maize production and CF performance. A combined approach of documentary review and field survey is employed to conduct the study. Documentary review provides a building block to develop an empirical model in the study. It is also a key source of secondary data in addition to primary data that is collected from the field survey for empirical analysis. Logistic regression is instrumentally employed.

In Cambodia, maize is the second major cash crop after paddy rice. It is basically produced by the smallholder farmers rather than large-scale farms. Production of maize is a kind of agricultural subsistence. It is predominantly dependent on rainwater and climate condition. As agricultural extension services are hardly available, farmers face huge difficulty in enhancing quality and quantity of maize production. Market access also stands as a chief constraint for farmers. As there are a few processing factories in Cambodia, Cambodian maize is generally exported to Thailand and Vietnam for further processing. It is of note that large amount of maize production is from the North-west provinces of Cambodia. Hence, Thailand is nearly an exclusive importer of Cambodian maize. The present maize CF practice in Cambodia is an informal contract that involves between smallholder farmers and individual middleman on seasonal basis. The contract is made by the means that a middleman provides a loan to the farmers and farmers agree to pay back the loan by selling maize to the middleman (contractor) at the cultivated season. The loan consists of cash and maize seeds (calculated into cash) that are recognized as input supports from the contractor. In this sense, the contract is made in advance when the maize production starts and price of maize is not predetermined. The price is kept open until the day that maize is collected from farmers by the contractor.

The empirical result indicates that maize contract farmers are likely inferior to the contractor in negotiating the price of maize. It is very often that farmers sell their maize to the contractors even though the price is sometimes lower than other buyers because they would find it difficult to get into the contract (get a loan) with the contractor next years if they sell to other buyers. Bargaining power of the contract farmers basically depends on six key variables. Firstly, the current contractor has positive relationship with the bargaining power of contract farmers. As the current contractors are local middlemen, contract farmers are very likely to be able to negotiate the price before reaching the selling and buying of maize. Secondly, years in the contract has negative relationship with the bargaining power of contract farmers. The longer the farmers are in the contract, it is probable that farmers have no bargaining power when they sell their maize. Thirdly, the duration of the present contract has positive relationship with bargaining power of the contract farmers. They are at odds of negotiating the price of maize when selling to the contractors. It is noteworthy that the present contract lasts about a season of maize production which spans around six months. Fourthly, type of the contract also has positive relationship with the bargaining power of the contract farmers. Since the present contract is a resource provision type in which farmers are supported only production inputs such as cash and seeds, farmers are more likely to be able to negotiate the price of maize when the contractors come to collect the maize. Fifthly, producing other types of crop has negative relationship with the bargaining power of the contract farmers. It means that contract farmers who

do not produce other types of crop beside maize are at the high odds of being unable to negotiate the price with the contractors. They are extremely vulnerable to price manipulation by the contractors. Lastly, but not least, knowledge of where to get advice or information about CF has negative relationship with the bargaining power of the contract farmers. The farmers are highly likely to be unable to negotiate the price of maize with the contractors because they do not have knowledge of CF and they do not know whether they can negotiate the price with the contractors. In conclusion, the Cambodian maize faces the problem of narrow market access which constrains the development of maize production and economic impact on farmers. Contract farmers as well as general farmers are highly susceptible to price fluctuation and external shocks. As the demand for maize from Thailand and Vietnam seem to be lower than the supply of maize from Cambodia, farmers are unable to get the high price and thus high return from their maize production. In particular, the maize contract farmers are very unlikely to negotiate the price with the contractors. Thus, expansion of market access for Cambodian maize plays a crucial role in attracting private firms to establish processing factories in Cambodia. In order to get the guaranteed supply of maize, the private firms would need to initiate the CF with farmers, who are the major holders of present maize production in Cambodia. As a result, the current informal CF practice which is not significantly helpful to farmers, especially the poor farmers, would be transformed into the formal one that would be able to promote economic benefits of maize production to farmers and sustainable agricultural development.

### **Role of Apiculture in sustainable development**

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Social development cannot be conceptualised without improvement of income generating capabilities of the people still laagering for basic needs and essential comforts of life. Use of natural resources without causing any harm to the existing environment is the only way to developmental sustenance.

Man, animals and plants are the main components of environment. Though independent in nature yet their interactive action plays a great role in maintain ecological balance. Absence of any component may cause ecological upheaval and upset system.

A synchronised behaviour of these three factors is very important for development and its sustenance.

Activities in Apiculture is one of cheapest and best ways of bring about the target area development, economically and socially with the desired sustainability and also without causing any harm to environment.

Artificial rearing of honeybees in available natural surrounding and production of honey is a very viable even in rural area. It involves less and affordable cost and yields much more profit.

Honey is in human use since the pre-historic days and testimony of its nutritional as well as medicinal value is traced back in epic age. It has also been and still been used in many of the Aurvedic medicines

Previously the method extraction of honey from natural honeycomb was not only difficult but crude also. Longstroth (1951) first designed artificial bee-hives to rear the honeybees and made the process easier, scientific and commercial.

Developed countries like USA, Australia, Canada, and New Zeland adopted the methodology and have achieved success.

Honeybees are dependent on plants. They collect nectar, pollen and sugar bearing secretions of flowers. The pollen so collected gets mixed up with enzyme secretions of the honeybee and gets converted in to invert sugar i.e. dextrose and laevulose. This mixture also gets mixed with some other contents and carried in the honey sacs of the bee up to the hive where it is stored. It is sweet and flavours in taste.

It is based on two principles, firstly Plantation and secondly, application of modern appliance

The activity aims at protecting the environment by plantation and thereby improving the climatic cycle as well as creating the opportunity of gainful employment for rural population, especially the women and enable them to add to the family income, improve and ameliorate their life style and the society for the sustenance of sustainable development.

### **Biotechnological approaches for food security, nutritional enhancement and sustainable development**

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Food security is a human right, and its provision is a common responsibility. Official recognition of this fundamental right has been marked by a progressive evolution either in international or national levels. However, and despite the high level

deliberations to end food insecurity and malnutrition around the world, more than one billion of people suffer at present from hunger. Long-term prospects foreshadow a continuation of this suffering – in fact, a worsening is seen on the horizon, in particular for Sub-Saharan Africa and Southeast Asia. Currently, the food issue has re-emerged vigorously and has been placed at the highest level of national and international (political, scientific, economic, and advocacy) agendas in a context dominated by such factors as: the soaring prices of basic food products; a decrease in non-renewable energy and mineral resources; alarming scenarios of climate change; and widespread domestic and international migration. It may seem unnecessary to remember that food insecurity is a result of the combined effects of many factors such as poverty, inadequate food production, degradation of natural resources, weather hazards, low incomes of farmers, debt service, the overvalued exchange rate and inflated human population growth. All of these have amplified pressure on the environment and on available natural resources. In addition, distortion and fluctuations in international agricultural markets—in particular the concentration of agricultural production in some exporting countries recognized by their protectionist trade policies—weigh heavily on food security deficits within many countries. Finally, the liberalization of world agricultural trade is also worsening the already deteriorated situation of the poorest countries. As a response, it is generally recognized that food production will have to increase to meet the constantly increased global demand. In these circumstances, the pressures that will be placed on agriculture to meet this demand require additional innovative solutions. In this perspective, we do not hesitate to consider sustainable agricultural development as a strategic choice to achieve food security. But the generic and cross-cutting nature of the concept of sustainable agriculture requires precaution in its use, country by country, and continent by continent. In other words, any strategy or policy development could now embrace the goal of sustainability, but the implications of such choices are numerous, particularly with regard to: food sovereignty; air, freshwater, and land use and management; biodiversity; social justice; ethics; and local or global governance. Addressing this specific cross-cutting characteristic of sustainable agriculture, therefore, is very crucial. Differences between contextual frameworks and objectives often confuse and complicate the decision-making process. Without a clear understanding of the purposes and expected outcomes of sustainable agriculture with reference to sustainable rural development, compromises on strategies and policies to be implemented would be less productive.

Although agriculture is an activity integral to human life and that of societies, and given that it marshals and consumes significant resources (that is, financial and technical, natural and human), the choices adopted at different political, socio-economic and scientific levels, there is -as yet- no consensus on the future of agricultural economy, food systems and rural areas. The current global food crisis, however, can be considered at this point as overwhelming evidence. The sustainable management of natural resources in today's world is a primary global concern, as increasing population and rapid technological strides are putting tremendous pressure on these resources. Plant genetic resources (PGR) are one of the most important components and these hold the key to a solid foundation of agriculture and nutritional security. The last three decades of the 20th Century witnessed an era, where in agriculture registered rapid progress and along with that, the collection, conservation and sustainable utilization of PGR gained importance. By the turn of the 21st century, PGR conservation has become one of the most widely discussed issues in the field of agriculture and environment. As the world population expands, the demand for food will increase; and as people become more prosperous, they will want to improve the quality of their diet. These two factors will require an approximate doubling of food production in the next 50 years. Only a small amount of this increased food can come from opening up new land for farming and reducing post-harvest losses of foods. Biotechnology can be part of the solution by making agriculture more productive and reducing pre-harvest losses to insects, plant diseases, and competition with weeds. Improving the nutritional quality of staple foods and enhancing the resistance of crops to drought, cold, and salt will also increase productivity and upgrade human diets. We need to adopt a global view of this issue, realizing that farmers in different countries and different environments face a variety of challenges. Biotechnology has much to offer these farmers. And both government and private sector groups should increase research efforts to find additional solutions for increasing the food supply while, at the same time, preserving the health of the environment and taking into account the social and political consequences of these changes in agriculture. In the past, genetic erosion was largely caused by natural processes within the context of evolutionary time scales, mainly because of climatic changes. The recent acceleration in the loss of genetic diversity, however, is mainly due to human activities. Hence, we are in a position to safeguard the plant genetic resources which are viewed as the heritage of mankind through exploration, collection and conservation. During every phase of exploration, we must keep in mind the economics of not only exploration, but the subsequent investment that must be made in increase, evaluation, regeneration and specially storage. Each collection is true worth its weight in gold or perhaps, in the long term, even in diamonds. Good coordination is needed so as to enrich our gene pool. We must not duplicate diversity already safely stored in our gene banks. So, explore today to use it tomorrow for betterment of mankind.

## Sustainability of Agricultural Development in Tribal Regions

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Agriculture in India is facing serious environmental conflicts. This problem is severe in tribal regions. Exploitation of biotic resources and coercive mining and mechanical development process has seriously affected land degradation and disturbances in agro-ecosystem at local and regional levels. The recurring conditions of drought, increasing waste and fallow lands, decreasing forest cover and high level of poverty etc. are the physical, ecological and socio-economic indicators of the degradation and depletion in the eco-system and the environment in these regions. The agricultural development policy in decentralized planning framework is more focused around transfer of modern technology and agricultural financing. However, under the condition of degradation of agro-ecosystem, the technology transfer is not effective enough for sustainability and growth of agriculture. It is necessary, therefore, to design a sustainable agricultural development approach in tribal regions in decentralized planning framework. Looking to the problems of degradation of agro-ecosystem and environmental conflicts and life-cycle degradation, the sustainable development would require restoration and regenerative activities in grass-root approach to develop a regional bio-productive cycle and bio-productive system.

The article is divided in the following sections. The first part identifies the pattern and causation of unsustainable growth in agricultural system in the study area. The environmental and resource degradation are the basic degrading factors. The second part deals with the strategic conflict in agricultural development policies pursued in tribal areas. The third part develops an integrated approach of sustainable agricultural development in system dynamic framework.

## Food as binding domain and concept in urban transitions: the case of Rotterdam

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This paper will explore food as an integrative theme in urban sustainability transitions. It will take up the challenge of applying transition theory to develop a long term sustainable urban development vision on food systems. Transition theory (Grin, Rotmans & Schot, 2010) operates on the premises that current routines and practices are not sufficiently equipped to dealing with the persistent sustainability issues that urban areas are faced with. Instead of emphasising the control of current problems, transition studies focus on conceptualising a long term vision for the future and developing strategies to realize this vision. Transition studies take a systemic approach to societal systems (e.g. 'the food sector'), focusing on the various societal functions fulfilled by this system. From this transition perspective, food in urban development is not merely a matter of efficiently producing healthy nutrition for people. Rather, it fulfils a range of (possible) societal functions connecting and creating synergies between different public domains, such as public health, education, social cohesion, environmental protection, employment and quality of life (Wiskerke, 2009:376). In this paper the city of Rotterdam, The Netherlands, is used as a case-study. Therein the focus is on the regionalization of the food economy (through spatially bound producer-consumer relationships) and subsequent issues such as the social norms, cultural traditions and food-related problems encountered in that region. The purpose of this paper is twofold. First, it will explore in what ways food can be used as binding concept in urban transitions. Second, it will suggest some first steps towards an integrated food strategy for the municipality of Rotterdam.

Cities are constantly in transition in which old functions lapse while new functions need to be integrated. Over decades such urban transitions have for example evolved cities from industrial to service-based or from rural to urban communities. Urban transitions may therefore be characterised as long term structural transformation processes in complex urban systems. The drivers for such transitions are of a diverse nature and are constantly at play, evolving and accumulating over time. The urbanization process that is currently taking place in large parts of the world requires an adequate urban development response reassessing urbanity and making sustainability a main driver. Major aspects here are integrating spatial planning, socio-economic stimuli and ecological solutions. Through public participation and experimentation, a more ecologically sustainable, socially liveable and economically healthy urban environment is strived for. Under these general denominators a large number of more operational principles like space use, health, affordability, safety, mobility, environmental impact, food (production) etc. are included and interconnected. Together these shape the complex social system that cities are, making us aware of related subsystems that compose urban transitions.

Transition management (Loorbach & Rotmans, 2010) searches for ways to deal with semi-autonomous processes in a pro-active way, guiding and accelerating social innovations while developing new modes of governance and policy making. A transition analysis, as applied in this paper, provides insights into what the characteristics of a sustainable urban food system could be (e.g. re-use, short supply chains, closing of cycles), what the preconditions for achieving such a system in the Rotterdam area are (e.g. policy support, internalizing hidden costs, sustainable products) and how such a transition



can be dealt with. In the analysis both intensive production methods (e.g. agro-parks) and extensive production methods (e.g. urban agriculture) are considered, while consumption is also problematized and elaborated upon.

At the level of cities multiple sustainability problems converge and become visible, while local government is increasingly in a position to influence local/regional development. Although the Rotterdam municipality committed itself to sustainable (re) development and is considered to be an exemplary front runner with respect to sustainable urban development compared to other cities (scoring high on indicators as economic development and physical quality and above average on indicators of energy, water and waste, and transport), it lacks in comparison to other global frontrunner cities on indicators of public green, self support, inhabitant mix, spatial quality, health, facilities, safety, and multiple area use. Using food as central binding concept, this paper argues that urban agriculture in the Rotterdam metropolitan area can contribute to more sustainability on such indicators. With food, production and consumption are brought together and opportunities arise to create solutions to a multitude of sustainability issues that surface in urban areas, such as health issues (e.g. obesity), liveability, climate change (food miles), food waste, water quality, land use, biodiversity and social justice.

The first part of this paper elaborates on food as a binding concept. Second, a transition analysis is carried out in order to gain insight in options for a sustainable urban food system. It finishes with concrete suggestions for the Rotterdam case study for implementation.

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### **GHG emissions hotspots identification of ice cream production: A case study in China**

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Unilever would like to assess greenhouse gas (GHG) emissions from the perspective of the ice cream chain as expanding its production in China. This study divided its entire chain into seven stages from dairy cows on farms till storage at selling points. Mass balance approach and scenario analyses were used to gain insight into the GHG hotspots of the ice cream chain. Integrated scenario results show that the carbon footprint of the ice cream (only based on milk, excluding other ingredients) in China is 1.2-1.8 kg CO<sub>2</sub> equivalent per litre. Milk production on farms, manufacturing in plants and storing at selling points were found to be the GHG emissions hotspots of the chain. Fossil fuels combustion for transportation and generation of electricity after the farm-gate mainly resulted in the GHG emissions. Carbon dioxide is the main GHG and accounts for 80% of the total carbon footprint.

# Material cycles

Pauline Deutz & Donald Lyons

## Oral Presentations

### **Conflicting principles of water and sanitation management in the context of rapid urbanization, growing inequalities, and climate change: A comparative analysis of India, Brazil, and South Africa**

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LaDawn Haglund, Arizona State University

In spite of their growing economic power, megacities around the developing world still struggle to provide their populace with basic services, such as water and sanitation (W&S). In this paper we situate these struggles in terms of the multiple (and often conflicting) framings of W&S with reference to economic, social, ecological, and human rights issues. The basic premise underlying this work is that understanding these conflicts is key to addressing not only the current problems in access but also the emergent risks and vulnerabilities - particularly in the context of climate change - and the opportunities for social learning and institutional innovations.

Taking the case of three major megacities in the global South - Delhi, Johannesburg, and São Paulo - we use census data to first examine the spatial distribution of household access to W&S and its correlation with socio-economic, demographic, hydrologic, and bio-physical variables. Previous studies have looked at the issue of water and sanitation in isolation. Our integrated analysis reveals how access to these two services is correlated quite differently with the underlying socio-economic and demographic variables both within and across the cities in the study. The second part of the analysis uses spatial clustering techniques to identify hot spots where these problems with access to W & S converge. Interestingly, we find that these hot spots are also areas where conflicts arising from unmet human needs (such as inadequate housing), ecological threats, and economic constraints are particularly acute. The third part of the paper uses a cross-comparative approach to understand what these conflicts are, how these have been addressed (or not) through the formal and informal legal structures, policy instruments, and governance mechanisms at play in each context. The paper concludes with comparison of outcomes through the lens of human rights and sustainability, analyzing the efficacy and generalizability of attempted solutions, mechanisms, and strategies across these contexts.

Our cross-comparative analysis across these megacities helps relate the structure and pattern of urbanization in these cities - particularly, the growth of informal settlements - to the spatial distribution of access to water and sanitation services. It throws light on what new risks and vulnerabilities are emerging with rapid urbanization and how these are likely to be exacerbated by climate change. Finally, it explores some of the cross-comparative lessons, particularly in the form of innovative approaches towards multi-use arbitration and citizen participation.

### **An empirical study on the interplay of eco-design practice and theory in UK large companies**

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There are manifest physical and socio-technically mediated limitations on the Earth's resources, the implications of which need to be balanced with the additional (potentially conflicting) requirements of meeting the climate change imperative. Notwithstanding that the environmental impact of a product's life cycle is established at the point of design, eco-design remains a marginal activity in manufacturing. The potential of eco-design as a point of intervention in product life cycles has been widely discussed in academic literature and is increasingly recognised in European Union and other policies. At the heart of innovation, product design requires a complex balance of intuition, iteration, practical skill, creativity, engineering and compliance. Design theory attempts constructively to bring these elements together. Significantly, an appreciation of design theory is largely absent from both policy and academic eco-design realms. Conversely, design theorists have shown limited interest in the extent to which their ideals are applied in industry. This empirical study of UK based manufacturers investigates the interplay of design theory and practice, whilst examining how environmental issues and policies are incorporated into the design process. A postal survey of manufacturers was undertaken in conjunction with semi-structured interviews, focussing on large companies drawn from a broad range of product categories. We have

found that whilst the formal design process advocated by theorists is recognised in industry, it is seldom deployed in full. Designers in general are satisficers rather than optimisers. The incorporation of environmental issues is largely confined to regulatory requirements. Further work is required to develop the lessons from this study to render all design sustainable.

## **Assessing Impact of Urban Growth on Efficiency of Water Utilities Using Data Envelopment Analysis (DEA)**

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Provisioning of water supply in terms of quality and adequacy is of foremost concern among all other urban infrastructure. In India the existing institutional set up consists of predominantly public utilities and is marked by organizational inefficiencies- lack of accountability, bureaucratic procedures, controlled and low tariffs; technical flaws such as, extent of metering, unaccounted for water, old piping systems, high leakages etc. Role of the central government is restricted to defining norms, guidelines and imparting technical assistance, the states are primarily involved for the provisioning of urban water supply, while the urban local bodies are responsible for the operation and maintenance.

Efficiency is the measure of how much output is generated vis-à-vis the input. Technical efficiency is a measure of maximizing output given the level of inputs employed. Data Envelopment Analysis (DEA) is a non-parametric frontier approach to define a simple measure of efficiency that could account for multiple inputs and does not require the explicit specification of the form of the underlying production relationship, Farrell (1957). The Malmquist Index (MI) is used to measure the productivity change between two firms or one firm over two time periods. The Index can be decomposed to estimate the technical efficiency change (EFFCH-with respect to the distance of the firm from the frontier) and the technological change (TECHCH-reflecting the frontier shift) over a time period (fare et al. 1989). It thus not only measures the productivity change but also the source of that change viz. Technical change/ technical efficiency change.

A National Institute of Urban Affairs (NIUA) study -“Status of water supply, sanitation and solid waste management in urban areas” and “Benchmarking and data book of water utilities in India” by Asian Development Bank (ADB) provide for data on water utilities in select Indian cities for the year 1999 and 2006 respectively. This data provides for a comparison over a seven year time period i.e. between 1999 and 2006 that is marked by significant economic growth coupled with equally strong population growth resulting in migration and pressure on the urban centers and subsequently on the urban water supply services. Water utilities of nineteen cities from the 2006 report and thirty seven cities from the 1999 report have been considered.

The methodology involves formulating a DEA model using GAMS software (release 22.2) to generate efficiency scores for the selected utilities for year 1999 and 2006. Staff, average daily production, unaccounted for water, distribution length & storage has been considered as the input variable. Water availability, connections & quantity of water supplied forms the output variables in the input oriented DEA model. For the common utilities in the two dataset the distance function was used to calculate the Index to measure the productivity change for the utilities between the 1999 and 2006.

Efficiency scores ( $\theta$ ) of 1.0 indicate the utilities at the frontier, and scores of less than 1.0 indicate scope for reduction in one or more inputs by the utilities. The average efficiency scores were 0.94 in 1999 and 0.96 in 2006. In 1999 unaccounted for water (UfW) emerges as the most critical factor affecting the efficiency of the utilities. The three worst performing cities viz. Jaipur, Kanpur and Hyderabad have among the highest values of UfW in the range of 30-36%. At the same time some of the utilities at the efficiency frontiers also have significantly high values of UfW such as Bangalore, Amritsar, Meerut and Nagpur. The inefficiencies arising in the distribution length of the network and storage capacity may be not only due to pure technical reasons, but can also be linked to the process of urbanization and the type of spatial development of the cities. These factors have a nondiscretionary dimension, and may arise in cities characterized by distantly placed pockets of development which may be the case of cities having an inner city area followed by urban sprawl, or cities undergoing high urbanization along with physical growth, which is characteristic of the smaller metros. In 2006 for the utilities with efficiency scores ( $\theta$ ) less than 1.0 viz. Bhopal, Coimbatore, Kolkatta and Nashik, UfW is the most critical factor, as is the case for the utilities in 1999. These utilities have among the highest values of UfW- in the range of 30-60% in comparison to the 30–36 % UfW levels for the least efficient utilities in 1999. Hence the UfW condition has deteriorated in 2006. But at the same time some of the utilities at the efficiency frontier also have significantly high values of UfW such as Bangalore, Amritsar, and Nagpur. While the overall range of inefficiencies has decreased from 1999 to 2006, UfW continues to be the most critical factor for the inefficiencies.

To identify the productivity change in the utilities between 1999 and 2006 the Malmquist Index for the eighteen utilities that are common in the 1999 and the 2006 data has been calculated.

From 1999-2006 four utilities show productive growth ( $MI > 1$ ), these are Ahmedabad and Mumbai at 33% growth, Surat at 31% and Vishakapatnam at 10%. The growth is mainly attributed to technological progress ( $TECHCH > 1$ ), with the exception of Vishakapatnam which has a higher efficiency change component. The four high growth water utilities belong to cities with both high and medium population- Mumbai with a 10 million plus population at 16.4 million; mega city Ahmedabad with population of 4.5 million and the lesser populated cities of Surat at 2.8 million and Vishakapatnam at 1.3 million population. During this period Chandigarh, Nashik and Kolkatta are the worst performing utilities with decline of 53%, 49%, and 42% respectively. In all the three cases the decline is largely attributed to the technological change component. In case of Kolkatta a detailed analysis of the change in the inputs and outputs over the time period of 1999 and 2006 shows that while population and physical growth has resulted in an increase in number of connections, storage capacity and distribution network; but at the same time a phenomenal increase in unaccounted for water has resulted in decrease in the total quantity of water supplied as well as the number of hours of water availability.

The Malmquist Index is further correlated to key efficiency indicators for the utilities such as operating ratios (OR) and revenue collection efficiencies (RCE). As expected an inversely proportional correlation exists between OR and MI and its components. Also the RCE shows a positive correlation to the MI, especially for the technological change component, but the correlation is weak. This could be attributed to the utilities under consideration being public owned utilities and may suffer from unviable pricing policy and weak managerial capacity.

Cities face increasing levels of urbanization. High levels of productivity are dependent on the availability and quality of infrastructure services. The Malmquist Index of the water utilities is studied with respect to their city's decadal growth rates (1991-2001). It indicates no strong impact of population growth rates on the productivity of the utility. This may be attributed to the ability of the water utilities to adapt to the increased urbanization pressures as the productivity of the utility is dependent on several other factors, such as institutional set up, state level policies, management etc.

It can thus be concluded that while the efficiency of the water utilities has largely remained unchanged to the production frontier between 1999 and 2006, there has been a deterioration of the technological best practice between 1999 and 2006. The increase in unaccounted for water is the major source of the inefficiencies and the deterioration of the production frontier merits immediate attention with necessary steps to be taken to reduce the losses in the urban water supply system. The performance measurement can be used for regulating the water utilities and can serve as a planning instrument for strategic interventions and effective funds allocations

The authors alone are responsible for the views expressed in this paper.

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## Enviro-Pozzolan: A Promising Construction Material

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Construction activities around the world use three billion tons of raw materials each year, which is equivalent to about 40 percent of total global use. Consequently, efforts aimed at sustainable development and environmental preservation are increasingly necessary, and depend heavily on every industry for success. The building and construction industries can significantly reduce the negative impacts of their activities on the environment through the use of green materials, which are made from renewable resources, such as industrial by-products and agrowaste. The cement industry is no exception in the effort for sustainability. Cement is one of the major raw ingredients that is used to make concrete, which is the most popular construction material worldwide. Although cement is a very versatile building material, it is made from non-renewable resources, it requires high amounts of energy in the manufacturing process, and it produces high amounts of CO<sub>2</sub>, which is one of the main contributors to global warming. The manufacture of one tonne of cement produces 0.5 tonne of chemical CO<sub>2</sub>, in a reaction that takes place at 1450°C. An additional 0.4 tonne of CO<sub>2</sub> is given off as a result of the burning of carbon fuel to provide this heat. To put it simply, the production of 1 tonne of cement results in the release of 1 tonne of CO<sub>2</sub> into the atmosphere. It is estimated that 5 to 8% of global CO<sub>2</sub> emissions come from cement production, which is the second fastest growing source of CO<sub>2</sub> emissions. Without altering the chemistry of cement, the reaction component of this CO<sub>2</sub> cannot change.

To this end, this research focuses on the use of palm oil fuel ash (POFA), which has great potential as a pozzolanic material that can be used as a cement replacement. POFA is a by-product of the palm oil industry and an agrowaste that is simply

disposed of without any commercial returns. The physical and chemical characteristics of POFA are significantly influenced by the operating system in the palm oil factory. Therefore, the aim of this study is to establish an optimized process for the production of a supplemental cementitious material using ground palm oil fuel ash for high-strength concrete. The production of this agrowaste-based cementitious material, referred to as “Enviro-Pozzolan” in this study, is optimized through systematic experimental investigation concerning various parameters: the optimum temperature needed to produce POFA with suitable physical and chemical properties, the optimum particle size for the ground POFA, as well as the optimum replacement ratio for using the POFA as a supplemental cementitious material for high-strength concrete.

This process involves an optimized production process based on pyrolysis, through which the palm waste material is thermochemically decomposed at controlled temperatures in the absence of oxygen; further processing of the resulting material involves combustion in the presence of oxygen to obtain the oxidation product, which is the POFA with suitable physical and chemical properties. The “*Enviro-Pozzolan*” produced through this optimized process demonstrates satisfactory improvements in the mechanical and physical properties of high-strength concrete, as well as its durability.

Taking into consideration the high availability of palm oil fuel ash in Malaysia, and the fact that it is an industrial waste that is normally sent to the landfill, this research is focused on employing this material towards sustainable development. Palm oil fuel ash (POFA), is an agro-waste that is produced in enormous quantities in Malaysia and Indonesia, as they are the biggest producers of palm oil and palm products in the world. It has been estimated that more than 8.1 million tonnes of the total POFA waste is generated from this industry in Malaysia alone. POFA is normally disposed of in landfills with no economic returns; therefore, the recycling of this agro-waste for use as a cement replacement poses many benefits.

Since environmental concerns are at a peak, the use of “*Enviro-Pozzolan*” has many advantages in promoting material greenness, as it involves the recycling of a waste material obtained from renewable sources. By comparison, fly ash, which is a by-product of coal combustion that is widely used as a cement-replacement material in concrete, is facing renewed environmental issues. Producers of fly ash contend that it is harmless; however, according to the US Environmental Protection Agency (EPA), fly ash contains heavy metals, including nickel, vanadium, arsenic, beryllium, cadmium, barium, chromium, copper, molybdenum, zinc, lead, selenium and radium. Additionally, traces of radioactive materials are present in fly ash. Given the large quantities of fly ash that are produced, a tremendous amount of radioactive waste is generated. As a result, in many parts of the world, a limit has been set on the level of radioactivity permitted in building materials made using fly ash. All this indicates that fly ash can pose serious health problems to the people who handle this material, as well as to those in the vicinity of infrastructure built with fly ash.

Although more fly ash is used beneficially in the cement and construction industry, more than 65% of fly ash produced from coal power stations is still disposed of. This amounts to approximately 7 million tonnes (Mt) disposed of annually in Australia, 40 Mt in the United States and hundreds of mega-tonnes in India and China. As a result, the disposal of fly ash is a growing concern for many countries worldwide. In India alone, fly ash landfills cover an area of 40,000 acres (160 km<sup>2</sup>). Furthermore, the hazardous nature of fly ash can create surface and groundwater contamination in landfill areas. This is an indication that although fly ash is considered a good replacement material for cement in the production of concrete, it raises great environmental and health concerns. Consequently, the EPA is currently proposing to regulate, for the first time, coal combustion residuals (CCRs) under the Resource Conservation and Recovery Act (RCRA) to address the risks from the disposal of CCRs generated from the combustion of coal at electric utilities and independent power producers.

The temperature for producing fly ash is generally around 1500°C, whereas the temperature for producing “*Enviro-Pozzolan*” is usually around 400°C to 700°C, which provides a great advantage for energy conservation. The method for removing fly ash from the flue gases can affect the quality of fly ash being produced. Fly ash obtained from cyclone separators is comparatively coarse and contains a large proportion of unburned fuel, while fly ash that is obtained from electrostatic precipitators is relatively fine. On the other hand, the collection of “*Enviro-Pozzolan*” is very simple, since it remains at the bottom of the furnace. In terms of economic savings, fly ash usually provides little cost break, depending on the geographic location. If the source of Portland cement is significantly closer than the source of fly ash, the cost differential may be minimal. Since palm is widely available in this region, and “*Enviro-Pozzolan*” involves a relatively simple production process, it can result in higher economic benefits.

The physical and mechanical properties of POFA are quite similar to those of fly ash. Both physical properties and chemical analysis indicate that POFA is a highly-reactive pozzolanic material that is rich in silica, grouped between Class C and Class F, as specified in ASTM C618-92a. Investigation into the use of “*Enviro-Pozzolan*” as a pozzolanic material for the production of high-strength concrete shows that the results are satisfactory in terms of compressive strength, drying shrinkage, water permeability, alkali-silica reaction, and sulphate resistance. The introduction of “*Enviro-Pozzolan*” produces moderate hydration, and increased setting time of the paste. Therefore, this research provides further technological knowledge concerning the use of “*Enviro-Pozzolan*” for high-strength concrete. The performance of the high-strength concrete is demonstrated through testing of its mechanical properties, through techniques such as the

scanning electron microscope (SEM), compressive strength test, direct tensile test, deformability and viscosity test, and flexural test. Durability of the high-strength concrete is determined through durability tests, such as alkali-silica reaction test, chloride immersion test, and water permeability test.

### **Tracking material flows over time: A case study of Non-Hazardous Industrial Waste in Pennsylvania, 1992-2008**

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While there is mounting case study evidence of successful industrial ecology (IE) practices via industrial symbiosis and material cycling from across the world, it is still difficult to gauge the impact of these practices on industry in general. In large part, this is due to the lack of available data. For example, while municipal solid and hazardous industrial waste are relatively well documented and understood in the United States, there are no federal and few state requirements for firms to report details on the billions of tons of nonhazardous industrial waste (NHIW) generated each year. An exception is the Commonwealth of Pennsylvania which began requiring all firms generating NHIW waste to report both the quantity and type of waste generated and how and where the waste was managed since 1992. As such, this dataset provides a unique insight into the structure and geography of non-hazardous industrial wastes in a major industrial state. The purpose of this paper is to present some preliminary results from this dataset to determine if industrial production in Pennsylvania has become more ecologically benign over the last 20 years. The results are significant because at the core of IE is the relatively optimistic argument that changes in technologies and institutional structures will promote ecological sustainability without the necessity of alternating the fundamental structures of capitalism. By examining how the generation, treatment and redirection of NHIW in Pennsylvania has occurred over time, we can begin to determine whether contemporary society has the capacity and willingness to make the necessary reforms to fundamentally reduce the environmental footprint of production and consumption.

### **Human Excreta: Resource for Sustainable Development**

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Among all known celestial bodies, the Earth is probably only place where any forms of life exist. All necessary resources (water, air, food, minerals, biodiversity, etc) and services (air and water purification, soil renewal, climate control, population control etc) to make any kinds of biological life possible are being endowed by the earth. Increase in human population coupled with technological innovation created tremendous pressure on the Earth. The Earth has limited capacity to cater life saving resources. Since past few decades, human being is utilizing natural capitals (natural resources + natural services) of the Earth more than its sustaining or supporting capacity. Currently rate of utilising natural capitals is about 21 % faster than the earth can support them. Indiscriminate exploitation of natural capital (resources + services); has now arisen question mark on sustainable human life on the Earth. Therefore, it is necessary to reduce pressure on natural capital while keeping continuous resource supply to the human society.

Modern society creates lots of wastes [solid (such as garbage, municipal, industrial, agricultural waste etc), liquid, gas, and temperature]. The generation of waste depends on several factors including population, economical status, climatic condition, and degree of modernization. Suitable modification in applied technology may affect quantity and quality of the waste. However generation of one especial type of waste, that is human excreta, may not be affected by any kind of technological changes.

Every day a huge quantity of human excreta is produced by human being. Indiscriminate disposal of human excreta is responsible for various types of life threatening water borne diseases such as jaundice, typhoid, dysentery, cholera and many parasitic infections coupled with loss of valuables resources in the form of energy and fertilizer. Human excreta remain among the most serious contaminants of drinking water. In 2002, 1.8 million people died from diarrhoeal a diseases caused due to human excreta contamination. Other problems related to indiscriminate disposal of human waste is emission of green house gases such as methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>) due to microbial activity under uncontrolled anaerobic condition and contributes accelerated global warming condition.

Availability of energy is the primary issue of any nation. Presently fossil fuel (coal, natural gas, oil) is the main source (about 82 % worldwide) of commercial energy. Energy production from "clean technology", a source other than the conventional fossils fuel which may prevent emission of CO<sub>2</sub>, the main culprit for global warming and climate change, is also a growing interest of today's technological society. Utilizing one of the most objectionable substance for production of biogas (methane) via anaerobic digestion will benefit the society by providing a clean fuel from renewable feed stocks. Thus biogas recovery from human excreta could be a promising option for both pollution control and energy recovery.

Some part of the world including India and China, human excreta is being utilized as a fertilizer and soil conditioner. Though there is potential applicability (such as a source of fertiliser and energy) of human excreta, still it is considered the most unwanted waste/refuse of society because of its nuisance and disease causing characteristics. Thus modern society generally does not give due consideration for efficient utilization of human excreta and only considers it as a pollutant, and thinks that it must be removed from society at any cost to protect human health. Presently most commonly adopted method to keep away human excreta is use of flush toilet, where a small volume of excreta is being mixed with large volume of water, and transported the mixture to a centralized treatment site employing a costly and complicated sewer network. Disadvantage associated with this process are loss of valuable resource in terms of plant nutrient, energy and water. Therefore, a holistic approach is warranted for utilization, which could lead to pollution control, resource recovery and water conservation.

The present paper will provide information about generation and characteristics of human excreta along with its disease and nuisance causing potential. Response of modern society towards human excreta will be discussed. Merit and demerit of modern and western concept of human excreta disposal and its suitability in developing country will be also be presented in brief. A secured option of human excreta disposal suitable for developing country, in which resource recovery (fertiliser and energy) would be possible, will be discussed in detail.

### **Moving Toward a Sustainable Future: Opportunities and Challenges for Ho Chi Minh City, Vietnam**

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The Vietnamese government has stated its intention to make the nation an industrialized country by 2020, and it has been actively seeking industrial investors by offering favourable investment conditions and highlighting its high proportion of labour-age population. As the result, there is currently a total of 233 industrial, export processing, and hi-tech zones in the country. In addition, there are plans to build an additional 106 industrial zones by 2020 (Vietnam Economic News, 2010). Economic development, population increase, urbanization and industrialization have resulted both in the increase in solid waste generation and also a diversification of the types of solid waste generated. The large amount of industrial solid waste increasing annually creates serious environmental problems in recent years. Environmental impacts coming from industrial solid waste management include soil contamination through direct waste contact or leachate, surface and groundwater contamination through leachate, and odour from landfills. In one of efforts to deal with the problems arising from industrial activity, the Vietnamese government revised the Law on Environmental Protection in 2005, in which it imposed strict controls through a registration-licensing system for industrial waste generators (Vietnamese National Assembly, 2005). In addition, the government has introduced a waste management strategy, to be carried out by 2025 that 100% of solid waste from urban areas and hazardous and non-hazardous industrial solid waste must be collected and treated (Vietnamese Government, 2008). The government considers that this can be an approach toward sustainable waste management solutions.

Before the revision of the Law in 2005, Nhan and Heinz (2003) examined cleaner production and industrial pollution control in Vietnam. In the same year, Jos (2003) studied the government policy on relocation or renovation in small-medium sized enterprises. Also, Dieu, et al. (2003) evaluated waste exchange practices in industrial zones and pointed out the key role of environmental information exchange in environmental management for industrial zones in Vietnam. In 2004, the World Bank reported that the amount of industrial solid waste was the second largest in the total of solid waste generation in Vietnam. Since the adoption of the revised Law of 2005, researches mainly focus on municipal solid waste management, and there are some studies focused on domestic waste landfill and energy recovery. Dan and Viet (2009) focused on the status of and strategies towards solid waste management in Ho Chi Minh City (HCMC). Today, questions arise about the current industrial solid waste management system because of the discrepancy between the ideals embodied in the revised Law and the actual practices occurring in the industry. We report in this study on the effectiveness of environmental policies, focusing on environmental performance in industrial zones of HCMC.

We studied the revised Law and related regulations on industrial solid waste to learn about the new structure of industrial hazardous solid waste management (Vietnamese Government, 2006a. b, 2007, 2008a. b; MoNRE, 2006a. b). Government records and reports from industrial solid waste generators were examined to ascertain the current status of its management system in HCMC. These records and reports were used to determine whether the regulations

had succeeded in addressing environmental pollution issues, and how industrial solid waste generators applied the regulations at individual sites. In addition, on-site surveys were carried out at 44 companies in HCMC in 2009-2010 to gain a better understanding of the totality of controls in the current industrial solid waste management system. On-site surveys were conducted at randomly selected locations based on a list of companies provided by Department of Natural Resources and Environment of HCMC. Interviews were also carried out with company representatives regarding their environmental performance. Questions about waste generation, separation, and treatment methods at the site were given together with questions assessing their knowledge of current environmental regulations. In addition, we also investigated material intake, production processes, discharge from each process, and collection and storage of waste at the site in order to learn more about company's efforts to deal with industrial waste they were generating.

The results show that problems related to industrial solid waste are increasing quite alarmingly in HCMC. Firstly, the companies' consciousness of their environmental performance was extremely low. In addition, in almost all cases' on-site surveys showed that large amounts of industrial solid waste were generated from old-fashioned manufacturing processes and equipments in every day. It is a threat to the environment. Secondly, a shortage of treatment facilities and its capacity is also a factor causing environmental violations. Due to a lack of both treatment facilities and techniques, problems arising from industry continue to be a pressing issue threatening the environment and health of people. Also, the problem of illegal disposal of industrial solid waste is a recent frequent topic in pollution control. Finally, the results also revealed that the incoherence of the revised Law and regulations in industrial solid waste management caused serious pressures on current domestic landfills. Development in sanitary landfills for treated hazardous waste is very late due to lack of funds in environmental protection. We conclude that there is a strong need for changes in the current regulatory and management systems so as to make them more effective for future sustainable development. It is required to examine environmental policies for urban sustainability not only from a very broad aspect but also from very specific aspects in all industrial activities. Besides addressing the current environmental issues on industrial solid waste management, this report suggests solutions for future sustainable development in developing countries.

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## Sustainable waste management for a rapidly growing and developing world

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Materials and energy are linked in several ways so it may not be surprising that the per capita generation of municipal solid wastes (MSW) is nearly proportional to the consumption of energy in a nation. As the generation of solid wastes has doubled and tripled, land and water pollution has become a major environmental problem, e.g., the «garbage patches» of millions of tons of solids floating in the oceans. This new problem has led to the «hierarchy of waste management» which requires to design products and services that result in the minimum possible amount of waste; and then recycle or compost as much as possible. However, international experience has shown that after all this is done, there remains a large fraction of post-recycling MSW that must either be landfilled or processed thermally to recover energy. Sanitary



landfilling reduces the potential for groundwater contamination and captures some of the generated methane, but consumes land (about one square meter per ton MSW). Thermal processing(also called waste-to-energy or WTE) produces over half a megawatt-hour of electricity and also reduces the carbon footprint of waste disposal by one ton of carbon dioxide, per ton of MSW combusted rather than landfilled. However, the implementation of either sanitary landfilling or WTE requires that government takes an active role in developing the necessary infrastructure, as it has done in providing transportation, potable water, electricity, and wastewater treatment. In developing nations, the first step is to provide separate collections of recyclables and trash.

## Posters

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### Exploring Waste-to-Energy in Red Hook, Brooklyn

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Sustainability in waste management is a growing area of concern for a majority of communities in the United States, as population continues increase while available space does not. During the past century the predominant waste disposal method has been via landfill - an unsustainable solution due to both land use and greenhouse gas concerns. An alternative to traditional landfilling is Waste to Energy (WTE), a technology that not only addresses the problems associated with landfilling, but also captures energy in the form of electricity. WTE facilities are characterized by their ability to incinerate municipal solid waste (MSW), a process which produces electricity and recoverable heat energy. Despite the benefits of WTE, many communities are resistant to the installation of WTE facilities out of fear that MSW incineration leads to the emission of high levels of toxins and pollutants into the atmosphere. However, this common misconception neglects the fact that WTE facilities emit pollutants at levels far below the EPA's emission standards due to their utilization of maximum available control technology (MACT).

As communities continue to struggle with the issue of sustainable waste management, our design team aims to design a WTE facility on an industrial site located in Red Hook, Brooklyn. In addition to the design, we will quantify the impact of the WTE facility in terms of waste reduction and energy production, while also demonstrating the benefits of WTE to the community. The industrial site is located near the Hamilton Avenue waste transfer station, which handles 2,600 tons per day of MSW along with an additional 1,274 tons per day of commercial waste. The proposed WTE facility plans to utilize the 2,600 tons per day of MSW as its source stream and is projected to generate 60 MW of electricity and 9,723 mm btu/day of heat available for industrial processes or district residential heating, while also recovering approximately 130,000 lbs of metal per day to be recycled.

Overall, traditional WTE offsets one ton of CO<sub>2</sub> equivalent emissions per ton of waste combusted. This means our proposed facility could reduce green house gas emissions by 950,000 tons of CO<sub>2</sub>-eq annually. Emissions reductions come from the elimination of methane accumulation in landfill waste, a reduction in transportation related emissions due to the 90% reduction of waste volume, and metal recovery. Additionally, electricity and heat generated on site will offset demand that would otherwise come from fossil fuel-based sources. Moreover emissions from a WTE facility are more strictly regulated and cleaner than those from a coal plant and fuel is supplied from a preexisting, renewable source rather than via energy intensive mining or drilling processes. Finally, the risk of harmful landfill leachate escaping into the groundwater supply is eliminated, addressing an important environmental health concern.

The WTE facility's design will be constrained by multiple factors: available site area, available waste stream input, air pollutant emission standards, economics, and overall desired efficiency of the facility. Based on these parameters, a design specification table will divide the WTE plant into three sub sections representing the requirements for the feed preparation, combustion and power generation, and emissions control processes. The proximity of this site to other

industrial and commercial buildings allows for the utilization of WTE process waste heat for district heating. The proposed WTE design is an optimized WTE plant with combined heat and power (CHP), which has the highest overall efficiency and therefore the lowest carbon footprint

The WTE design is divided into three stages mentioned above: feed preparation, combustion and power generation, and the emissions control processes. The feed preparation stage determined the overall tonnage of waste available, composition of the waste stream, waste truck routes to the WTE plant, and capital and operating cost of the plant. Next, the combustion and power stage determined the design specifications for the sizing and type of storage pit, grate, burner, boiler, steam turbine, and heat exchanger for low grade heat recovery as well as the optimal operating conditions for each unit. Lastly, the emission control stage determined the optimal combination of air pollution control technologies such as Selective Non-Catalytic Reduction (SNCR), scrubbers, and baghouse filters to reduce emissions to levels below EPA standards. Additionally the optimal ash treatment process for industrial use and metal recovery was determined.

The primary results and deliverables will be the complete design and layout of the WTE plant. Information regarding size and placement will be shown for the entry path in and out of the facility, the control room, pit, crane, hoppers, grates, boilers, turbine, electricity generator, steam distribution system, air pollution control technology, and ash recovery. Specific hardware for the plant will be chosen based on environmental and economic considerations. A thorough material and energy balance will be provided. Hardware sizing, operating parameters and maintenance cycles will be given for the combustion boiler, the steam turbine and generator, MSW feed system, and air pollution control units. A thorough economic analysis will be provided.

### **Sustainable Technology Development: A Case Study of Flyash Utilisation in India**

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Government of India started making concerted efforts from 1994 to utilize flyash. As a result, the utilization of Fly Ash got increased from one million tonne during 1993-94 to 60 million tonne during the year 2006-07. The authors explore sustainable development of technology by analysing flyash utilisation pattern in India. The paper presents the growth of flyash utilisation, different technologies available and factors affecting the utilisation rate of flyash. Flyash which was considered a waste earlier and needed large area for disposal is now being utilised for various purposes. A number of technologies were developed, demonstrated in the field along with user agencies, standards and specifications were prepared/updated and statutory measures were also taken during last decade.

Identification of appropriate sustainability indices to evaluate the developmental aspects becomes crucial to demonstrate and illustrate the associated aspects. The paper analyses the sustainability aspects of the technology development for flyash utilisation in India, considering ecological, social, economic, technical, legal and political dimensions in mind. The classification and mapping of different dimensions of sustainability, and the policy framework and action plans are correlated to adjudge the impact on sustainability of the technology development.

Utilizing waste for productive use becomes important from sustainability school of thought and its sustainable development thereby become more significant to develop and exploit it for sustainable future. This technology assessment exercise towards the use of flyash in India may help other technology developmental scenarios to support and contribute in ensuring the sustainability of a technology thereby leading us to sustainable future.

The success of the technology development fructifies from several initiatives both at institutional level as well as at individual level. To ensure the sustainability, the involvement of various stakeholder agencies such as those from R&D, academia, industry, power producers, Ministries and other Governments agencies of Central / State Governments, Regulatory bodies as well as user agencies is discussed for their contribution towards ensuring sustainability. With the estimates of generation of fly ash during the year 2031-32 to be around 600 million tonne, sustainable technology development and management becomes highly significant. Renewed thrust and increased impetus to already supported R & D and technology development activities is considered as a major factor along with a framework to continue the good initiatives already undertaken.

## **A Novel Design for Green Engineered Cementitious Composite (Green-ECC) Concrete using Palm Oil Fuel Ash (POFA) for Sustainable Development**

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Sustainable development encompasses all types of human activities, whether individual or collective, and relies heavily on every industry for success. This includes the construction and design industries, which have significant potential to reduce the negative impacts of their activities on the environment through the development and use of new materials, deliberately designed with sustainability as a primary goal. This can be accomplished through many methods, such as the use of new materials to extend infrastructure service life, the development of improved materials to replace less sustainable materials, or the replacement of dwindling raw materials with suitable waste products.

The cement industry is no exception in the effort for sustainability; although cement is a very versatile building material, it is made from non-renewable resources, it requires high amounts of energy in the manufacturing process, and it produces high amounts of CO<sub>2</sub>, which is one of the main contributors to global warming. The manufacture of one tonne of cement produces 0.5 tonne of chemical CO<sub>2</sub>, in a reaction that takes place at 1450°C. An additional 0.4 tonne of CO<sub>2</sub> is given off as a result of the burning of carbon fuel to provide this heat (Davidovits, 1994). To put it simply, the production of 1 tonne of cement results in the release of 1 tonne of CO<sub>2</sub> into the atmosphere. It is estimated that 5 to 8% of global CO<sub>2</sub> emissions come from cement production, which is the second fastest growing source of CO<sub>2</sub> emissions. Without altering the chemistry of cement, the reaction component of this CO<sub>2</sub> cannot change. Furthermore, cement is one of the raw ingredients that goes into the making of concrete, which is the most popular construction material; more than 11.4 billion tons of concrete is consumed annually worldwide (Mehta, 2001). In general, a typical mortar consists of about 45% cement by volume, and about 10 to 15% cement by weight for concrete. The demand for concrete is predicted to double over the next decade (Battelle, 2002); consequently, this trend is decidedly unsustainable.

In order to overcome the economic and environmental impacts resulting from the use of large amounts of cement, the proportion of 'pure cement' in a cement-based mixture can be reduced by replacing some of it with other pozzolanic material, which has the ability to act as a cement-like binder. Ashes from agricultural sources have also been used for making cement substitutes (Bentur et al., 1986; Mehta, 1992). Their improved properties of workability, long-term strength, durability, rheology and cohesiveness, along with lower heat of hydration, lower permeability and higher resistance to chemical attack, are reported in the literature (Khan et al., 2000; Mehta, 1989). The use of these supplemental cementitious materials not only reduces the amount of cement required for making concrete and mortar, but also leads to a reduction in construction costs.

One pozzolanic material showing great potential is palm oil fuel ash (POFA). Malaysia and Indonesia are the biggest producers of palm oil and palm products in the world. It has been estimated that more than 8.1 million tonnes of the total waste generated from this industry is from Malaysia, as reported in 1993.

POFA is a by-product of the palm oil industry; it is a waste material that is simply disposed without any commercial returns. The ash is produced as a result of the burning of palm oil shell and husk (in equal volumes) as fuel in a palm oil mill boiler to produce steam for electricity generation and for the palm oil extraction process. The resulting ash is 5% by weight of the original solid materials and sometimes varies in colour from whitish grey to a darker shade, depending on the carbon content. Thus, the physical characteristics of POFA are very much influenced by the operating system in the palm oil factory (Awal and Hussin, 1997). Both physical properties and chemical analysis indicate that POFA is a pozzolanic material, grouped between Class C and Class F as specified in ASTM C618-92a. Various researchers have reported that POFA is highly reactive and can be used as a unique cement replacement for building construction materials, if the POFA is ground to reduce the median particle size to 10  $\mu$ m.

Engineered cementitious composites (ECC) can significantly improve the durability of civil infrastructure. Unlike conventional tension-softening concrete and fibre-reinforced concrete (FRC), ECC exhibits metal-like tensile strain-hardening behaviour after matrix first cracking. The tensile ductility of ECC is several hundred times that of normal concrete and its fracture toughness is similar to that of aluminium alloy. Notably, ECC uses short, randomly distributed fibres with a moderate volume fraction, which is generally 2% or less. The high-performance, moderate-fibre content combination is achieved through micromechanics-based composite optimization. Compared with normal concrete, however, ECC uses more cement due to the absence of coarse aggregate in the mixture design. High cement content usually introduces higher hydration heat, autogenous shrinkage, and cost. Moreover, the associated increase in primary energy and emission of carbon dioxide create a negative environmental impact. ECC is currently emerging in

full-scale structural applications, including composite ECC/steel decks of cable-stayed bridges and precast R/ECC coupling beams of several high-rise buildings. As applications of ECC materials broaden, it is imperative to incorporate environmental concern into their development.

This research develops a novel design for green-ECC concrete by introducing ground POFA, which is normally an industrial by-product destined for landfill. The design for this new version of green ECC was optimized through systematic experimental investigation concerning various parameters, such as the optimum temperature needed to produce POFA with suitable physical and chemical properties, the optimum particle size for the ground POFA, as well as the optimum replacement levels for using the POFA as a supplemental cementitious material. A micromechanical design procedure was implemented, in which micromechanical principles are used to tailor the various components of the composite at the microstructural level to achieve the exact material performance required. A micromechanical model was developed in order to relate macroscopic properties to the microstructure of the composite; the effect of matrix mechanical properties on composite properties was reviewed with regard to conditions of composite pseudo-strain-hardening. A systematic investigation was then conducted on the effect of matrix composition on matrix properties. Evaluations were carried out to determine the optimum temperature needed to produce the POFA in order to control the carbon content, and the optimum particle size for the ground POFA. This systematic microstructure tailoring of the green ECC was carried out in order to develop an optimal design that produces mechanical properties, such as tension, compression, shear, fatigue and creep, and physical properties, including shrinkage, and freeze-thaw durability that satisfy or even exceed standards and specifications for ECC.

Incorporating palm oil fuel ash for the production of ECC helps to achieve many significant goals. Firstly, environmental impacts are reduced since the POFA is recycled rather than sent to the landfill. Also, the use of POFA as a cement binder decreases the amount of cement required, which results in lower greenhouse gas emissions from the production of cement, as well as lower hydration heat and less autogenous shrinkage. Since a lower amount of cement is required to produce the POFA-ECC, it is also a cost-effective alternative for making concrete structures, with improved durability. All these goals serve to promote sustainable development through simultaneous enhancement of material greenness and infrastructure durability.

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### **Critical issues in the life cycle inventory of a new technology for the inertization of MSWI fly ashes**

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Improving the environmental performance of waste treatment technologies can give a great contribution to sustainable waste management systems. In recent years, the incineration of municipal solid waste (MSWI) has continuously grown worldwide. Incineration also generates waste. In particular, the quantity of fly ashes produced by MSWI represents a significant percentage of municipal solid waste (MSW) incinerated. Fly ashes are a hazardous waste, since they contain large quantities of soluble salts (NaCl, KCl, calcium compounds), and significant amounts of toxic heavy metals (Pb, Zn, Cr, Cu, Ni, Cd) in forms that may easily leach out.

There are basically two possible ways to treat these residues: landfill after adequate treatment or recycling as a secondary material. Nowadays, research is being directed to the inertisation of fly ashes, since it can facilitate their recycling as a secondary material instead of landfilling, but also specific applications of inertized materials are required in order to prevent landfill practices.

The best available techniques for inertization process of fly ashes can be grouped into three categories: separation processes, solidification/stabilization processes and thermal methods.

Among the solidification/stabilization processes is the COSMOS process, developed at the Chem4Tech laboratory of the University of Brescia (Northern Italy). This technique combines the metal stabilization of the metals in a solid matrix with a successive washing treatment.

The process is composed of two main stages. In the first stage the MSWI fly ashes are mixed with coal fly ashes and with flue gas de-sulphurization residues. The mixture is then added with a water and colloidal silica. The slurry obtained is ripened at ambient temperature obtaining a solid, clay-like, aggregate.

In the second phase, this aggregate is shattered and washed to rip off the soluble salts, mainly chloride compounds of sodium and calcium.

Finally, the mud obtained from the aggregate washing is dehydrated and again shattered obtaining a solid inert: the COSMOS.

At the moment, it is under study the possibility to use the COSMOS as a filler in different materials (rubber, polymeric compounds, cement, etc.) and the preliminary results seems to be promising.

Recently, the European Commission, with the funding program Life+, has funded a project, called COSMOS project (<http://www.cosmos.csmt.it>), proposed by a set of partners, among which the University of Brescia, that has the objective to demonstrate the industrial applicability of this new technology, including the assessment of the possible environmental advantages.

Considerable research has been undertaken worldwide on the general subject of fly ashes management, in particular considering coal fly ashes generated during the combustion process for energy production.

In literature there's also a large amount of papers investigating new processes for the treatment of MSWI fly ashes. In particular, great attention is paid to the stabilization of heavy metals, not only with high temperature processes, such as vetrification, but also with low temperature processes. Among the most investigated stabilization methods at low temperature are cement solidification, chemical stabilization using organic chelators or inorganic chemicals, or combination of organic and inorganic reagents.

Few studies are dedicated to other pollutants within MSWI fly ashes, such as polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzo-furans (PCDFs).

The primary objective of these studies is the reduction of the environmental impact of MSWI fly ashes treatment, and thus in general of MSWI waste management. Despite this, few of them assess the environmental benefits of the process or of the technology studied in a systematic manner and using a structured environmental assessment methodology, such as the life cycle assessment (LCA).

In the waste management field, in particular in waste policy decision making, a large amount of guidelines and methodologies based on LCA have been developed even though a lot of issues are still to be addressed.

Also with reference to LCA of waste management processes and technologies, a large amount of papers have been published, but very few of them have as subject matter the management of fly ashes. In particular, they consider coal fly ashes and wood fly ashes, while there's no evidence in literature of LCA applied to MSWI fly ashes management, except for one work of Fruergaard (Fruergaard T. et al., 2010).

Based on the case of the COSMOS process, this work focuses on the analysis of the critical issues to be addressed during the life cycle inventory (LCI) phase of an LCA of a new technology process for the inertization of fly ashes coming from MSWI. The LCA analysis conducted over a new technology bears some problems, due, for example, to the lack of primary data (i.e. data gathered on the field) or to the lack of consistency of secondary data (i.e. data taken from literature and databases) with respect to the data quality requirements. Of great interest for the LCI of the new technology process taken into account in the paper is the fact that a pilot plant for the MSWI fly ashes inertization process, funded by the European Commission through the Life+ COSMOS project, will be available as a source of data. In the paper, the main different possible assumptions for the LCI phase will be identified and discussed, also in order to assess the advantages arising from the availability of a pilot plant.

Fruergaard T., Hyks J. and Astrup T. (2010). Life-cycle assessment of selected management options for air pollution control residues from waste incineration. *Science of the Total Environment*, n. 408, pp. 4672-4680.

## **Characterization of municipal solid waste (MSW) in the town: Case study of Luzhi Town, China**

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With the continuous rapid development of urban construction in China, management of municipal solid waste (MSW) has become a significant environmental problem, especially in fast-growing towns, due to the continually increasing amount of MSW being generated and the limited capacity of waste treatment facilities. One of the particular interests is the way of comprehensive utilization of MSW. To determine the most sustainable waste management strategy for China, it is necessary to identify the composition of the MSW. However, an analysis of the physical–chemical characterization of MSW is not available for the town in China. This research focuses on it as a baseline for the sustainable municipal solid waste management (MSWM). Luzhi Town in Jiangsu Province is taken as a case study to provided MSW generation and composition for compilation and assessment. Three-stage stratified cluster sampling was used to evaluate solid waste data collected from 36 households and 4 MSW transfer stations in spring and autumn. The average MSW generation rate was 0.65kg/person/day. Key household waste constituents included 67.9% kitchen waste, 11.6% ash and dusts, 7.7% paper and paper products. Moisture content is higher in spring than in autumn. And MSWs from the transfer stations are with higher moisture content than from the domestic rubbish. The calorific values of MSW were analyzed. The results are essential for making decisions regarding the management of waste and constitute a valuable contribution to the study on integrated management plan of MSW in Suzhou.

# Equitable resource allocation and poverty reduction

Cheryl Palm & Annelies Zoomers

## Oral Presentations

### **An Integrated Approach for Water, Environment, Livelihood, and Rural Income Sustainability in Mali, Africa**

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Mali is one of the poorest countries in the world, with approximately 60% of the population living in poverty. The Food and Agriculture Organization (FAO) of the United Nations has estimated that 28% of Malians are undernourished. The UN has projected that the population of Mali could increase by 49% between 1996 and 2015, which will further strain already deficient resources. Agriculture accounts for a substantial portion of Mali's gross domestic product (GDP) and employs a large portion of the country's workforce. Malian farmers are still using primitive irrigation methods, manual tillage tools, flood irrigation without drainage systems, and unimproved crop varieties for producing their food. As a result, they have dispersed and small cultivated plots (100 m<sup>2</sup>/family), water and soil quality degradation and desertification, insignificant income and extreme poverty, Jobless, and food insecurity and hungers. The overall goal of this research is to develop and evaluate an integrated approach for water, environment, livelihood, and rural income sustainability in Mali. The specific objectives are to establish multi-season agriculture and crop diversification, increase yield and crop water productivity, achieve water and food security, eradicate extreme poverty, promote gender equality and empower women by increasing the cultivated area per woman (25 times), improve soil and water quality, control malaria and combat desertification, and ensure water, environment, livelihood, and rural income sustainability. The overall goal and the specific objectives will be achieved by proposing six potential strategies which are applying simple, efficient, low-cost irrigation technologies, using tillage systems and farm machinery, improved crop varieties and certified seeds, establishment of multi-season agriculture, forming water Users' associations, and establishing warehouses. This study will deal with food security and livelihood challenges to ensure livelihood and rural income sustainability and food security in Mali. Also, the six potential strategies will be presented and discussed

### **Evolution of Traditional Chinese Villages into Sustainable Towns: The Sustainable Area Budget**

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Laura A. Frye-Levine, Center for Sustainable Cities

Heidi Dumreicher, Oikodrom – The Vienna Institute for Urban Sustainability

Perhaps the greatest experiment being carried out on the planet today is the trajectory of Chinese development. There are so many dimensions to this trajectory that it is impossible to understand if the positive ones like China's growing dominance in renewable energy technologies, have any chance of balancing out its harmful trajectories like the growing pollution through accelerated burning of fossil fuels. A good indication of China's ultimate effect on the global unsustainability equation will lie in the fate of China's million small farming villages where the majority of Chinese people still live. The largest ongoing global migration in history is the relocation of Chinese peasants from these small villages to the new and growing, grossly unsustainable industrial cities, mainly along China's coasts. There are many additional reasons why these villages, at least in anything like their current form, will be gone within a generation. One way of viewing the Chinese experiment is to cast it in terms of the many possible ways in which China can transform itself from an agricultural country of numerous small villages to a manufacturing country of vast industrial cities. This paper describes how the energy and resources embodied in this migration can bring about a transformation from traditional Chinese villages to sustainable towns. The paper describes how a participatory, multiple alternative scenario-building, design based approach at the scale of the town-region may hold the keys to a smooth transformation to a sustainable society in China.

Current approaches to sustainability are analytically based. Sustainability indicator methods have become popular ways of assessing how badly we are doing in any number of separate categories. As such they should rather be called

“unsustainability indicators.” Ecological Footprint methods have the advantage of aggregating the levels of unsustainable activities into a single quantity of biologically productive land area necessary to support a given way of life on a regenerative basis. For the sake of global equity this area is applied to the 6.7 billion people now inhabiting the Earth to indicate the number of planets that would be necessary if everyone lived according to such a lifestyle. This is a powerful way of raising awareness as to the magnitude of the growing problem, but it doesn’t lead to an integrated plan of action that might have any possibility of resolving the problem.

In contrast the Sustainable Area Budget (SAB) Method has been developed that starts where the footprint methods leave off. If we divide the Earth’s arable land area by its 6.7 billion inhabitants, we arrive at the area of land that each of us can lay claim to on an equitable basis – land that we can use while we are here as long as we don’t degrade its biological possibilities. The land available to a town is thus the aggregated land area of its inhabitants – its Sustainable Area Budget. In principle the town can use this land (and only this land) any way that can be negotiated among its citizens, in an informed, participatory, balance-seeking process, as long as its use of the land does not export harmful imbalances beyond its territory or into the future. This principle forms the basis of perhaps the only operational definition of sustainability that has thus far been proposed.

There are no towns or cities in the modern world that are operating on this basis, but in China there are many villages that because they have been touched only lightly by the modern world have a very small ecological footprint and are nearly operating at what we have called a protosustainable level. (We use the term protosustainable rather than sustainable because they operate at rather low levels of material comfort and are far from having social conditions that could be acceptable in modern society.)

In a temporal and a material sense the metabolism of life in the Chinese village is quite transparent, permitting the construction of system dynamics models of the energy, material and time flows of individual families and of the whole village. With such modeling we can regress the model and eliminate the few aspects of the village that are effected by unsustainable means replacing them with sustainability oriented means. Yet such a protosustainable model does not describe a settlement that is acceptable in the modern world. In order for that to happen we need to incrementally enlarge the village model through a participatory, balance-seeking process to include a diverse array of businesses and occupations providing sufficient opportunities and life choices to become a viable alternative to the large cities. Such a sustainable town provides for all of its own food and energy (on a net basis) and balances its exports and imports, within its Sustainable Area Budget. The villagers evolve the protosustainable village model into the sustainable town by playing the Sustainable Town Game™ using system dynamics software – the Sustainability Engine™ (think, Sim City). The game starts out with a village of farmers whose interests are all much the same, but the larger and more diverse the village/ town becomes the more the interests of the new player/citizens diverge and compete with one another. This is one reason a number (three or more) of different town models are developed in parallel, each with different constituencies, and different inherent interests causing the emerging towns to develop different structures and characters. In the first few iterations of the game, none of the models works very well or is near balance and each has its strong and weak points. After a few iterations the better aspects of individual models tend to be adopted by other models and the weaker aspects tend to be replaced. Over time through a number of playings of the Sustainable Town Game™, the vibrant sustainable town emerges.

## **The Kenyan Handicraft Industry and Environmental Sustainability: The Case of Mwala District, Kenya**

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The study was set out to research and assess the impact of the handicraft industry on the environment. It specifically looked at the wood carving and basket weaving handicrafts in the Wamunyu and Katangi areas of Mwala District. The respondents were sampled from men and women in these areas who were involved in the actual production and marketing of these handicrafts. Co-operative officials and development agents working in these areas were also interviewed to analyze the link between change agents and community development in the region.

In order to obtain the set out objectives the research sought to answer the following questions:

What is the level of environmental impact awareness amongst the woodcarvers and basket weavers?

What are the various environmental impacts of woodcarving and basket weaving?

How do the wood carvers and basket weavers source and manage their raw materials?

How can the wood carving and basket weaving be undertaken in a sustainable way?

What is the role of development partners in the study area?

From the study it emerged that wood carving is a major informal industry in Mwala district, which provides a source of livelihood for many families from the drought-prone area. This being a semi-arid region, dependence on crop production



is risky. Wood carvers have traditionally used specific tree species in the industry. These include 'muhugu' (mahogany or *Brychylaena huillensis*), 'mpingo' (African Ebony or *Dalbergi melanoxylon*), Olive (*Olea africana*), and Rosewood (*Combretum schumannii* or *Spirostacys africana*). As the industry has grown and the demand for these woods increased, carvers have become main forest users contributing to the severe destruction of Kenyan forests. Consequently the demand for these indigenous trees has outstripped the supply. This has led to wood carving being practiced to the detriment of the environment as witnessed by the complete disappearance of some indigenous trees that were originally used in the industry.

The future of the wood carving industry is therefore threatened if the current products, consumption patterns and use of raw materials do not change. This situation is particularly worrying in such a country as Kenya where employment opportunities are extremely limited and, where over 500,000 people enter the labour market each year. Therefore, for a meaningful shift to environmentally sustainable carving, it is essential to create awareness and to educate the carvers and consumers of carved wood products. Also in order to satisfy current and future demand, efforts must be made to manage and utilise natural resources on a sustainable basis.

To reverse the trend of progressive forest degradation and reduced incomes from sales of carvings, the implementation of a Sustainable Product Development (SPD) strategy is essential. Producers and traders must work together to develop strategies that ensure a sustainable supply of raw materials. Reforestation is urgent and needs to be done on a scale sufficient to ensure a sustainable source of raw materials for future generations. This approach will promote a sense of ownership of the trees among the carvers.

In general, there is no effort in the area to replenish the resource base as most carvers view the industry in terms of monetary gain. As for the basket weaving, the destruction of the resource base is not as much as that for the wood carving. However, this should not be interpreted to mean that no efforts should be made to replenish the resource base.

From the findings of this study, conclusions drawn were that although there is some reasonable level of awareness about the impact of the activities on the environment, this is irrelevant to the wood carvers and basket weavers because their immediate concern is income to meet their basic needs. It is important to note that this is a semi-arid area where rain-fed agriculture is not economically viable and as such the handicraft industry gives the inhabitants of this area an alternative means of survival. To this end, environmental awareness alone is not sufficient to effect sustainable wood carving and basket weaving.

The findings also indicate that there is no clear link between the farmers, wood carvers and basket weavers; a link if properly exploited, can be useful for a sustainable handicraft industry in that the farmers would grow most of the raw materials needed. They would in turn sell them to the carvers and weavers to make money.

The research confirms that the handicraft industry has vastly expanded in recent years as a result of increased unemployment thus making wood carving an option for school leavers and dropouts. There is also a need by rural households to find cash income sources as well as increased demand by the tourist sector and the international market.

The study found out that there is a serious conservation problem for the industry and there are clear indications that this business cannot be sustained unless drastic steps are taken to reverse the trend. The tree species preferred by the carvers are rapidly disappearing because of their immediate commercial value.

The women should also be empowered to demand more from co-operative society that markets their products. This is more so because the art of making a basket is so tedious and returns are minimal. Ironically, when the baskets get to the urban centres or to the international market, the price is usually almost ten times the original purchase price. This would empower the women financially and in turn use the extra income for environmental projects such as tree nurseries.

## **Sustainable Management With Participatory Compensation Techniques For Coastal Tidal Basin: A Case Study On Beel Khukshia**

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Khulna-Jessore Drainage Rehabilitation Project (KJDRP) was implemented during 1997-2002 to recuperate 106,000 hectares of land from drainage congestion in Jessore and Khulna districts of southwestern Bangladesh. Tidal River Management (TRM), suggested by the local people, was elaborated as an innovative and sustainable participatory approach for the sustainable drainage and flood management. As the TRM process is technically and environment friendly, the effective initiation depends on social, institutional and managerial involvements. Previous experience of TRM

application on Beel Kedaria reflected that effective compensation mechanism is required for sustainable and participatory TRM. The main objective of this study was to develop a compensation mechanism to compensate the stakeholders of Beel Khukshia, under TRM operation to ensure its sustainability. According to the participatory sessions, seven possible compensation options with two proposals were identified and analyzed in this study. "Crop Compensation by Cash and Free Fishing" was selected as the most effective compensation mechanism considering the stakeholders (landowners and local people) of Beel Khukshia. Finally, a compensation plan was suggested to ensure sustainable compensation for TRM in Beel Khukshia. The selected and identified compensation mechanisms can be replicated with subsequent modification to the other tidal basins in future for TRM under KJDRP and other drainage congested area of southwestern Bangladesh.

### **Can Forest Land Allocation policy solve conflicts between conservation and sustainable development? Evidence from protected area management in Central region of Vietnam.**

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With global concerns over climate change and forest degradation, poverty reduction in and around forest areas seem to be less prominent on the agenda, even though there is an intrinsic link between poverty and deforestation. In this highly complex context, where forests must fulfill roles that range from global to local ecological and socio-economic services, forest policies face new challenges, depending on the institutional, legal and economic conditions in different countries. Vietnam has already taken up this challenge to integrate rural development with conservation issues from the early nineties onwards through their Forest Land Allocation (FLA) policy.

After almost 20 years of FLA policies implementation, this paper analyses the impacts of these decentralization FLA policies have on forest protection and socio-economic improvement of selected rural communities in and around the buffer zone of the Bach Ma National Park (BMNP), Central region of Vietnam. It pays particular attention to the effects of FLA policies on long existing customary institutions at the community level to sustainably use and protect forest resources. The research argues that the policy was a good initiative to create resource use rights as well as co-management for local communities. However, conservation goals do not seem to be met, as local people do not benefit from the implemented "conservation" measures, shown by continuous illegal encroachment into the core zone of the BMNP. The main reason is that active participation of local people is absent, and policies do not fit the local needs and priorities. The paper concludes by considering new challenges in policy development to address new obligations in conservation and rural development through decentralization reform.

## **Posters**

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### **Mining And Sustainability Of Small Island'S Community Livelihood (A Case Study In Sebuku Island, South Kalimantan, Indonesia)**

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Known as the biggest archipelagic nation in the world, Indonesia comprises of more than 17,500 islands. Many or most of the islands are categorized as small islands. Therefore, small islands play a very important role in Indonesia's in term of social, political, economy, and ecology.

Sebuku is one of the 109 islands in Kotabaru Regency (*Kabupaten*) in South Kalimantan Province, Indonesia. The size of the Sebuku island is 245.5 km<sup>2</sup> and therefore categorized as a small island [1]. Since a couple of years ago, two mining companies enter the island to exploit iron and coal.

This study investigates impacts of the mining industry on the local community, especially their livelihood. As an initial study, we used Rapid Rural Appraisal as our method. Data were collected mainly through interviews with several key informants and through focus group discussions. The research was conducted in July 2010.

Our study found that the introduction of the two mining companies into the Sebuk island has profound impacts on the local community. A significant size of the island has been “taken over” by the companies and therefore can not be used for agriculture by the local community. There is even a plan to “buy” entire of a village in the island by one of the mining companies in order to expand its operation areas.

Many villagers in the island switch their livelihood from agriculture to mining activities. Villagers consider working in the mining companies is better than in agriculture, both in term of income as well as prestige.

Mining activities have another direct impact on the local community’s livelihood. On April 2010, the wall of a mining waste storage broke up. The incident brought flood surrounding the area and damage local plants. It also polluted the water. Mining activities also disturb fishermen livelihood in the island, both through environmental degradation and by “occupying” fisher’s fishing ground.

Thus, penetration of the mining industry into the Sebuk island threaten sustainability of the local community’s livelihood, both in the short and the long runs.

[1] Indonesia law No 27/2007 (UU No 27/2007) defines small island as an island with size smaller or equal to 2,000 km<sup>2</sup> with its ecosystem.

## **Impoverishment Risks Due to Involuntary Displacement and Resettlement in the Hydroelectric Development Project: How are they managed?**

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The objectives of the research are to investigate how impoverishment risks are managed, to identify achievements and limitations of displacement and resettlement plan and policy, and to provide decision and policy makers, practitioners, and researchers with support information, analysis models, and lessons learnt to improve the efficiency of involuntary displacement and resettlement plan and policy during the preparation and implementation of hundreds of in-coming hydroelectric plants in central Vietnam.

The research investigated information from resettlers including direct and indirect affected persons, local authority levels, the project owner, and compensation committees. Furthermore, there were several dialogues organized between villagers and local authorities to discuss on the real situation before and after relocation. All data and information was compiled and analyzed in order to draw a picture of relocated persons on impoverishment risks and livelihood restoration strategies. There were 50 affected households interviewed to obtain information on changes before and after displacement to make an assessment in combination with the analysis of household data using SPSS software.

Findings show that the displacement and resettlement is a complicated social transition process that might impoverish affected persons, many compensation and support measures applied to mitigate or eliminate impoverishment risks work very well, including compensation for houses and direct property losses, better infrastructure, assistances for living stabilization and agricultural production. However, those only cured risks for displaced persons in the short-term, but the long-term because of lacking firmly financial support sources and limited capitals provided for resettlers. Production land area, in-direct losses (common pool resources and land without Red Books, and other incomes), and employment are typically not satisfactory or not considered to compensate. The displacement and relocation process impacts the same severe levels on displaced persons and recovered landholders for constructing the relocation site, in other words they encounter the similar impoverishment risks. In addition, analyzing the life and production situation of the displaced reflects a picture of opportunities and challenges that villagers are facing with. Their opportunities include in a very convenient living area, (2) benefiting from good infrastructure conditions such as electric, road networks, irrigation systems, and production and extension services, (3) the supports of the authorities in Thua Thien Hue province and the project owner, (4) their money savings can be used for production investment, (5) increased production and profession skills gained from many training courses. However, there are many challenges which villagers are facing with to stabilize their life and production, and to increase their future income. The limitation of production land, temporal jobs and low income, lack of financial estimation capacity, increased costs for foods, rice, and lack of professional works and skills are existing difficulties and might be more challenging in the near future. If those problems will be not resolved, households’ financial sources will be declined gradually but villagers are step by step turning into poorer.

There are several lessons learnt from the research that should be applied when prepare and implement a displacement and resettlement plan. First, utilizing the Impoverishment Risks and Reconstruction (IRR) model is very useful to orientate better the preparation and implementation of displacement and resettlement plan. Second, responsible authorities should actively collaborate and lead the project owner to undertake well their duties and help the displacement and relocation plan complete in time and efficient. Third, the land preparation and compensation committee should take into account direct and in-direct losses for compensation, and the direct participation of affected persons is very necessary to prevent miscounting of their property losses and to increase their role in the compensation decision making process. The compensation prices should be the same as the market prices of properties or higher. The land compensation and livelihood restoration programs should most concentrate to provide farmers favourable conditions for agricultural production. Last but not least, the long-term benefit sharing regulation should be formulated to maintain resettlers' rights in the long-term, but the specific regulations should prevent the self-rely of resettlers on the sponsors.

In summary, this research is very closely correlated with several topics of the conference, because it deals with the issues of population dynamics, stresses on natural resources, and especially the theme of equitable resource allocation and poverty reduction. Moreover, displacement and resettlement is a process that displacees might lose their human, social, physical, financial, and natural capitals causing the increase of existing poverty situation and the intensification of new poverty levels.

### **Rethinking Africa's Growth and Development Strategies**

Professor Mark Swilling, Sustainability Institute, School of Public Leadership, Stellenbosch University, South Africa

There is a new wave of optimism sweeping across Africa as growth rates climb, consumer spending rises and returns on investment escalate higher than most other parts of the world, since the onset of the economic recession in 2007. By 2008 Africa's collective GDP was \$1.6 trillion, roughly equal to Brazil's and Russia's. Real GDP has increased by 4.9% per year since 2000, more than twice what it was in the 1980s and 1990s. Although these levels of growth are not uniform across all of Africa's sub regions, at current growth rates, GDP by 2020 is projected to be \$2.6 trillion underpinned by a rapidly urbanising youthful and increasingly educated population with over 128 million households moving into the middle class to become vibrant consumer spenders.

However, Africa cannot escape the resource depletion challenges that face the rest of the world. If Africa invests in a growth and development path that is resource and energy intensive, it might end up undermining the key conditions for growth and development that it is dependent on in order to eradicate poverty and rise up on the human development index. Most countries that rate high on the Human Development Index also have high ecological footprints (i.e. they are resource and energy intensive). The Latin American countries, which tend to cluster more closely around the nexus between lower ecological footprints and high human development indexes, can provide useful models for an alternative development pathway to the one selected in developed economies (especially those in Europe and North America).

Africa will be forced to choose: it can either try to follow the same pathway to prosperity as the developed world, or it can strive to achieve its developmental goals by finding a pathway that generates poverty-eradicating development precisely because is not resource and energy intensive. If it opts for the former, it will gradually end up lagging behind the rest of the world technologically because many other countries (in particular Europe and China) are rapidly advancing by investing in resource productivity and energy efficiency. If it opts for the latter, it will need to invest in human capital and technological innovation on an unprecedented scale. Indeed, there is already evidence that the most significant contributors to African growth are economies that are diversifying by doing just this. The challenge is how far is Africa prepared to go towards the building of rapidly growing green economies. It will be suggested in this paper that the notion of 'decoupling' (drawn from the work of UNEP's International Resource Panel) offers African policy-makers ways of thinking about development strategies that are less dependent on primary resource extraction and export. Indeed, Africa may well need to discover ways of 'leapfrogging' over stages of industrial development that have been particularly destructive and resource intensive in the developed economies.

Three dimensions of the African development challenge will be addressed. The first is the so-called 'resource curse' and the implications for development of ongoing dependence on low price primary exports. Using a material flows analysis perspective to understand the current global economic crisis, it will be argued that low resource prices reduces incentives for moving towards more sustainable consumption and production in developed and fast growing developing economies, and it ensures that Africa is denied access to resource rents for re-investment in human capital development and diversification through technological change. The second the recent interest in Africa's agriculture potential which tends to ignore the fact that 65% of Africa's arable soils are degraded and that half of all fertilizer used in Africa is for free. In this light, banking on Africa's agricultural sector without a simultaneous commitment to sustainable agriculture seems foolhardy. The third will be Africa's oft-denied urbanization process that is creating cities with the highest number

of people living in informal settlements compared to other regions in the world. No African Government has a coherent urban development strategy. Where investments in cities take place this is usually using traditional resource and energy-intensive urban infrastructure technologies with very high long-term negative externality costs.

The paper will conclude by suggesting a perspective that will make it possible to rethink African growth and development from a sustainable resource use perspective.

### **Reversing Two Centuries of Wetland Degradation: Can Science Better Inform Policy & Practice and the “Case” for Secondary Production?**

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Perhaps more than other ecotones, the land–water interface has been “reclaimed” solely for human uses - living space, harbors and agriculture - essentially extirpating other goods and services that these ecosystems provide. In the US alone, more than half of the nation’s wetlands have been lost since colonial times, most others have been degraded and/or altered, yet their collective value to society has only been recognized in the past 60 years. It is encouraging that heightened human consciousness of the value of wetlands has led to recent initiatives to contain, and perhaps reverse these historic trends. But although promising new efforts are leading to substantial wetland area “restoration” and “rehabilitation”, the approach has largely lacked scientific rigor. Purporting to do otherwise, restoration efforts have been largely relegated to society-based (largely anthropogenic) goals; i.e., restoration to some practical use, rather than ecological integrity. While sometimes including elements of scientific rigor - hypothesis testing, observations, and field and laboratory experiments - ecological restoration may be thought of as the entire sum of practices that address the goals of restoration, including those that encompass the human dimensions: social, political, technological, economic, cultural, and religious. The status of coastal wetland restoration practices are discussed herein with specific attention on restoration design criteria that attempt restore wetland functions and ecological fidelity, the means to determine success and the methods used to monitor the trajectory of these sites towards desired functional endpoints. Methods for better integration of science and practice to inform policy, and the quantification of restored functions are discussed.

### **Point-nonpoint trading: can it work in china?**

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In the past decades, China has made painstaking efforts in water pollution controls. Unfortunately, without including nonpoint sources, the aquatic environmental condition has not been improved successfully. Watershed abatement trading between point and nonpoint sources may serve as a cost-effective way to deal with the problem. Several real trading programs have been put into practice in U.S. and gained positive effects. It is suggested that China should also launch point-nonpoint trading programs. However, there are some distinct differences between China and U.S.A. In China, the farmland owned and operated by a single farmer is much smaller. Since farmland is the major nonpoint in point-nonpoint trading, the trading program needs to involve many farmers in order to provide enough nonpoint trading permits. Therefore, uncertainty and transaction costs of the trading scheme are bigger and the trading program may be very complicated.

However there are insufficient studies aiming at point-nonpoint trading scheme in China, and some important things like transaction cost and different uncertainties of nonpoint emissions have not been explored satisfactorily under the conditions of China.

In this paper, by using the stochastic programming model, we studied the uncertainty due to the stochastic events such as rainfall and the uncertainty caused by imperfect knowledge about the effectiveness of nonpoint sources control efforts separately. Also we examined the trading scheme when transaction costs exist. We find that under the specific conditions of China, point-nonpoint trading scheme can be affected more significantly by transaction costs, the total impact of uncertainty is not fixed and depends on the scales of 2 kinds of uncertainties. It is suggested that in China we need to design the trading scheme more carefully in order to gain the effect expected.

# The role of ethics and faith values in sustainable development

Yamini Narayanan & Robert Pollack

## Oral Presentations

### Effectiveness of Decision-Making and Advocacy for Sustainability among Faith Communities

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The purpose of this paper is to highlight the positive role of faith communities in increasing concern for sustainability, and to expand research on group process by identifying additional successful factors in decision-making models related to faith values.

In the United States, faith congregations remain a strong social presence and moral influence, retain political influence, and often provide neutral meeting ground for diverse political views.[1]

Many religious organizations are under-recognized for their interest and commitment to sustainable community practices as a matter of faith and justice. Globally and locally, leaders and institutions have called for sustainable practices and have implemented changes to reduce their footprints. b. Important alliances between scientists, policy leaders, and religious leaders have already been established. c. While such groups do not have technical expertise and often lack a culture of measurement and reporting, they demonstrate the effectiveness of group process to engage and accelerate social change as well as show the unique capacity of religious groups to raise awareness within civil society.

#### a. Evidence of Global, National, and Local Action:

- Pope Benedict XVI presides over the only carbon-neutral state, the Dalai Lama and the World Council of Churches have urged greater care, and the UN Interfaith Partnership for the Environment maintains an extensive news update of religious-environmental projects.[2]
- The Alliance for Religion and Conservation (ARC) and the UN Development Programme recently celebrated seven-year strategic sustainability plans from many world religious traditions at Winsor Castle.[3]
- All American major faiths and denominations have issued statements of environmental responsibility.[4]
- Scholarly research has created a new field of religion and ecology, led by the Forum on Religion and Ecology at Yale (FORE).
- Research documents many examples of local congregations who are “greening” their worship, sanctuaries, community practices, and member footprints.[5]

#### b. Evidence of Collaboration across Scientific, Policy, and Civil Society-Religious Sectors:

- Carl Sagan, An Open Letter to the Religious Community[6]
- Religion, Science and the Environment Symposia on the world’s waterways hosted by The Ecumenical Patriarch[7]
- FORE series of 10 Harvard conferences on religion and ecology with over 1000 scientists, economists, policy makers, UN officials and educators in attendance[8]
- Common Ground Conference, CSSR, Earth Institute, Columbia University, May 2009[9]

#### c. Assessment of Effectiveness

- Focus group discussions among 27 diverse faith-based sustainability committees demonstrate the effectiveness of engaging small groups to leverage significant pro-environmental activity.
- The data confirm the importance of factors identified by the Center for Research on Environmental Decisions (CRED), Earth Institute, Columbia University, such as scientific literacy, appropriate framing, short-term thinking, and the power of social goals and affiliations.[10]
- Effective additional faith-related factors include local trusted leaders, moral orientation of community, willingness to examine and change behaviors, concerns for justice, and reverence for nature.

This research builds bridges between the science/humanities research communities and across the academic/ practical divide. This paper concerns both policymakers and civil society by 1) showing that many American faith-based groups are intrinsically motivated to use technical support to meet their own sustainability goals, 2) recommends enhancing advocacy by implementing the identified factors in the faith community decision model, and 3) highlights the impact of involving scientists in their own local communities as trusted leaders.

This interdisciplinary research draws upon behavioral decision theory, social cognition theory, social group theory, religious studies, and the sub-field of religion and ecology. The research strategy includes multiple focus groups designed to identify the critical issues influencing environmental spirituality and action. Semi-structured focus groups surfaced both similarities and differences between congregations. Using standard questions allowed replicability and systematic analysis, redefining knowledge gaps until “data saturation.” This project balances empirical research and humanist reflection, using qualitative and quantitative assessment, coding both inductively and deductively with NVivo 8 content analysis software.

My research included interviews and focus groups with over 100 religious environmentalists: Baptists, Buddhists, Catholics, Episcopalians, megachurch Evangelicals, Hindus, Jains, Jews (Reconstructionist, Reform, and Conservative), Muslims, Native Americans (Navajo and Gwich'in), Reformed Christians, Presbyterians, Unitarian-Universalists, migrant workers, and urban environmental justice advocates. Columbia University IRB-approved.

The social science research pioneered by CRED has established multiple successful dynamics for environmental decision-making.[11] Extensive theological research highlights the intrinsic connection of justice and spirituality with sustainability.[12] Nonetheless, analyses of what concretely influences effective religious environmentalism is limited. These focus group data demonstrate the added value of religious motivation, concerns for justice, willingness to change behaviors, and volunteer-based, collaborative and interfaith partnerships.

Religion is not going away. As a social force, religions have greater presence than ever.[13] While technical environmental know-how and data reporting is not their strength, raising interest and inspiring change is. Ban Ki Moon's recent appearance at the Winsor Castle ARC-UNDP Conference signaled to commentators a frustration with government action post-Copenhagen and new interest in partnering with civil society.

Jeffrey Sachs, Earth Institute director and UN Advisor, acknowledges that “scientific, engineering, and organizational solutions are not enough. Societies must be motivated and empowered to adopt the needed changes.”[14] This research directly addresses the dynamics of motivation among the large and potentially influential group of faith communities.

[1] <http://religions.pewforum.org/reports#>

[2] <http://planetsave.com/2010/10/28/vatican-to-become-first-carbon-neutral-state/>; <http://www.dalailama.com/messages/environment>; <http://www.oikoumene.org/en/programmes/justice-diakonia-and-responsibility-for-creation.html>; James Sniffen of UN IFP at [www.nyo.unep.org](http://www.nyo.unep.org). See also *1986 Assisi Declaration* <http://www.nyo.unep.org/eaf.htm>; [http://www.vatican.va/holy\\_father/benedict\\_xvi/messages/peace/documents/hf\\_ben-xvi\\_mes\\_20061208\\_xl-world-day-peace\\_en.html](http://www.vatican.va/holy_father/benedict_xvi/messages/peace/documents/hf_ben-xvi_mes_20061208_xl-world-day-peace_en.html); *Carl Pope's outreach to the religious community* (<http://www.christianecology.org/CarlPope.html>); *Interfaith Appeal for Action on Tropical Forests* ([http://www.ucsusa.org/assets/documents/global\\_warming/Interfaith-Appeal-for-Action-on-Tropical-Forests-and-Globa.pdf](http://www.ucsusa.org/assets/documents/global_warming/Interfaith-Appeal-for-Action-on-Tropical-Forests-and-Globa.pdf)); *Earth Charter* <http://www.earthcharterinaction.org/content/pages/Read-the-Charter.html>.

[3] <http://www.arcworld.org/projects.asp?projectId=358>. Collaboration between developed and developing counties promoted by religious groups is called “eco-twinning” (<http://www.arcworld.org/projects.asp?projectId=368>).

[4] <http://www.nrpe.org/statements/index.html>.

[5] E.g. Larry Rasmussen, *Earth Community, Earth Ethics*, Maryknoll (Orbis Books, 1996); Roger Gottlieb, *A Greener Faith: Religious Environmentalism and Our Planet's Future*. Oxford University Press, 2006; Gary Gardner, *Inspiring Progress: Religions' Contributions to Sustainable Development*, New York (Norton/Worldwatch) 2006.

[6] ([http://earthrenewal.org/Open\\_letter\\_to\\_the\\_religious\\_.htm](http://earthrenewal.org/Open_letter_to_the_religious_.htm))

[7] <http://www.rsymposia.org/more.php?theitemid=3&catid=27>; <http://www.ec-patr.org/docdisplay.php?lang=en&cat=14>

[8] (<http://fore.research.yale.edu/information/about/index.html>)

[9] <http://cssr.ei.columbia.edu/?id=eventsarchive2010>

[10] <http://www.cred.columbia.edu/>

[11] Center for Research on Environmental Decisions, 2009, *The Psychology of Climate Change Communication: A Guide for Scientists, Journalists, Educators, Political Aides, and the Interested Public*, New York.

[12] See note 6.

[13] See Langdon Gilkey, “Theology for a time of troubles,” *Christian Century*, 98 no 15 Ap 29 1981, p 474-480.

[14] *The Psychology of Climate Change Communication*, 1.

## Role of Ethics and Faith Values in Sustainable Development

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This paper is an attempt to analyse the role and impact of ethics and faith values as an entity on the question of “sustainable” development, separate from religion.

'Development' is a seductive term and the biggest challenge that development as a separate field of discourse faces today is the idea of whether we really need it, in the first place, or not. A widely held premise on which this proposition is based is that development, specifically the idea of sustainable development involves suffering for a group, especially the economically underprivileged against other groups. This raises questions of conflicting values, priorities intended, effects and policy alternatives. The role of *ethics and faith values* attempts to question this very idea of mighty structures build upon the life of victims.

Ethics of policy practice, including professional ethics guide conduct and choices in pressured real situations, but they need to be viewed in the global context. Looking at the rapid depletion of much in the name of "development" globally, - the time has arrived to abandon the "ghetto specialisation" on the south only- the need of the hour is to look at north and south both, and their inter-relations.

We need to look at the value of faith in a broader philosophical perspective to understand its importance on sustainable development.[1] Faith based convictions among indigenous communities have led to preservation of ecology and environment. What should then be clearly understood is the dichotomy between faith and religion. For eg, Adivasis/ indigenous people of India don't necessarily confirm to Hinduism but preserve forests, land and local ecological system. It's been a constant debate whether *adivasis* are part of Hinduism or do they confirm to a separate and distinctive religion called *adi dharma*. The point here is that development ethics is largely about choices: choices about values and about strategies.

Organizations like Rastriya Svayam Shevak Sangha (RSS), the religious wing of Bharatiya Janata Party (BJP) and Adivasi Kalyan Kendra, the indigenous/tribal/rural wing of the BJP do talk about preservation of culture and practices of tribals' & indigenous rights on political front under the guise of religion. Thus, while harping on the importance of faith, we should be careful to not deny the universalizability of religion, which again is often misunderstood as *faith*.

It is, therefore, very important to understand *ethics and faith* independent of religion, only then can their role carry moral convictions towards sustainable development. *Faith* in itself is also not a universal prescription towards preservation of environment and attainment of sustainable development. It must be seen in light of the cultural values enshrined within the faith practised by such indigenous communities. For example, under the tenets of *adi dharma* a great part of their duty consists in an observance of the *rights* and a furtherance of the *interests* (of others) on a mutual basis. The others, here, would constitute the local ecological system that support their needs. However, this concept of right goes beyond the Platonian notion which is limited to an involvement of his/her self interest.

Faith based values as well as culturally specific ethics vis-à-vis sustainable development should be, hence, seen more in terms of self-righteousness than a mere self-interest.

[1] *Faith* based model of development harps on the ill-effects of consumerism and talks about mutual offer of peaceful and fruitful co-existence.

## Inspiring Sustainability Beyond Sustainability: Sustainable Development and the Ultimate Hindu Purpose

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Planners and practitioners of development, including sustainable development, are increasingly looking to religion as a means of addressing the ecological crisis. However, such approaches generally tend to view religion in an instrumentalist manner. In this paper, I argue that the relationship between religion and sustainability is a mutually productive one, and suggest that sustainability may also be a means to enable some of the key practices of religion, that in turn, assist sustainability. As one illustrative example, I propose the Hindu notion of the Purusharthas or the four-fold path to self-actualisation as a green telos. The fundamental sustainability tension lies in reconciling want and need. The Purusharthas prescribe a path comprising of material and sensuous experience, in obedience to dharma or duty, such that moksha or a state of complete self-awareness may be achieved. The stage of dharma is thus where the most profitable connections between Hinduism and sustainable development might be made.



## **Harnessing the Power of the Religious Commitment to be “In Community” for the Good of the Planet**

Cynthia Reville Peabody, Director, The Center for the Study of Science and Religion, The Earth Institute, Columbia University. Please address correspondence to [cmr93@columbia.edu](mailto:cmr93@columbia.edu).

This paper will speak directly to ISDRC topic 2E, “The Role of Ethics and Faith Values in Sustainable Development.” Given that the 2011 conference is focusing on identifying steps toward a sustainable future that are ready for implementation I will be looking at already in place programs that are strengthened a religious understanding of what it is to live in community. I will suggest that these programs and their foundational ethic are worthy of imitation.

Almost every faith tradition throughout the world has a strong tradition of calling on its believers to live in cooperative community. Today, faith leaders employ a responsible understanding of modern advances in the natural sciences to continually expand their definition of “community”. People of faith appreciate that all living communities, from the cosmological to the bacterial, call for behaviors that respect and enhance the lives of all their members.

In his book *The Creation: An Appeal to Save Life on Earth* E. O. Wilson, a secular humanist, recognized that because people of faith are already organized, speak with a unified voice, and have long standing traditions of advocacy and activism they are a great boon to the sustainable development movement. More and more people of faith - evangelical, conservative, progressive, and liberal; Christian, Jew, Muslim, Hindi, and Baha’i have embraced the urgent cause of the Earth and all its creatures. They have banded together, leaving doctrinal differences behind, and gotten down to the business of respecting the rights of “The Creation”. The cohesion, power, and influences of world religious voices are major forces in bringing about a just and sustainable future.

This paper will look at the ways the natural sciences have informed religious definitions of community on universal, global, regional, and local scales. Using specific examples, the paper will demonstrate how religious admonishments to live in community have given birth to morally sound, imitable, lasting projects and programs designed for the healing of the Earth. Each of the four projects the paper will highlight can be (and has been) used as a model for duplication.

Finally, the paper will suggest ways in which inter-faith, inter-disciplinary, and community centered programs can continue the cooperative work of scientists and people of faith in the interest of a more just and sustainable “Earth Community”

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## Values-based indicators: Bridging the gap between ethical values and sustainable practices

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'Values' have been adopted by innumerable civil society organizations (CSOs), governments and businesses worldwide as a way of articulating their goals for ethical and sustainable practices. There is an increasing acknowledgement that ethical values are intertwined with positive social, economic and environmental change (Leiserowitz et al. 2006, Crompton 2010) yet when evaluating progress principally the focus is on material outcomes. Some initiatives have begun to rectify this at a national or regional level through the development of genuine progress indicators and well-being indices (European Commission 2009, New Economics Forum 2009, Stiglitz et al. 2009, Sustainable Seattle 2010). At a project level, however, CSOs still lack the research tools to turn subjective awareness of the social dimensions of their work into indicators that can be used systematically to evaluate outcomes.

For the past two years, an EU-funded research initiative working to develop values-based indicators for sustainable development projects (ESDinds [1]) has sought to fill this gap by developing tools which are contextually relevant for a diverse range of businesses and civil society organizations. In order to do this, the ESDinds project brought together CSOs and academic researchers from five countries to collaboratively develop useful indicators and assessment tools to measure the presence and role of values. An iterative and grounded approach to indicator development led to the creation of a set of indicators for the values of trust, integrity, justice, empowerment, unity in diversity, and care and respect for the community of life (see Podger et al. 2010 for a detailed description of indicator development). It also led to the design of a process for organizations to identify their own values and develop context specific measurement methods, and to the formation of a community of practice[2] around value-based indicators for sustainable development.

The ESDinds project has developed an approach for conceptually linking ethical values with sustainable practices by relating values to concrete actions. This approach provides a tool for exploring the sustainability 'value-action gap' (Blake 1999) – a disconnection between espoused values and observed behavior – at an organization and project level. Research into corporate social responsibility and sustainability policy adoption has shown that many organizations face discrepancies between formal commitments and actual policy implementation (Ramus & Monteil 2005), possibly leading to cynicism, mistrust, alienation and a loss of credibility (Cha & Edmondson 2006). Accountability for adherence to espoused values, through adoption of measurable indicators, provides a means for overcoming this disconnect. Bansal (2003) found that environmentally responsible action is more likely to be taken when it is consistent with both individual concerns and organizational values. The ESDinds indicator development process serves as a mid-way point between values and locally-specific actions and behaviors by enabling groups and organizations to collectively identify how their values are, or should be, enacted in their specific context, thus creating shared understanding and meaning.

Using relevant ESDinds indicators encourages organizations to think about perceptions, observations, attitudes, beliefs or outputs that relate to their values, first by developing a shared vocabulary and understanding of values, second by selecting which indicators they find relevant to their context, and third by thinking of specific ways in which to assess each indicator by reshaping it and finding appropriate measurement methods. This approach encourages a localized 'dialogue of values' (Ratner 2004) around sustainable development goals and actions, addressing values discourse as well as associated behaviors. Existing value-behavior models can help to identify potential blocks in the pathway between values and related behaviors (Homer & Kahle 1988, Ajzen 1991, Stern et al. 1999, Jackson 2005); the values-based evaluation process developed in the ESDinds project then provides a useful framework for identifying and overcoming these blocks.

Previous research has shown that values can be activated and strengthened through self-awareness, leading to more action being taken in concert with espoused values (Maio et al. 2001, Hitlin & Piliavin 2004). Through the evaluation process developed in the ESDinds project, values become conscious and articulated, thus enabling individuals and organizations to overcome, confront or understand the potential blocks that might be causing a gap between positive values and actual behaviors. When values are not drawn out at the outset, the evaluation process triggers individual and collective reflection on values and can also lead to values change, increasing congruence between espoused values and desirable behaviors. The process of eliciting values and developing indicators, therefore, becomes a tool for bridging rhetoric and practice in sustainable development.

- [1] ESDinds (*Development of Indicators & Assessment Tools for CSO Projects Promoting Values-based Education for Sustainable Development*). [www.esdinds.eu](http://www.esdinds.eu)
- [2] For more information see [www.wevalue.org](http://www.wevalue.org)

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## Role of Ethics in Sustainable Development: Some Indian Examples

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Sustainable Development (SD) is one of the most fundamental challenges confronting humanity. Inter-and-intra generational equity with regard to the utilization of the earth's resources is a major element in this challenge. Capital formation remained an important component of growth for centuries. Considering limitation of these models, Mahabub ul haq started advocating search for "Models of development which enhance human life, not marginalise it, which treats GNP as means not an end; which replenish natural resources for future generations, not destroy them, encourage grass root level participation of people in the events and processes that shape their life".

Introduction of Human Development Index (HDI) by Haq and Sen through UNDP Reports helped to focus on issues such as mortality rate, education, poverty, women's development, tolerance etc., and availability of basic infrastructure for assessing overall development, thus widening the perspectives of development.

The behavior of individuals and the priorities of society depend on people's moral, ethical, and spiritual values. Hence, actions have to flow from these values in building a secure, sustainable, and hopeful future. The parliament of World's Religions held in Chicago in 1993 identified environmental issues as ultimately spiritual in nature and third *Annual World Bank Conference on Environmentally Sustainable Development* held in October, 1995, recognized the need for Ethics and Spiritual Values for Promoting Environmentally Sustainable Development. The millennium declaration has identified that adherence to certain fundamental values such as Freedom, Equality, Solidarity, Tolerance, Respect for nature, Shared responsibility are essential in the 21st Century.

Human development is a struggle between pain and pleasure. Happiness, which is beyond pleasure, requires human being to raise his conscious level. The concept of various conscious level has been explained in Taittiriya Upanishad as Pancha Koshas viz., Anna(food)maya Kosha, Prana(energy)maya Kosha, Mano(instinctive)maya Kosha,

Vigyana(intellectual) Kosha and Ananda(blissfull) mayakosha. The various koshas (sheath) represents growth of an individual from physical level to blissful personality. First three koshas have the potential of both positive and negative emotions whereas, next levels experiences only positive state of mind, peace and harmony. Leadership with such qualities can only look at the problems in a broader perspective and help conceptualize sustainable solutions. The long term solutions need to evolve from deep consciousness devoid of fear, guilt and egoistic nature with the aim of overall development by understanding symbiotic relationship of both living and non-living.

Indian Culture which has its roots in Vedic Philosophy stresses on the ethical approach in every aspect of human development. The Vedas bring about understanding and cultivation of the human mind for development in an unfathomed broad sense. The human yearnings are held to be the acquisition of knowledge and health, enjoyment of the good things of life with responsibility, conducting business with a sense of service and achieving self actualization/ liberation (*Dharma, Artha, Kama, and Moksha*). Here, the ultimate element of yearning or *Moksha* is said to be the state, where one seeks nothing and needs nothing – one jettisons all wants.

The external world is a manifestation of human internal world. Peace and sustainability is possible only when there is equilibrium in terms of formation of human capital and material wealth. The importance of understanding the human psyche and disciplining the same before solving the external crises were advocated by Amarthya Sen.

Simon Kuznets hypothesized relationship between the various indicators of environmental degradation and income per capita. The environmental pollution increases in early stages of economic development due to lower per capita income and affordability but trend reverses later on. However, it has been observed that increased per capita income also led to consumerism and purchase of more inessential goods which put pressure on environment. Similarly, with the increase in material wealth, the animal instinct in human beings triggers emphasis on physical pleasure; but only when they realize the futility of sensual pleasure the search for real happiness begins within.

Social norms can compliment traditional public policy approaches and measures such as regulation, taxation, and pricing. But some policies purely based on economic incentives might do more harm. Pricing pollution/emission might give polluter the impression that, they have right to pollute as long as they pay for it! The recent financial crisis, showed the pitfalls of deregulation and unrestrained markets. Insurance system though helped to take care of damages, slowly leading to moral hazards by making people to make bad choices because of insurance.

The all round development of nation depends not so much on its material, ecological or technological resources but primarily on its human resources having ample potential energies. The Western idea of progress, is outer expansion by ever increasing possession of material wealth, whereas, Indian ethos stresses the need for inner evolution of human consciousness through renunciation of attachment to the aims and values of a lower order of life so that one can rise into higher level of consciousness, so that, one can look at the entire system with broader vision. Intellect is considered as a good servant but bad leader.

This paper proposed to take the discourse on Sustainable Development from present level of economic and environmental issues to disciplining inner environment of human being i.e. ethics to ensure balanced development of economic, environment and human capital. The authors have examined some cases based on the above parameters and found supporting grounds in the following case studies:

- An international airport with 3.7 km of runway, 20,000 sq. mtrs of terminal complex was completed with an investment of just US \$ 50 million at Cochin, Kerala, India. This is considered as one of the least cost Airport in the world and this was possible mainly because of the integrity, ethical behavior and passion of the leadership involved in the project.
- An illiterate person took initiative to establish a 250 bedded hospital and completed successfully by borrowing US \$ 2 million from a financial institution and completed the repayment within 6 years. The project helps thousands of poor people around the area today (Tellicherry co-operative Hospital, Kerala, India). This show, mere academic qualification may not be a requirement for ethical behavior.
- When population was considered as a problem, a young Computer Engineer started the software company (INFOSYS) along with few close friends and converted the human skill into valuable asset for the company and society at large. With this initiative, IT sector became an engine of growth for Economic Development in India.
- TATA is one of the oldest multi product companies in India which has products in almost all sectors of human settlement. Design and Manufacturing of NANO car at the cost of just US \$ 2000 is considered as a revolution in the automobile sector. The value systems and code of conduct of the Company has carved separate niche in the Indian Market and synonymous with innovation, transparency, consistency and integrity.

Historically, humanity has responded to demand for more resources by trying to increase supply by effective material resource management. With the advent of technology, natural resources exploitation started at a faster rate than the

regenerative capacity of the environment. Focusing more on material growth and pleasure led to a decline in time honored human values leading to various financial scams and environmental deterioration, both physical and moral.

As Mahatma Gandhi rightly said, there is enough for everybody's need but not enough for anybody's greed. Hence, it is time to learn from the mistakes committed by certain societies in terms of unsustainable consumption and energy intensive living patterns. We need to reorient policies based on - living closer to environment and use of resources well within the regenerative capacity of nature. This will help to harness full human potential for balanced and meaningful evolution. Once the inner self is cleansed, the energy is focused on achieving higher level of consciousness and dependence on material resources for quality life gets reduced, results in peace and harmony with nature.

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## Posters

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### **The Determinants of Rural Households Multidimensional Poverty In Oriire Local Government Area of Oyo State, Nigeria**

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Nigeria is richly endowed with natural and mineral resources. However, Nigerians are also among the poorest in the world, (Etim et al., 2009). The conventional way of making a judgment about whether an individual or household is above or below the poverty threshold is income and/or consumption expenditure which is a much better welfare indicator, particularly in developing countries (World Bank 2005, UNDP 2005). The reasonable thinking and rationale behind the money-metric approach is that an individual or household above the monetary poverty line is ordinarily assumed to have the potential purchasing power to acquire the set of attributes that will give an acceptable level of wellbeing (Thorbecke, 2005).

The income approach has a drawback as the well-being of a population and hence its poverty are dependent on several dimensions of human life, such as education, housing, life expectancy, and income is just one such dimension (Bossert et al., 2009). The policy relevance of multi-dimensional nature of poverty can be seen, partly, to the genuine possibility that uni-dimensional approach to the measurement of poverty is likely to underestimate the complexity of the nature of poverty which can largely impact poverty alleviation strategies (Qizilbash, 2003).

Chaudhary (2003) in examining the determinants of poverty in Cholistan (Bahawalpur district of Pakistan) performs a multivariate income regression analysis on the potential determinants of poverty incidence at the village level. The results show that household size, educational attainment, participation ratio, female/male ratio of workers, dependency ratio, persons per room, population of livestock, landholding, area under irrigation and age of household head tend to be significant determinants of rural poverty across all villages in the sample. In addition, the study performs a logistic regression analysis of the determinants of probability of being extremely poor. The results indicate that household size, dependency ratio, and housing condition are the variables that are positively and significantly correlated with the probability of being extremely poor.

Mussard and Alperin (2005) extends the study of multidimensional poverty in Argentina by introducing a synthetic analysis of decomposition that points out the dominant dimensions such as health and education, and the most urgent target sub-groups for policy interventions.

The objective of this study is to examine the multidimensional nature of poverty among rural households in Oriire Local

Government Area of Oyo State. Specifically to: (i) profile poverty status of rural households, (ii) estimate the determinants of rural household poverty, (iii) estimate the determinants of deprivation suffered by rural households.

The major limitations of this study can be linked to data collection. Respondents gave information based on memory recall, thereby subjecting the data to memory bias. Nevertheless, the outcome of this study should be relevant in understanding the multidimensional nature of poverty among rural households in Oriire Local Government Area, Oyo State, Nigeria.

The study employs multi-stage sampling procedure in order to get a representative sample. The study area is under the Oyo State Agricultural Development Programme (OYSADEP). The data for the study are essentially from primary data collected from 200 households using pre-tested and validated interview schedule/structured questionnaire. Questionnaire covers socio-economic characteristics, average monthly income, expenditure on various household items, food consumption pattern, health, housing condition, energy use, durable household assets and degree of satisfaction with rural life.

Data analysis employs descriptive analysis that shows the distribution of households with respect to each of their socioeconomic characteristics. The study constructs indexes for the monetary and non-monetary dimensions of poverty (Fuzzy monetary, Fuzzy supplementary, and Total Fuzzy) and presents the distribution of poverty levels and mean incidence of households and their socioeconomic characteristics.

Only the  $P_0$  (Poverty incidence) measure of the P-alpha weighted measure of poverty analysis by Foster, Greer and Thorbecke (F.G.T) is employed to profile poverty of households. In the study, the estimated poverty incidence is derived from the general formula given as:

$$P_0 = \frac{1}{N} \sum_{t=1}^n \left( \frac{z - y^i}{t} \right)^\alpha$$

where

Z = poverty line.

n = the number of individuals below the poverty line,

N = the total number of individuals in the reference population

$y_i$  = the income or expenditure of the household in which individual lives

$\alpha$  = the Foster – Greer – Thorbecke (FGT) index.

The two measures, FM and FS, are then combined to construct composite measures which indicate the extent to which the two aspects of income poverty and non-monetary deprivation overlap for the household concerned.

Multinomial logit regression is employed to present the maximum likelihood estimate of the factors that determine whether households will be moderately poor or core poor compared with non-poor in monetary terms (Fuzzy Monetary).

The regression equation is:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \mu$$

Where

Y = Fuzzy Monetary Index (0=non-poor, 0.5=moderately poor and 1=core poor);

$X_1$  = Primary Occupation of Household Head (D=1 for farming head, 0 otherwise);

$X_2$  = Family Type (D=1 for polygamous family type, 0 otherwise);

$X_3$  = Household Size;

$X_4$  = Dependency Ratio;

$X_5$  = Primary Education Dummy (D=1 if head had primary education, 0 otherwise);

$X_6$  = Secondary Education Dummy (D=1 if head had secondary education, 0 otherwise);  $X_7$  = Gender of Household head (D=1 if head is female, 0 otherwise);

$\beta$ 's = Parameter Estimates

$\mu$  = Disturbance term

Since there are multiple categories (0, 0.5, 1), we choose a base category as the comparison group, and here our choice is the non-poor group (FM=0). Maximum likelihood is the actual mechanics in running the Multinomial Logistic Regression.

Tobit regression presents the probability of the outcome variable in terms of households being poor in the Fuzzy Supplementary and Total Fuzzy dimensions. Furthermore, tobit regression is employed to estimate the probability of

deprivation suffered by rural households in Durable Asset, Health, Energy Use, Housing Condition, Nutrition, and Social Inclusion. Hence we censor the data (at 0.5 lowest through), that is, we place a restriction based on the values taken by the regressand.

Statistically, we can express the tobit model as:

$$W_i = \beta_0 + \beta_1 X_i + \mu_i; \text{ if RHS} > 0$$

The regressors are same as in Multinomial logit regression.

Poverty incidence is highest in single person households with male heads, household size of more than 8 persons and per capita monthly expenditure below N 1000 (U.S 26 cents per day; at N128 to U.S \$ 1 during the period of this study). The gender of household head, household size, and family type are significant determinants of being moderately poor in monetary terms (Fuzzy Monetary) while household size, family type, and primary occupation of household head are the significant determinants of being core-poor (Fuzzy Monetary). The only significant determinant of poverty (Fuzzy supplementary) is dependency ratio. Interestingly, the trio of household size, family type, and the primary occupation of household head still appears to be significant drivers of poverty in the Total Fuzzy analysis. On the other hand, deprivation in household asset, energy use, health, nutrition, housing condition and social inclusion is being driven at varying magnitudes by factors that include household size, primary occupation of household heads, dependency ratio, gender of household head, as well as the level of formal education attained by household heads.

The study concludes that a good understanding of the demography of rural communities, improvement in the quality of primary education, improved access to yield enhancing techniques, and better framework for cooperative societies will significantly improve household income (invariably per capita expenditure), and reduce deprivations suffered by households in non-monetary dimensions. One useful insight from the difference observed in the factors responsible for rural households being either moderately poor or extremely poor is that eradication of extreme poverty may require an extra policy push; employment generation to be specific. Therefore our findings suggest that any policy intervention in Nigeria aiming at reducing the incidence of rural household poverty which is multidimensional warrants using a multidimensional approach.

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## **The Integration of an Islamic Environmentalism to Holistic Models of Sustainability, Case Study: Jeddah**

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The city of Jeddah in Saudi Arabia is characterized by its substantial growth in urban development and its manifested modernization and urbanization. Though these social and economic transformations are implemented with the intent to increase prosperity for the city, they have consequentially had a negative impact on the region's natural resources and environment. Environmental issues that are rooted in poor urban planning, a lack of environmental awareness among the population, and a general disregard of environmental issues from city regulators have placed Jeddah in an increasingly critical state of environmental degradation and unsustainability.[1] Such environmental issues include the continuous increase in the aridity of local topography, air pollution, poor wastewater sanitation, critically high levels of energy consumption, and more. All of which, are increasingly threatening to local ecosystems and the long-term health and longevity of the resident population.

What is perhaps the greatest obstacle to the population's engagement in environmental stewardship and sustainable initiatives is its lack of an environmental awareness. As evident in the past few years, such as in the Saudi Arabian

stance at the 15th Conference of the Parties (COP15), scientific findings are not enough to convince the Saudi Arabian government that it should conserve, or at the very least not over-consume, its country's natural resources.

[2] In examination of the Saudi Arabian culture, it is evident that the primary instigator for the people's engagement in ethical actions is the population's religious beliefs. Virtually all residents of Saudi Arabia are Muslim, and the potentially most effective way to engage the Saudi Arabian government and population in initiatives of sustainability is through an integration of Islamic teachings of environmental stewardship with such initiatives. Given the history of Saudi Arabian tradition and culture, an argument for environmental stewardship that is based on Islamic teachings, perhaps an "Islamic Environmentalism," is virtually the only argument with potentially fruitful results. It is similar to the situation that American Evangelists were recently in; only when Evangelists were talked to in the language that they understood—when they were shown the direct correlation between environmental injustices and the social injustices that they fight against out of religious duty—did they announce climate change as a religious concern and take a stand against global warming.[3]

Though not publicized or well-known, the Muslim argument for environmental stewardship is quite strong, detailed, and well-encompassing. The Qur'anic portrayal of nature, for example, is one of a companion in the glorification of God, a gift of sustenance, a cosmic book of which to learn from, and more. According to Qur'anic teachings, it is humanity's divinely ordained responsibility to act with care for the natural world and not transgress the balance and harmony placed within it.[4] Per Islamic belief, humanity was made as God's vicegerent and steward of the earth.[5] The reasons for environmental stewardship and sustainable development from an Islamic perspective are many; they are also the reasons with the most potential to convince the Saudi Arabian population, let alone the world's Muslim population, to promptly address the need for a proper environmental awareness and sustainable way of living.

In explaining that the Prophet Muhammad taught of the many blessings in the desirable act of planting a tree, even if it were known that the next day was the end of days, Muslims may be motivated to plant trees in their communities. In explaining that the Prophet Muhammad condemned the over-consumption of water, even when faced with an abundant supply of it, Muslims may develop a more conservative and sustainable approach to their consumption of water. In drawing attention to the Qur'anic portrayal of all animals and natural phenomena as worshippers of God, and the natural world as a great congregation of worshippers to God, Muslims may develop a more compassionate approach to their natural surroundings. The facets of this "Islamic Environmentalism" are many and can help form a strong eco-friendly and sustainable model for Muslims to live by.

It is important to note that this "Islamic Environmentalism" is not one-dimensional. It simply refers to the integration of a perspective into a larger holistic approach that incorporates scientific, cultural, and social aspects, among others. Throughout history, Islam has claimed a strong compatibility with science. The many contributions to modern science from traditional Muslim scientists, ranging from Ibn Arabi to Avicenna to Averroes, is enough to support this claim. The contemporary Muslim world has also opened itself to the world of modern science and there is generally no friction between the two, but for a few exceptions such as the general scientific disregard for metaphysical interpretations of physical phenomena. Thus, initiatives of sustainability that are scientifically based can do well in Muslim populated countries, such as Saudi Arabia, but have a much higher probability of success through an integration of an Islamic dimension; which does not oppose today's pursuits of sustainability in energy-consumption, but rather supports them. Moreover, an "Islamic Environmentalism" is also compatible with initiatives taken by those of other faiths, especially given the pluralistic aspects of Islamic belief.

Jeddah is Saudi Arabia's second largest city and any successful methods of sustainable development in it may be copied and implemented throughout the country. Jeddah is also a sister-city of many other developing cities in Muslim populated countries, and thus a success story in Jeddah may be carried out to similar cities of primarily Muslim populations that similarly need stronger models of sustainability. Moreover, even though the Saudi Arabian government is viewed by many in the Muslim world to be more of a cultural-based government than a religiously-based one, it nonetheless is the custodian of the two holy cities of Mecca and Medina. Thus, progressive changes in Saudi Arabia, in terms of sustainability in natural-resource consumption, can have influence on the rest of the Muslim world—48 countries and roughly one-third of the human population—to promote sustainable development and adopt sustainable ways of living.

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## Bringing the poor to central stage in solving global warming: understanding about street workers in Brazil

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The paper is the initial result of a larger project which proposes to identify entrepreneurial individuals among the poor, understand their working conditions and their abilities, and create a pilot interdisciplinary social laboratory to harness the conditions for the emergency of a bottom-up process of social innovations to help tackle the problem of global warming.

The project proposes to use a holistic, inclusive and interdisciplinary approach where informal street workers will form partnerships with others in similar conditions, and with university students, university researchers, NGO activists, government workers, and businesspeople willing to participate in semi-structured, self-organizing groups to generate innovative solutions beneficial to the planet and everybody, particularly the poor. This research hypothesizes that there are significant numbers of entrepreneurial people among the poor, who has the merit of having deep knowledge of their environment and the problems faced by those living on or from the streets, and the strength or belief that the situation can always be changed for the better.

The project has three phases. The first phase is understanding who the street workers are, what they do, why they do, and the abilities they have. In this phase semi-structured interviews were carried out with 112 informal street workers. The numbers might look small, but interviewing those street workers is not easy, particularly because they are permanently scanning the horizon for enforcement agents, or afraid that we might be the agents in disguise. The initial result is discussed in this paper.

The second phase will start with one or more groups comprised by the volunteer poor (44 of those interviewed already accepted to participate in the second phase of the study) and other parties described above. Currently, all these actors are already involved and have been active in this research design. The research team will act as a catalyst of complex and creative interactions by mediating and providing an environment conducive to self-organization and facilitating the emergency of innovative socially empowering solutions for global warming. In the third phase, the project would like to explore the possibilities of developing similar approaches in cooperation with researchers from other countries.

Active in the community: Twenty-six (23%) of the interviewees identified problems in their community and proposed solutions that do not rely on government action.

Knowledge of global warming: Eighty-seven percent have heard about global warming and 84% had an opinion about the causes. Eight-five percent had an opinion on how to attack such causes.

Not lazy: Street workers declare that they work 6.1 days per week. Many, 64%, also work on Sundays. On average, they work 9.3 hours a day, or about 57 hours a week. Only 14% of those interviewed belonged to cooperatives or informal support groups. However, on the streets, 54% declared that there is more cooperation than rivalry, while 31% saw more rivalry than cooperation.

Sources of Information: TV, mentioned as the most important source of information by 71%, is the top source. Interestingly, right after TV, the internet came in second with 9% declaring it their main source of information.

One of the most successful approaches to poverty reduction in the last few decades is the microcredit movement started in Bangladesh by Mohammed Yunus. The initiative enabled people to participate in the market economy, giving freedom from exploitative local pawn shop owners. This and other creative initiatives such as those described by Prahalad have the great virtue of taking people out of poverty but does not question or challenge the malfunctions of the current economic system which is destroying the environment and oppressing the poor.

Some initiatives try to address both problems simultaneously, such as the collection of recyclable materials by the poor. This is a decent job, but still assigns the poorest people to do the dirtiest jobs of society.

The approach adopted in the current research has the following point as the motivating factor: A decent society should not make people who do not have the luck or ability to find jobs do the dirtiest jobs. As suggested by Herbert Simon, nobody can have all the information needed and make the best decision, but only the satisfying decision. This also means that there are pieces of knowledge and wisdom learned by the poorest people over their lives that might be harnessed to solve problems starting locally to have a global impact. One important such knowledge is that richer people do not have an idea of poor neighborhoods particularly regarding how much damage is done by the waste produced

by the rich and always stored or dumped in poor neighborhoods. To build a truly sustainable society is fundamental to ensure that the poor are truly empowered to design solutions to environmental problems.

Giving the power to design solutions to environmental problems to the poor has at least two advantages:

The solution will never be “dump the toxic waste and dirty stuff in poor neighborhoods”.

It will force companies and governments to search for solutions that are truly holistic and real, in the sense that they will not be solutions only to gain time.

## **Overview of Ethics and Justice in the Field of Development: An Assessment of Amartya Sen's *The Idea of Justice***

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Over the last fifteen years, there has been a heightened awareness to understand how ethics in development and the ethics of development must be articulated and developed as a full-fledged field of research and practice. Although one can argue that self-reflection on ethics in development began decades ago with the critical ideas of the economist Gunnar Myrdal and the development theorist Denis Goulet, many would agree that ethics must be brought to the forefront of development education. There is so much we have learned over the last 65 years of development as a global, multi-disciplinary field of research and practice. In the multicultural, multi-polar, globally diverse 21st century, governments, NGOs, academics, think tanks, multilateral entities such as the UN and World Bank, Aid agencies, and these days, corporations are all concerned with questions of ethics and social responsibility. NGOs typically have statements of values and ethics in their mission and operational statements, and most of them attempt to adhere to those values in the field. However, as every development practitioner knows, the complexity, the uncertainty and the exigency involved in making quick decisions in the absence of explicit ethical guidelines, let alone rules and procedures, often times leads to ambiguous, psychologically challenging situations. How do we guarantee participatory approaches with target populations that address their ‘values, capabilities, functionings, opportunities and substantive freedoms’ to use Amartya Sen’s language?

Moreover, how do we do so in a way that respects local customs, wishes, aspirations, explicit and implicit, oral or codified moral precepts? When facing the practicalities of implementing preformed development programs and agendas, what do we do when the intentions and aims of different stakeholders (donors, organizational leadership of organizations) conflict or contrast with the self-articulation of target populations about their own needs and priorities? How do we negotiate the insider-outsider distinction when differences exist within the target populations based on gender, religion, race, ethnicity and class or rank in social order in comparison and contrast to the social, cultural, moral, linguistic and psychological differences that external practitioners bring to the field? Lastly, given the Post-Cold War emergence of development agendas from new participants shaping the world economy, say China and India, how do we reassess 500 years of understanding theories of modernization, secularization, change and development in the West based on the colonial, decolonized, and postcolonial phases of world history as a complex, evolving global system of interdependent relations? These questions raise very complex issues about how ethics relates to global justice given the assumptions that underpin the history of development as theory and practice, and what it means for the future of development in general.

For some time now, academic philosophers as applied ethicists and even theological and religious studies scholars are entering in to the debate on global poverty. In addition to mainstream development economic theories, social policy analysis and rights-based approaches that inform current theories of development, whose assumptions in turn affect the definition of goals such as the UN Millennium Development Goals, some philosophers are beginning to weigh in on what are called ‘cosmopolitan’ debates. To what extent do we as a human species as a whole have the ethical obligation to build consensus for global justice and social change to alleviate world poverty? What are some of the primary reasons for making such an argument at this juncture in history? How would effective social, political, cultural and economic sets of interrelationships in a globally diverse world shape institutions that could undertake the successful eradication of world poverty by the mid-21st century? What would those institutions look like in comparison to contemporary institutions engaged in global, sustainable development? What is exciting about the early 21st century is that we have the hindsight of what has worked and what has not worked in 20th century political, economic and social theories to collectively imagine new configurations and ideas. Perhaps these emergent ideas can be translated in to concrete solutions for global sustainable development.

A significant contribution to ethics and the theory of justice for development studies is the latest work by the economist-turned-philosopher, Amartya Sen. One can argue that his *Idea of Justice* is the summa of an enormous and influential corpus, which has shaped the field of development. By responding to the vast scope of Western philosophy dialoguing

with figures as diverse as Aristotle, Condorcet, Smith, Wollstonecraft, and Rawls, and also Eastern classics from Hindu thought, Sen tries to rethink what justice means. He does so not in 'transcendental institutional' terms, but in measurable practical realities, particularly for those who face deprivations and loss of capabilities and thus freedoms. Sen's recapitulation of his "Capabilities Approach" occurs in a broader framework concerning relations between ethics, justice, democracy and global development.

We want to question critically some of Sen's main arguments and his interlocutors. First we will examine his assessment of utilitarianism and Rawls' critique of utilitarianism. To what extent does Sen carve out an original space beyond Rawls on the one hand and before the cosmopolitan conclusion of a potential, one world government on the other? Does Sen articulate a full-blown theory of the relationship between global justice and global development, which is distinct and original, in contrast to the vast panoply of interlocutors in his mammoth work, *The Idea of Justice*? Few would dispute Sen's achievement for welfare economics and social policy and, as a working economist, his integration of ethics back in to the central sphere of economic theory. However, we hypothesize that there are certain limits based on his philosophical and epistemological assumptions of a theory of justice-based on the idea of 'capabilities'-precisely when he engages questions of reducing inequities and poverty, or the cultivation of development and/as 'freedom.' We intend to trace the consequences of these limits and what that means for a future theory of the relation between justice and development.

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# Green design, architecture, & materials

Patricia Culligan & Asanga Gunawansa

## Oral Presentations

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### **Design and Implementation of a Sustainable Housing Unit: A Technical, Economic and Environmental Evaluation of a Sustainable Residential Building in the Philippines**

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This paper investigates the potential of green building designs in reducing the adverse impact of building constructions to the environment. In a tropical Philippine climate the performance of a so called sustainable residential housing unit was evaluated, in line with globally accepted elements of a sustainable building design. Following the LEED (Leadership in Energy and Environmental Designs) criteria, the following are evaluated and analyzed during the design and the implementation stages of the project: the architectural considerations in selecting and developing the site for the residential building; the extent of energy use and the energy efficiency strategies applied in the building; the extent of water use and the potential for energy conservation; the selection of materials for the construction of the residential building; the resulting improvement in the indoor air quality and the overall improvement in the environmental air quality of the residential building; and the social and community acceptability of the design and construction of the residential building. The sustainable residential building is then compared to a standard/traditional residential building constructed in the same locality in order to quantify the performance of the sustainable residential building. In the comparison, the following significant factors are considered: the technical, economic and environmental aspects of both designs. It was found that the sustainable residential building has the potential to reduce as much as 20% to 40% of its energy use as compared to that of the standard/traditional residential building, the reduction can be attributed to the use of efficient lighting features and daylighting designs of the building. The study also indicates that the building may reduce its dependency to utility water as much as 30%-40%, this reduction was made possible through incorporation of water conservation features and use of rainwater in the design. In terms of associated carbon and the amount of primary energy used in the construction of the sustainable residential building, the analysis and evaluation reveal that there was a 30% reduction in associated carbon dioxide emissions and about 20%-30% reduction in primary energy for the sustainable residential building when compared to that of the standard/traditional residential buildings. The qualitative performance of the residential building was also determined using performance surveys. The respondents responded from moderate to high level of acceptability with respect to the following parameters: the overall indoor air quality and thermal comfort of the residential unit, the lighting and daylighting features of the design and also other factors such as the psychological factors that affect the building occupants, i.e. health and comfort and others while survey participants responded low to average acceptability with respect to the cost of construction of the residential building.

### **Eco-districts and Eco-cities: Public-Private Partnerships for Urban Innovation**

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As urban communities face the challenges posed by climate change, increasing populations, and declining resource availability, innovative approaches to building, urban design and community engagement are increasingly important for both developed and developing countries. In times of financial turmoil and constrained resources for investment, the development of partnerships is especially critical in order for such efforts to succeed. This presentation will examine two efforts to advance integrated urban development that provides for resource efficiency, environmental protection, and a thriving “civic ecology” - Eco-district development in Portland, Oregon, USA and Eco-city development in Hoi An, Viet Nam.

While these two communities face very different challenges and opportunities, both efforts explicitly integrate the development of “hard” infrastructure with the development of social structures and relationships in their respective communities. Each effort has made the development of innovative partnerships a central part of its strategy. For Portland, Eco-district priorities include air quality and carbon, energy, habitat and ecosystem function, access and mobility, water, materials management, and community vitality. In Hoi An, priority areas include renewable energy and habitat conservation, urban management and infrastructure, social development and cultural preservation, leadership and governance.

What lessons can be derived from these two initiatives that might inform other communities interested in pursuing such integrated development strategies? How might these efforts inform each other?

In Portland, Oregon, Eco-districts seek to become integrated and resilient neighborhoods that are resource efficient, capture, manage, and reuse a majority of energy, water, and waste on site, offer a range of transportation options, provide a rich diversity of habitat and open space; and enhance community engagement and well being. Building on Portland’s leadership in green building, green infrastructure, and community engagement, the Eco-district initiative seeks to develop comprehensive assessment tools, scalable project financing, and public policy support that will ensure strategies for enhancing neighborhood sustainability can be successfully implemented. Four pilot eco-districts are being developed in Portland, each representing a different mix of commercial and residential development, socio-economic patterns, existing infrastructure and community involvement. Eco-district partnerships involve industry, local and state government, universities and non-governmental organizations.

In addition to seeking integrated approaches to energy and water management systems, green streets, and resource conservation, “civic ecology” is a centerpiece of the Eco-district pilot program. A civic ecology framework is characterized by several guiding principles: a whole systems approach, focus on place, development of a new “social contract” that amplifies the role of community engagement, matching of needs and assets, and “dynamism” or adaptive management.

In Hoi An, Vietnam, local, regional and international partners have come together to support the development of an “Eco-city”. A town of approximately 80,000 inhabitants, Hoi An’s ancient town quarter has been recognized by UNESCO as a world cultural heritage site. The town’s reliance on cultural tourism is challenged by conditions that bedevil much of Vietnam and other developing countries, including fragmented and fragile infrastructure related to water quality, transportation, and health, lack of expertise in urban environmental management, and lack of an integrated planning framework to guide development in the face of rapid growth.

Recognizing these challenges, the Hoi An Eco-city initiative seeks to development of a strategy that will ensure harmony between socio-economic growth and environment protection. The first phase of the Hoi An Eco-city project involves development of a Master Plan Concept Paper to develop the Hoi An region into a “Creative Global Village”. This strategy may include encouraging public transportation, developing eco-tourism, promoting environmental preservation, establishing pollution control mechanisms, and developing other “eco-friendly” practices.

Similarly to the Portland Eco-district framework, Hoi An’s “eco-city” concept reflects the integration of natural and social and cultural systems. In what they describe as the “cycle of engagement and synergy”, the Hoi An Eco-city effort seeks to build a broad base of support for the region’s “creative class” – the artists and other craftspeople who contribute to the city’s cultural vibrancy. The Eco-city effort seeks to embed cultural considerations in all aspects of community development, including socioeconomic development, land use, transportation and facilities planning. As in Portland, this effort is founded on civic partnerships– libraries, community centers, neighborhood houses and social systems that support cultural development in Hoi An.

The research presented in this presentation will examine the similarities and differences between these two efforts. How did the diverse partnerships involved in each of these efforts come together? How do the challenges and opportunities that these efforts face compare? Are there approaches being taken in Portland that can inform Hoi An’s efforts? Likewise, are there concepts and frameworks being employed in Hoi An that can enrich Portland’s efforts? What lessons can be derived from these initiatives that might inform other communities interested in pursuing such integrated development strategies?

### **Slum upgrading as a contribution to a more sustainable city**

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Cities have for long been viewed as problematic areas from the environmental point of view, given that they continue to attract increasingly large numbers of inhabitants, thus generating negative impacts on the natural environment. This negative situation can basically be traced to the following: (a) an increase in land occupation resulting from the

phenomenon of urban sprawl; (b) the use of natural materials to build cities, such as sand, stone, timber, concrete and steel; (c) the consumption of energy and materials to sustain the operation of the cities; and (d) the production of wastes such as greenhouse gases, garbage and sewage.

In developing countries the above are compounded by rapid city growth and by the shortage of resources needed to properly manage this situation. Informal settlements have tended to mushroom as a result, frequently as a direct outcome of urban planning deficiencies. Areas that are undervalued and rejected by the real estate market or those that are unsuitable for building, such as areas at risk from flooding and landslides, end up by being occupied by low-income segments of the population with insufficient funds to rent or purchase a minimally habitable property.

Cities have thus become the scenarios for two very different co-existing realities: on the one hand, the 'formal' city conforming to legal guidelines and enjoying standard urban infrastructure and services, and on the other, the 'informal' city built by the residents themselves in precarious areas with no access to infrastructure, services or shops, and which is often not even acknowledged as being part of the city proper.

For many years public policies focused on efforts to eradicate slums and transfer their populations to social housing complexes. Given the need to render social housing financially viable the units were often located in low-cost areas increasingly remote from the city centres and where services, shopping facilities and transport were in short supply.

These policies were doomed to failure since many of the relocated residents in such buildings were dissatisfied and in many cases abandoned their new homes to move back to slum areas closer to the city centre. A further disadvantage of the outlying social housing estates was that the public authorities were forced to employ their scarce resources to supply infrastructure and a range of services - including transport to ensure access to such places. In view of the failure of these relocation policies local governments gradually came to accept that the most effective solution for resolving the housing shortage problem, as well as the negative environmental impacts caused by informal settlements, would be to upgrade these settlements.

The term «slum upgrading» is open to broad interpretation. It can be applied to any intervention in an urban settlement that results in the improved quality of life of its inhabitants. Slum upgrading can range from the installation of basic infrastructure and improvements to streets, access-ways and upgrading dwelling units, to providing basic services such as garbage collection, health and education amenities. In recent years new items have been incorporated into the slum upgrading programs such as environmental education, land tenure regularisation, income generation and suppressing crime and lawlessness. The slum upgrading process in Brazil has grown and evolved as governments and technical staffs have succeeded in accumulating experience of upgrading informal yet highly complex settlements. Four programs have been developed in the main Metropolitan Regions of Brazil as follows:

In the case of the Metropolitan Area of São Paulo, the Guarapiranga program aimed principally to recover and improve the quality of water supplied from the various springs around the city (1). This water was contaminated by the enormous amount of sewage flowing into the reservoir from the slum areas built on its banks. In order to undertake the environmental recovery of the water catchment area it was necessary to develop a multidisciplinary approach to deal with the various problems caused by water contamination and sewage disposal, by constructing adequate infrastructure for the existing slum areas around the reservoir. In Salvador<sup>1</sup>, the Ribeira Azul program was also targeted principally at improving the environmental and sanitary quality of the water of the Baía de Todos os Santos, which is the recipient of a vast number of rogue drainage and sewage systems, many of which originate in the slums located around the bay. The program embraces a number of different actions including infrastructure and environmental recovery works, the construction of new houses, human development projects, etc.

In Rio de Janeiro, in the 1990s, it was estimated that around 1200 informal settlements occupied approximately 10% of the built-up of the city and was home to roughly 1.4 million people<sup>1</sup>. The urban situation was even more precarious given that only between 25% and 30% of the informal settlements benefited from normal urban infrastructure services such as sewerage networks, drinking water, public lighting or regular garbage collection. The Favela-Bairro program aimed to transform the slums into conventional city neighbourhoods by installing sanitary and drainage infrastructure and ensuring that the access routes and streets of the informal settlements were connected to ordinary neighbouring areas, with a view to ending the relative isolation of the slum settlements and integrating them properly into the conventional urban fabric of the city.

In Belo Horizonte<sup>[1]</sup>, the program aimed to construct housing units and improve existing ones. The priority in that city was to deal with truly precarious and insalubrious risk areas occupied by families with the very lowest incomes. V.

The slum upgrading programs, in addition to providing minimum living conditions, also conform to a set of guidelines which inter-alia include many of the urban sustainability guidelines publicised by movements such as New Urbanism,

Smart Growth etc. These guidelines aim to address some of the following:

- Integrate the settlement's transport system with the existing system and with local or nearby links/streets/sidewalks
- Promote the landscape potential near to the project for recreation and leisure
- Eliminate risk areas with slope stabilization and drainage structures
- Provide a new water and sewer infrastructure and ensure that both are connected to the public network.
- Design an environmental preservation system to conserve or recuperate native vegetation through reforestation with native species
- Conserve water bodies and wetlands by planting with native species to avoid new informal settlements
- Treat watercourses and design a sediment and erosion control plan.
- Avoid land movement
- Provide services and equipments close to the project in order to satisfy local demand for services
- Maintain stormwater volume and water pollution rates. Provide adequate drainage for developed areas in order to minimize pollution outcomes of watercourses
- Avoid urban sprawl
- Work directly with community associations and/or other social community networks. Advertise public meetings aimed at generating public comment on project design.
- Analysis undertaken of local and regional historical patterns of neighbourhood development and building design. Attention paid to drainage systems, transport facilities, water and sewer infrastructure and availability of natural sunlight.
- NBR 9050 - Brazilian regulation to accessibility
- All dwellings to be supplied with energy
- Promote economic activities among the local population compatible with environmental preservation

In the four Slum Upgrading Programs it was possible to detect improvements in the quality of life both of the people living in the intervention area as well as in the city as a whole, mainly in the cases of São Paulo and Salvador, where a significant environmental component was involved. Slum upgrading has softened negative environmental impacts with the installation of proper sewerage networks, and existing water bodies were freed from clandestine inflows of raw sewage. Moreover, the introduction of garbage collection services meant that rivers, streams and vacant lots ceased to be dumping-grounds for domestic waste generated by people living in the surrounding areas. Finally, with the efforts to improve street systems and shore up precarious slopes, the risk of landslides was considerably lower. A further advantage is that the electric power companies stand to benefit from fewer losses, generally caused by rogue connections.

It can be affirmed that slum upgrading has contributed to making Brazil's cities more sustainable. However, much work remains to be done. Regardless of the immediate improvements flowing from the various programs what is needed is a policy designed to underpin and maintain the various interventions so that the systems, materials and solutions that have been deployed are absorbed by the resident populations of the intervened areas, so that local people are able to provide continuity to the programs without depending totally on the public authorities. In tandem with the engineering work, what is needed is to press ahead with social and community work aimed at enhancing the awareness of the beneficiaries of the interventions in their new capacity as members of the conventional, 'formal' city.

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## **Framing approaches to urban physical infrastructure development in relation to global environmental change**

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It has been estimated by United Nations that in the next twenty-five years almost two billion more people will move into cities. Intergovernmental Panel on Climate Change lists the increased occurrence of extreme weather events, rise of average temperatures and sea level rise as the most important predicted impacts of climate change on urban areas. These two factors - urbanization and climate - are the major drivers of global environmental change. Cities are very important for global environmental change research since they are both: drivers and recipients of the change.

This paper focuses on urban physical infrastructure (UPI) and analyses perspective strategies for its development considering factors of global environmental change as a starting point for this analysis. UPI includes water, sanitation, energy, transportation and communication systems. UPI can be defined as a set of artificial structures, interconnected

physically or functionally. UPI is presented by physical objects: bridges, roads, pipelines, sewerage, transmission networks, etc. These different types of infrastructure are interrelated, interconnected, and interdependent. UPI as a whole has a significant impact on cities' sustainability and vulnerability.

The paper starts with a review of relevant concepts and theories from a number of disciplines, and builds UPI analysis on them further on.

A concept of ecosystem services, which has been largely advanced during Millennium Ecosystem Assessment study, views natural environment as a provider of a variety of services to humanity. UPI often replaces ecosystems as a service provider (e.g. drinking water supply infrastructure).

Infrastructure development outlook study done by OECD revealed some common infrastructure development trends, the most notable are interdependence and convergence.

A theory of compact city claims that such a city with high density of built environment and population can be the most sustainable and efficient urban form. A concept of a city as a combination of activity centres provides a vision for a sustainable city as well.

Further on the paper discusses some generic UPI characteristics that might be important to consider for UPI sustainability and "preparing" UPI to global environmental change. Among these desirable characteristics are energy efficiency, compactness, reliability, resilience, adaptability, economic feasibility, compatibility with other types of infrastructures, and multifunctionality.

UPI development strategies, or scenarios for UPI development are identified and discussed in the paper as well. These UPI development strategies can be alternative or complimentary ones. These strategies have been listed along with some examples. The strategies actual future implementation likelihood has been discussed as well. The main analysed strategies are: new cities development with modern infrastructure (or city districts) (e.g. utilidor in Amsterdam); existing infrastructure upgrading (e.g. pipe repairing technologies, convergence of telecom infrastructures); over reliable infrastructure (e.g. high design reliability coefficients); light infrastructure (e.g. movable power stations); coupling and decoupling of infrastructure types; global and limited networking within infrastructures).

In conclusion the paper draws linkages between the above discussed concepts and theories, such as ecosystem services, and the future of UPI development. The outcome of this research highlights synergies and discrepancies/ open questions regarding UPI perspective development strategies and the global environmental change. A concept of eco-infrastructure systems is discussed as one of the possible ways to address complex issues of UPI development and adaptation to global change.

### **Does more insulation always lead to less energy consumption?**

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It is widespread among civil construction professionals and even researchers that the higher the thermal resistance of a building's envelope, the better its thermal performance. In the Thermal and Energy regulations of many countries, there is a tendency to stipulate higher insulated envelopes, in order to achieve lower energy consumption. This was the case of Thermal regulations for buildings in the European countries, which were recently revised to comply with the European Directive on the Energy Performance of Buildings [1]. As an example, the Portuguese thermal regulations for residential buildings were modified in 2006 [2] and insulation requirements increased by about 50% and a similar tendency was visible in most EC countries [3] [4].

The benefits of decreasing the U-value of the external envelope are evident in a typical winter situation, where heating needs are directly reduced. In countries that have long heating periods and short and mild summers, energy consumption can be considerably reduced by installing highly insulated envelopes. But the consequences during the summer are not so evident. Under certain conditions, when solar and internal gains are not adequately controlled, a highly insulated envelope may cause a rise in the indoor temperature, possibly above acceptable comfort limits. Recent studies indicate cases where added insulation does not contribute to more comfort and less energy consumption. This is the case of a study carried out for Portugal and Southern European countries, where distinct building models were analyzed through computational simulations [5]. The results showed that, with added insulation, solar and internal gains must be controlled more closely to avoid overheating in summer. Similar results were found by Masoso and Grobler [6], for Botswana, in Africa, and Melo and Lamberts [7], Carlo and Lamberts [8] and Roriz et al. [9], for Brazil.

The aim of this paper is to investigate the impact of decreasing the U-value of the external envelope on the energy



consumption of commercial buildings in Brazil. The methodology of this study was based on parametric studies carried out through computational simulations. The EnergyPlus Program was selected to predict the energy consumption of the cases studied. Distinct building models were simulated with distinct envelope insulation levels, in various Brazilian climates. Other parameters that influence a building's thermal behavior were changed, such as internal gains and mechanical cooling strategies.

The results showed that heating energy consumption always decreased when envelope insulation level was increased, as expected. Nevertheless, heating consumption was so low that could be disregarded. On the other hand, in many of the simulated cases, cooling consumption increased when the U-value of the walls was reduced. There is a tendency towards increased cooling energy consumption in buildings with highly insulated walls when the buildings have (a) greater numbers of floors (b) higher cooling set-point temperatures or (c) higher internal gains. Natural ventilation, especially when it was extended to the non-occupied period, showed to be an important strategy for reducing the negative impact due to wall insulation increase. In contrast, when only the roof had a higher thermal resistance, cooling and heating consumption were significantly decreased. Highly insulated and white roofs proved also to be very efficient, with considerably reduction on both cooling and heating consumption.

The results clearly show that this issue needs to be addressed in the Thermal and Energy Regulations of certain countries. They also showed the distinction that has to be done between the requirements for the U-value of walls and roofs in countries that have high radiation exposure and lower latitudes, like Brazil.

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## The Attainment of Sustainable Construction in Housing Projects through a Rule-based Expert System

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Due to international agreements, such as the Kyoto Accord, and the increase of scientific evidence on climate change, the authorities of different countries have taken actions on the sustainable development of their economies, including their construction industries. However, the literature reports that though the knowledge on sustainable development is vast and continuously expanding, the practice of sustainable construction is still limited. This paper describes the development of a rule-based expert system (RBES) that aims at facilitating the attainment of sustainability goals in housing projects by means of the assessment of the factors that affect these goals. The premise of this system lies on the integration of the explicit (documented) and tacit knowledge regarding the sustainable construction of housing projects, which can be respectively obtained from the specialized literature and construction practitioners and specialists.

The methodology included a comprehensive review of the literature in order to obtain the explicit knowledge that would lead the modelling of the system. The modelling of the system considered inherent features of sustainable construction, such as the social, economic, and environmental attributes of the projects, as well as the life-cycle of construction projects (e.g. pre-design, design, and construction). In this sense, the proposed system targets the application of modelling techniques, such as fuzzy logic and expert systems, to incorporate this knowledge into decision making concerning the implementation of management and operational practices that support the attainment of sustainability goals in construction projects. The paper also explains a prototype of the system as applied to the design and construction of social housing projects in Mexico.

## Making the case for Design for Deconstruction

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With increasing exploitation of the Earth's natural resources it is important to remember that they are finite and so efforts should be made to conserve them for later generations. As steps are taken to secure a sustainable future, resource consumption is an important issue. The built environment consumes a large amount of materials and energy, and whilst there are many strategies in place to reduce energy in buildings, there are few that deal with the depletion of resources in construction. This paper proposes that taking steps to close material loops in construction is important to the sustainability of the planet. By significantly increasing reuse rates and recycling rates dependence on the extraction of natural resources will be lessened. From a built environment perspective it is proposed that by taking action now, and designing buildings for deconstruction, the future supply chain of reused materials can be significantly increased. Within buildings, a fragmented supply chain has been identified as a significant barrier to material reuse. This can be combated through design for deconstruction, which allows buildings to be taken apart at end of life in a way that avoids damage to the components and enables maximum reuse. This approach is starting to be implemented to a limited extent within buildings, some examples of which are explored. Several case studies of buildings that utilise reused components are presented in order to demonstrate the feasibility of reuse. For design for deconstruction to be truly effective it should be adopted across the building sector.

All materials have a finite limit; however, as they vary in abundance and usage it will differ from material to material when these limits are approached. Several rare materials are at risk of depletion, some of these are considered to be important for sustainable development; for example indium and gallium, which are required for thin film photovoltaics, are believed to be scarce and there are concerns that there is only a limited supply of these (Speirs & Gross, 2010). Whilst many other materials are abundant, extracting them still damages the environment. Iron ore for example, is the fourth most abundant material found within the Earth's crust but accounts for around 95% of all the metals used within modern life (GSA, 2010). According to some studies it may start to run out surprisingly soon. Yellishetty et al. estimate that the depletion time of iron ore across the world could be as less than 50 years (2010, p.1086) because the demand for iron ore will continue to dramatically increase. Yellishetty et al. (2010, p.1086) compare this to work from the U.S. Geological Survey which estimates that the depletion time is 79 years. Both of these numbers emphasise that even those materials which are plentiful are not limitless, demonstrating that conservation methods are crucial.

One way to address the potential problem of a limited supply of natural materials is to stop considering material usage in a linear fashion (as is generally done, ie. extraction, manufacture, use, end-of-life disposal), embracing the concept of a material loop instead. This focuses on recycling and reuse as end-of-life options, so that the process is cyclic, feeding back into itself. Dramatically increasing reuse rates, as well as recycling targets, will move towards closing the material loop, so the extraction of natural materials is less relied upon. Currently, within some material loops, for example steel, there is not sufficient scrap available to close the material loop completely, such is the demand for this material (Yellishetty et al. 2010). This approach supports waste hierarchy theories, of which there are a number of different types, which essentially vary in complexity, the Ladder of Lansink (Dorsthorst & Kowalczyk, 2003) is the most comprehensive of these. It is important to highlight that waste going to landfill should always be the last resort, as not only does this squander natural resources but in some countries like the UK, there is limited landfill space. Within the UK, construction and demolition contributes more waste than any other sector, much of this has the potential to be (i) reduced through good design and ordering practices and (ii) reused or recycled if end-of-life is considered at the design phase. Within the European Union (EU) the Waste Framework Directive requires member states to set up programs to reduce waste, this calls for 70% of construction and demolition waste in the UK to be reused and recycled by 2020 (SCI, 2009).

There are a number of advantages of material reuse within construction projects, and these will be explored in the presentation through the use of case studies: BedZED (Dowling 2010), University of Toronto's Student Centre (Dowling 2010), and the Ottawa Convention Centre (Chernos, 2009). Reuse will be investigated on a whole building scale, on a system level and on an individual component level; difficulties and barriers to reuse will also be considered.

A significant barrier to material reuse is the fragmented supply chain in many areas (Storey & Pedersen, 2003). The current supply chain could be increased by deconstructing buildings rather than demolishing them at end-of-life. This minimises the damage incurred to materials, allowing maximum recovery for reuse. However, some buildings are not suitable for deconstruction due to the way they were initially designed and built. This can be addressed in the future by designing all new buildings for deconstruction.

Strategies for optimal design for deconstruction will be explored through the use of case studies within the presentation.

The 2012 Olympic Stadium (Cooper, 2009), Vulcan House (OGC, 2009), Chartwell School (USGBC, 2008) and ProLogis Park (Dowling 2010) are examples that will be investigated for the advantages and disadvantages of the way they have been designed.

A significant issue for design for deconstruction in the current economic climate is persuading designers and clients that it is worth designing buildings in this way when it may cost more. It is the aim of further work to provide an easy to use tool that demonstrates the environmental benefits of design for deconstruction and the subsequent material reuse that it allows. These benefits will be shown as embodied carbon reductions and the decrease of material extraction required. A methodology is being developed to form the basis for this tool.

Additional work that could be carried out to further encourage design for deconstruction is the development of the business case for companies that deal in reused materials, or the idea of material leasing could be developed. A brief analysis of some product design precedents is carried out, investigating how companies not only reduce waste and the embodied carbon of their products but can also receive a financial benefit by designing products for disassembly. It is thought that some of the theories employed in this industry could be transferred to the construction industry.

Design for deconstruction is a practical step towards a sustainable building solution that can be easily implemented, first at a regional level and then increasingly on a global scale. The greater the uptake of this practice, the more successful it will be in terms of developing a complete supply chain for reused materials.

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## Life Cycle Assessment to evaluate the environmental impacts of energy-efficient technology on office buildings

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The aim of this paper is to present and critically analyze the results of a Life Cycle Assessment (LCA) study on the environmental impacts of energy-efficient technology on office buildings.

Currently in the UK, there are concerns that the building sector will not meet its zero carbon targets by 2050. UK's current focus on energy reduction has turned to new and existing non-domestic buildings, which account 18% of the UK's emissions, a figure that has not improved in 20 years. The government has introduced new rules that require all new non-domestic buildings to meet zero carbon standards by 2018. Internationally, several studies have shown that energy consumption for heating space is higher than that of lighting, cooling and of other electrical appliances. In the UK, heating is by far the largest end-use. Sustainable measures for heating reduction include passive strategies, the use of sustainable technologies, renewable energy sources and the use of effective control strategies. Even if there has been some clear evidence that energy reduction attached to office buildings in correlation with these measures is already appearing, it does not seem to be enough for UK to meet its zero carbon targets. Extensive energy efficient retrofitting in

building services is currently under discussion in the energy reduction agenda for non-domestic buildings. In order this to be achieved, there is a need for a holistic life cycle approach to identify areas for improvements.

Further to that, our LCA study attempts to inform the stakeholders involved in the operational phase of the office buildings, about the environmental impacts of the heating systems and of “hot-spot” areas for potential improvements. For this purpose we test the hypothesis that sustainable technology will be more beneficial in the long run. To examine that, a comparison case study approach has been used to assess a conventional and an energy-efficient heating system in office buildings in the UK. The Life Cycle Impact Assessment (LCIA) method used to evaluate the impact indicators of the heating systems is the eco-indicator99. For this comparison, the functional unit is the heating output needed in 35 years to constantly heat office buildings of similar scale, in the same location, in order to maintain the interior temperature to 210C.

Results have shown that the conventional office building consumes higher amounts of energy for electric heating than the sustainable office building. However, the amount of total raw-materials used in the heating system of the sustainable office building is much higher than that of the conventional heating system, because of the amount of equipments used to provide combined heat and power in the building. Also the burning of fossil fuels in the conventional heating system produces methane and carbon dioxide through the chimney flues, which contributes to the global warming effect. On the other hand burning of natural gas in the energy-efficient heating system causes respiratory effects in the indoor environment. In terms of retrofitting, fuel burners in the boiler systems need particular attention. LCA has been a useful tool to evaluate the environmental impacts of the heating systems, and to identify areas where energy and emissions can be reduced. However as in most LCA studies, some data limitations, has driven us on making certain assumptions.

### **Appropriate Measures to Reduce Greenhouse Gases from Iran's Cement Industry through Sustainable Development**

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Cement industries are among the major industries in the production of greenhouse gases. The large amount of such gases released is due to two reasons: First, cement production and second, the high amount of energy consumption. The released CO<sub>2</sub> is the most important source of non-energy industrial processes. In the world, cement production holds 2.4% of the total CO<sub>2</sub> released in industrial sector. Carbon dioxide is released during clinker production and its intermediate products. In the energy section as well, the fuel mostly used by cement factories is Mazut and natural gas is also used as an alternative fuel. Right now there are 54 active cement factories in Iran and regarding the increasing demand for cement in the country the number of such factories are increasing. Therefore the need for studies like the present one is justified. Results show that amount of CO<sub>2</sub> released in cement production (calcination), is much more than its amount released due to consumption of energy in thermal and electric forms. As a result, corrective measurements to reduce the amount of CO<sub>2</sub> released during cement production can be effective. The amount of CO<sub>2</sub> released in cement production is 830 Kg per each ton of cement production. Considering the important role of cement and the general approach of Iran's increasing cement production capacity, environmental issues related to this industry must be studied.

### **“If You Build It, They Will Come” – Emerging Trends in the Era of Megacities**

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By 2050, 70% of the world's population will live in an urban environment, and according to the UN, 10.3% of them will live in megacities.[1] There are currently 21 megacities in the world, and that figure will rise to 29 by 2025. Two of the most interesting places to examine issues of sustainable development are India and China. India has 25 of the top 100 fastest growing cities[2], three of which are megacities (New Delhi, Mumbai, and Kolkata). In the top ten list of megacities, China has one (Shanghai), but it is projected to accumulate three more by 2025 (Shenzhen, Chongqing, and Guangzhou). A plethora of questions emerge from this phenomenon. This is beyond traditional urbanization. We are witnessing unprecedented development – cities are growing at an exponential level in a short amount of time. Governments need to take action now before the situation becomes unsustainable.

Density is the key to a city's vigor. Promoting low density just does not make any sense – high-rises will enable cities to expand in the future. Regarding the issue of sprawl, cities in the developing world should build up rather than out. India and China, the two countries with the most number of megacities, should embrace density over sprawl and build and promote an efficient transportation system over buying cars. While overall trends show an increasing population

growth and migration to cities, resulting in an increasing aggregate demand for energy, urban dwellers tend to be more energy efficient on a per capita basis. However, this could change in the near future because if more people are moving to the cities, society as a whole will hoard more energy. The majority of urbanization and energy demand will come from developing countries. If an estimated 70 percent of the population becomes urban, and they consume the same amount of energy as we do now, there is going to be a serious problem. We need to either radically change the combination of energy we use and/or change our energy consumption patterns.

Megacities may become too big to sustain from a social perspective, and most governments are stalling to take action. Added to a population and infrastructure problem is the increasing effect climate change will have on these cities of more than 10 million people. In order to remain sustainable, these cities need to enact public policy initiatives. Some countries are aware of the long-term consequences and have even built entirely new cities to solve overpopulation and reduce their carbon footprint. On the whole, cities are more energy efficient than the countryside. With this in mind, megacities can incite change, transferring and borrowing policies from other urban and rural areas as long as sustainability remains the ultimate goal.

Megacities will need to be more user friendly than they are today. They are the centers of culture, commerce, and increasingly, political power. When cities were established in the past, there was not a Field of Dreams “if you build it, they will come” mentality. Cities were, and are more than ever in this increasingly globalized world, a necessity. They have had the ability to know what makes them prosper and what hinders them. There is an enormous demand to build new urban spaces to accommodate our rapidly growing global population. But in many places this results in tension because most government and development agencies focus on high-end, single-purpose designs instead of thinking how these projects can help accommodate the growing community. What governments need to realize is that the city is plastic in nature, capable of being molded in such a way to develop new types of urban space that quell the tensions and improve the standard of sustainable living. Increasingly, there are new city building projects cropping up in the developing world, in countries such as Egypt, the United Arab Emirates, India, and China.

There are commendable environmental initiatives taken by cities, proving that urban public policy can affect traditional global governance. These cities are enacting new policies heavily reliant on new technologies in order to not only be more sustainable, but also to provide economic growth. Two of these cities, Dezhou and Baoding, are in China. The former is dubbed the “Solar City” because it is trying to generate solar energy for everything, from electricity, heating water, and powering vehicles. The latter is dubbed the “Green Electric Valley”, akin to Silicon Valley. The city has over 200 companies manufacturing wind turbines and other new energies that not only fulfill the energy demand in China, but for the rest of the world as well. Like Dezhou, Baoding is lowering its emissions profile while stimulating economic growth. A better-known example of an urban “greenfield” is Masdar, the planned city in Abu Dhabi. Its goal is to be completely sustainable and not have any negative impact on the environment by solely relying on solar power and other renewable forms of energy.

It certainly matters how a city was built in its early stages. Infrastructure is what allows a city to grow and eventually mature. Looking at policies matter when thinking about how to shape the profile of a city. Technology is another important factor, but it is a slightly more complicated issue. The stipulation with technology is that it is believed to be the solution only when it is close to being competitive, but to remain afloat it needs to be subsidized. In the past, subsidies have proven to be effective, like through a stimulus package or through creating a hybrid system that helped expand the automobile industry.

Given the right policies and incentives, these are examples of how new cities are being made with support from the government. But what can be done about existing cities? Certainly, it is more difficult to change one’s habits as time goes on, but it can be done. In Freiburg, Germany, energy efficiency is the main focus. Buildings are being retrofitted, the mass transit system is being revamped, and car-free initiatives have all resulted in a significant reduction in carbon emissions. Ultimately, the goal is to not only make the city sustainable, but livable. It is challenging to deal with rapid population growth and this century will be defined by urbanization. New policies, technologies, and financing will play a role, but they are not sufficient in and of themselves. Sustainability, livability, and providing economic opportunity are keys.

The megacity is with us. We cannot stop their development, so instead we need to be more flexible with regards to our thinking about urban sustainability. Megacities have the potential to be forces of efficiency, and other cities should take note that there is opportunity in the sustainable, green retrofitting trend of existing systems and infrastructures. The reality is that cities are, and will continue to be the engine of ideas, technologies, and political will, all of which will be needed in order to build a globally sustainable future.

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## Innovation through Low carbon-city design

Martina Maria Keitsch

Global warming is a world-wide environmental issue and requires international efforts to abating the emission of greenhouse gases (GHGs). Currently, over half of the population in the world lives in urban areas, and human activities in these areas emit about 75% of CO<sub>2</sub> from anthropogenic sources. Cities are the key to the establishment of the low-carbon society. Therefore, creating a "low-carbon city" has become a critical mission for both theoretical research and practical management (Jacobs 1985). While European eco-town projects have shown that industrial and urban metabolism and symbiosis are able to improve resource efficiency by exchanges of wastes and by-products generated from various enterprises, industrial parks, and urban areas, many cities in China are still suffering from resource scarcity and lower resource efficiency. Improving the overall eco-efficiency of Chinese cities through urban symbiosis (regional 3R: reduce-reuse-recycle strategies) and responding to global climate change through creating low carbon cities is essential, and greenhouse gases emission can be reduced by 3R activities. During this process, because of the complexity of urban systems, appropriate evaluation methods and planning proposals for establishing a low-carbon city have to be raised. Starting in the 1970s, the concept of energy and material symbiosis in human society was widely applied to describe the interaction of socioeconomic systems with their environment (e.g., Odum, 1971; Costanza, 1998; Ayres, 2007; Fischer-Kowalski, 1998). This concept also called urban metabolism (UM) can be applied to cities, since they "transform raw materials, fuel, and water into the built environment, human biomass and waste" (Decker et al. 2000). UM provides a means of understanding the sustainable development of cities by drawing analogy with the metabolic processes of organisms. Munda (2008) explored urban sustainability as a multi-dimensional concept, for which he suggests the use of various methods and multi-criteria evaluation as a framework for the assessment of urban sustainability, recognizing that human-dominated systems are special ecological systems, where renewable and non-renewable resource flows support the growth of complexity under human control (see also Odum, 1996).

Urban symbiosis means the use of byproducts (waste) from cities (or urban areas) as alternative raw materials or energy sources for industrial operations. Based on the synergistic opportunity arising from the geographic proximity through the transfer of physical resources (waste materials) for environmental and economic benefit, urban symbiosis is an extension of industrial symbiosis, i.e. to engage traditionally separate industries in a collective approach to exchange materials, energy, water, and/or byproducts (van Berkel, Fujita 2009). Urban symbiosis can improve the overall eco-efficiency of the whole city through various 3R activities. This is of particular relevance in Chinese cities where the proximity principle, namely, management of waste close to source, is popular (Geng et al., 2010). The other benefit of urban symbiosis is that through regional 3R efforts, more natural resources can be replaced by recyclables and more wastes can be reduced so as to minimize the total wastes to the landfill. Since the extraction of natural resources always consumes a lot of energy, especially fossil fuel based energy in developing cities, such efforts can also reduce the total greenhouse gas emission, helping achieve the target of low carbon cities and promoting local sustainable development.

The aim of the presentation is to discuss strategies towards low carbon-city innovation by presenting and evaluating existing methodologies and practices. Innovation has here to two interrelated goals: reducing the urban ecological footprint and designing and maintaining low-carbon infrastructures. We analyze urban metabolism and urban symbiosis approaches in Norway and China and present correlated examples from architecture and site construction. Further, we discuss user involvement methods that focus on infrastructure maintenance in form of citizens' participation in low-carbon ways of living. The presentation concludes with a summary on what concepts and values low carbon-city innovation entail, and which methods and practices work to achieve it.

The presentation provides examples for low carbon-city innovation in Oslo, Norway and Shenyang, China. Norway and China are countries, where economic development and a socio-political focus on the citizens' consumption behavior are challenged by limited resource availability and ecological carrying capacity. By the same time, both countries are leading in creating low carbon-city innovation. The choice for combining modeling, planning and participatory tools in the presentation is not only to illustrate comprehensive methodologies for complex questions but also to trigger the interest of the participating conference experts for interdisciplinary research and development activities within industrial ecology and sustainable development. For these reasons, this presentation of low carbon-city innovation goes beyond the traditional combination of scientific disciplines, and explores interface and cooperation possibilities between architecture, engineering, industrial design, urbanism and the social sciences.

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## Sustainable Cities: A Scale and Process Allowing Design Science to Supersede Analytical Science

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The necessity of forging a sustainable way of living on this planet is the most significant challenge facing civilization in the new millennium. Though the spirit of sustainability has been well-expressed through abstract definitions, no coherent plan or vision has yet succeeded in either imagining or articulating how such a society would operate on the ground. Actions taken in the name of sustainability remain controversial and even contradictory.

Paradoxically, policy programs centered around environmentalism and nebulously defined rights of the future foster two insidious effects in the name of sustainability. Most immediately, they privilege programs that focus on the immediate accomplishments of what we call 'low hanging fruit' - actions that are incremental, technocratic, local, individual, siloed, and term-dependent. Choices made in this context are along the lines of changing light-bulbs, and improving fuel economy in the personal automobile. In bringing immediate apparent benefits, these actions distract from the necessity of considering synergistic social choices at the scales that we now understand long-term ecological decline to be occurring. In the Pareto-Optimality with which policy frameworks understand future needs, that we do not "owe the future any particular things." [1] That is, we now operate as if an ecosystem has no more collective value than a basket of goods that might be manufactured from its resources. Such a shallow understanding of the sustainability process is a virtual guarantee that we continue on a path large-scale environmental decline.

Sociologists understand the framework of current sustainability approaches as emergent from the worldview of the scientific and technical expert. Such policy programs use analytical processes to map out the territory of current metabolisms and effects. As a result, we have become increasingly familiar with a growing litany of indicators of ecological decline. In the process, this approach has developed some valuable tools for assessing the extent of the un-sustainability problem, including the Sustainability Indicator approach and the Ecological Footprint approach. Policy programs emerging from these approaches lead to the lingua franca of contemporary prescriptions: a partitioning of responsibility, a focus on quantifiable problems, the use of the individual as actionable node, and a faith in continuous marginal incremental gain. In the realm of urban planning, city design and development follows this piecemeal approach. Almost every new decision is either an intervention made for private gain or a remedy to correct problems created by previous decisions and interventions.

Analytics has little to say about creating a sustainable way of life. While scientists are skilled at assembling the tools and the theories for studying complex systems, the scientific process is different from the process of bringing into existence complex systems that don't already exist. Sustainability is fundamentally a question that plays out in the messy and complex adaptive systems of society & culture. Where the *un-sustainability* problem is a collection of complex interconnected systemic effects, of which choices by individual humans contribute only marginally, the sustainability solution must evolve out of a negotiated system of collective action. As designers, we understand the sustainability problem to require a coherent on-the-ground operationality establishing a new paradigm of development, one that acknowledges the synergistic and cumulative effects of human actions in a world of limited environmental resources.

We argue that any significant long-term success in the preservation of an ecological envelope requires the delineation of a systems boundary, from which can follow the establishment of an effective scale of action. But rather than the usual boundary limitations placed on the individual, we recognize the utility of one that accounts for cultural variation and the effects of collective action in a differentiated community.

We have identified the scale at which the design and negotiation of sustainability is possible. This is the scale that it has historically always been, the scale of the city-region. The city, with its agricultural hinterland, is at once large enough to accommodate aggregate efficiencies and small enough to be a cultural organism of local accountability. The city allows the environmental effects of human actions to be understood within a discreet boundary of appropriate size and limitations, it is the necessary place where sustainability happen.

From these principles, we have developed the only operational definition of sustainability:

*“Sustainability is a local, informed, participatory, balance-seeking process, operating within its Sustainable Area Budget, and in so doing exports no negative imbalances beyond its territory or into the future, thus opening spaces of possibility and opportunity.”*

Key to this definition is the Sustainable Area Budget (SAB): the aggregated land area based budget that the city-region has to work with on an equitable basis, within which it obtains its resources and balances out its wastes. In principle each person is entitled to one six billionth of the earth’s bounty on a regenerative basis interpreted as land area. While the Ecological Footprint answers the question, “How much land area is the metabolism of our city appropriating,” Sustainable Area Budget says, “This is the amount of land to which we are entitled.” We have thus flipped an analytical tool on its head and turned it into a design problem. In the process, sustainability becomes answerable question: “How can we explore different scenarios for the design of our city and the use of our available ecological resources to support the highest quality of life among our citizens?”

The operational definition allows on-the-ground deployment of an advanced democratic sustainability process. Interdisciplinary teams of local stakeholders and design scientist carry forward numerous designs and partial designs to be compared and inform one another. Using the Sustainability Engine™ and the Sustainability Game™, modeling and feedback tools that are being deployed to build systems models of emerging city design scenarios, in both parts and wholes, to see how various proposals will work as a system within the budget.

[1] Solow reference.

## **Alkali-Activated Cement as an Appropriate and Sustainable Building Material**

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Concrete is the most extensively used material on the planet besides water [1], but the Ordinary Portland Cement (OPC) that makes it possible raises serious concerns. The manufacture of OPC is responsible for 5% of global CO<sub>2</sub> production and industrial energy consumption, and over 2.6 billion tons of mining annually [2]. Aging infrastructure in industrialized nations and rapid development in Newly Industrialized Countries (NICs e.g. India, China, and Brazil) are only increasing demand. Quality housing remains unaffordable in many places. Herein, promising OPC alternatives, alkali-activated cements (AACs), are discussed as a partial solution to these problems. An analytical approach used by the authors is described, followed by the results of two case studies in the U.S.A. and India, respectively.

The advantages of AACs include up to 95% reduction in the CO<sub>2</sub> of manufacture [3], no need for thermal processing, large-scale recycling of industrial wastes, and up to 50% cost savings [3]. They are competitive in performance with OPC and in fact demonstrate longer life, improved durability in harsh environments (e.g. marine, chloride, sulfate), and superior bonding to reinforcement and existing concrete [4]. Much of this is accomplished through their composition, chiefly industrial byproducts such as ground granulated blast furnace slag (GGBFS) from the iron industry and/or coal fly ash from power production, blended with common alkali and other chemicals.

Despite their advantages and multi-story proof-of-concept buildings in Ukraine, commercial use of AACs is all but nonexistent decades after discovery. This is due primarily to four challenges: i) variations in raw materials, ii) difficulty achieving standards compliance (e.g. rapid setting, leaching, efflorescence), iii) incomplete understanding of chemistry and performance, and iv) barriers to market penetration.

To overcome these and other challenges, statistical mixture Design of Experiment (DOE) was used to investigate cements comprising ground granulated blast furnace slag (GGBFS), soda ash (sodium carbonate), fly ash, and up to 66% fine



limestone. This approach is uniquely suited to designing and analyzing complex multi-variable experiments. A distinct advantage is that the system itself can be a “black box;” once appropriate boundaries have been established, both the hypotheses and conclusions can be determined simultaneously. Statistical algorithms are then applied to allow for the identification and understanding of key factors, response modeling, optimization, reducing variability, and more. Compared to simple one-factor-at-a-time (OFAT) experimentation, the number of runs required is significantly reduced, and additional valuable information, such as the presence of component interactions, is obtained.

The first case study was conducted in the U.S.A., with the goal of developing and understanding AACs to replace OPC in ready-mix concrete. Successful formulations have minimal environmental impact (evidenced by low CO<sub>2</sub> production), low cost, and comparable performance to OPC (including strength). By analyzing compressive strength, modulus of elasticity, hydraulic properties, cost, and CO<sub>2</sub> production, models were derived to understand the impact of mix design on performance and for optimization. Observations include multi-variable, non-linear influences on hydraulic stability, the success of compositions comprising up to 66% limestone by weight (far above current US or European standards, respectively 5% and 35%), and the ability to optimize formulation for specific applications and improve performance (e.g. 5% higher strength than the strongest non-optimized formulae).

Successful formulations are hydraulic, cure at room temperature, and have strengths as high as 40.7 MPa at 3 days and 64.5 MPa at 28 day. CO<sub>2</sub> production is as low as 16 kg /tonne, a 98% reduction in CO<sub>2</sub> compared to OPC. Costs are as low as \$43/tonne, a 57% savings compared to OPC and an 89% savings over white portland cement. These formulae were not standards compliant, but more recent ones may be. A company was co-founded by the authors to develop commercially viable versions. Detailed life-cycle analysis is ongoing.

This work was extended to correlate not only mix design and performance, but the chemical phases and pathways responsible, yielding insight into why AACs behave as they do and how to better control them. Rietveld analysis of x-ray diffractograms, quantification of unreacted slag by backscatter scanning electron microscopy (BSE-SEM), and analysis of amorphous phases by Nuclear Magnetic Resonance (NMR) were carried out. Major chemical products include calcium silicate hydrate/calcium aluminum silicate hydrate (C-(A)-S-H), gaylussite, and calcite; the former two are most important to strength at 3 d, and the latter at 28 d. A fraction of the limestone is consumed and becomes part of the C-(A)-S-H, which tends towards a CaO/SiO<sub>2</sub> ratio of 1.4. Excess Na<sub>2</sub>CO<sub>3</sub>, indicated by thermonatrite, significantly harms strength, while a high slag-to-limestone ratio benefits strength [5].

The second case study was conducted in Mumbai, at the Indian Institute of Technology (IIT) Bombay, to investigate the use of AACs for equitable and sustainable slum improvement. This motivation is supported by the draft National Slum Policy of 2001 [6], which includes a goal to “...enable households to have access to better technology and materials at cheaper prices.” The National Building Code promotes the use of locally available building materials, cost effective substitutes, and appropriate technology [7]. Further, the National Action Plan on Climate Change includes a Sustainable Habitat Mission [8] and a recent national news special on the environment stated that “green and sustainable buildings have to become the norms [9].”

In Mumbai, slums occupy 16% of the land area and are home to over 50% of the city’s population of 12 million [10]. Government bodies and politicians thereof have crafted a top-down approach to slum improvement, not unlike historical development strategies in New Haven and Detroit [11, 12]. Ranging from slums presently best to worst settled, these are: land tenure, in-situ redevelopment, resettlement, and demolition.

Regardless of the exact nature of each slum development initiative, cement and its products (concrete, blocks, etc.) are central to both housing and infrastructure (e.g. water, roads, sanitation). Amongst alternatives like masonry and wood construction, mass concrete (monolithic, poured on site) is typically the cheapest, quickest, most trusted and familiar, and requires the least skilled labor; making it the material of choice [13]. The use of AACs could benefit all parties, but current interests of those in power would limit the benefits directly enjoyed by slum dwellers. A non-profit construction firm was identified, part of the non-governmental organization Society For Promotion of Area Resource Centers (SPARC), that prioritizes the lives and livelihoods of slum dwellers and would maximize the benefit to them.

DOE was applied to local GGBFS – that was nominally chemically identical to that used in the U.S.A, but behaved quite differently. Nevertheless, in less than 6 months, formulae were developed that meet each of the three grades of Indian Standard (IS) cement: 33, 43, and 53 MPa at an age of 28 days. Cost savings were as high as 45%, yielding a savings on concrete of 7.5% and on a typical slum improvement project of 3–5%. These savings could be passed on to slum dwellers that finance the improvement, a path favored by SPARC. As important, the simple and low-capital nature of AAC manufacture lends itself to distributed and small-scale operations, which could further empower slum dwellers and others.

In both the U.S. and India, technical, environmental, economic, and social analyses show that AACs are viable alternative cements. Critical paths have been identified and embarked upon for commercialization, principally comprising

formulation, passing appropriate standards, building consumer confidence, and collaboration amongst several interests (e.g. manufacturers, builders, architects, regulators) to bring AACs into the mainstream.

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### Effect of Growth Conditions on the Performance and Cooling Ability of Street Trees

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Urban forests appear to be an excellent way of mitigating the urban heat island and adapting cities to climate change, as trees provide cooling by evapotranspiration. Air temperature reductions up to 3° - 4° C have been reported during hot summer days in urban parks. However, the effect of growing conditions on tree growth and cooling performance and the likely effect of climate change have not been investigated. The current study is addressing this shortcoming by studying the growth, transpiration rate and physiology of urban trees growing in Manchester, UK under a range of conditions.

A survey of the commonly planted tree *Pyrus calleryana* 'Chanticleer' was carried out between February to October, 2010 on street trees that had been growing for 5 to 6 years under 3 contrasting growth conditions: in pavement; in grass verges; and in Amsterdam soil. Trees growing in Amsterdam soil had grown almost twice as fast as those in pavement, the differences being related to the degree of soil compaction; trees growing in soil with lower shear strength grew faster. Physiological parameters of the trees, measured at the end of May, July and August also showed differences. The stomatal conductance of trees grown in the less compacted Amsterdam soil was significantly higher compared to trees grown in the other streets, and midday leaf water potential was also significantly lower. This enhanced physiological performance of trees grown in Amsterdam soil led to significantly higher evapotranspiration cooling. Foliar nutrient analysis showed that the macronutrients N and P were significantly higher for trees grown in Amsterdam soil and grass verges compared with trees grown in pavements. Among the micronutrients B, Na and Mn contents were also significantly higher in trees growing in Amsterdam soil compared to other growing media. These differences were consistent with the observed differences in growth and physiological performances of the trees. Amsterdam soil had significantly lower moisture content in the top 20 cm, but there were no significant differences at depths of 80 cm. Presumably this reflects a higher infiltration rate and more available moisture to plant roots in case of Amsterdam soil. Phenological observations showed that trees in pavements had fewer growing days compared to ones in grass verges and Amsterdam soil; initiation of bud burst was about a week later and initiation of autumn colouration was 8-10 days earlier. These field growth data indicate that planting conditions have an important impact on the growth and cooling effectiveness of urban trees. To compare the cooling effectiveness among different species another study has been set up with 5 commonly planted urban street tree species around Manchester, UK. *Sorbus arnoldiana* Schouten, *Crataegus Laevigata* Pauls Scarlet, *Prunus uminecko*, *Malus Rudolph* and *Pyrus calleryana* Chanticleer trees growing for 6 years in the pavements will be investigated and might help the urban designers to select suitable species to mitigate urban heat island effect.

To further study the effect of common growing conditions on the growth and physiological performance of urban trees, a third experiment has been set up with street trees growing either in conventional 1.2 m × 1.2 m pits, in pits filled with urban soil, or in 1.2 m × 2.8 m pits filled with urban soil and an interlocking root cell system. Finally, a fourth, factorial experiment has been set up at the Botanical Grounds of the University of Manchester to investigate the effect of simulated urbanization and climate change. Urbanization is being simulated by paving around the trees and compacting the soil, while climate change is being simulated by warming the soil using heating cables, and by decreasing precipitation by 30% during summer and increasing it by 30% during the winter. Both experiments will be monitored over the next 3 years. The results of these studies should help remove some of the uncertainties around the environmental effectiveness of urban forestry.

## Charting Experiments for Eco-cities of the Future

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Transurban – Charting Experiments for Cities of the Future is a continuing interdisciplinary research and design project that documents and analyzes design ideals, ideas, and processes of recent and current projects for cities of the future. The idea of sustainable design is investigated in more than environmental and ecological aspects, and the emergent forms of architecture and urbanism documented and analyzed for lessons that inform on the shape of cities to come. These built model projects embody complex topics of design, dwelling, community in space, building technologies, environmental strategies, as well as models of affordability, but at the same time, explore new trajectories in the role of design and the development of the city. The patterns that emerge reveal complexity and integrated thinking across disciplines. Transurban draws from these rich databases of documented and analyzed precedents for applicable design strategies for the future sustainable cities.

The five case studies were selected on the bases as exemplary, new integrated developments that were coupled with political will and ambitions to become models of sustainable urban development. These developments may vary in size and scale, but do represent development densities that are prevalent in the European context, embodying mixed-use programs, social agendas as well as innovative design solutions for architecture, urbanism, environmental design and landscape architecture. Many of these developments, to varying degrees of success, are planned to have an optimal allocation of land and natural resources while preserving exiting ecological systems; they strive towards the reduction of environmental impact and to enhance the health of quality of life of the communities that inhabit them. The role of design in the development of an integrated approach in the built environment as well as in creating good aesthetic qualities of forms and spaces cannot be overemphasized.

Vauban, a 38-hectare former barracks site near the center of Freiburg, Germany, was purchased by the city in 1994 with the goal of converting it into a flagship environmental and social project. Vauban comprises 2,000 homes to house 5,000 people, and business units to provide more than 500 jobs. Vauban displays a complex network of environmentally friendly planning measures that work synergistically within its lively social and community framework. The development presents itself as a viable and real alternative to preconceived models of architectural typology or urbanism, bringing back qualities of the city into neighborhood development and yet at the same time seeking environmental alternatives to car-reliant development.

SolarCity Linz in Austria comprises about 1,300 homes and 3,000 inhabitants. It was designed as a flagship development for renewable energies in urban design and includes projects by architects including Foster and Partners, Richard Rogers, and Thomas Herzog. Construction of the nucleus of solarCity took place from 1995 to 2005. This experimental project aims to be a model for ecological living at the beginning of the twenty-first century while being at the forefront of architectural and landscape design.

Sarriguren, in the metropolitan area around Pamplona in Spain, is the result of the partnership of the Valle de Egüés and the government of Navarra to build a new city that houses 13,000 people with over 5,500 residences serving middle to low-income populations. It was built within stringent environmental criteria, being a showcase of sustainable energy practices in Spain. The urban design encompasses a variety of lively spaces with mixed uses. There are numerous housing types throughout the development, ranging from high-rise apartments to less dense, single-family housing.

Ecociudad Valdespartera resides on the southwest edge of the city of Zaragoza, Spain. With a footprint of 234 hectares and providing housing to nearly 10,000 people, with a capacity for 24,000, the development has been purposed to provide a new model for sustainable urbanism and technology. The project aims to be an innovative solution, through public and private ventures, to the many issues surrounding sustainable design and planning. The project persists as an artful showcase of high quality materials and structures that are made available to a population that might otherwise not be able to afford these luxuries.

Bo01, Malmö was completed in 2001 - a mixed-use district resulting from an international housing exposition initiated by the Swedish government was planned as a demonstration project for sustainable urban development. Today, Bo01 comprises of 1,420 privately developed and owned dwelling units for a population of approximately 2,000 on 22 hectares of developed land and open space located in the Västra Hamnen district of Malmö, Sweden. Bo01 touts an infrastructure that relies on 100% renewable energy and is a veritable test bed for innovative ideas and new techniques for environmental standards, delivery and management.

To evaluate the success of sustainable projects at an urban scale and make useful comparisons of various efforts, it is necessary to develop more sophisticated measurement tools and inclusive methodologies that will be available to architects, urbanists, environmental engineers and landscape architects. Such an evaluative system should apply

at different scales – from large-scale infrastructure projects at the regional scale as well as at urban design scale, incorporating different disciplinary inputs as well as specialized requirements.

An evaluative system for assessing sustainable projects at an urban scale must also be capable of highlighting the role of architectural and urban design in creating integrated environmental technology systems, so that these projects form part of the larger inhabitable environment rather than remain limited showcases of environmental science. Projects will be successful only when they exceed the sum of their environmental technologies, such as photovoltaic and waste disposal systems, and consider aesthetic, economic, and social dimensions. Designers can create urban environments that address multiple variables—quality of life, diversity of population, alternative modes of transportation, and ecologies of site. By becoming part of a comprehensive framework for evaluation, such variables could foster new trajectories in the development of future sustainable cities.

### **A Life Cycle Assessment of Power Generation Possibilities for a Stand-Alone Mobile House**

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As the interest among the general public towards environment grows, society has become more concerned about natural resource depletion and environmental pollution. Through this attention, increasing eco-efficiency, reducing energy and raw material consuming per product became an important way to meet the global environmental problems. The Life Cycle Assessment (LCA) is used for the evaluation of the eco-efficiency of a product. LCA investigates environmental impacts of e.g. systems or products from cradle to grave throughout the full life cycle, from the excavation and supply of the materials and fuels, to the production and operation of the investigated objects, to their disposal/recycling. LCA can also be applied to compare products or processes and to analyze the contribution of the life cycle stages to the overall environment load [1].

Renewable energy sources can be considered as clean sources when not considering the impacts of their manufacturing and transport. Although power generation from renewable resources is free from fossil fuel and greenhouse gas emissions, transportation and manufacturing of the elements of such systems consumes considerable amount of energy. Decommissioning phase also should be taken into account to carry out a fully informed environmental assessment [2, 5].

Being located where there is not competing energy sources (e.g. remote areas, rural homes in developing countries, etc.), stand-alone hybrid systems do not need to justify their primary energy use. Nevertheless to keep track of the different system elements and to pinpoint the elements that is energetically and environmentally most expensive LCA study is a very useful tool [5]. Although solar and wind power is inexhaustible and highly available their highly sporadic too, it has been a challenge to generate reliable power with photovoltaic and/or wind turbines alone [6-7]. Several studies show that fuel cells are a possible way to overcome this challenge, also simulated results showed that a PV/Wind/FC hybrid power system may be a feasible solution for stand-alone applications [8-10]. Since a multi-source hybrid power system increases energy availability significantly, it becomes advantageous for practical applications that need highly reliable power regardless of location [11].

To evaluate future energy systems at early stage of market development has many advantages. Conduction of an LCA study will give the opportunity to evaluate the environmental and energetic impacts of alternative combinations of stand-alone power generation systems.

As the impact assessment method Eco-Indicator 99 is used. The reference systems that is used in normalization step is highly suitable with Turkey's geography, climate, social and economic conditions. The method classifies 11 impact categories from inventory results. In this study these impact categories grouped under three damage categories as the method suggests, which are; Human Health, Ecosystem Quality, Resources.

The stand-alone mobile house is a project of United Nations Industrial Development Organization - International Centre for Hydrogen Energy Technologies (UNIDO-ICHET) (PR08-GN-01). The idea of a mobile stand-alone system was stated by Turkish Ministry of Energy and Natural Resources in 2008. The aim of building such a system was to use the system as Disaster Coordination Offices in case of disasters such as floods, earthquakes etc. [12].

The goal of this study is to evaluate the power generation alternatives of a stand-alone mobile system, and to point the combination which has the least impact on the environment.

Most of the LCA studies hybrid power systems focus on wind-PV hybrid system. On the other hand, LCA studies that

addresses fuel cells mostly focus on the use of fuel cells in transportation sector. This study conducts a comparative attributional LCA of a stand-alone mobile house's power generation alternatives, which uses electricity for appliances and heating. This is one of the few examples of Wind/PV/FC hybrid power system LCA studies. The alternatives are combinations of PV panels and wind turbine as main energy source, fuel cell and diesel generator as backup source and batteries, compressed H<sub>2</sub> and H<sub>2</sub> in metal hydrides as excess energy storage. The system components of the mobile house are an 8x1 array of 100W PV panels, a 1kW wind turbine, and a 2kW fuel cell, 4 modules of 12V 100Ah sealed lead acid mono block gelled electrolyte battery, one metal hydride tank of 5Nm<sup>3</sup> and two hydrogen tanks of 10L at 150 bars.

The results of the study showed that although renewable energy sources are carbon free in their use phase, they are not as environmental friendly as thought by the public, considering the manufacturing and decommissioning phases. Unlike big capacity power generation systems, the use phase of these systems affects the environment so little; it causes the impact on resources to look relatively big. This is also connected with the recyclability of the materials used. Systems that include fuel cells and PV panels generally have the most impact on resources of the world. This is generally because of the types of materials used, platinum as catalyst in fuel cell, and the losses during the production processes, Si dust while sawing of PV panels.

Overall comparison showed that the most environmentally sound solution for such systems is to use wind turbines as the main energy source, and diesel generator as the backup power system.

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## Posters

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### Biophilia and Urban Design: The Case for Integrating Nature into Our Built Environment

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Biophilia, the concept framed by Harvard biologist E.O. Wilson to describe our innate need for contact with nature, can often seem more intellectual than pragmatic. Biophilia in practice is both pragmatic and necessary for cultures with thinning opportunities to be outdoors and engage in the natural world. A growing number of publications indicate that humans are biologically wired to need interaction with the natural world, and that a separation from it results in effects that reverberate in areas as diverse as mental and physical health, work-place productivity, and levels of urban violence.

The incorporation of nature into the built environment, especially within the context of urban design, has immense implications for communities at large, since urban design is the tool that forms both our infrastructure and built environment. Our work in biophilic architecture and urban design derives from over 30 years of academic research. We believe that exposure to nature correlates to improved mental and physical health, which in turn are able to affect communities at large. Using the methodology of a review of existing academic literature, we propose that urban design

and infrastructure should be thoughtfully re-examined to incorporate the natural elements they currently lack.

Beginning in the 1980s researchers began studying human physiological response to nature. In 1981, Roger Ulrich measured the quality of human responses to nature. Subjects viewed slides of either natural or urban settings. The natural views had more positive influences on psycho-physiological states than the urban scenes (Ulrich 1981). Ulrich later conducted studies that indicate accelerated recovery rates and reduced stress in hospital patients that could see nature from their windows (Ulrich 1984, 1991).

Other researchers have isolated more minute human reactions to biophilic experiences. One study documented the reduction in stress levels in older adults engaging in park-based leisure experiences by measuring the relationship between length of park stay and the subjects' systolic blood pressure (Ortega-Smith 2004). A study conducted at the Swedish University of Agricultural Sciences found that significant effects could be found in subjects' EEG while they were viewing fractals. This may explain our fascination with the fractal patterns that appear in vegetation, crystal formations, ocean waves and mountain ranges (Hagerhall et al. 2008).

Research in the past decade has measured the effect of exposure to nature around the home, school and work-place on the general well-being of people of all ages. A 2001 study showed that views of nature specifically increased the self-discipline of teenage girls— a key component in achieving positive outcomes such as academic achievement, and avoided pregnancies and delinquency (Taylor et al. 2002). Similarly, two other studies published in 2001 looked at the relationship between acts of aggression and violence in urban public housing and the presence of green spaces. The study measured the levels of aggression in public housing residents randomly assigned to buildings with varying levels of nearby nature (trees and grass). Residents living in relatively barren buildings reported more aggression, violence and domestic abuse than did their counterparts. (Kuo & Sullivan 2001, Kuo & Sullivan 2001).

Researchers have observed the effect of a 20-minute walk in a park in increasing mental concentration in children diagnosed with ADHD, and have concluded that “doses of nature” might serve as a safe and widely accessible new tool for managing symptoms of the disorder (Taylor & Kuo 2009). In a similar vein, the positive effect of horticultural therapy on hospital patients has also been well-documented (Ulrich 2002). Terrapin Bright Green is four years into a five-year productivity study of workers in a LEED Platinum office building, which has measured workers' improved well-being, resulting from the incorporation of biophilic elements, such as daylighting, views of prospect and refuge, and the incorporation of natural materials. The research team has estimated that a 5% increase in productivity resulting from increased well-being could save a company as much as \$23 million a year (Browning et al. 2010\*).

Case studies measuring the impacts of green infrastructure and design show that their incorporation makes practical sense. The City of Seattle, for example, undertook a project called Seattle StreetEdge Alternatives, which reduced impervious street surfaces, narrowed streets, and added bioswales, shrubbery and trees in parts of Seattle. Two years later, the result was a 99% reduction in stormwater runoff and a significantly more biophilic streetscape (Tracy 2007, Seattle Public Utilities). A city that incorporates trees into its streetscapes can combat the heat island effect more effectively than cities with greater areas of asphalt and other heat-conducting surfaces (Solecki et al. 2005).

Landscape architect Herbert Dreiseitl redesigned the thousand year old city center of Hannoversch, Munden, Germany, to incorporate a series of urban water art installations among pedestrian walkways. Besides connecting the residents of the area to a basic natural element, the project involved collaboration between two ethnic groups, the Germans and Turks, who have had historically tense relations. Combined with research linking exposure to nature and enhanced well-being, one can conjecture that these installations can improve the overall lifestyle in the town. An added practical benefit is that since the installations are recharged by rainwater catchment, the town has experienced decreased drainage problems (Grau & Dreiseitl 2005).

Infrastructure could easily be redesigned to incorporate nature. The inclusion of more trees along city streets, for example, could create a stronger connection between urban dwellers and nature around them. A thoughtful re-examination of urban land-use planning regulations for public parks is a necessary move toward the increased interweaving of society with nature. In most cities, there are usually few large public parks available for the daily, recreational use of residents. However, research on stress-level reduction and horticultural therapy supports our assertion that urban dwellers need daily access to nature in each neighborhood—access to parks large and small, community gardens, green roofs, and pieces of intact local habitats. Urban communities need to integrate policy planning with biophilia in order to achieve improved health outcomes, reduced violence, increased infrastructure resiliency, and improved water and air quality. The effects of such a measure could, in a similar vein, slowly improve the health and well-being of cities overtime.

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## Incorporation of paper fibers from cement sacks recycling in the production of compressed earth blocks

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Most of the cement sacks used in civil construction every year is thrown out without any environmental treatment, having associated an enormous negative environmental impact. For example, in 2009 the cement production in Brazil reached 51.5 million tonnes. Of this production, 71% was bagged, which is equivalent to 36.5 million tonnes [1]. Considering that cement in Brazil is typically packed in 50 kilogram's sacks, it can be estimated that, in Brazil and only in 2009, 731.3 million cement sacks were used, which corresponds to a consumption of 109.7 tonnes of Kraft paper.

The fibers of these cement sacks have excellent mechanical and physical properties. Its fabrication is oriented by strong specifications demanded by the cement industry, i.e. high resistance long-fiber sulphate cellulose, which is mainly used in its pure form.

After the use of the cement, the sacks made of paper with good mechanical characteristics are not accepted by the recycling industry, as it has been "contaminated" by the cement. However, there is great potential on its reuse for the production of new construction materials, for example in the improvement of technical, economical and sustainable properties associated to traditional components used in the dwellings construction.

Plant and vegetable fibers have been used extensively in traditional earth construction to improve the mechanical properties of constructive components and elements whose raw material is the soil. The Compressed Earth Block (CEB) is the modern descendent of the molded earth block, more commonly known as adobe block. Hand and hydraulic presses are used in CEB production to compact the particles, thus increasing density and strength.

A series of tests to characterize the mechanical behavior of KRAFTTERRA COMPOSITE were developed, under a collaborative framework set up between the University of Brasilia, in Brazil, and the University of Aveiro, in Portugal. The study's objective focuses on the development and performance evaluation of CEB, incorporating kraft-paper fibers recycled cement sacks. The research's main goal was the verification of the hypothesis that the fibers sourced from cement sacks could be used to improve the properties, and particularly the mechanical characteristics, of blocks using soil as their raw material.

Kraftterra production process is very simple and does not require any special tool. The first stage of the recycling process is the cleaning of the cement sacks, which are normally discarded. This procedure is particularly necessary for the sacks

that have been exposed to excessive humidity or have had contact with water, which can lead to the production of small pieces of hardened cement in the interior of the sacks. This solid material should be removed, since it may damage the equipment used in the preparation of the recycled material. This stage requires care in the handling of the sacks to avoid contamination.

After cleaning, the cement sacks are transformed into a cellulose pulp, which is basically the made by the dispersion in water of the kraft paper fibers. This dispersion is done through the immersion of the cement sacks in water and agitating until the separation of the fibers is complete. The addition of chemical products or heating of the water are not necessary to complete the dispersion of the fibers. To remove the water excess from the cellulose pulp, the use of a centrifuge machine is recommended. Then, the fibers must be dispersed, for this a waste grinder or a tree grinder, largely used in gardening, could be used. After the dispersion, the process of mixing the Kraftterra can begin.

With the homogeneous mixture, the composite is removed from the equipment and the compacting process of the CEBs can begin. The Kraftterra CEBs were produced with 6% of cement (in mass), 6% of disperse fibers (in mass) and enough water content for each composite to reach optimum compacting humidity levels.

For the production of the CEBs, a manual press TERSTARAM made by Appro-Techno was used. This press produces two solid flat CEBs at a time, with the following dimensions: 22cm x 11cm x 5,5cm. The soil used for the production of the CEBs had 84.5% of sand and 15.5% of fine fraction (7.3% of silt and 8.2% of clay). This soil is from a region close to Aveiro, Portugal.

The prisms tested in axial and diagonal compression were made with five courses, each with one CEB and a half, and joints with approximately 15mm thickness, which resulted in square prisms with average dimensions of 34.5x34.5cm and a thickness of 10.6cm . The tests were performed according to the RILEM recommendations [2] and ASTM standards [3].

The maximum value of the simple compressive strength reached by the Kraftterra CEB prisms and by the soil-cement CEB prisms was 7.20MPa and 7.10MPa, respectively. However, the average compressive strength of Kraftterra CEBs was 11.23% higher than the corresponding for the soil-cement CEB prisms, which reached values of 6.04MPa and 5.43MPa, respectively.

The average values of compressive strength tests registered with Kraftterra prisms (5.66MPa) was very close to the average recorded in the tests with the Kraftterra CEBs (6.04MPa).

The average value of the shear strength reached for the diagonal compression tests (0.566MPa) is around to 1/10 of the average value of the ultimate simple compressive strength (5.66MPa). This ratio was already observed in the work of Varum et al. [4] for adobe walls.

The diagonal compression strength tests show that the prisms produced with Kraftterra CEBs have excellent bond conditions between the blocks and mortar. The monolithicity of the prisms was observed visually at the end of the diagonal compression tests. All the prisms present a diagonal fissure path and these fissures occurred in the blocks and in the mortar but not in the contact surface between them.

After several tests and comparative analyses between the new composite material and cement-soil blocks and prisms, a better performance by the Kraftterra was noted in what regards the compression and diagonal compression strength. However, the Kraftterra presented a tendency to absorb more water than the cement-soil. In turn, this feature can easily be controlled or minimized with the use of natural or synthetic additives.

The use of disperse Kraft paper fibers from recycled cement sacks shows by itself the environmental concern of the proposed research technological topic. However, the possibility of using such an abundant residue in our society must not be seen as the unique contribution of this work, taking into account that this measure also results in a significant improvement in some of the physical and mechanical properties of the building components (CEBs) and construction elements (walls).

The inclusion of Kraft paper disperse fibers from recycled cement sacks in CEBs and mortars allows for a large increase in the walls' ability to resist to compression and diagonal compression, even after the maximum strength is reached. Furthermore, the mortar made with Kraftterra results in strong connections between blocks and produces more homogeneous building walls, with more uniform properties and high monolithicity, which induces better performance to the wall elements.

As final conclusion, it can be stated that the Kraftterra may be adopted in construction as an economic and sustainable alternative for the production of CEBs for walls construction.

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## Fibrous Hemp Insulation: An Initial Study of its Hygric and Thermal Properties

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In the United Kingdom, the domestic sector accounts for 28.5% of total energy use, of which the highest amount of energy is used for keeping the internal temperature within a comfort range, by using mechanical heating system mainly in winter and by using mechanical cooling system in some buildings in the summer. Energy use from fossil fuels is directly linked to greenhouse gas emission and greenhouse gas emission is widely recognized as the cause of global warming. As a measure of reducing greenhouse gas emission, the United Kingdom has committed to cut its energy use by 80% by the year 2050. Having to use 80% less energy to achieve similar level of thermal comfort in a house will result in relying more upon passive measures and energy efficient mechanical equipments. It has been found that among the energy saving measures, improved insulation standard in building envelope is the most cost-effective one. In the United Kingdom about 11 million older homes have to be thermally refurbished and another 11 million new homes have to be built by 2050. While using adequate insulation will effectively lessen the operation energy use of these buildings, at the same time the scenario of increased use of insulation also puts into perspective the necessity of reducing the embodied energy and other environmental impacts of the insulation materials. Natural insulation materials are thought to be superior to synthetic and mineral insulation materials in terms of embodied energy, renewability and the end of use environmental impacts of the constituent materials. Among the natural insulation materials, fibrous hemp insulation is a relatively new product. However the high yield of hemp crops (8-10 tonne/Hectare) in the United Kingdom makes fibrous hemp insulation a potentially viable product for a diversified market including building, automobile and clothing industry. Although many of the properties of fibrous hemp thermal insulation can be found in trade and academic literatures, there is still lack of data about the relationship between the moisture uptake behaviour of hemp insulation and building energy use. Moisture uptake can significantly affect thermal performance of the insulation. Thermal performance of insulation depends both on its conductivity and the effects relating to its thermal mass. These parameters may change dynamically in time depending on the moisture content of the insulation.

Therefore a series of investigations are being carried out in order to understand and further quantify these effects and their influence on the thermal behaviour of the building. This paper reports some of the initial findings. Fibrous insulation materials are complex multi-phase matrices of fibres and largely still air. The thermal conductivity of fibrous insulation materials can depend on its material properties and the boundary conditions. Some of the material properties that have been identified to have influenced the thermal conductivity of fibrous insulation materials are: length, orientation, mass distribution and volume fraction of the fibres as well as thermal conductivity of the gas phase and fibre-phase of the matrix. The boundary conditions that can influence thermal conductivity are temperature, humidity, vapour pressure, air flow and radiative heat flux. In addition to the influence of aforementioned material properties, biobased fibres and mineral based fibres yield distinct micro-level response in contact with boundary conditions, especially in contact with moisture and very high temperature. Since the influence of very high temperature is not relevant for building applications, it has not been discussed any further in this paper. Bio-based fibrous materials are hygroscopic meaning that the fibres can attach water molecules to their surfaces during vapour transfer through the fibre matrix. The degree and significance of this distinctive behaviour in terms of heat propagation through hemp fibre insulation has been studied through lab-based experiments and thermal simulations. To find out the moisture uptake behaviour, the insulation materials are conditioned at 23°C temperature and relative humidity values between 20%-98% using a climatic chamber until they reach equilibrium moisture content (EMC) at each humidity step. For each EMC, weights of the insulation materials are measured with high precision. Sorption isotherms are developed from these data showing the change in moisture content in the insulation materials as a function of relative humidity at 23°C temperature. Thermal conductivity, diffusivity and volume heat capacity of the insulation materials at each EMC have been measured using a transient thermal analyzer. In thermal analyzers, conductivity is determined from power input and time dependant temperature variation using a transient

line source (for needle probes) or transient plain source technique (for disc shaped surface probes) based on ASTM D5334 - 08. By relating these readings of conductivity, heat capacity and diffusivity to the sorption isotherms, it has been possible to relate thermal conductivity and diffusivity to relative humidity and moisture content in the selected fibrous insulation material. It has also been possible to establish a co-relationship between changes in conductivity and changes in diffusivity. It is observed that conductivity of fibrous hemp insulation increases with the increase of moisture content in the fibre matrix. For fibrous hemp insulation, significant increase in conductivity is observed from dry condition to EMC at 98% relative humidity. Increasing conductivity means that heat loss in higher rate from the insulation will begin once steady heat exchange starts between steady internal and external boundary condition. The time to reach the point where steady heat exchange is achieved changes with heat capacity. The heat exchange phenomena will become further complicated when boundary conditions at one side of the insulation becomes unsteady, which is a very likely condition for external climate and internal conditions can also vary. To understand the significance of taking dynamic heat capacity of this thermal insulation material into account, the inter-relationship between conductivity, diffusivity, moisture content and volume heat capacity has been analysed. To further explore the implications of changing diffusivity and conductivity in conditions similar to real-life, thermal simulation had been carried out using dynamic thermal simulation in a number of building types and scenarios. It is observed that there are variations in the yearly energy use figures when change of diffusivity is taken into account for any particular scenario. It has also been observed that the heat loss due to increasing conductivity can be partly mitigated by the decrease in heat propagation due to decrease in diffusivity in some cases. It can be argued that, dynamic diffusivity needs to be recognized as a key performance criterion along with dynamic conductivity to fully appreciate the thermal capability of an insulation material. Finally the paper looks at the limitations of transient method and steady state methods in measuring thermal conductivity.

### **Preferred solar access in high-density sub-tropical living environment**

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The ability of a unit to continue to receive sunlight without obstruction from any other properties or structures is termed as solar access. Appropriate solar access is considered to be important to residents' health, comfort and daily living. Guidelines and standards for the provision of sunlight in terms of areas of sunlight received by residential units have been formulated in the past few decades in low-density living environment. In high-density living environment like Hong Kong, associated guidelines and standards are generally lacking and it has become a growing concern for better provision of sunlight to residential units. Residents' preference of solar access is very important to the formulation of standards for solar access and daylighting, as well as urban planning and building design. This paper presents the results of a questionnaire survey regarding residents' preference of solar access in terms of time, duration and place of the exploitation of sunlight and computer simulation which provides information on current situation of sunlight environment of visited households. Results show that the majority of the respondents (about 60%) preferred to have sunlight penetration to their households in the morning. There is likely a need to improve the provision of solar access in terms of the time of sunlight received by residents since less than 40% of the respondents had their desirable time of sunlight entering their flats. There are not any particular preferences of the expected amount of solar access. Policy-makers, as well as planners and architects, should therefore take the findings into account when establishing appropriate guidelines and standards in order to provide residential units with better sunlight environment.

### **A New Model for Sustainable development in the Bedouin communities of the Negev**

Alon Shepon

The Bedouins of the Negev region are the decedents of semi nomadic tribes that have inhabited the region hundreds of years ago. Today, concentrated in a small triangular area they are mainly settled in unrecognized villages deprived of basic infrastructure of water, electricity and municipal services. An ongoing conflict between the Bedouin society and the state of Israel, especially concerning land issues has yet to be resolved. Bustan[1], an NGO working on issues of sustainable development through permaculture and community empowerment, believes that there is a lack of an effective platform for community empowerment of the Bedouin population. It seeks to create in the village of Qasr A-Sir, within the regional council of Abu Basma, a model for a new platform, suited for the special needs of the Bedouins, in which ability of the community to function in the modern reality will be assured, and the connection between the community and its cultural heritage will be renewed. A community center serving an extended family of 800 people constructed in different green building techniques is in the last phase of design with plans for beginning of construction during 2011 followed by the approval of the regional council Abu Basma. The community center, which will serve as a hub of community activity, includes a separate space for the men, women and nursery as well as a center for professional trainings. The

community center will serve as a stepping stone of metamorphosing the village into an eco-village and close work with the community including social and economical empowerment and leadership training has began. The long term target of the project is to promote principles and culture of sustainable development among the population, on the basis of the unique Bedouin tradition; strengthen the Bedouin identity and narrow the generation gap; supply the population with tools to integrate into the modern economic structure through local sustainable economy models; and empower women in the village while diversifying their role in society. The work in Qasr A-Sir is to be viewed as a case study, with potential for creating a new culture of cooperation and fertile ground that will allow a just and worthy regulation of the relations between the state and the Bedouin population in the Negev.

- [1] Bustan is a local NGO that operates in the Negev region for social and environmental justice mostly for the Bedouin community. The NGO has been operating over a decade while encouraging sustainable development and equal rights. As a part of its activities, Bustan initiated the building of a straw ball clinic in Wadi El Na'am, the installation of solar systems for sick children in unrecognized villages, developed a permaculture course for Bedouin and Jewish citizens and initiated a tree planting project (Shatla). For more information please visit: [www.bustan.org](http://www.bustan.org).

## **Carbonation of reactive magnesia-based porous blocks: effect of cement content, water content and aggregate size**

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Portland cement (PC) is the most widely used construction material in the world, with current global annual production of over 2.6 billion tonnes. It requires one of the most energy intensive manufacturing processes and results in significant CO<sub>2</sub> emissions, 5-7% of global anthropogenic emissions. The recently emerged reactive magnesia (MgO) cements, with their much lower manufacturing temperatures, ability to sequester significant quantities of CO<sub>2</sub> and gain high strengths as a result, have recently experienced considerable global interest as a far more sustainable alternative to PC. MgO cements are a mixture of PC and reactive MgO in different proportions, depending on the intended application.

Previous work in this area has led to the use of reactive MgO alone as the cement, the carbonation of which leads to significant strength gain. In porous blocks, MgO hydrates to form magnesium hydroxide (Brucite) which then carbonates to form a range of hydrated magnesium carbonates. Recent work which involved a combination of laboratory and commercial full-scale trials using laboratory developed mixes showed that blocks containing 10% MgO achieved between 40-100% carbonation, depending on their composition.

Hence the aim of the current study is to investigate the effect of the various variables that affect the degree of carbonation of reactive MgO in porous blocks. These include: cement content, water content, aggregate type, use of additives and admixtures, particle size distribution and associated particle packing and porosity, and curing conditions (i.e. relative humidity, CO<sub>2</sub> concentration, carbonation period). This paper will present the details of the investigation into the effect of the cement content, water content and aggregate size on the degree of carbonation of reactive MgO in porous blocks.

Block samples, 50mm in diameter and 60-70mm high were prepared in the laboratory in which the MgO content was varied between 4 and 10%. The water content was varied using a range of standard consistence (SC) from SC-12.5% to SC+12.5%. In addition to the cement, the mix composition was composed of fly ash and natural aggregates (sand and gravel) where the particle size distribution of aggregates varied from an even distribution to more uni-size, including gap grading as well. The ash content was also modified for each mix composition and the results were reported. The samples were then cured under elevated CO<sub>2</sub> conditions at 20°C temperature, 50-70% RH and 20% CO<sub>2</sub> concentration as well as ambient conditions, at ambient CO<sub>2</sub> levels.

Following 1 to 28 days of curing, the samples were tested for their compressive strength as well as stiffness. Microstructural analyses were also carried out by using scanning electron microscopy (SEM).

The paper will present the details of the work performed and results obtained, aiming to shed light on the effect of the variables investigated on the carbonation of porous blocks and hence the developed strength. The results show that varying the MgO and water contents, along with the aggregate size and composition produced strength values of 3-25 MPa for samples subjected to accelerated carbonation and 2-8 MPa for those which were cured in ambient conditions.

# Technology

Vijay Modi & Alissa Park

## Oral Presentations

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### Agro-processing Farming Cooperatives Powered by Locally Grown Plant Oil

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The green revolution brought incredible growth over the last half century to the country of India. A core component in the green revolution was mechanization of agriculture. The first important landmark in the modernization of Indian agriculture was the mechanization of the lifting of irrigation water via small 5 horsepower stationary diesel engines. India's GDP tracked closely with the growth in the number of diesel pumps in the country during the last 50 years. The stationary diesel engine, especially where electricity access is limited, is thus a proven technology for improving agriculture related activities. Even with so many significant advances in distributed alternative energy based solutions such as solar photovoltaic, wind, and the like, the importance of diesel engines holds firm for remote applications, given their status as a mature, widely available technology.

Small, slow speed diesel engines are still widely used throughout India, Africa, and many developing countries around the world. Multi-function energy Platforms (MFPs) are agro-processing centers comprised of a small stationary diesel engine driving various milling, grinding, or pumping attachments. MFPs are often a central component of community run farming cooperatives. Several countries, including Mali, even have national MFP programs. The pairing of MFPs with plant oil fueling has potential to provide a cost effective mechanism for farming cooperatives to carry out sustainable agro-processing business activity.

A variety of plant oils exist throughout the world, many of which possess an energy density only slightly lower than diesel fossil fuel (39 MJ/kg versus 44 MJ/kg). At room temperature, however, plant oil can be ten to twenty times as viscous as fossil diesel. Ignition qualities of plant oils also impact its use. Direct combustion of plant oils in many modern diesel engines can thus result in problems like: poor atomization of the fuel, increased fuel spray penetration resulting in engine deposits, incomplete combustion, coking of the fuel injectors, ring carbonization, and contamination of the lubricating oil.

To overcome the obstacle that increased viscosity poses, usually one of two pathways is taken: alter the engine (Elsbett's engine design) or alter the fuel (produce biodiesel). But a third, hybrid approach may exist: create an add-on engine kit that minimally alters the fuel in situ. Such a kit would involve preheating the plant oil to reduce its viscosity to a level comparable to fossil diesel.

Such an engine modification kit was designed to allow the Lister CS 6/1 engine to be fueled off of locally grown Jatropha Oil in Mali. After a series of short-run tests to refine the kit, a 500 hour laboratory durability test was carried out. Following this, ten MFP sites in Mali were outfitted with this kit and monitored for a year to provide comprehensive field testing.

This model of utilizing locally grown plant oil to fuel cooperative run MFPs is analyzed at length. Lessons learned are detailed. These lessons learned include an accounting of the installation, training, and operation & maintenance costs of these systems. The service fees charged in the 10 systems studied are compared to these costs – a sustainable business model is proposed involving payback periods and profit margins. Common maintenance issues are discussed as well as an analysis of the lubrication oil degradation, with an explanation of how to better prevent such maintenance issues.

### Technology Diffusion and Social Networks: Evidence from a Field Experiment in Uganda

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The substantive motivation of this project is to examine the potential for using the Gold Standard or CDM to spur the dissemination of improved woodstoves in East Africa. A key motivation for the project is to examine the potential for poor households to benefit from carbon credits through the Clean Development Mechanism through adoption of stoves.

We estimate that with a market size on the order of 50,000 households, households could produce savings that could translate into a 5 subsidy for a 15 stove. A key question then is whether such a subsidy could generate a market for stoves at the subsidized price of 10.

The improved stoves were developed at the Aprovecho Research Center and use about 40% less fuel and reduce emissions by 40-50% while reducing green house gas (GHG) emissions an estimated 40% or about 1-2 tons per year from Laboratory tests. Earlier work has shown that these stoves are preferred over a locally made stove and a three stone fire by 95% of users in this study area of Uganda. The stoves were also tested in the field under local kitchen conditions by cooking Matoke, the common local food, with local biomass fuel available, using paired tests (same food, same amount, same fuel mix, same pot) to compare with cooking on a three-stone fire. These results confirmed savings of 38%.

Adoption of this technology could come with economic, health, and environmental benefit. Economic benefits may include savings on purchases, savings on labor time for gathering fuel wood, and savings on labor time for food preparation; these latter savings are likely especially important for women. Health benefits could include reduced respiratory infections and eye diseases. Environmental benefits could include a reduction in the destruction of local forests and a reduction in carbon dioxide emissions. However, experience shows that even simple technologies, such as fertilizers to improve yields, mosquito nets to contain malaria, and condoms to limit the transmission of AIDS, have been surprisingly slow to diffuse in Africa. Part of the reason for the slow diffusion may lie in the ways that information about the effectiveness of these technologies is transmitted through social networks. Limited information transmission can slow the spread of a technology that can have real benefits for end users. Then the primary question is: Can a market for stoves be sustained at a scale and price that allows consumers to benefit from carbon credits? The second question is: What is an optimal way to generate such a market in conditions under which technological diffusion is often slow?

One approach to overcome this hurdle is to use a marketing approach in which technologies are “seeded” throughout the site in a way that maximizes demonstration effects. We have begun our assessment of the market for these stoves at a project site in Ruhira in the Isingiro District of southwestern Uganda. The region is the site of one of the “Millennium Villages» and as such is subject to numerous interventions. Compared to otherwise similar sites, populations in Ruhira are likely more exposed to new technologies especially in the areas of agricultural production. The region is a poor area with an estimated annual per capita income of \$250. Fuel wood in Ruhira is extremely scarce; clearing of forests to open land for cropping is estimated to have left only 5% of the land with tree cover (Ruhira Wood Supply Report). As a result there is a serious shortage of fuel wood; women and children spend many hours searching for fuel wood mainly from tree stumps. Some households are not able to prepare two meals a day, not because there is a lack of food, but because there is a lack of fuel wood to cook the food. Biomass is the main source of fuel for cooking in the region. An energy survey conducted in 2007 showed that 99% of cooking was done with fuel wood and crop residue. 95% of fuel wood is collected, and the remainder is purchased.

Our strategy is to examine the scope for stimulating diffusion using Uganda’s LC1 system as units. In Uganda, LC1s are the lowest administration units, containing approximately 100 households. In many (though not all) locations, LC1s have demonstrated considerable organizational power and enjoy the confidence of populations. In our design we use the LC1 system to randomly select different nodes of social networks for exposure to the technology; the procedure employed is designed to maximize the potential for estimating both direct exposure to technologies and also indirect “neighborhood” effects on take-up and usage.

Our results are largely negative in that we do not find evidence that the presence of local disseminators spurs takeup, despite the fact that there is a broad interest in the technology, and disseminators are socially well established and incentivized to encourage take up. Our design helps us to rule out the possibility that the non-result is due simply to the difficulty of identifying positive effects in the presence of spillovers. To speak to this question this research addresses a set of substantive and methodological challenges.

## **Analysis of Biochar Pyrolysis Potential as a Sustainable Development Intervention in La Coupe, Haiti**

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As a result of a growing population and over 2 centuries of harvesting trees for fuel wood, rural Haitians spend a significant portion of their meager income on charcoal and have experienced decreased agricultural productivity because of soil loss from deforestation. Widespread deforestation has reached as much as 30 million trees felled per year. Resulting soil loss has led to an estimated decline in agricultural productivity of 0.5% -1.2% per year in recent decades. A preliminary survey in September 2010 indicated that residents of Cinquantin, a village in the La Coupe Region of

Central Haiti, identified two high priority needs: 1) cheaper cooking fuels, and, 2) agricultural improvements. The intent of this study is to analyze rural Haitian livelihoods and resource use to develop a strategy for the adoption of a simple technology – pyrolysis. Production of green charcoal and biochar through pyrolysis promises to allow Haitian farmers to create both a sustainable cooking fuel and an improved soil amendment from crop wastes that would otherwise be burned or left to rot.

Heating of biomass in an oxygen-poor environment, known as pyrolysis, results in carbon-rich charcoal. Called “green charcoal” if the biomass input is from agricultural waste, the product can be carbon neutral. Alternatively, the resulting charcoal is called “biochar” if it is applied to soil as an amendment. Biochar combined with small amounts of compost aids water retention, improves cycling of nutrients, develops organic nutrients, and decreases soil acidity, resulting in a 30%-100% increase in crop yields (Laird 2008). In addition a biochar soil amendment removes 50% of carbon in biomass from the global CO<sub>2</sub> cycle in a much more enduring form. With a half-life of ~1,000 years, this approach may be considered an effective form of carbon sequestration (Lehmann 2006).

The results of follow-up research during January 2011 will be reported for the first time in this conference. Because of the urgency for action in Haiti and the on-going nature of this study, progress will be reported rather than final results. The objective of the study is to understand current livelihood conditions of several villages in La Coupe, using the Sustainable Livelihood Framework (DFID 1999). Within this context, we will co-develop with community members a rationale for the adoption of modern biochar technology as an adaptive livelihood strategy. This strategy will be analyzed in depth with citizens of Cinquantin where we have already introduced the technology. A broader aspect of the study will identify conditions that act as either barriers to, or drivers for, adoption in other local villages. Research methodologies include participatory rural appraisal techniques, surveys, focus groups, before and after observations, and unstructured but documented discussions designed to understand the current use of resources (trees, fuel, crops).

This study will provide an understanding of local resource use and biochar pyrolysis potential to guide the investments and activities of Carbon Roots International (CRI), a non-profit company (<http://www.carbon-roots.org>). CRI is working with the community in La Coupe to holistically document the local livelihood strategies as they evolve. Pyrolytic techniques will be tailored to the specific conditions of each individual community in the region. If one group requires cheaper, more sustainable charcoal, CRI will work with the community to design the project around green charcoal pyrolysis. If others would prefer their crops to provide more food, CRI will help develop biochar-oriented pyrolysis and appropriate educational programs. As the initial communities in a region become more facile with modern pyrolytic techniques, we expect the model to spread to other areas through suitable facilitation.

The Short-term goals of this extended study are to provide alternative sources of primary fuel at the local level. Within a year, we anticipate that communities will have reduced local consumption of purchased charcoal with a green alternative and, in some cases, completely eliminated market-based charcoal consumption in the village of Cinquantin. Longer-term goals include improved crop yields, improved soil quality and retention, and supplemental income to locals from trading their green charcoal with other rural farming families. The full potential of biochar as a soil amendment, however, will not be reached for several planting seasons.

If properly tuned to local needs, this model has potential to scale-up over the next 5 to 10 years, with millions of subsistence farmers in rural sub-Saharan Africa, South Asia, and Latin America in need of improved agricultural capabilities and alternatives to wood-based fuel. Use of green charcoal as a fuel can decrease the reliance on trees for firewood. Biochar can curb top-soil loss due to erosion by increasing moisture retention in the soil. On a global scale, sequestration of carbon through biochar use will help mitigate climate change through reduction of atmospheric CO<sub>2</sub>. These broader impacts have timescales of decades, but can simultaneously address significant local and global issues.

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## **Avoiding the Bottom: A Novel Policy for Addressing the Inefficiency and Un-Sustainability of Groundwater and Electricity use in Indian Agriculture**

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The excessive exploitation of groundwater aquifers is emerging as a worldwide problem, but it is nowhere as dramatic and consequential as it is in India, the world's largest consumer of groundwater (250 km<sup>3</sup> a year), and a country where up to 70% of agricultural production and 50% of the population depend on this vital resource (World Bank 1998). Groundwater irrigation has played a key role in the green revolution that started in India in the 1960s (Shah 2009), but there is ample evidence to suggest excessive groundwater withdrawals have led to declining water tables in most key groundwater irrigated areas (CGWB, Rodell et al 2009, Tiwari et al 2009). As water tables fall, water quality can suffer irreversibly; Wells have to be deepened at considerable costs; If the resource is exhausted or irreversibly damaged, the impacts for agriculture and rural development can be devastating; And even if it is not, the energy required to lift the same amount of water will keep increasing.

The depletion of groundwater is taking place against a backdrop of extremely inefficient use of irrigation of water in Indian agriculture, with little signs of improvement. The Minor Irrigation Census and other sources show that the great majority of farmers still flood their fields through open channels, with very low rates of adoption of technologies such as drip or sprinklers. In fact, every stage of the irrigation production process is riddled with inefficiencies in the use of the principal inputs of energy and groundwater.

This paper discusses the connection between the inefficiency and un-sustainability of groundwater irrigation. First, we use available national-level data and estimates on groundwater and land use and to ask to what extent improvements in efficiency can arrest water table declines. Second, we ask what kind of policies can stimulate the adoption of water efficient technologies and practices, and whether they will lead to a reduction in water use that maintains agricultural production, or to simply an enhancement of production using the same or higher water use.

We focus on a policy design that creates financial incentives for farmers to reduce energy and water use. During the past 18 months, we have been advising the government of Gujarat on the design of such a reform, and have carried out extensive fieldwork for that purpose. Our research in the region paints a stark picture of the possible fate of groundwater-irrigated agriculture in the country. Our fieldwork shows that even where farmers lift water from a depth of 300 meters and use sophisticated water-sharing schemes (CWC 2010), they have failed to invest in efficient irrigation systems, despite the large potential for such cost-effective improvements. This is a worrisome indication the prospects for large-scale adoption of these technologies in the present institutional setup are quite poor.

Our proposed reform attempts to address these institutional failures directly (see below). On April 1st, we are beginning a pilot test of this novel policy in a dedicated study area that experiences some of the most dramatic depletion in India, and should also be able to report preliminary findings. Due to many political and technical obstacles, this is the first time a policy of this kind is attempted in India and it has the potential to transform the entire course of groundwater use in the country.

At the heart of the present institutional failure is the lack of sufficient incentives for efficient water use. In most of India, groundwater is unregulated or priced, and even electricity for pumping is provided at low (or free), and flat rates. This practice began in the 1970s to save metering costs, but has since become entrenched by populist politics, an escalating cycle of dependency, and the central government's desire for self sufficiency in grain production and to support growth in India's lagging agricultural sector. The result has been a rapid increase in electricity use in agriculture,[1] with agriculture already responsible for as much as 40-50% of total electricity consumption in some states (Mukherji 2009), an increasing pressure on India's energy sector and state budgets, an unaccountable public energy sector and a deteriorating infrastructure and quality of supply (Morris 1996, Dubash 2007), and the depletion of aquifers. Even in areas like North Gujarat, where our estimates (CWC 2010) indicate that the energy costs have made irrigated agriculture have negative value-added, this subsidy is still in place.

Many scholars and development agencies have argued for the full pricing of electricity for pumping in order to reduce usage and incentivize efficiency. However, the political prospects for such reforms are unrealistic in the foreseeable future (Morris 1996, Dubash 2007), and there is some concern about their possible outcomes for food production (marginal pricing of energy may reduce it) and equity (placing a marginal cost on water use may lead well-owners to increase the currently low price at which they sell water to those who do not own their own wells and the latter may lose access to the resource).[2]

Under the novel reform we are proposing, farmers will be compensated for voluntary reductions in electricity use for pumping (they are currently paying a low, flat rate for their energy) relative to an established baseline. In this way, a marginal opportunity cost on water use may incentivize farmers to improve their water use efficiency without burdening them with the full costs of energy and without affecting government budgets. Our research and pilot testing are designed to rigorously evaluate to what extent this marginal opportunity cost on energy use might affect five parameters that are key to the course of Indian rural development and food security:

- I. Water use and food production.
- II. Uptake and adoption of water saving technologies and practices.
- III. Poverty alleviation and equity in access to groundwater.
- IV. Water table declines.
- V. Rural development and exit from agriculture.

While our study area is not representative of the entire country, we believe it is an important and pioneering first step towards the assessment of this reform as a potential way out of the current vicious cycle.

- [1] According to some estimates, the energy intensity of Indian agriculture has already increased from 2.8 Kwh per 1,000 Rs worth of food production in 1960 to 94.8 in 1991 (World Bank 1998, see also Shah 2010).
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## Testing Fuel Savings and Adoptability of Improved Biomass Cookstoves

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Roughly half of the world's population burns solid biomass fuels for cooking and heating. Throughout poor, rural areas of the developing world, biomass is the dominant fuel, and cooking is usually performed using a simple three-stone fire (or "open fire"), often in poorly ventilated structures. The inefficient and incomplete combustion of these fuels without good ventilation produces indoor concentrations of health damaging pollutants, including particulate matter and carbon monoxide, which far exceed international standards and guidelines and are associated with acute lower respiratory infections, chronic obstructive pulmonary disease, and lung cancer. Moreover, women and children, who are primarily responsible for providing fuelwood for cooking, may spend many hours searching for fuelwood each week, and some households are unable to prepare even two cooked meals a day, due to difficulties obtaining fuelwood.

Earth Institute researchers developed a field testing program based upon the widely accepted Controlled Cooking Test (CCT) methodology to compare fuelwood consumption across multiple stove models (locally manufactured improved stoves and imported improved stoves). To perform these CCTs, local women are first loaned improved cookstove models, and trained on the best use of these stoves, per the manufactures instructions. The cooks are asked to use these stove models for two weeks in their homes, cooking for their family as normal. The test team identifies two local staple foods, and CCTs are conducted in which local women cook local foods with local fuelwood and typical cooking techniques in order to test both local and imported improved cookstoves simultaneously alongside the three-stone fire.



Questionnaires assess the cooks' overall impression of the stoves' design, usability and cost, including specific questions regarding which stoves the cooks would purchase and use at various prices.

In the Millennium Village (MV) in Uganda, the local staple "matooke" (steamed, mashed plantains) was used to test the locally produced Ugastove against the imported StoveTec stove and the three-stone fire. Both improved stoves show substantial and statistically significant fuel savings relative to the three-stone fire, defined as the percentage difference between the SFC values of each improved stove relative to the three-stone fire. The Ugastove stove showed fuelwood savings of 46%, and the StoveTec showed fuelwood savings of 38%. In a region where fuel scarcity is a serious problem, fuelwood savings of 38-46% can have a large impact. While in the MV in Tanzania, CCTs were conducted with ugali (corn flour) and beans on the locally produced Advent stove, imported StoveTec stove and imported Envirofit Stove. When beans were tested, the Advent stove had average fuelwood savings of 36% (with a 95% confidence interval  $\pm 6\%$ ). The StoveTec stove had a statistically similar fuelwood savings of 34% ( $\pm 6\%$  C.I.). The Envirofit stove demonstrated the lowest average fuelwood savings of 22% ( $\pm 6\%$  C.I.). When ugali was tested, the StoveTec and Envirofit Stoves showed comparable fuelwood savings of 41% (with 95% confidence intervals of  $\pm 12\%$  and  $\pm 10\%$  respectively), while the Advent stove showed fuelwood savings of 25% ( $\pm 14\%$  C.I.).

Preference surveys in Uganda show cooks overwhelmingly preferred the StoveTec stove, with 23 of 24 respondents ranking it first. Over half ranked the Ugastove second, but 42% ranked the Ugastove last, actually preferring the three-stone fire over the improved stove. In Tanzania, StoveTec was rated highest overall by a wide margin, with nearly two-thirds (63%) of respondents ranking it most preferred and 33%, followed by Envirofit, then the three-stone fire and lastly the Advent. Interestingly in Uganda, although the Ugastove showed the lowest fuel consumption overall, other unfavorable aspects prevailed in nearly half of users' assessments. This disparity between fuel savings and acceptability strongly recommends inclusion of a qualitative evaluation alongside fuel consumption tests in stove assessment efforts. In surveys cooks were asked to rank the three things they liked and did not like about each stove, and these results helped to inform their preference rankings.

A generally accepted value for household biomass use for cooking in sub-Saharan Africa ranges from 2.5 to 3 tonnes per year. Estimates from MV survey data suggesting that only 50–60% of cooking would be performed with an improved stove if only one were owned, along with testing data from Uganda and Tanzania suggesting that a biomass cookstove might be expected to save 30–40%, the expected fuelwood savings per year can be predicted (using the mid-points of each range) to be roughly:  $55\% \times 35\% \times 2.75\text{tonnes} = 0.530\text{kg}$ . Overall one half-tonne per year appears to be a credible estimate of yearly fuelwood savings from ownership of one improved StoveTec or Envirofit cookstove. These results have implications for potential carbon financing contracts and currently stoves sold in the MVs are subsidized up to the market-rate of carbon credits based on the calculation of 1 tonne per stove per year, assuming a two-year lifespan of a StoveTec stove.

The fuel efficiency of any stove, including the three-stone fire, can vary greatly with cooking methods, the skill of cooks, the fuel used and the type of food being prepared. Additionally, any potential beneficial effects of improved cookstoves on respiratory health can be disproportionate, according to cooking methods in different countries. To address these, investigations are being undertaken in the "geography of cooking" in the MVs, in which additional data is collected regarding the most commonly prepared foods, as well as typical cooking times, methods and locations (such as whether cooking is typically indoor or outdoor, how long a staple food is stirred, if a cook typically sits next to a fire or stands over it, etc). This information, combined with CCT data, creates a more complete picture of the quantities of foods cooked, overall fuel requirements, and the typical cook's risk of harmful secondary effects of cooking. It is anticipated that this data will not only help to establish where improved cookstoves may be most useful, but also help to determine in which African countries cooks may be at higher risks of the harmful effects of IAP, and target more in depth studies into the longer term effects of IAP in these locations.

## **Improving Household Energy for Off-Grid Communities: Introduction of Solar LED Lanterns**

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Rural populations worldwide have limited access to modern energy services. Instead, these households typically rely on inefficient and expensive lighting options such as kerosene, candles, or low-quality electric lanterns powered by disposable dry-cell batteries. These technologies deliver low light levels for the amount spent, and villagers pay a high premium due to frequent, small volume purchases and poor distribution networks. The situation is similar for mobile phone charging. While penetration of cell phones in many rural places in the developing world is high, these communities

typically lack grid electricity, making mobile phone charging difficult and costly. Some of the various methods employed to charge cell phone batteries include use of car batteries, diesel generators, or commuting to the nearest town with grid access.

Introducing solar lanterns into rural villages increases access to cost-effective, high-quality technologies and, more specifically, delivers more light at lower or equal cost to previous kerosene expenditures. The Millennium Village Project (MVP) approach for introducing rechargeable, solar LED lanterns in the Millennium Villages (MVs) is market-based, where village-level vendors sell lanterns to village households at full-cost (no-subsidy). This enterprise-driven approach spurs entrepreneurship at the local level. A lantern program implemented by the MVP in Malawi showed significant benefits to village-level lantern vendors, including increased income in the first few months, and growing self-sufficiency in training, promotion and placing orders with international lantern suppliers.

Studies of lantern pricing in MVP sites show that 70%-80% of the respondents are interested in purchasing the lanterns at around the \$40-\$50 price point, while demand drops to 10%-20% at a price of \$70-\$80. Thus, a project must keep the price low to maintain high demand. The benefits demonstrated in the program so far include more light (higher light output for longer hours) combined with a decrease of 85-90% on kerosene expenditures among households who purchase the lanterns (which equates to a 6-9 month "payback" period) (1). In household surveys performed in the MVs, respondents reported expenditures of between \$50 and \$80 per household per year for lighting and \$50 to \$100 on cell phone charging. The lanterns also offer greater convenience and reliability for both light and mobile phone recharging, since lantern owners no longer need to walk the sometimes long distances (5-10 km or more) to purchase kerosene or dry-cell batteries.

During the implementation of MVP lantern programs in six sites across five countries, it has become clear that strong international supply chains and enthusiastic local demand are crucial to growing sustainable programs. Without in-country access to products and supply chains into rural areas, even fully market-based programs will be unsustainable. Once products reach rural areas, local demand will vary with the cost of traditional energy products, the lantern product price, and the functionality of the lanterns.

Other key lessons learned include:

- A market-based, private-sector led approach is crucial for sustainability and scalability of lantern programs. Data from the MVs demonstrates that even rural villagers are willing to pay full-market cost for a lantern. By engaging private-sector markets, distribution responsibilities can be shifted from development assistance programs to national vendors and international manufacturers.
- Lanterns that provide both light and mobile phone recharging were strongly favored in many communities over models that provide only light. Sales records in several MV sites demonstrate households purchasing lanterns with cell phone charging more frequently than lanterns with light alone.
- In-country partnerships with other lighting organizations/companies lend sustained project support and help contribute to economies of scale for lantern imports. There are many nongovernmental organizations, governmental sectors and private companies working to support the distribution of solar lanterns. Partnering with actors already engaged in national lantern distribution accelerates growing market demand and can help to decrease lantern import costs.
- The ability to repair or replace faulty lanterns is important, and although many products come with warranties, returning lanterns to manufacturers is difficult due to transport issues and the lack of supply chains for replacement batteries. Currently lantern programs should not rely on company warranties or shipped replacement parts. In the short-term training local technicians in lantern repairs may provide a viable alternative to manufacturer warranties, though come with their own risks, such as diminished product life.
- In many countries there are poor-quality, low-cost lanterns on the market, even in rural areas, and in some places bad experiences with these lanterns has led to market spoilage. Columbia University, the World Bank and others have tested various lanterns available on the market for basic technical standards of light output, charge and discharge control for preserving battery life, the option for recharging using a solar panel, and overall durability and quality. Introducing high-quality lanterns is crucial for creating a reputable program.
- Household income is often highly seasonal. Because of this, if no financing options are provided, seasonality may cause spikes in lantern sales after harvest periods and lulls during planting. A financing system can help smooth annual sales.

Experience shows that lantern programs are a viable energy solution for improved electricity services for off-grid communities in rural areas. They save money and increase the quality of lighting for rural families and may also provide phone charging services. However, to increase availability to rural populations, both international and national supply chains need to be strengthened. At a grass roots level, this is being done by NGOs. At a national level, this is facilitated

by the World Bank through their Lighting Africa program. Internationally, companies like D-Light Design, Barefoot Power, and many others, are working to establish regional distributors. The availability of lanterns to rural populations in Africa will ultimately depend on the success of these actors' to develop sustainable supply-chains for low-cost, high quality products.

Adkins, Eapen, Kaluwile, Nair, Modi. "Off-grid energy services for the poor: Introducing LED lighting in the Millennium

## **A grid expansion model of centralized and decentralized electricity infrastructure development**

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It is estimated that approximately 1.6 billion people do not have access to electricity and of these some 85% reside in rural areas (IEA 2009). The problem is specifically pronounced in sub-Saharan Africa, where the overall electrification rate falls below 30%. The presence of electricity in a region can directly improve a wide range of services, including health care, sanitation, education and communication, greatly improving quality of life. As such, enabling effective, large-scale electrification is an important humanitarian and development challenge.

While it is widely accepted that the presence of electricity will greatly benefit a region, there is significant debate over the best means of electrification (Kaundinya, Balachandra, and Ravindranath 2009). Most developed countries rely on a centralized electricity generation and distribution system. Electricity is generated at scale in large central plants and distributed to end users through a transmission network. These networks can be expensive and in most cases are developed over many years. It may be advantageous for undeveloped countries to bypass centralized technologies entirely, a concept known as leapfrogging (Goldemberg 1998). An example can be seen in today's telecommunications industry, in which traditional landline telephone infrastructure is being leapfrogged in developing countries in favor of cellular technologies.

We present an electricity grid expansion model using algorithms that solve the well-known minimum spanning tree (MST) problem, which determines the minimum length network necessary to connect a given set of nodes. The goal of this study is to provide a general methodology to estimate the costs of grid expansion at the national level. These costs can be compared to the costs of decentralized electricity generation options. We then analyze the cost-benefit tradeoff between on the one hand, the low cost of centralized generation and the high cost of its distribution, and on the other, the relatively higher cost of decentralized generation but lower cost of distribution. This information can be used to determine the conditions under which regions or countries could be best served by connection to a centralized electricity grid versus decentralized generation options.

Given a population distribution, our model determines a near optimal network that connects a desired percentage of the total population. The flexible nature of the model and the use of a single comprehensive global database allow it to be easily applied to any country or region world-wide. In contrast to other studies, we focus on optimal design of a large-scale high voltage (132 kV) electricity distribution infrastructure that reaches a desired percentage of the population for the lowest cost. The input data used for this study is particularly well suited for large-scale analysis of undeveloped countries where electrification rates remain low. However the model could also be applied to smaller scale analysis of un-electrified regions in developed countries if appropriate cost and population data were obtained.

Zvoleff et al. present a methodology that utilizes an adjusted version of Prim's algorithm to determine a near optimal network that spans fewer than 100% of the nodes in a given set; we refer to this as the partial Prim's algorithm (PPA). They apply this methodology to analyze grid expansion plans in nine rural African villages. Deichmann et al. present a grid expansion model that is based on Zvoleff et al. to determine where decentralized electricity options may provide a cost-effective alternative to centralized electrification. They apply their methodology to case study analyses of Ethiopia, Ghana and Kenya and conclude that decentralized electrification will play a significant role in energy development sub-Saharan Africa, but will likely not provide a comprehensive solution.

We take this modification of Prim's algorithm one step further to consider the case where nodes have associated weights, which in our case represent populations. The goal is to find the shortest tree than spans a given percentage of the total population as opposed to a percentage of the given nodes. A simple modification can be made to improve the algorithm's efficiency by allowing it to 'seek out' more populous nodes. We refer to this as the Weight-Adjusted Partial Prim's Algorithm (WAPPA).

A starting node is chosen at random and the population-to-distance ratio is calculated between the starting node and all remaining unconnected nodes. A connection is then made between the starting node and the node that provides the greatest such ratio and this node is brought into the connected set. In the context of grid expansion applications, this

identifies the most efficient means of providing grid access on a cost-per-person basis. This process is continued until a desired percentage of the total population has entered the connected set, a network is generated and the whole process repeated from a different starting node.

Multiple iterations are performed and the shortest length network generated from all of the iterations is recorded as the near optimal network. The nodes connected by the resultant near optimal network are isolated from the unconnected nodes, and the original Prim's algorithm is executed on just this set of connected nodes. This process determines the guaranteed optimal network that connects all of the nodes identified by the WAPPA, further improving the efficiency of our methodology.

This methodology is executed with target penetration rates from 0% to 100% in 1% increments and the levelized costs of grid connection are compared to the levelized costs of decentralized electrification for each penetration rate. The first penetration rate for which the levelized cost of a centralized electrification is found to exceed the levelized cost of a decentralized electrification is called the breakeven penetration rate.

We perform this analysis on a wide range of countries to identify characteristics that might be predictive indicators of the breakeven penetration rate in a given region. We find that a strong positive correlation exists between the breakeven penetration rate of a country or region and its weighted population density.

This work contributes to the growing body of literature that provides planners, developers and policy makers with guidance on approaches to electrification in developing countries, and provides a basis for considering distributed versus centralized generation approaches.

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## **Of Volts and Leaves: Apples vs. orange effects distort relative benefits of grid-electricity vs. gasoline powered vehicles**

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A key advantage of plug-in hybrid or all-electric vehicle propulsion over conventional ICE cars is reduced GHG emissions arising from the automotive sector – an important lever to a low carbon society. Other advantages include zero-tailpipe emissions and thus cleaner inner-city air, storage to facilitate micro grids and (intermittent) renewable electricity generation, petroleum independence, providing a bridging technology to future, less carbon-intensive grids, and (potentially) smaller cost per driven km [1-2].

Reliable quantification of the relative merits of different technologies to reduce GHG from the automotive sector are crucial for environmental strategy and policy makers in developed and developing countries alike. Such quantification must include not only the theoretical savings on a «per car and km» basis, but need to consider realistic market penetration scenarios of the various vehicle technologies and their contribution to a country's cumulative miles driven – a particular car type that consumers simply won't buy or that is used only for minimal distances will not (materially) reduce country-wide GHG from the transportation sector.

In addition to GHG savings, electric cars have been hailed to provide a channel for a more efficient use of cropland to grow biofuels. For example, a recent study finds that using biomass to first make electricity (to then power electric vehicles) yields about twice as many vehicle miles from a given land area than cellulosic ethanol (to power conventional ICE cars) [3].

Many such comparative studies exhibit one or more of the following limitations, all of which result in unfair advantages of grid-electricity vs. gasoline powered cars: (i) Life-cycle GHG emissions of the grid are based on the electricity generation electricity alone and thus do not reflect losses during grid distribution and battery charging; (ii) life-cycle GHG emissions of the electric cars do not account for the (disproportionally higher) emissions from battery production; (iii) finally, and

most importantly, electric cars (e.g., Nissan's Leaf ®) with advanced optimization such as regenerative braking, light weighting, improved aerodynamics, and power control electronics are compared against conventional ICE cars without these fuel saving technologies – even though all these technologies are in fact available in advanced gasoline-powered cars as well (e.g., GM's Volt ®).

Correcting for such distortions in the present study, we find that advanced gasoline-powered series drive train cars such as GM's Volt, when adjusting for size/performance, actually emit even less life-cycle GHG per km than equally advanced all-electric cars such as Nissan's Leaf. This finding holds true for the current carbon intensity of the US grid (national average). Previously, the finding that series hybrid cars emit less life-cycle GHG per km than all electric cars was reserved for above average carbon intensive grids, such as certain US states or countries such as China with higher reliance on coal.

Over the past decade, studies of advanced propulsion technologies have evolved from mere technical and customer-oriented feasibility analyses (e.g., [4]), to a focus on GHG and economic merits of specific parallel hybrids (e.g., Honda Civic [5]), to GHG and economic comparison studies of a comprehensive set of parallel hybrid, series hybrid (with or without plug-in capability) and all-electric options. Many such studies include a breakdown of the individual effects of vehicle weight, battery, series vs. parallel drive train, gasoline vs. diesel, gearbox, regenerative braking, and of advanced options such as in-wheel electric motors [6-11].

However, until this year, only non plug-in, parallel hybrids were commercially available (from major car manufacturers and as versions that would enable meaningful comparison with conventional ICE cars of similar size and performance). Therefore, comparisons in above studies usually relied on an analytical understanding of a propulsion technology's performance, guided by early prototypes such as GM's EV1 [11], but with consumptions and hence GHG emissions per km obtained via simulation.

In contrast, the present study analyses life-cycle GHG emissions of cars that are available in show rooms today, using, where-ever possible, publicly available, measured performance and consumption parameters, while reverting to robust extrapolations and predictions of expected consumptions only when required for the sake of an apples-to-apples comparison between cars of differing size and performance. Within hybrid technology, we focus on series drive trains as these have gained particular interest, because they provide additional GHG reductions by (i) eliminating weight and friction of a gearbox; and (ii) using the ICE in a more efficient torque/rpm regime (to turn the generator rather than the wheels) [7-8, 11].

How much GHG emissions can these advanced cars be expected to save, and which propulsion technology is preferable? We find that only in countries with low carbon electricity grids (e.g., Brazil) do all-electric cars emerge as clear winners in terms of life-cycle GHG emissions (GHG per km, incl. battery manufacturing but excluding vehicle manufacturing). For the current U.S grid (national average), an all-electric Nissan *Leaf* (142g CO<sub>2</sub>e per km) actually causes 13% higher emissions than advanced gasoline-powered alternatives such as GM's Volt (when driven on gas). But even cars with conventional ICE drive trains do not fair so badly: On a carbon-intensive grid such as China's, a Smart Electric's GHG emissions (115g CO<sub>2</sub>e per km) are only 7% below those of the Tata *Nano* – at a purchasing price an order of magnitude higher, offering only 2 seats instead of 4, and with restrictions on range.

Moving to the aforementioned discussion on biofuel vs. bioelectricity, conventional ICE cars consume about twice as much fuel as advanced series drive train, gasoline-powered vehicles of similar size and performance. This essentially neutralizes the advantage of the bioelectricity route that was found in a related study [3].

In environmental policy and public discourse, the finding that even all-electric cars cause GHG emissions is of course not new – even though some electric car and light truck companies still advertise their products as «zero carbon». Still, we suggest our finding has far reaching consequences for environmental strategy and policy makers, particularly in the developing world with yet small penetration of personalized transport: It appears that (in countries with average or above average carbon intensity) advanced gasoline-powered cars can actually offer higher potential GHG savings than their all-electric peers. Furthermore, smaller purchasing prices (no expensive battery), and lack of range anxiety may lead to a larger market share of the gasoline-powered cars. And finally, once on the road, such a car will likely share a larger portion of a country's cumulative miles driven than an electric alternative (which would be limited by range and/or availability of charging stations). This calls into question the promotion of all-electric vehicles for the purpose of immediate GHG reduction – and, by the same token, demands increased emphasis and scrutiny of the other advantages that all-electric cars promise (storage, etc., see above).

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## Riding the Rails to a Sustainable Future

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If High Speed Rail (HSR) is this century's interstate highway system, then how can different programs achieve measurable sustainability outcomes? What "sustainable" outcomes are assumed or planned into different systems? HSR stations have the potential to be anchors for regional eco-districts, but that desired outcome only occurs as the result of planned and implemented policies.

Extensive planning is currently underway to create a HSR system that can balance the U.S. transportation network, promote livable communities, facilitate economic expansion, and respect environmental sustainability. High-speed intercity passenger rail supplements interstate highways and regional air travel between metropolitan regions, sustaining the movement of people and goods while meeting the demands of current and future population growth. Implementing a high-speed intercity passenger rail network within the U.S. is a monumental task – often compared to the planning and build-out of the Interstate Highway System.

The initial study of a sustainable HSR system begins at the feasibility level, with the examination of corridors connecting major metropolitan areas. A feasibility study examines other transportation modes and compares implementation, operation and maintenance costs, ridership, environmental impacts, and funding to lead to further studies for the most sustainable transportation investment. Paralleling the feasibility studies are public involvement, education and consensus building. Once the need for HSR is established, planning, environmental review, and engineering studies identify required trip times and infrastructure needs to meet the transportation demands within a corridor.

To some extent, the infrastructure industry has been inspired by the green building movement, the global concerns of climate change and the sustainability of human development. Sustainability as a framework for project delivery has been gaining momentum since the Bruntland Report, *Our Common Future*, was issued in 1987. This United Nations Commission Report alerted the global community to the urgent matter of achieving economic and human development without depleting natural resources or harming the environment.

U.S. federal policy, partially motivated by dependence on foreign oil, has been incorporating the language of energy independence, greenhouse gas (GHG) reduction, water resource efficiency, and livable communities over the past decade. Executive Order (EO) 13514, Federal Leadership in Environmental, Energy and Economic Performance, issued in October 2009, establishes sustainability goals, targets, and requirements for federal agencies. In October 2010, the Council on Environmental Quality (CEQ) issued guidance for federal agencies to report GHGs, and in February 2010 CEQ issued draft guidance on considering GHGs under National Environmental Policy Act (NEPA) review. This involves accounting for both operational and construction GHG emissions when comparing alternatives in the environmental process.

There is no federal mandate for "sustainable infrastructure," per se. However, with the growing attention towards sustainability targets, measurement and assessment tools have been adopted by infrastructure membership organizations in an effort to set benchmarks and provide metrics to achieve sustainability within the infrastructure context.

Globally, European and Asian HSR systems have made varying commitments, with differing degrees of intensity, to sustainability. Among these commitments are:

- Contributing to national GHG reduction targets through mode-shift from auto and airplane to rail;
- Contributing to national GHG reduction targets through electrification of systems and generation of renewable energy;
- Achieving environmental sustainability through maintenance and operations practices;
- Achieving social goals through station planning and land-use integration;
- Contributing to GHG reduction through demand reduction in systems, rolling stock, and facilities; and
- Contributing to sustainability through station design and location.

In Germany, Deutsche Bahn (DB) has operated the Eco Plus Program, which provides an option to both freight and passenger rail customers to select carbon dioxide (CO<sub>2</sub>) free travel. This program is intended to reduce the specific CO<sub>2</sub> emissions of the global DB group by 20 percent by 2020.

In the U.K., Network Rail has a Sustainable Rail Program that takes a three-pronged approach to emissions reduction while emphasizing the gradual de-carbonizing of the U.K. national grid. The three prongs are: (1) reduction in demand; (2) accurate measurement of use; and (3) electrification of as much as possible in order to take advantage of the diminishing carbon intensity of electricity. (<http://www.networkrail.co.uk/asp/7669.aspx> 30 November 2010)

In Spain, *Red Nacional de Ferrocarriles Españoles* (RENFE) has taken the approach of reducing demand, metering activities, and electrifying as much as possible to take advantage of a national grid that has incorporated several major photovoltaic projects and other renewable generation activities. In 2007, over 20% of the energy used by RENFE came from renewable sources. ([http://www.renfe.com/EN/empresa/RSE/compromisos\\_y\\_acciones/sostenibilidad.html](http://www.renfe.com/EN/empresa/RSE/compromisos_y_acciones/sostenibilidad.html) 30 November 2010)

In France, Société Nationale des Chemins de Fer Français (SNCF) also takes the approach of reducing demand as the first order of action. Because the national grid relies on nuclear power, the more efficient and electrified the system becomes, the greater the CO<sub>2</sub> emissions reductions. SNCF is also designing “ecosustainable stations” with solar panels and sensor-activated lighting. ([http://www.sncf.com/en\\_EN/html/media/CH0006-Ecomobility/BR0533-Energy-is-our-future/MD0505\\_20080911-Read-article.html](http://www.sncf.com/en_EN/html/media/CH0006-Ecomobility/BR0533-Energy-is-our-future/MD0505_20080911-Read-article.html) 30 November 2010) By focusing on the purchase of nuclear-generated power and increasing ridership, SNCF has reduced their CO<sub>2</sub> emissions by 31%. ([http://www.sncf.com/en\\_EN/html/media/CH0006-Ecomobility/BR0535-Targeting-CO<sub>2</sub>-reductions/MD0705\\_20080911-Read-article.html](http://www.sncf.com/en_EN/html/media/CH0006-Ecomobility/BR0535-Targeting-CO2-reductions/MD0705_20080911-Read-article.html) 30 November 2010)

In Belgium, the energy company Enfinity is working with the rail infrastructure firm Infrabel to install 16,000 solar panels on the roof of a two-mile long rail tunnel connecting Paris to Amsterdam, thereby generating renewable energy directly in the rail right-of-way. The power is supplied for both conventional and high speed rail, as well as to power the Antwerp Station. (<http://inhabitat.com/2010/10/25/belgian-high-speed-rail-system-to-get-solar-boost/> 30 November 2010)

In Switzerland, Schweizerische Bundesbahnen (SBB) produces most of the power needed for train operations in its own hydroelectric power stations, therefore resulting in zero CO<sub>2</sub> emissions. To cover the residual demand for power, SBB has taken a share in French nuclear power stations and purchases power on the free market as required. ([http://mct.sbb.ch/mct/en/konzern\\_schweiz/konzern\\_umwelt/konzern\\_klima/konzern\\_klima-massnahmen.htm](http://mct.sbb.ch/mct/en/konzern_schweiz/konzern_umwelt/konzern_klima/konzern_klima-massnahmen.htm) 30 November 2010)

In order to reduce CO<sub>2</sub> emissions from diesel locomotives used for shunting operations, track maintenance and freight (which accounts for 37% of their CO<sub>2</sub> emissions), SBB has been training its diesel locomotive drivers to use driving methods which are less harmful to the environment (EcoDrive). ([http://mct.sbb.ch/mct/en/konzern\\_schweiz/konzern\\_umwelt/konzern\\_energie.htm](http://mct.sbb.ch/mct/en/konzern_schweiz/konzern_umwelt/konzern_energie.htm) 30 November 2010)

In Asia, the Central Japan Railway Company focuses on demand reduction through the introduction of energy-efficient rolling stock throughout the system. (<http://english.jr-central.co.jp/about/lowcarbon.html> 30 November 2010). Korea's Korail relies on efficient electrical-powered equipment and station “ecodesign” in order to reduce GHG emissions. ([http://info.korail.com/2007/eng/ein/ein01000/w\\_ein01100.jsp](http://info.korail.com/2007/eng/ein/ein01000/w_ein01100.jsp) 30 November 2010)

In the U.S., California's HSR program is well advanced in planning and is characterized by some aggressive sustainability goals: operating entirely on renewable energy, incorporating recycled content into major components, employing transit oriented development (TOD) guidelines for station areas, and applying environmental mitigation. The California High Speed Rail Authority (CaHSRA) has made a comprehensive commitment to the use of renewable energy for train operations, as the system is explicitly intended to be a component in helping California meet the GHG emissions requirements set forth in the California Global Warming Solutions Act (AB 32).

The California HSR project was one of the first major infrastructure projects to investigate and analyze GHGs in the project context. Changes in the amounts of CO<sub>2</sub> emitted as a result of project alternatives were estimated on a statewide basis. These estimates were based on the projected variations in fuel use (resulting from changes in highway vehicle miles traveled [VMT], number of plane operations, and number of train trips) as well as the energy required to operate the system. For the purpose of the analysis, and per direction from the U.S. Environmental Protection Agency (USEPA), the energy for the California HSR system was not assumed to come from renewable sources. CO<sub>2</sub> emissions generated by on-road sources (vehicles), off-road sources (planes, trains), and stationary sources (electric power generation) were combined and compared to the No Project Alternative. Overall, the project is predicted to lower statewide GHG emissions by approximately 1 percent.

As the U.S. HSR program comes into existence, policies ensuring sustainable planning, implementation, and operations are emerging alongside. The benefits of HSR and associated best practices (such as effective land use planning, use of recycled materials and generation of clean energy) are also being recognized. The use of GHG analysis for California's HSR demonstrates one of the advanced methodologies for evaluating infrastructure sustainability, and this type of analysis is paving the way for the evaluation of future transportation projects' sustainability. With HSR, the world's leading infrastructure providers have exhibited a wealth of creative ideas, therefore ensuring HSR as a trendsetter for sustainability in transportation systems.

### **Beyond Mobility: Measuring Transportation in Terms of Equity, Resiliency and Economic Efficiency**

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A vital underpinning of any modern economy and society is its transportation system. Within the past century, transportation systems have greatly evolved and transformed cities and communities around the world. In particular, freeway networks and private automobiles have gained prominence in many countries – indicated by a significant increase in vehicle miles of travel (VMT). The fact that VMT and gross domestic product (GDP) have increased simultaneously in many societies has led some researchers to conclude that an increase in automobile travel signifies a strong economy and, consequently, that a decrease in automobile travel signifies a poorly performing economy. [1, 2] However, other researchers suggest that strong economies can exist with low levels of vehicle travel. If true, this is an important result because it is widely acknowledged that excessive vehicle use results in a myriad of adverse socioeconomic and environmental impacts that jeopardize the sustainability of a society.[2, 3]

Furthermore, the fact that sustainability is often viewed exclusively as an environmental issue helps to exacerbate the misconception that economic growth and sustainability are incompatible.[3] In this work, we examine these issues by studying the inter-relationship between GDP and VMT for the 50 states and the 50 largest metropolitan regions in the United States. In this study, we also examine how economic equity and economic resiliency vary across the country for places with different types of transportation systems.

In order to assess the relationship between GDP and VMT we use a measure of transportation efficiency, which we define as the ratio of GDP to VMT. The resulting measure for transportation efficiency is in terms of dollars per mile of travel. The idea is that the most efficient places are those that maximize economic activity – represented by GDP – while minimizing the social and environmental costs that are associated with increasing VMT.[4] Our assessment of efficiency looks at the GDP to VMT ratio in absolute terms and how this ratio has changed over time in terms of GDP growth to VMT growth. For GDP, we use the value adjusted for inflation, which is chained to the year 2001 dollar value.

The results at the statewide scale show that in 2007 (the latest available data), GDP per vehicle mile of travel ranged from \$2 in the worst performing state to \$7 in the best. Looking at changes in efficiency over a period of ten years, the state of Oregon significantly outperformed all other states with an increase in GDP per vehicle mile of travel from \$3 to \$4. This reflects the fact that in Oregon GDP growth far outpaced growth in VMT. Oregon has been able to increase GDP while implementing policies that have restrained the growth of VMT. At the other end of the spectrum, the state of Mississippi saw a decrease in GDP per vehicle mile of travel from \$2 to \$1.50. This signifies a place where the growth of VMT outpaces the growth of GDP. In general, states with more diverse travel options performed better on these measures of transportation efficiency.

Results for the urbanized areas reveal even more extreme differences. In San Francisco, GDP per vehicle mile of travel increased from \$7 to \$10. The data for San Francisco shows a GDP increase of 13 percent, while VMT actually decreased by 20 percent over the ten year period. In Miami, GDP per vehicle mile of travel decreased by more than half,



from \$11 to \$5 per vehicle mile of travel. The reason for this was that in Miami, GDP increased by 25 percent while VMT increased by nearly 200 percent. As with the statewide results, the areas that performed the best were the ones with a more diverse suite of transportation options.

We also compare the states and the metro regions with respect to economic equity and potential economic resilience in the face of a global run-up in gasoline prices. The cost of transportation has implications to individual accessibility and overall economic robustness.[5] Transportation costs are an equity issue because people do not always have a full range of transportation options to choose from.[6] Furthermore, transportation costs are regressive in nature – meaning, as a percentage of income, transportation costs place a greater burden on lower income households.[6] The parameter we use to assess economic equity is the average expenditure on transportation services. This is measured in terms of average percentage of median household income spent on transportation – which included the cost of transit, car ownership (insurance, registration, taxes, depreciation), and car use (gas, maintenance). In addition to looking at how transportation costs impact individual households, we also look at the relation of gasoline prices to the overall economy. One approach to describe this relationship is to look at it from a resiliency perspective.[6] A resilient transportation system will be able to continue operation and support economic activity despite dramatic increases to the price of gasoline.[6] We measure economic resilience by using the total expenditure on gasoline for transportation as a percentage of total GDP in the state or region.

The results for the economic equity parameter reveal major differences both among the states and among urbanized areas. For example, in Mississippi – where the median income is the lowest – residents spend roughly 44 percent of their income on transportation. In New Hampshire – where the median income is the highest – residents spend only 23 percent of their income on transportation. However, this difference in percentage is not just because of the difference in levels of median income. The gross expenditure on transportation is also greater for residents in Mississippi than in New Hampshire. In urbanized areas, the percent of median household income spent on transportation ranges from 18 to 37 percent. Those with the lowest transportation expenditures are those with well-established transit systems such as New York City, San Francisco, and Washington DC. The results also suggest that differences in the cost of transportation to households are dependent not just on the local availability of transportation options but also on the location and distance between jobs and housing.

With regard to the overall economy and transportation's reliance on gasoline, which is highly volatile in price, we again found a wide gap among the states and among urbanized areas. For the states, the percent of GDP spent on petroleum (excluding local taxes) ranged from less than 2 percent in places like New York to more than 7 percent in places like Mississippi. These results suggest that when the price of petroleum increases, some states, such as Mississippi, will face a significantly greater economic shock than what will be felt in other states. This is particularly debilitating because expenditure on transportation fuel represents money leaving local economies because transportation fuel is mostly imported. As with most of our other findings, the results show that the most resilient places are those with less automobile use and a wide selection of transportation options available.

Transportation systems play a vital role in the economic growth of societies, but this does not mean that increases in vehicle travel and economic activity should be linked conceptually or in practice. This study shows that the relationship between VMT and GDP is highly variable due to differences in the form of transportation systems across the country. In a number of studies, high levels of automobile use have been linked to issues of environmental and social sustainability. Our study reveals that the economies in communities with higher levels of automobile use also tend to be less efficient, less equitable, and less resilient. The most important finding from this analysis is that in the transportation field, solutions that improve social and environmental sustainability tend to also have favorable economic outcomes.

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[3] Low, N. and B. Gleeson, Eds. Making Urban Transportation Sustainable. Basingstoke, Hampshire (United Kingdom): Palgrave Macmillan, 2003.

[4] Lawrence, M. F. and T. Kornfield. "Transportation Subsidies, Economic Efficiency, Equity, and Public Policy." *Nonrenewable Resources*, Vol. 7, No. 2, 1998: pp. 137-142.

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[6] Litman, T. "Evaluating Transportation Equity." Victoria Transport Policy Institute, 2007. Accessed February 2011. <<http://www.vtpi.org/equity.pdf>>

### **SharedSolar: a Last-Mile Technology for Pre-paid Electrification via Mobile Telephony**

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Much of the energy consumed by rural households in the developing world comes from kerosene, dry-cell batteries, and other sources that could be substituted with electricity. Compared to the developed world, these rural poor are consuming energy at levels orders of magnitudes lower but paying rates that are orders of magnitude higher. Access to a regional or national electric grid could bridge this gap, but high connection costs combined with low consumption levels can result in an unappealing business model for private utilities. Furthermore, traditional post-pay, end-of-the wire metering technologies drive capital and recurring costs still higher.

While rural electrification seems illusive, success in mobile telecommunications serves as an example of a leap-frog technology that has made a tremendously deep and wide penetration into the developing world. Much of the success realized by mobile telephony business models is due to the modularity of the mobile network and a pre-payment approach to billing. The rural poor's cash-flow is highly variable (often related to harvest seasons, etc.), which is better matched by a pre-payment as apposed to post-payment approach.

Small, 1-2 kilowatt (kW) micro-grids, utilizing stand-alone, modular power generation technologies paired with aggregated, pre-paid power meters remotely controlled and monitored via mobile telephony may provide a novel technology toward meeting the last-mile energy gap. Unlike individual, home solar devices, *SharedSolar* takes advantage of a slightly higher economy scale. Remote management of the systems may further reduce operational costs compared to traditional micro-grid models.

A series of SharedSolarpilots are being undertaken across both west and east Africa to test this model. Electricity consumption trends will be presented and compared to pre-pilot energy preferences and expenditures. Key lessons learned, both positive and negative, will be described. These lessons learned include a detailed presentation of transaction costs and capital costs, explanation of appropriate system sizing based on usage patterns, and an analysis of the presented micro-utility business model.

### **Towards Sustainable Transport: an analysis of high speed rail proposals in line with the UK's commitment to carbon reduction**

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Sustainable mobility is a fundamental objective for UK policy. Transport, especially high speed, is critical for both economic and social development. In response to mounting environmental concerns, particularly related to climate change, the UK Government is seeking to identify the most sustainable transport options for the UK transport network. Key factors for comparison include carbon dioxide (CO<sub>2</sub>) emissions, capacity, demand (which is highly influenced by journey cost and time), and the carbon implications of new infrastructure and technology.

CO<sub>2</sub> emissions are important within the context of sustainable development and, in particular, the development of a sustainable transport network. The current UK transport system is unsustainable and the impact of this unsustainable system is becoming more evident as passenger numbers increase. Demand for high speed transport is growing as people's lives become increasingly busy. However, it is the relationship between growth in the air transport industry and CO<sub>2</sub> emissions that is causing the most concern. As passenger numbers escalated between 1990 and 2005, global CO<sub>2</sub> emissions from aviation increased by 42 percent (Meinshausen and Raper, 2009). This indicates that as passenger numbers continue to grow, emissions from this sector are also likely to continue to increase, unless technological and operational developments, such as improved air traffic management, and airframe and engine technology, reduce the CO<sub>2</sub> intensity of operations to the point at which they fully compensate for growth in the sector.

The UK Committee on Climate Change (2009) have acknowledged that growth in aviation, without improvements in technology and operations, will increase emissions further, making carbon reduction targets harder to achieve. The Committee's 2009 report '*Meeting the UK aviation target – options for reducing emissions to 2050*' made assumptions on future technological development, the uptake of alternative fuels and improved air traffic management and stated that a growth of only 60 percent in UK air transport could be accommodated for if CO<sub>2</sub> emissions in the industry are not to exceed 2005 levels by 2050, a target the UK Government has set. However, without appropriate policy intervention, such as carbon pricing, demand is forecast to increase by more than 200 percent by 2050 (Committee on Climate Change, 2009). It is therefore clear that aviation is becoming increasingly significant in its contribution to climate change as the growing demand for air travel encourages the development of an unsustainable transport system. In November 2008, the UK Government enacted the World's first long-term legally binding framework to address climate change, known as the Climate Change Act. The Act has set out targets for greenhouse gas emissions to be reduced by at least 80 percent by 2050 and by 34 percent by 2022 from a 1990 baseline (DEFRA, 2008). In order to curb passenger growth and CO<sub>2</sub> emissions from UK domestic aviation, the UK Government are concentrating on a modal shift from air to rail. In March 2010, the Government unveiled plans for a new high speed rail line running initially from London to Birmingham in the midlands, with possible expansion to the North of England and Scotland. The plans published by a new company, High Speed Two (2010), expect work on the construction to begin in 2015. However, a detailed comparison of the true CO<sub>2</sub> intensity of air and rail transport in the UK has not been established. Previous analysis has concentrated on emissions from operations, ignoring the CO<sub>2</sub> intensity of construction and maintenance. Yet a recent study in North America stated that emissions from non-operational activities (such as maintenance and track construction) could be almost double that of operational emissions for rail transport over its entire working life (Chester and Horvath, 2009). This research has established the need for a detailed life cycle assessment of high speed rail and air transport, taking into account key variables that will determine future CO<sub>2</sub> emissions (these include construction, technological changes, and load factors as a result of modal shift). Economic and temporal issues will also influence the amount of modal shift that will occur from air transport.

This paper presents a framework for the comprehensive assessment of the carbon implications of high speed transport in the UK. Firstly, the study sets out the initial scoping and boundaries for a life cycle analysis. Two baseline scenarios have been established; these are air in the current situation and rail in the current situation. The scoping has identified key future variables for air and rail, which will impact on CO<sub>2</sub> emissions, these variables include the availability of high speed rail, construction of new infrastructure, the extent of modal shift, technological developments, operational changes and composition of electricity generation. The study has also undertaken a comparative analysis of the current journey price of air and rail between selected city pairs in the UK in order to give an indication of the volume of modal shift that may occur. Further work will test these key variables through the life cycle analysis model in order to identify the most optimal situation for future high speed transport in terms of minimising CO<sub>2</sub> emissions and achieving the 2008 climate change targets.

Preliminary results from the life cycle analysis baseline models have established the current CO<sub>2</sub> intensities of air and rail on a seat availability basis, highlighting stages in the journey that contribute to significant CO<sub>2</sub> output. This analysis suggests that a switch to more fuel efficient rolling stock (for example, electric trains) on the rail network may be more effective, in terms of reducing CO<sub>2</sub> output, than constructing a high speed rail line. The initial scoping has identified that modal shift will play an important role in determining the efficiencies of these two modes of transport as significant fluctuations in CO<sub>2</sub> output have been recorded when calculated on a per passenger kilometre basis rather than seat availability. The assessment of current journey price and time suggests that a modal shift from air to rail is unlikely on the proposed high speed rail route as this is currently the most efficient part of the UK rail network, holding the majority of the market share. It is likely that passengers switching from conventional rail as well as newly generated traffic will make-up the majority of high speed rail users on the proposed route. These issues raise questions over the contribution high speed rail could make towards curbing air transport demand and promoting a sustainable transport system for the UK.

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## **Beyond the electric car as a silver bullet in environmentally sustainable automobile technology: The importance of understanding psychological barriers to multiple solutions**

Johan Jansson

Currently transportation accounts for roughly a third of the world's current energy use and two thirds of the fossil oil use (Schäfer, Heywood, Jacoby, & Waitz, 2009). Transportation is also continuously increasing coupled with rising demand for mobility and a growing world population. During the last five decades the world motor vehicle fleet grew by five percent per year. According to the vehicle industry the number of motor vehicles is estimated to reach one billion around 2020 signifying a tremendous environmental impact.

The purpose of this paper is to present a combination of possible solutions for a more sustainable transportation system as opposed to single solutions and silver bullets such as alternative fuel motor vehicles or electric cars. A secondary purpose is to present the results of an explorative experiment that demonstrate how people tend to cognitively focus on single solutions as opposed to multiple solutions. By understanding the need for multiple solutions and the psychological barriers to these policymakers can formulate better targeted measures.

Ownership and use of private automobiles will continue to increase, perhaps even at an accelerating rate. Since the problems of increasing transportation and a growing car fleet are becoming more recognized, solutions are being sought. Politicians, the mass media, and the general public seem to have unjustified trust in that the solution is one new automobile technology which minimizes the dependency on fossil mineral oil (gasoline and diesel) and substitutes this with other forms of energy such as biofuels and/or electricity. On several markets heavy subsidies have been introduced to reach market acceptance of these alternative fuel vehicles (AFVs) and fuels (OECD, 2007). In some markets this has resulted in a narrow focus on one type of alternative fuel and currently much hope is put on the electric vehicle (EV) as the primary solution. Viewing the EV, or any other single automobile technology, as a silver bullet for sustainable transportation technology is problematic since any new technology is related to new types of (oftentimes unexpected) problems. For example, the production and distribution of ethanol for automobile use has been argued to be unsustainable due to questionable agricultural practices in some areas. Concerns have also been raised as to whether there are enough scarce minerals to produce electrical cars and batteries for a large portion of the world car fleet (Andersson & Råde, 2001). However, considering the current debate it is clear that an insight is lacking that there is no single environmentally sustainable automobile technology solution. Instead it seems more that a portfolio of changes and solutions are necessary both on the demand and supply sides. In line with this, the argument has been made that governmental subsidies should not focus on a particular automobile technology but on the goal of sustainable transportation and communication as a whole (Gärling & Steg, 2006). Policy with such a goal needs to promote many types of sustainable automobile technology as well as extend beyond this to the development of alternative means of transportation (slow modes, public transportation), electronic communication, and increasing accessibility by rebuilding urban environments so that travel is viewed as less attractive.

A crucial issue is how multiple solutions can be accomplished and what barriers there are to focusing on many solutions instead of one silver bullet. In terms of solutions we arrive at the importance of local anchoring when developing a more sustainable transportation system. Much environmental and sustainability literature argues for local production and consumption of resources in (e.g., Berlik, Kittredge, & Foster, 2002). As new transportation technology is developing, this local focus becomes highly relevant for the transportation sector as well. However, regional differences need to be taken into account meaning that one solution would be less effective in one region than the same solution in another. In urban areas, public transportation is clearly a viable alternative and should therefore receive priority in policies. However, in many suburban and rural areas the automobile as a travel mode has no clear substitute. In these regions, a focus on greener technology such as AFVs and EVs, are likely to be more attractive by individuals. Indeed local differences apply in these less populated regions as well. In areas with plenty of wind, hydro, or solar power the EV would be the best alternative. In other areas where agricultural and/or forest waste is abundant, biofuels such as bioethanol, biodiesel and/or biogas would be more viable alternatives to encourage individuals to chose alternatives to the fossil oil fuelled automobile.

In combination with these solutions interregional travel should, as much as possible, be substituted by electronic communication such as teleconferencing. Thus, instead of attempting to achieve a single solution in directing their subsidies, enforcement of taxes, and other transport policy measures (including soft measures such as information campaigns) governments should consider promoting different solutions taking into account regional differences. Although more challenging, multiple solutions like these are likely to be less environmentally damaging and easier to promote locally and thus gain market breakthroughs faster together than individually. In addition, competing technologies and systems will ensure that the sustainability of each solution is continuously kept at the developmental front.

On a conceptual level, the attractiveness and suitability of the multiple solutions discussed here are relatively easy to recognize. So, why have these type of solutions gained so little interest from media and policymakers? We argue that multiple solutions are cognitively harder to grasp than the single – “one-size-fits-all-solution”. In order to analyze whether this may be the case, we show in an experiment with undergraduates that the “focusing illusion” (Kahneman et al., 2006; Schkade & Kahneman, 1996) to a certain extent generalizes to how people perceive solutions to problems faced by society. We also find that “defocusing techniques” may be effective to reduce the illusion as has been found in other contexts (Wilson et al., 2000). We conjecture that politicians are similarly susceptible to the focusing illusion. How to apply defocusing techniques in politics is an important issue requiring additional research.

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## Portable Method for Measuring Thermal Properties of Refractories

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The thermal properties of building materials and cookstoves have a significant effect on their energy efficiency. Building materials are usually made on site, and various compositions can have a significant effect on their thermally insulating properties. In addition, current efficiency tests for cookstoves, such as the water boiling test, test overall stove performance. Material properties have a significant effect on thermal efficiency and choosing a material with the right thermal properties is a simple way to optimize efficiency of stoves and building materials. Knowing the thermal properties of materials also eliminates some of the unknown factors in play when comparing designs and evaluating performance.

Current methods for testing thermal properties require expensive testing equipment, specifically shaped specimens, or require a laboratory setup. In addition, for thermally insulating materials, test time can be significant. The method introduced employs an approximation of the semi-infinite heat equation to calculate thermal diffusivity and thermal conductivity. A single test can be performed in less than three minutes. A method and apparatus are also introduced for measuring granular materials. Knowing the density of a material, the thermal capacitance can then be calculated as well. Most importantly, the method is inexpensive, completely portable and can be used on almost any shaped material without affecting its usability.

The properties in questions are thermal conductivity, thermal diffusivity and thermal capacitance. Thermal conductivity is the property of a material that indicates its ability to dissipate heat due to a temperature gradient. Refractories typically have low thermal conductivity and diffusivity values. Heat transfer through a material is governed by conduction. The equation that explains transient conduction is

$$\nabla^2 T + \frac{q}{k} = \frac{1}{\alpha} \frac{\partial T}{\partial t} \quad (1)$$

where T is the temperature, k is the thermal conductivity, q is a constant internal heat generation rate per unit volume, and  $\alpha$  is the thermal diffusivity.

The Fourier number, defined as

$$Fo = \frac{\alpha t}{l^2} \quad (2)$$

is a dimensionless number that characterizes heat conduction. For sufficiently short times, the conduction process is confined to a thin region near the surface into which temperature the heat has penetrated. In order to satisfy the semi-

infinite equation assumptions, the Fourier number should be kept less than 0.05. The characteristic length was chosen as the length that limited the semi-infinite assumptions, which in this case is the heater length of 52 mm. Using this length, it is determined that  $\alpha t$  must be less than  $2.45 \times 10^{-6}$ .

In the 1D case where there is no internal heat generation, the second order PDE can be solved applying boundary conditions of constant heat flux,  $q_s$ , at the surface and modeling the refractory as a semi-infinite object. The solution is:

$$T - T_i = \frac{2q_s}{k} \left(\frac{\alpha t}{\pi}\right)^{0.5} e^{-\frac{x^2}{4\alpha t}} - \frac{q_s x}{k} \operatorname{erfc}\left(\frac{x}{2\sqrt{\alpha t}}\right) \quad (3)$$

where  $T_i$  is the initial temperature,  $x$  is the distance from the surface of the region,  $T_1$  is the temperature at  $x_1$ , and  $T_2$  is the temperature at  $x_2$ .

With two sets of temperature data,  $T_1$  and  $T_2$ , at locations  $x_1$  and  $x_2$  respectively and the time data,  $k$  can be eliminated from the equation (3). The dimensionless temperature created by using data from the two temperatures can be related as a function of only thermal diffusivity and time, and the equation can be solved for the unknown thermal diffusivity  $\alpha$ .

$$\frac{T_1 - T_i}{T_2 - T_i} = \frac{2\left(\frac{\alpha t}{\pi}\right)^{0.5} e^{-\frac{x_1^2}{4\alpha t}} - x_1 \operatorname{erfc}\left(\frac{x_1}{2\sqrt{\alpha t}}\right)}{2\left(\frac{\alpha t}{\pi}\right)^{0.5} e^{-\frac{x_2^2}{4\alpha t}} - x_2 \operatorname{erfc}\left(\frac{x_2}{2\sqrt{\alpha t}}\right)} \quad (4)$$

With  $\alpha$  known, thermal conductivity can then be determined:

If the specific heat capacity is needed, it can be calculated from the thermal diffusivity and conductivity:

$$c = \frac{k}{\rho \alpha}, \text{ where } \rho \text{ is the density} \quad (5)$$

Solving for thermal diffusivity in the semi-infinite equation (4) is difficult even by numeric methods, so a simplification is introduced. As the complementary error function produces a small number in this case, it can be eliminated to show an approximation that is based on the difference between squares of distances where temperature measurements are taken.

$$\frac{T_1 - T_i}{T_2 - T_i} \approx e^{\frac{x_2^2 - x_1^2}{4\alpha t}} \quad (6)$$

A second order power series based on a function of the inverse log of the dimensionless temperature shows a good fit.

$$\alpha t \approx a_2(x_1, x_2)\psi^2 + a_1(x_1, x_2)\psi + a_0(x_1, x_2) \quad (7)$$

Where

$$\psi = \frac{1}{\ln\left(\frac{T_1 - T_i}{T_2 - T_i}\right)} \quad (8)$$

The constants  $a_2$ ,  $a_1$  and  $a_0$  are determined using a least-squares linear fit. This approximation is valid except when the dimensionless temperature approaches zero. The error of the approximation is less than 0.6%.

A numerical analysis comparing the 1D approximation to the 3D situation was also used to determine the effectiveness of the model. The analysis showed an error of 2.5% after 150 seconds using the 1D approximation. This analysis gives a better understanding to the Fourier limits of the semi-infinite equation. Using the results of the model chosen, with an  $\alpha$  is  $8.5 \times 10^{-7} \text{ m}^2/\text{s}$ , the run time of the experiment should be kept less than 159 seconds. The computational analysis gives a further understanding of the error in our approximations. The propagation of error leads to an underestimate in calculating the thermal diffusivity,  $\alpha$ , of about 2.5% over a time period of 40 to 160 seconds. A method to correct for this error has yet to be determined.

Testing equipment was chosen to be inexpensive and simple. An electrical output heater was chosen as it outputs constant heat flux. Sandwiching the heater between two samples of material was an option that is commonly taught as a way to measure thermal properties. However, this method would introduce a significant amount of error. Most refractories are not uniform from one batch to another and therefore the assumption that both refractories have the same properties would introduce error. In addition, both samples would have to be identical in size and shape which would prove problematic when measuring unordinary shaped object such as stoves. A metal block surrounded with insulation serves as a heat sink on the other side of the heater. Total flux into the refractory is calculated by subtracting the lumped sum heat that goes into the metal block from the power output of the heater.

Three thermocouples are used to take measurements, one in the heat sink and two at different positions along the length of the refractory. A data acquisition system amplifies the thermocouples and connects to a computer to record data. To conduct the test, two holes should be drilled to hold the thermocouples close to a flat surface where the heater can be placed.

The above method for measuring solids can also be modified for measuring granular materials such as sand and gravel. A box should be constructed from an equal or superior insulator than the sample in order to contain the sample. The box should be constructed to fit the heat sink and insulation around it. The setup still requires one thermocouple for the metal block and two thermocouples for the refractory.

Tests were performed on a standard brick, two cookstoves and a concrete block. The results clearly show the difference between the thermal properties of the refractories. This method is not without limitations. Precise positioning of thermocouples is the single largest source of error in this analysis because the linear fit model is based on their positions. In a rugged environment, precise positioning is not always possible. However, the method produces good results using simple procedure in a portable package. None of the required instruments are complex, specialized, delicate, or exceedingly expensive. The results are repeatable for a wide variety of samples.

This method is meant to be utilized in the field where accessibility and portability are key factors. It can be used to easily determine the optimal compositions of refractory materials. The ability to do this has significant ramifications in the ability to add a level of control to the production process in remote areas and increase the energy efficiency of buildings and stoves.

### **Sustainable Development by Technology Seeding**

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Science and technology are critical to development (Sachs 2005; Schumacher 1973; Bhatt 1980). Numerous examples exist, ranging from cellular phones that allow farmers to learn the day's fair-market crop prices, to water delivery and treatment systems, to treated bed nets that drastically reduce malaria (Sachs 2005). Many devices and systems that could relieve the suffering of the global poor have been understood for centuries, but a major challenge of our generation is to adapt and disseminate them for sustainable and socially just development (Jowitt 2006).

Technology Seeding (TS) is here proposed as a design and dissemination methodology to answer that challenge. It is defined as: development by the transfer and participatory adaptation of appropriate proven conceptual designs. Key characteristics include the building of technology from first principles, local adaptation, and self-propagation, and it draws upon appropriate design, technology transfer, and development scholarship. Its objective is social justice through equitable development, and any technology or design is strictly a means to that end. By way of analogy, scientific principles are like the genetic material of a seed, and engineering principles the seed itself. Simple devices and systems are like seedlings, and increasingly completed technologies like increasingly complex and mature plants. Technology Seeding, in contrast to most current methods, promotes the transfer of technology at an appropriately basic level - seeds rather than mature plants - and enables end users to cultivate them to their own social ends. It will be shown that in comparison with competing models, has the potential to fill a gap in sustainable long-term development.

A technology-for-development project led by the authors, Lathes For Africa (LFA) was important source material for developing the formalized TS methodology. Despite excellent wood craft skills, the daily income for fundi is limited to daily income of \$5 - \$10 gross and \$2 - \$5 net, often insufficient for them and their families to live comfortably or to save. Limitations include the time required for hand crafting and the high costs of purchasing a lathe or hiring its use. To address this, the following problem statement was executed through a Senior Design program at Drexel University:

Improve the livelihood of fundi in East Africa by providing the knowledge to build inexpensive woodworking machines that do not require grid electricity. Specifically, collaboratively develop lathes with and appropriate for end users.

Through participatory design with 30 fundi, a human-powered design costing less than 5% of commercial cost was implemented. Without further intervention, some of the actors in Tanzania have built an improved lathe for income and education.

TS can be considered an adaptation of Ashby's (2005) five-step design archetype: market need, concept, embodiment, detail, and product. Significant departures from the general process are that i) problem choice is heavily weighted, and focused on social justice, ii) the priorities, values, and considerations of the design space are shaped by Appropriate

Technology, iii) participatory design in the field is used to determine details (though some detail must be explored in the embodiment phase), and iv) the deliverable is not a finished product, but the dissemination of adaptable ideas.

TS evaluates market need in terms of “social justice»: the ability of people and people groups to adequately meet their wants and needs in all domains that impact human functioning (natural, economic, interpersonal, etc.) (Oosterlaken 2009; Margolin and Margolin 2002). By aiming for this from the very beginning, with “design as the point of intervention (Nieusma 2004),” the decision of which functional problem to address or technology to use becomes less important and is made easier.

The design space of TS is “appropriate technology” which stands, at times, for a movement, for a philosophy, or for specific hardware (Abraham 1999). According to Long(1980): “...appropriate technology is the technology that is appropriate to the particular situation faced by a given group of people, with consideration given not only to economic circumstances and available resources but to value priorities.” The local environment is emphasized, implying that solutions will vary across boundaries. ‘Value priorities’ encompass a gamut of considerations beyond the economic, such as political environment, natural environment, cultural values, utilization of local resources, power, and ownership. Rather than propose a new approach, the design space of TS is inspired by the paradigms of Schumacher, Papanek, and others.

TS uses a balanced approach for generating design concepts: design from operating principles while considering existing solutions across the spectrum of complexity. This approach has several benefits: i) improvement of transferability through universality, ii) minimization of social constructions inherent in the original design, iii) promotion of simpler final designs, and iv) helping to avoid the problem of overthinking. Prototyping of these concepts is an important step, and TS can accommodate the full spectrum of options for doing so.

For TS, detailed design is participatory, conducted in the field, a significant departure from the norms of the general design process. The advantages are i) “it is the details of design that are morally significant (Oosterlaken 2009),” ii) field conditions vary from those assumed in the design process, and iii) participatory design promotes the use of local knowledge and innovation, understanding, independence, and ownership.

TS disseminates ideas rather than objects, which has several advantages: i) “... ideas ... can be used over and over again, without ever being depleted.” (Sachs 2005, 41), ii) it is simpler and often less expensive for ideas to cross international borders, iii) dissemination can be highly decentralized, making use of existing social networks, and iv) the transfer of ideas requires little capital investment from stakeholders. In a sense, the approach is like the “open source” software movement, where the building blocks of the technology are freely available for anyone to adapt.

Other technology-for-development models are appropriate for certain situations. First is the direct donation of items for consumption – a sound response for disaster response. Second is the donation of technology to produce consumables, as in drilling a well, a longer-term solution. Third is the delivery of a final product designed by outsiders with input from the client community – a more customized response.

In comparison, Technology Seeding assigns the most power to the agents and groups who stand to benefit from the intervention, and makes substantial use of local experiential knowledge. It also lends itself to a decentralized, grassroots effort and limits dependence on designers and donors. As such, it is highly scalable. The time required for a TS intervention would exceed that of providing products for immediate consumption, so it is largely unsuitable for emergency situations. The short- and long-term costs and time requirements may however be on par with providing general or adapted technology. TS is also better suited to simple technology systems, though the definition thereof will vary by situation.

The value of TS is embodied in a short message received from a fundi a year after the Lathes for Africa project:

“Hi Alex! I hope you’re ok. Now I have made a strong wood lathe. I used bars and bought a power-runned motor. We are testing it today. If it works well it will be very productive.”

The use of metal bars for the frame and an electric motor for power, while the team only demonstrated a wooden frame and bicycle power, is evidence of the method’s value.

A combination of approaches will be required to effectively leverage technology for development. Technology seeding provides the critical component to support socially just long-term sustainability through enabling and empowering the poor.

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## Greater Kuala Lumpur, Malaysia: Public Transport As A Solution To Urban Mobility In A Fast Developing City

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*Introduction:* As a measure to encourage use of public transport, reverse dependence on personal cars and to alleviate congestion in Greater Kuala Lumpur, the federal government introduced track-based transport systems comprising urban commuter rail, light rail transit and monorail in the conurbation several years ago. Park and ride (PAR) areas were provided at most stations to facilitate personal car owners in using the rail-based transport services. A study on the utilization patterns of these stations is presented in this paper to investigate whether the facilities are helping the system to encourage use of public transport, thus reduce pressure on urban spaces in the area.

*Purposes of Paper:* The main concern of this paper is to investigate the effectiveness of using rail-based transport system as a measure of reducing road congestions in Greater Kuala Lumpur. In particular, the objective is to gauge the level of usage of the park-and-ride (PAR) facilities provided at 12 out of the total 53 urban rail commuter stations in the area. The second objective is to analyze and compare the daily workday utilization patterns of the park-and-ride areas and to detect whether utilization is influenced by factors such as distance to city center, population density and land use. The third objective is to discuss the implications of the findings of the study to better manage the facilities.

*Methodology:* The main objective of this study is to gauge the present level of usage of PAR facilities of the urban commuter rail stations in the study area in terms of its level of utilization (occupancy rate), its pattern of accumulation as well as the extent of its parking duration. The methodology employed is based on a license plate survey involving a continuous observation for a period of 18 hour, from 05:30 morning to 23:30 in the evening. It was carried out on a weekday for each of the 12 stations. The number plate and time of all access and egress vehicles were recorded throughout the period on a formatted sheet. This research was carried out with the purpose of generating a pattern in terms of the daily workday parking demand of the users of the rail-based PAR facilities of commuter stations that are spatially located outside or the fringe of the city. The term demand refers to the propensity of people to make trips using urban commuter rail. In this study demand refers to the estimated number of vehicles that will require parking spaces at staging areas to transfer trip makers to higher occupancy modes namely rail. The parking demand is further analyzed by means of its parking utilization indices namely its utilization (occupancy rate), accumulation as well as the duration of using the facility. Utilization here refers to the occupancy of the designated spaces within the facility and is calculated as the number of spaces occupied over the total number of spaces available. Accumulation relates to the number of vehicles parked at a given time while duration explains the total hours of the vehicles being parked at the facility and is divided into short-term parking, mid-term parking and long term parking. Short-term parking is defined as those parking duration of less than 5 hours while long-term parking refers to those exceeding 8 hours. Mid-term parkers would therefore be those that park their vehicles between 5 and 8 hours. In this study the term 'supply' refers to the sum (capacity) of all the parking with the exception of spill over while demand is equal to the sum of all parking including the spill over. The case of spill over here relates to both the on-site spill over as well as the off-site spill over. With respect to the choice of the stations, factors of locations and geographic background of the study areas are taken into account.

*Empirical Findings:* The first finding from this study is that the 05:30 am–06:30 am weekday period saw the morning peak of its in and out-vehicle flow with a relatively high number of pickup and drop-off passengers (PDOs). From 7:30 am onwards saw a significant accumulation of vehicles and reached its peak at 2:30 p.m.. The evening peak period of 5:30–6:30 p.m. saw the highest number of out-vehicles recorded with 16.3 % of the total number of vehicles. A relatively significant number of in and out-vehicles began to reemerge at the evening peak period from 4:30 p.m. up to 8:30 p.m.. This scenario reflects the regular weekday morning and evening rush hour for commuters and are consistent with the trip patterns of those on compulsory trips namely to work and/or school/college. Second, the majority of the stations especially those located in densely populated areas were over-subscribed with many car owners parked their cars outside designated parking lots such as on road shoulders due to lack of parking lots. Third, there was a significant difference in terms of the hourly accumulation of out-vehicles amongst PAR areas. In general, stations located near to the city center (Kuala Lumpur), experienced a sharp increase in out-vehicles between 4:30 and 6:30 p.m. compared with stations located

at the city fringe. The majority of the parkers during these times are those among the government department employees whose office hours ended at 4:30 p.m. Fourth, PAR areas located within densely commercial areas tended to be used by parkers who parked their cars for shopping at nearby shopping complexes, not for riding the rail commuter transport, indicating an abuse of the facilities. Abuse was less detected at stations located far from city centre.

## **A Competence Framework for Heterogeneous Collaboration for Sustainable Innovation: The case of BMW**

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The main research question of this paper is how to deal with the competences needed to collaboratively generate sustainable innovation? Consequently, this paper can be divided into three sections: (1) The competences required to enable inter- and transdisciplinary collaborative problem solving with respect to the generation of sustainable innovation; (2) The introduction of a systemic competence framework for heterogeneous collaboration; (3) The analysis of the peculiarities of a most recent real-life project on future mobility of BMW; and (4) Implications from the BMW case for the generation of sustainable innovation.

Based on a thorough literature review a theoretical competence framework was developed that had been applied in a real-life problem solving scenario of BMW. Within this case, the whole collaborative problem solving process had to be designed with special consideration of the interaction of internal stakeholders of BMW and external stakeholders (including customers, various experts, and a group of 16 industrial design students) as part of an open innovation approach. Furthermore, a core issue within this research was to find out the competences needed in order to accomplish the complex challenge of developing sustainable innovation in the field of future mobility that can simultaneously be considered as suitable for society and for BMW.

From a systems thinking perspective, sustainable innovation needs to be both sustainable with respect to its process of generation as well as to its implementation and diffusion on the market, encompassing economic, ecological, and social perspectives of sustainability. The BMW case points out that the heterogeneous collaboration processes that underlie the generation of sustainable innovation call for a competence mix that encompasses process competences and systems thinking competences (as synergy between logical and creative thinking) as a kind of meta-competence, personal competence, social competence, and certain domain-specific competences.

The generation of sustainable innovation understood as innovation that contributes to sustainable development from an economic, ecological, and social point of view can rarely be accomplished by individuals, in disciplinary respectively scientific isolation, and in relying exclusively on logics and reductionism. Instead, the generation of sustainable innovation is a complex problem and calls for a collaborative effort between various scientific fields, diverse practitioners and stakeholders based on the symbioses of logical and creative thinking. Therefore, the outline and the interplay of the competences needed to accomplish this challenge are crucial within this paper.

The experiences made within the real-life case of BMW are based on a project on future mobility with the company in which the author was responsible for the collaboration design.

## **Design of Low-Cost Thermophilic Microbial Fuel Cell for Sustainable Wastewater Treatment**

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Water and energy are interdependent resources subject to exponentially increasing demand fueled by population growth. The global multi-billion dollar energy and water markets are a testament to the opportunity presented to any technology that lowers the cost of these essential resources. A low-cost thermophilic microbial fuel cell was designed to help address the water-energy-demand challenge. The system design is a proof-of-concept that simultaneously produces energy and reduces COD of municipal wastewater. The two-semester project will culminate in a demonstration utilizing off-the-shelf components integrated in a novel way. The components of the system to be demonstrated are: An anode operating temperature at 60 degrees Celsius, stainless steel electrodes, cathode bio-catalysis, trickling-bed cathode, and a sequential anode-cathode flow-through configuration. Managing the competing temperature requirements between a hot anode for high metabolism and cold cathode for high oxygen solubility is achieved with heat exchangers. The performance of the system was modeled using estimates of the system's kinetic characteristics, which indicated the expected energy yield for every cubic meter of wastewater processed is on the order of 2.2 kilowatt-hours. This energy production occurs simultaneously with an expected chemical oxygen demand (COD) reduction of 90 percent. Optimization of flow rate of the system was calculated based on the trade-off between energy production and COD reduction, which indicated an ideal anode chamber hydraulic residence time of 1 hour. Initial economic analysis of a

wastewater treatment plant utilizing the Wastewater Power system indicated a 30-year plant-life value that was expected to be 4 times greater than that of conventional activated sludge plant when accounting for similar costs and a load of 37,850 cubic meters of wastewater processed per day.

### **Encouraging Sustainability Innovation through a Process of Knowledge Transformation in Society**

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Sustainability concerns long-term constraints on resources, including food, water, and energy. The challenge of sustainability is the reconciliation of society's development goals with the planet's environmental limits over the long term. Sustainability hence requires sound understanding of the fundamental character of interactions among natural and social systems. In the complex, dynamic interactions involving natural and social systems innovation occupies a crucial place. To ensure steady progress towards sustainability on a global scale, it is of critical importance to take a systemic approach to encouraging innovations from an international perspective. An innovation system can be considered to consist of three structural components, namely, knowledge, actors, and institutions, and it is crucial that diverse types of knowledge be integrated effectively for encouraging innovation. Sustainability innovation hence can be considered as a process of dynamic, complex interactions among diverse actors creating, transmitting, and applying various types of knowledge relevant for sustainability under specific institutional conditions. A variety of issues will affect sustainability, ranging from environmental protection to safety and public health, with the characteristics of scientific and technological knowledge characteristics specific to the issue at hand. Many phases can be identified in the production, diffusion, and utilization of knowledge by different actors, without necessarily involving coordination with one another. To understand the mechanisms of sustainability innovation, the dynamic process of knowledge transformation in society needs to be analyzed.

In a process of knowledge transformation, first of all, a problem affecting sustainability emerges. In this phase knowledge of the natural sciences is essential to investigating and understanding the causes and mechanisms of the problem. Next, the problem is recognized by many people in society. The way that the problem is reported in the media, including newspapers and TV, significantly influences how the problem is recognized and interpreted in society. Knowledge of methodologies such as discourse analysis is useful in understanding this process. As the problem becomes widely recognized in society, research activities are initiated by scientists at universities and research institutes. The behavior of scientists will be heavily influenced by the norms and incentives in their communities, which could be significantly different from those in industry. Studies of the sociology of science and economics of science have accumulated valuable findings about their behavior. Scientific investigation of the problem is followed or accompanied by technological development. In this phase private companies play a major role in inventing and diffusing technological solutions to the problem. Research and development activities of private companies have been studied extensively in the field of the economics of technological change and innovation studies. The technologies developed by industry are introduced in society and subsequently used by different stakeholders. This will cause a variety of impacts, some of them unexpected. Assessments of environmental protection and safety, energy/materials flow analysis, and life cycle assessment are useful in tracing and understanding the impacts on society. Following these impacts, there will be feedback from the stakeholders in society. Reactions of various actors to scientific and technological developments have been studied in the field of STS. Thus there are many phases of the knowledge transformation process with feedback among different actors, not necessarily with much coordination with each other.

Case studies of sustainability innovation in the field of energy and water are conducted by using bibliometric data on scientific papers, patents, and commercialization in Japan, Europe, and the United States. The cases of innovation on photovoltaic technologies for energy and membrane technologies for water suggest that gaps and inconsistencies in the knowledge circulation system could pose serious challenges to the pursuit of sustainability innovation. The development of photovoltaics illustrates a significant transition in the knowledge system from one based on R&D projects supported by the public sector for basic scientific knowledge to another based on investments in production facilities by private funds for societal diffusion. The pattern of innovation through university-industry collaboration, which has functioned relatively well for creating scientific knowledge in the past, may not be working in utilizing financial knowledge. For sustainability innovation on water, a wide variety of knowledge are required, including demand prediction, water treatment technologies, water management systems, infrastructure, and laws and regulations. The traditional innovation system focusing on specific technological knowledge may not function effectively. Various types of knowledge need to be integrated and utilized effectively through strategic collaboration and coordination between actors with relevant knowledge in the public and private sectors. Gaps and inconsistencies among different phases in terms of the quantity, quality, and speed of knowledge processed generate long-term consequences to society often unexpectedly. This effectively constitutes a major challenge in pursuing sustainability innovation on a global scale.

## Drinking Water Disinfection with Silver Ion Doped Nano Powder Coated Packing Material

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Worldwide population growth, pollution of surface water and groundwater, uneven distribution of water resources and droughts, to provide water for people to meet the needs of new and prospective resources have led to the search.

Nanotechnology is one of the most prominent and promising research area nowadays. This research area is very important for environment, medicine, energy, computer technologies, pharmacology etc. Nanotechnology can also create many advantages in solving environmental problems and in water treatment techniques. Only minor amount of world water reserves are able to be used due to the industrial water pollution; that's why drinkable water disinfection becomes very important issue. Using conventional methods in drinking water disinfection can be dangerous for human health and environment. In this study we investigated a novel alternative water disinfection method to prevent the potential dangers to environment and human health.

Disinfection is one of the applications areas of nano antibacterial materials on the engineering sciences. Disinfection is considered to be the primary mechanisms for the inactivation of pathogenic organisms to prevent the spread of waterborne diseases to downstream users and the environment. A variety of physical and chemical techniques can be used for disinfection. Most widely used disinfection method is chlorine addition into the water. Meanwhile, chlorine might get in reaction with organic matters and may cause formation of carcinogen side product such as trihalometane. Because of disadvantages of classical disinfection processes, advance and alternative disinfection methods have gained in importance recently. Increased water demand, wastewater reuse has brought with it the concept. This current phase of the waste inherent in the lethal bacteria and microorganisms, has a protective effect of public health as a disinfection treatment process stands out. In this study, silver ion doped calcium phosphohate based nano powder was used as a disinfectant. Antibacterial nano-powders consisting of Ag<sup>+</sup> ions was fabricated using wet chemical process. Spherical shaped filled materials produced from antibacterial nano-powders. For this purpose the prepared slurry was dropped to form 2 mm diameter beads. The antibacterial beads were filled into the glass column. Antibacterial ceramic filled column is one of alternative disinfection method. In this application, *Escherichia coli* bacteria were used for antibacterial tests. The survival ratios of bacteria have been investigated for different flow rates and initial bacteria concentration on continuous and recirculating systems. *E. coli* bacteria were killed successfully in the water.

*E. coli* are always present in human and animal faeces in very high numbers, they are very important indicator bacteria for testing water pollution and used as an indicator of faecal pollution in the microbiological surveillance of drinking water. This disinfection method is very advantageous because other routine methods change water taste and smell but this method doesn't cause these changes.

# Adaptation

Margaret Arnold & Shiv Someshwar

## Oral Presentations

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### **Dynamic Atlas: Modeling Water and Urbanization within the Ganges River Basin**

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Of the rapidly urbanizing regions of the world, the Ganges river basin of northern India remains one of the most elusive. This paper focuses on the methodologies used to measure and construct a *Dynamic Atlas*: a cartographic set of drawings that combine different scales of information and durations of time on a single picture plane of the Ganges river basin—one of the most densely populated river basins in the world. This applied research examines how the proliferation of hydrological infrastructure, namely tubewells and canals, combined with unprecedented growth in human populations is a major driver of diffuse urban settlement across the basin. It posits that the gulf between contemporary urban growth practices and the larger form-giving enterprises of physical development can historically be traced to the lack of dynamic representations of the environment, as well as a reluctance to engage larger infrastructural and cultural imperatives that reside outside of traditional, dense urban spaces. The Dynamic Atlas takes a trans-scalar approach to analyzing and developing the unique combination of ecological, cultural, and infrastructural transformations taking place across this unexampled landscape. It provides strategies and methodologies that operate from the scale of a single city block or hamlet to the scale of the city and large regional territory. Within this framework, both the scarcity and abundance of water dramatically shapes the larger built environment. Rather than a collision of ‘countryside versus city’, political and material conflicts arise over a shared set of support structures—especially those related to water extraction.

The basic issues of land and water development in the Ganges river basin results from the exceptionally dramatic seasonal flow of the river and its tributaries. Approximately 80 percent of the rainfall occurs during the wet monsoon (July through August), and some 80 percent of the annual river flow takes place during this same period. Water infrastructures, particularly tubewells and canals, precipitate fierce competition between domestic, industrial, and agricultural uses of water. The tubewell, a mechanized water extraction technology, numbering anywhere between the thousands and millions in the basin, populate this dense river belt. At first blush, this form of water extraction appears to tap into an endless and autonomous supply of water; however, it wreaks havoc at a regional scale, depleting critical aquifers recharged by the wet monsoon. Due to the cycles of the wet monsoon, water tables expand and contract dramatically over the course of a single calendar year. Millions of people depend on the water of the Ganges for their livelihood in terms of irrigation for agriculture as well as drinking water. Uttar Pradesh (U.P.), the largest state within the basin in terms of population and geographic area, contains the single highest percentage of flood-prone areas within India while also having the single highest number of irrigation potential and utilization in the nation.

As the Indian government embarks on an ambitious endeavor for the Ganges river, the Dynamic Atlas emphasizes the need to explore the use of alternative ‘soft infrastructures’ to reduce damage from monsoonal flooding and storm surge as well as drought and desertification caused by the tubewell and other water infrastructures. Rather than rely on nineteenth and twentieth centuries’ techniques of ‘hard infrastructure’, such as piped storm water drainage networks and massive barrages and levees, which have been proven to be expensive, ecologically irresponsible, and often ineffective (see Hurricane Katrina, 2005), the drawings and maps focus on the creative design of soft infrastructures that are, in fact, beneficial to the Gangesriver edge, such as designed wetlands and storm water harvesting to name a few. Likewise, the maps and drawings constructed are the most accurate and contemporary drawings of the dynamics of water and urbanization from the scale of the city block and natural drain (nalah) all the way to the river and regional scale. It also suggests that the development of these ‘soft infrastructures’ provides a means of generating energy through the use of monsoonal run-off, and adaptive re-use of infrastructures to make algae farms amongst others.

Constructed over the past six years through extensive fieldwork, the drawings and models use the annual solar and lunar cycles as a datum to measure the effects of rainfall and agrarian processes, all in relation to the fast-paced modes of urbanization within the basin. Extensive flooding and devastating droughts all contribute to the challenges facing homes, cities, and industry alike. Cultivating a new lens to visualize dynamic landscapes is needed to commensurate “natural systems” of flooding and drought with hydrological infrastructure and urbanization of this vigorous river valley. If ground

– as simultaneously a modern ‘development’ imperative and a locus of unbroken religio-cultural tradition thousands of years old– continues to inhabit a cartographic no-man’s-land, it will neither encourage doubt nor avidity about how it actually affirms and sustains itself across this vast alluvial corridor.

In order to move beyond the spectacle trauma of a single news cycle, maps and digital models must lucidly engage the lunacy of weather and cultural mores fuelling urbanism. Only through a critical reading of the disparate processes that have shaped this territory – from field and pasture to city to agro-polis –can we retrace the larger motivations that have reformatted this ground in order to project an underlying infrastructural framework for alternative futures. Representation must play a critical role as both a body of knowledge arrived at through methodical study as well as a technical tool to direct growth. In doing so we can better picture the veiled ecological and infrastructural pressures that have encouraged diffuse urbanism across this dynamic ground.

## Real Options as a Tool for Flexible Climate Change Adaptation

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The late Stephen Schneider developed the conceptual idea of a cascading pyramid of uncertainties which depicts the “uncertainty explosion” as the aggregated uncertainties of future emissions levels, carbon cycle response, climate sensitivity and possible impacts are multiplied (Schneider 1983). In general this constitutes a serious problem, but there is an ongoing debate over how important a reduction of uncertainty is for decision-making in the context of adaptation to climate change. While some scholars consider accurate and reliable climate predictions to be an essential input in adaptation planning (e.g. Shukla et al. 2008), others argue that adaptation is not significantly limited by the lack of precise climate projections and that one should rather look for alternative decision-making frameworks able to cope with uncertainty (e.g. Hallegatte 2009).

Naturally, different decision-making approaches are associated with these two positions. While the first aims to find the optimal policy, the second position holds that one instead should seek for robust strategies that perform well even in the worst case. However, instead of waiting for reliable predictions or seeking for a robust strategy, there is the alternative of applying a flexible strategy, i.e. a strategy that can be adjusted when new information becomes available.

The aim of this paper is to utilize real options theory (Dixit and Pindyck 1994) for the development of a conceptual framework for flexible decision-making in climate change adaptation planning. A related approach is adaptive management (Walker et al. 2004) as an iterative monitoring tool for environmental assessment and management. In this paper we build on this research and apply real options theory to climate change adaptation.

In order to develop the framework, it is necessary to structure and assess uncertainties surrounding climate change adaptation. The present paper adds to previous research by analyzing three aspects of uncertainty. First, in the climate change adaptation context two distinct ‘uncertainty cultures’ are brought together; a quantitative and a qualitative. Whereas the natural sciences rely heavily on quantitative methods utilizing statistical analyses with confidence intervals and probability distributions, the treatment of uncertainty when analyzing future socio-economic conditions – which often is a prerequisite for impact assessment – is often based on qualitative approaches. There has been proposals on how to combine quantitative and qualitative aspects of uncertainty (e.g. Funtowicz and Ravetz 1990, 1993), but very few have addressed climate change adaptation.

Second, adaptation planning always takes place in an institutional context. Adapting to rising sea-levels typically involve spatial planning, while adapting to future heat waves typically (but not exclusively) involve the health sector. Each institutional context has its own discourse and methodological approaches regarding uncertainty. Therefore, the approach to uncertainty in climate adaptation must be tailored according to the societal sector under consideration.

The third aspect is the distinction between static and dynamic uncertainty. The uncertainty is static when there is no indication that it will change over time and dynamic when it is expected to resolve over time. This distinction is important since it provides a means for relating robust strategies to flexible strategies. Let ‘projection time’ ( $t_p$ ) be the time between the time horizon of the projection (e.g. 2030) and the time when that projection becomes available. If, for a certain adaptation planning context, reliable climate projections for 2030 will be available in 2020 then  $t_p = 10$  years. Then, let ‘lead time’ ( $t_l$ ) be the time it takes from initiation of a decision to full execution. Depending on societal sector, the lead

time can range from years (e.g. procurement in the health sector) to decades (e.g. buildings) or even longer (e.g. land-use planning) (Hallegatte 2009). If  $t_l > t_p$  it is necessary to find a robust strategy, while  $t_l < t_p$  opens up the possibility of altering the decision when new information become available, i.e. to chose a flexible strategy.

With this structuring of uncertainty, we develop real options theory as a conceptual framework for flexible decision-making for adaptation to climate change. Real options theory is an approach for decision-making when there is 1) uncertainty over the future development, 2) partially or complete irreversibility and 3) a possibility to postpone actions in order to learn more over time. From the discussion above, it is clear that the first point is valid in the context of climate change adaptation. Typically, adaptation investments are also irreversible, i.e., once capital has been used in a particular adaptation scheme it is “sunk” in the sense that it cannot readily be converted to other uses. Spending money today to protect from climate impacts that never materialize means we waste money that could be used for other purposes. On the other hand, refraining from acting now could involve significant, and sometimes irreversible, damage to developments, infrastructure, and ecosystems in the future, should climate in fact change. The problem is that decision makers seldom have sufficient knowledge to determine which path – proactive action or postponement – constitutes the best (most effective, cost-efficient, ethical) solution.

Regarding the possibility to postpone actions in order to learn more over time it is essential to compare the value of waiting for more information with the cost of not having the benefits of the investment in the meantime. In essence this is an optimization problem: when is there enough information over climate impacts to execute an adaptation decision?

In the context of climate adaptation, three option values are at stake. First, there is value in waiting to invest scarce resources in adaptation measures, since these resources are then available for other types of investments. By taking incremental adaptive action, only limited sunk costs arise. Second, there is value in waiting for more information in order not to destroy some environmental asset or process. The option value consists in the possibility of saving the environment from irreversible damage, which could, for example, be the consequence of more robust adaptation measures. These two reasons for awaiting more information converge in the sense that they support the same kind of adaptive action, namely no or only moderate measures (Ha-Duong 1998). However, there is a third option value working in the opposite direction. Taking incremental adaptive action could itself create an option value (so-called “learning options”). This option value consists in the possibility of modifying, or building on, the measures that have already been taken in order to provide effective and cost-efficient protection against more serious impacts of climate change, should this turn out to be necessary in the future. The assumption here is that this option would not exist, if not incremental adaptive steps have been taken.

We conclude that making an irreversible decision over an adaptation measure is to give up the possibility of waiting for new information that might affect the desirability of the decision. This lost option value is an opportunity cost that should be included in the overall valuation of the adaptation measure.

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## **Traditional custom(s) usage in sustainable water management of modern Mongolia**

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Water scarcity and pollution are serious problems and they became a national security issue of Mongolia. 70% of total water sources have no fixed zone for sanitary protection, 30% has no sanitary passport and this indicates the weak implementation of regulations about securing of human drink and daily water need and water protection against pollution in aimags[1].

An inventory done in 2007 revealed that 887 rivers and streams out of 5121, 2096 springs out of 9320, 1166 lakes and ponds out of 3732 had dried up due to climate change impact and human activities although their water use was relatively low[2].

Water resources amount of Mongolia is 34,600 cubic meters in streams and rivers, 62,900 million cubic meters in snow caps and glaciers. Snow caps and glacier amount is reduced by more than 30 percent in comparison to 1940's amount[3].

Research objectives:

- Conduct survey on traditional customs of water protection
- Study on harmonization of traditional customs towards sustainable water management

As shown our survey results, reasons of water resources exhausting in Mongolia are[4]:

- dominant of drinking water used technology in mining sector; for instance, gold and copper washing global warming negative effect;
- deforestation;
- rangeland degradation;
- old-fashioned sanitarian technical supply networks in the cities;
- individual's wrong habits; /specially wrong waste disposal and car washing/
- ineffective wastewater treatment plants;
- weak technology of reusing and treatment of wastewater;
- unevenly and limited distributed water resources;
- unclear and underdeveloped legislative environment;
- shortage of mass media advertisement and appropriate propaganda;
- limited water access in crop farming and animal husbandry sector;
- unreasonable water charge /unfair pricing for households and organizations/;
- tardy penetration of water measurement system throughout country;
- poor capacity of water testing laboratories;
- insufficient water points for animals, which cause overuse of water source;
- financial limitation of water conserving projects;
- very few nation-wide and successful implemented programs and projects regarding water enrichment and utilization;
- sustainable water usage training and education gap;
- shortage of professional personnel and human resource in water supply sector;
- loss of effective traditional customs for water protection of citizens.

The last reason was chosen as a motivation of further study on water protection solution. In "Khalkh juram" law, which conformed during Manjurians oppression in Mongolia, "it was forbidden to pee at the source of streams and putting of dairy products, blood and dirty clothes were forbidden. Consciously polluting actions of water were sentenced to a fine of horse and ox; eye witness should take an ox, too. Snatching away and quarrelling someone's dug well was sentenced to a fine of horse and possessing of water after finishing of own cattle watering was sentenced to a fine of horse, too".

During the XYII- XYIII Century, polluting of water was a crime; the criminal was judged and enforced a punishment. In the Constitution of Great Mongolian Empire polluting of water was strictly forbidden. As Chinggis Khaan's order stated "Who peed into water and ash was enforced capital punishment. Putting a hand into water is forbidden and for scooping water to use some container".

Those facts show that Mongolians had traditional customs to conform in its each historical period. They were realized until current legal system. Due to rapid urbanization process some effective traditional customs are disappearing, which are extremely useful and effective way of sustainable water management specially in rural area.

15 strategically significant mineral deposits are planned to operate step by step up to 2015, as a Government resolution. Recently, large scale projects (Oyu tolgoi[5] and Tavan tolgoi[6] are located in South Gobi region) are started to explore copper, gold and coals as well. Mining and energy sectors are the biggest water consumers and so they are harming water resources unexpectedly.

In order to solve water related problems the following activities to be done:

- Establish a water management network covering all territory that will provide continuous and sustained operation; and adopt new technology to provide efficient management and access to information;
- Accumulate water resources to improve water supply for industry and agriculture to reach sustainable development;
- Insert traditional customs for sound water management into school curriculum for public and private sectors training program;



- Support activities and initiatives within the legislative framework for sustainable water management;
- Develop the legislative environment and institutional arrangement for coordinating multiple requirements for water use, and capacity building;
- Protect the water resources of Mongolia, provide all means possible to support their formation, maintain their purity and natural replenishment;
- Mining companies have to prefer to apply sophisticated waterless and water saving technology due to Mongolia's Gobi region has limited water resources
- Promote community participation and public information, advanced technology enriching with customs and tradition on the protection of water resources and proper use to young people and citizens
- Establish motivated water pricing and charging system in line with market situation

- [1] Aimags /21/, soums /329/ and bags /1596/ are administrative units of Mongolia.  
 [2] Water Authority of Mongolia, 2007  
 [3] Research report, prepared by Water Authority of Mongolia, 2002  
 [4] Survey conducted within Ulaanbaatar city and Tuv aimag, from September to November 2010  
 [5] OyuTolgoi is a mining deposit which has 25.3 million tons of copper reserves  
 [6] Tavan Tolgoi has 6.4 billion tons of coal reserves

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## The Economics of Climate Change in River Deltas: Adapting to Increased Salinity

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Climate change impacts in the water cycle will be strongly felt in river deltas due to their hydrologic characteristics. The sustainability of the ecosystems which enable economic activity to take place in these areas can be in jeopardy due to these changes in the climate. We present a case study of climate change impacts and adaptation in the Lower Dong Nai Delta of Vietnam, an area characterized by having important agricultural production areas. The delta has relatively flat topography combined with low elevation with respect to sea level. The area has two clearly distinct seasons, the dry season when salinity intrusion occurs and the wet season when flooding happens.

The assessment of some the physical impacts of climate change in the delta suggests that salinity concentration levels will increase due to a combination of higher sea tides and lower upstream flows in the dry season (Dung Do Duc, 2010). These impacts can have an important effect on the sustainability of production from agricultural land in the long term. Adapting to increased salinity may involve changing cropping patterns, adjusting the crop input mix, constructing new water infrastructure or abandoning land.

We integrate agronomic and hydrologic aspects of climate change into a hydro-economic framework that examines the economic desirability and tradeoffs between available adaptation options in the districts located downstream in the delta. Our framework has two components, a model for agricultural land use, and a model for water infrastructure investment analysis. Using these components we are able to implement an integrated cost benefit approach that allows us to study aspects such as the economic desirability of adjusting agricultural land use as well as the appropriate timing and location of new water infrastructure in the delta.

An economic model of agricultural land use is constructed using data available from crop cost and return studies and land use observations for the area. The model structure and calibration is similar to the one introduced by Howitt (1995) and later on by Merel and Bucaram (2010). Our model aims at maximizing the net annual benefit from agricultural production in each of the delta's districts taking into account biophysical and economic constraints. An agronomic function is also incorporated in the model to relate crop yield and salinity levels following the work by Van Genuchten, M. T., and G. J. Hoffman (1984). When this yield-salinity relation is introduced in the model, the overall impacts of salinity in agricultural production can be studied in a more robust manner where both agronomic and economic aspects are

integrated. Using mathematical programming techniques the model is able to identify economically feasible adjustments of crop (agriculture land use) and input changes that can reduce the impact of increased salinity on production. Our model simulations allow us to parameterize a relationship between the value of annual agricultural production and different salinity concentration levels.

Secondly, we construct a model for analyzing investments in water infrastructure. The implicit objective of the model is to minimize land value loss in a district given different salinity levels by investing in water infrastructure. The economic value of agriculture land is derived using our agriculture model, which relates annual net benefits from agricultural production to salinity concentration levels. In other words, our model treats agricultural land as an asset that generates annual profits whose value is depreciating over time due to increased salinity. Hence, our model allows us to study the economic desirability of building protective structures that can prevent land from losing value.

Our water infrastructure model has an inter-temporal structure to study investment planning in a context of long-term climate change adaptation. The model maximizes the expected net present value of agricultural land using a stochastic dynamic programming model with one control and one state variable. Our state variable is salinity level and is randomly distributed based on hydrological simulations. Our control variable is a binary variable that represents whether or not a given water infrastructure is built. The formulation of this problem as a dynamic stochastic discrete choice problem allows us to study the timing of investment that will minimize the impact of climate change on agricultural production, which can also be described as an optimal stopping problem (Dixit and Pindyck, 1994). Using our dynamic model we study how the optimal timing for infrastructure investment differs depending on the district characteristics such as regional crop productivity or distance to the sea.

The results of the agriculture model simulations suggest that salinity damages to agriculture are not as pronounced when adjustments in the farming systems are allowed for a certain range of salinity levels. The possibility of switching towards more salinity tolerant crops such as changing from rice to beans can reduce the overall economic impact of salinity in the region.

The water infrastructure model simulation results suggest that there is economic value for building protective infrastructure in certain districts within the delta. Earlier investment in infrastructure is preferred in districts located closer to the sea due to their greater degree of exposure to salinity damages.

The analysis presented in this paper provides an example of an integrated framework for assessing the economic performance of adaptive measures that aim at reducing the long term climate change impacts of increased salinity on agricultural production. This framework can be a useful planning tool for climate change adaptation in a river delta where agricultural production is important.

\*The authors would like to thank Dung Do Duc and other members of the Southern Institute of Water Resources Planning (SIWRP) for kindly providing the data and for numerous discussions about the hydrology in the Dong Nai Delta. We would also like to thank Claudia Ringler for providing agricultural production data.

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## **Business Contribution to Climate Change Governance – Modes and Drivers**

Nicole Kranz

The relationship between business and climate change constitutes a key question with view to necessary paradigm shifts and new governance structures leading to ‘green economies’.

Business is commonly considered as main culprit for climate change, mostly due to climate-relevant emissions. While this has led to wide-spread criticism of business practices, there is a growing awareness that a contribution of the business community is necessary to address the emerging challenges. This requires an analysis of the role that business can play in this regard and of the motivations that drive business behaviour. This is supported by research on governance modes for sustainable development, which are described as complex but also inclusive of all potentially relevant actors, as government alone might not be capable of addressing these challenges. According to Liu et al. (2007) climate change epitomizes these complex, non-linear interactions between social and natural systems and is a suitable example for the type of “wicked problem” to be addressed by sustainable development governance.

Academic literature on the role of business vis-à-vis climate change mostly focuses on the strategic orientation at the firm level, with a strong emphasis on mitigating climate-relevant emissions and those changes within a business organization to cope with impacts of climate change on operations and render a more resilient business entity.

This paper takes a different perspective by focussing on the aspect of adaptation to climate-induced environmental changes. It is based on the premise that environmental change affects business and the surrounding communities alike, thus placing a stronger emphasis on the interaction between these. It covers firm-internal adaptation measures, as well as measures that originate from companies but have strong external implications and involve interaction with surrounding communities and are targeted at improving overall adaptive capacity. In this regard these measures transcend the immediate sphere of influence of the firm and contribute to overall climate change governance. The paper also investigates governance structures that motivate businesses to embark on adaptive strategies.

Since impacts of climate change on water resources are expected to be most severe, typical business strategies for climate change adaptation are derived using the example of sustainable water management as a proxy. Secondly, potential drivers for adaptive business behaviour are derived from the literature. Following Eisenhardt (1989), these initial assumptions are then tested in the context of case studies (the South African mining industry) in order to iteratively arrive at a more comprehensive and accurate picture of the underlying mechanisms. Case study data was collected through open-ended in-situ interviews in the case study region.

*Case descriptive* - South Africa was chosen as a water-stressed country, which is severely affected by climate change. It combines typical water problems of the industrialized world with those of developing countries.

South Africa furthermore is an emerging economy with a significantly developed industry sector and also a relatively stable national level government with albeit varying capacities.

Among the South African industry sectors, the mining sector with operations in the gold, coal and platinum commodities was chosen. Mining has a significant impact on water resources due to pollution incidents, freshwater abstraction as well as infrastructure developments to assure supply and thus also disposes of a considerable potential contribute beneficially to climate change adaptation.

*Overview of findings* - Examples for firm- internal measures are water efficiency improvements relieving the overall pressure on water resources. Internal monitoring and water resources planning support the careful use of the resource. Sharing and monitoring and planning data at the watershed level with communities and stakeholders, constitutes a further important contribution to water resources governance.

Businesses furthermore get involved with water infrastructure planning, development and financing, which also benefits community needs. Related contributions pertain to capacity-building for local administrations, e.g. with regards to planning and monitoring and the operation of water infrastructure.

Furthermore firms get involved with shaping policy dialogues, which lead to further learning and adaptation processes. Firms actively help to increase the adaptive capacity of surrounding communities through more stable water infrastructure better administrative capacity, better and more profound knowledge and planning. This type of contribution is no longer limited to companies and their immediate sphere of influence. These activities take place at very different levels ranging from local municipalities to the basin levels as well as in the national context.

Larger, better resourced firms usually were involved with farther-reaching contributions. In some cases these also had potentially more profound repercussions within the surrounding communities in terms of improving their ability to cope with climate change impacts.

The degree to which these activities eventually led to the improvement of the adaptive capacity can only be assessed to a limited degree based on the cases investigated. If assumed, that access to more information, strengthened institutional capacities, more careful planning and improved exchange with stakeholders improve adaptive capacities, firms' contributions in some instances could be considered conducive in this regard.

In terms of key drivers, the role of government actors, ranging from mandatory to more facilitation-oriented approaches, as well as resource-based considerations, emerged as most decisive. The latter include the relevance of the resource water, available financial resources as well as the disposition of the firm to address sustainability challenges. Detailed within-case analyses display interactions among and between these and other drivers, such as social drivers as well as competitive and normative drivers, which often exert an enhancing effect. Furthermore, a sequence of drivers could be identified, where certain drivers, such as government pressure and the relevance of resource constraints lay the foundation for the introduction of others. Next to strong government intervention, also certain weakness of (especially local) government actors constitutes a veritable driver in some cases.

There was also evidence that the most conducive contributions increasing overall adaptive capacity were developed where firms entered into a dialogue with government at multiple levels, most decisively however in the municipal context. This also indicates that the resource-driver, such as water scarcity alone does not suffice as a determinant of business contribution to climate change adaptation, but rather need to be complemented by government intervention.

Consequently, the necessity for governments to play a strong role, to interact with a wide range of actors and to diligently combine different policy tools remains a valid demand. However, the capacity necessary to fulfill this role probably needs to be viewed more differentially. Capacity-building measures should be targeted not only at improving managerial capabilities and financial viability but also at improving the ability to engage with business to activate internal motivations.

The results have clear implications for the debate on governance for sustainable development and the relationship of business and government in this regard.

### **Africa Adaptation Programme Experiences: Enhancing Stakeholder Engagement Processes for Adaptation**

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Stakeholder engagement is considered key to successful processes of adaptation to climate change. This is because relevant individuals and groups have extensive knowledge of their natural, political and socio-economic systems and can validate analyses and decision-making required for designing and implementing adaptation responses (e.g. vulnerability and adaptation studies (V&A), prioritising adaptation responses, monitoring and evaluating adaptation responses). Stakeholder engagement also promotes the ownership of adaptation responses by local stakeholders, and thereby facilitating the sustainability of such adaptation options after a project/programme finishes. This paper reviews the stakeholder engagement processes of the Africa Adaptation Programme (AAP), which is implemented by the United Nations Programme (UNDP) and supports 20 countries across the African continent to adjust their national development processes to incorporate climate change risks and opportunities. Questionnaires and interviews were conducted for each of the 20 participating countries to capture lessons from the formulation and initial implementation stages. The paper will study various aspects of stakeholder engagement, including inter-alia: a) types of stakeholders involved (e.g. governmental organisations at national, local and community levels, NGOs, community-based organisations (CBOs), women's organisations, private sector); b) the extent to which these stakeholders were engaged (e.g. from simple information sharing (passive role) to taking a leadership role); c) the involvement of marginalised communities to evaluate equity issues; and d) key challenges countries are facing in stakeholder involvement.

### **Challenges and Solutions to the Implementation of Payments for Ecosystem Services to achieve Sustainable Development**

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One of the most challenging problems facing sustainable development is to establish mechanisms for the sustainable use of ecosystem goods and services (Carpenter et al., 2009, de Groot et al., 2010). Traditional development continues to degrade key ecosystem services (e.g., carbon cycling, biodiversity, and water provisioning) often as a consequence of promoting others (e.g., lumber extraction). A widely adopted and rapidly evolving set of solutions concerns developing Payments for Ecosystem Services (PES) projects (Farber et al., 2006). PES represents a mechanism for monetizing the value of ecosystem services. This approach rewards land use or management practices that protect or increase the provision of select ecosystem services (Wunder 2005, Jack et al., 2008). As organizations and communities rise to the challenge of developing economic instruments that capture the value of nature while contributing to the improvement of human wellbeing, it is critical that guidance and best practice are made available on how to design an effective, scientifically sound, and sustainable PES projects.

The science underlying ecosystem services has been the subject of many studies over the last decade, and attempts have been made to quantify the contribution of organisms and ecological systems to ecosystem services (Kremen 2005, Luck et al., 2009). However, the scientific foundation of PES schemes, or the degree to which ecosystem service science has been integrated into the design, development and monitoring of PES projects, has not been investigated systematically. If the criteria for establishing success, models for guiding design and implementation, and monitoring schemes of a PES project are not founded on solid scientific principles, the long-term success of a PES project may be compromised and thereby undermine the sustainable development goals of the project.

We undertook an investigation into PES projects across the globe based on three classes of ecosystem services: biodiversity, water, and carbon. The goal was to better understand the extent to which science has been integrated into the development, planning, and ongoing monitoring of existing PES projects. The key concerns motivating this research were: 1) a lack of information on the scientific principles that informed the design, implementation and monitoring of the PES projects; and 2) the degree to which scientific principles are integrated in the design, implementation and monitoring of PES. These issues are of concern because they will influence the ability to “scale up” these initiatives and influence the ability of such mechanisms to succeed in the long-term.

Three-hundred PES projects from around the globe were examined in the assessment. To be suitable for analyses a project had to contain: 1) an ecosystem service definition; 2) at least one buyer and one seller and 3) evidence of conditionality on the payment for a given service. Those meeting these criteria were subjected to an analytical instrument involving ninety six evaluation points that quantitatively assessed the project’s scientific foundation. Only those projects where enough information was provided to permit a conclusive response (i.e. not “unclear” or “not applicable”) in at least 60% of the questions were included in the analysis.

Ultimately, only 104 cases met the criteria and were subjected to the analytical instrument. For the majority of cases reporting was incomplete and eclectic with respect to data, methods, and monitoring. Among the selected PES projects, those involving carbon were among the most thorough. We attribute this to high number of carbon-based projects that had applied for certification through the Voluntary Carbon Standard or the Climate, Community and Biodiversity Alliance, and, thus, followed a well developed template for project design and reporting. In order to disseminate information consistently PES schemes for water, biodiversity, and other ecosystem services would benefit from a standardized template for reporting to facilitate comparisons across sites in order to have a better understanding of what elements of PES planning and evaluation are most critical for project sustainability both within a given market type or across all three.

With little standardization across the cases (beyond select carbon projects) we still attempted to determine a measure of the degree of consideration for ecological science in each case by deriving a “scientific index” score, which included four elements:

- Use of baseline data
- Presence of a monitoring program
- Adaptive management/consideration of ecosystem dynamics present in management plan
- Inclusion of a plan to address threats to the ecosystem service in question

Multiple questions fed into the above categories and created a proportional score for each category as well as a composite scientific index score where four is the maximum. We then compared this score to other variables (buyer types, geographic location, market type, certification scheme, if payments were being made, proximity of the project to a protected area, among others) to detect any significant relationships. With few exceptions the scientific index did not correlate strongly to a particular project element. Thus, instead of deriving key ecological elements for inclusion in PES projects as had been our initial intention, our analyses suggest the following:

- 1) Given the rising prominence of PES programs in environmental problem solving, that the lack of uniformity and degree of available scientific information hinders the ability to evaluate the likely effectiveness of a PES program, its ability to scale up as programs expand, and to determine the sustainability of the project.
- 2) The development of a template for designing PES programs and their reporting would benefit project managers, project participants (e.g., community or individuals), assessment, and the wider environment and development communities.
- 3) Although due to the heterogeneity of data conclusive results regarding the role of science in the overall success of PES projects is lacking, extrapolating from the cases with the longest standing success with respect to effective payment and perceived ecological integrity, the following elements should be included when designing a PES program:
  - Assess threats to the ecosystem service in question that incorporates knowledge of ecosystem dynamics and ecological tradeoffs of the proposed activity
  - Monitor beyond the ecosystem service in question to understand full impact of project. Eg. measuring co-benefits (such as biodiversity benefits of a carbon project)
  - Disseminate project goals, outcomes, monitoring program and management practices in a standardized format to enable more detailed analyses and extraction of lessons learned

Broad assessments of PES, particularly from a scientific perspective are lacking across sectors and geographic locations. However, aid agencies, restoration projects, and municipal and federal governments are interested in how to effectively implement these programs. While guidance is widely available on the basic conditions of a PES project, these

criteria do not guarantee scientific rigor or sustainability. With the 21st century enthusiasm toward a green economy and environmental markets, these interests will continue to grow. Emphasis on PES has taken place at major meetings, including the United Nations Framework Convention on Climate Change, and Convention on Biological Diversity, and thus will be part of the discussion at Rio +20. In light of increasing enthusiasm surrounding the use of PES, our assessment of the current state of PES projects serves to promote the establishment of common reporting that may lead to scientific standards for PES projects. This study was a first step in that direction.

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## Goal conflicts in adaptation to climate change

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Two fundamental policy approaches exist to reduce the environmental, economic, and social threats posed by climate change: mitigation and adaptation. Adaptation has gradually received more attention in international policy discussions as scientists and decision makers have come to realise that changes in climate are unavoidable. Since emissions reductions will not abate all negative climate change impacts, mitigation has to be combined with a process of adapting to those impacts.

In decision-making processes concerning adaptation to climate change, there is often a choice between different strategies and measures. The choice of adaptation measure or strategy can have implications for other goals. In the context of climate change adaptation this means that a goal conflict arises when a measure that is taken by an agent (e.g., a local authority, county administrative board or county council) in response to actual or expected climate change or effect, obstructs the achievement of some other goal that the agent has set. These goal conflicts constitute a major policy challenge for decision makers involved in adaptation.

So far, research on adaptation has dealt a lot with needed adaptation measures, but rarely analysis of what kind of conflicts those measures could impose on other goals. The measures may even fuel climate change themselves and, hence, accelerate the need for further adaptation. To ensure the coherence of adaptation measures with other policy goals, there is a need for tools to assess and predict outcomes, but also to balance those outcomes and trade them off in situations where they are not easily reunited. As goal conflicts (and the nature of those conflicts) are identified, strategies and tools for managing them can be developed.

The purpose of this paper is to shed light on the existence of goal conflicts in the adaptation process, to provide examples of goal conflicts related to adaptation measures concerning physical planning, and to propose and discuss strategies for dealing with these conflicts. The basis for the paper is an inventory of potential goal conflicts in Sweden's climate change adaptation process. We use the adaptation process in Sweden as empirical basis, but we make the assumption that the results are sufficiently general to apply to other countries with similar socio-economic structure and climate.

The paper is focused on measures and goal conflicts concerning physical planning and decisions taken at the local scale, mainly the municipal level. A desk-based review of adaptation measures were carried out, and analysed with regards to potential goal conflicts in relation to environmental goals, goals concerning human health, recreational goals, and social justice goals. Goal conflicts were identified based on literature studies combined with interviews with relevant staff from national and local authorities and field experts.

The adaptation measures that were analysed within the area of physical planning, mainly concerned protection of the built environment against flooding, landslide and increased temperatures and protection against human health risks in the built environment. There are close connections between the identified adaptation measures. Many of the adaptation

measures that are taken to protect buildings and developments from the negative impacts of climate change are also adequate responses when it comes to mitigating harm to human health.

The paper shows that, goal conflicts in adaptation are common phenomena.

Sometimes, adaptation conflicts with mitigation efforts, such as when air-conditioning and other mechanical cooling systems used to reduce heat-related mortality also increase carbon dioxide emissions. At other times, adaptation conflicts with goals concerning the preservation of natural and cultural values, such as when ski establishments are relocated to meet snow deficits, resulting in biodiversity loss and damage to landscape integrity. Often, adaptation conflicts with some goals while at the same time benefits others, which makes choices concerning adaptation complex and difficult to manage.

Obviously, goal conflicts in adaptation to climate change can be managed through many different types of strategies. If actions to mitigate climate change are intensified, and are successful in halting climate change, fewer adaptation measures will presumably need to be taken, which reduces the risk of conflict between adaptation goals and other policy goals. Another strategy is to focus adaptation policy on reducing the vulnerability in social and ecological systems by making them more resilient towards the effects of climate change. With resilience built into the systems, systems are more designed and planned to withstand changes without collapsing, and the need for adaptation measures could also decrease and thereby conflicts between interests or goals.

Conflicts also arise between the local authorities' goals and the national authorities' goals. Hence, integrating adaptation policies and measures between different agencies and sectors is an important means of identifying and avoiding or limiting potential goal conflicts between proposed adaptation measures and other policy goals. Because of the diverse interrelationships that exist between different policy sectors today, adaptation strategies need to be developed in an integrated fashion to be effective and sustainable.

Some strategies are conflict-reducing in the sense that they reduce the need for (further) adaptation and, consequently, the risk of creating conflicts between the goal of adaptation and other policy goals. Other strategies are conflict-identifying in the sense that they help to detect actual or potential goal conflicts in present or planned adaptation work. These strategies are central to the goal conflict resolution process, since a first step in managing a goal conflict consists in being aware that the conflict exists. Conflict-directing strategies constitute a third type of strategies; they tell the decision maker how to act in situations where a goal conflict is present or foreseen.

An important conclusion is that, by pro-actively working with goal conflicts at an early stage in the decision-making process, governmental decision makers can play an important role in promoting sustainable adaptation at local and regional levels. The goal conflicts that exist in the context of climate adaptation make it clear that successful adaptation policy cannot be defined in terms of effectiveness, i.e., how well an adaptation measure, strategy, or policy succeeds in solving the problem that it is intended to solve. Before an adaptation measure is decided upon, the decision maker must also consider how appropriate the measure is, given her other policy goals.

## **Enhancing the Adaptive Capacity in the Asia-Pacific Region: Opportunities for Innovation and Experimentation**

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Developing countries of the Asia-Pacific Region are the ones most threatened by climate change, due to the limited institutional capacity and limited ability to respond to adverse impacts. If not addressed immediately, this has the potential to undermine economic growth. Adaptive capacity entails the ability to adapt, conduct a sum of actions to change behaviors, shift priorities, produce necessary goods and services and to plan and respond in ways that reduce harmful climate change impacts or transform them into no-regret economic opportunities.

Enhancing the adaptive capacity of the region is therefore important to safeguard existing and future development progress in the light of current climate variability and to reduce its vulnerability to extreme weather events. Nevertheless adaptation to climate change has not yet become a high priority policy issue in most of the Asia-Pacific, as barriers exist at both strategic and implementation levels. The main obstacles are the availability of credible climate information, transforming the scientific information into usable form, lack of communication, absence of knowledge of successful measures and lack of available 'no regret' strategies. There exist possible trade-offs between development priorities and adaptation measures, as well as deficient financial resources and funding mechanisms. Resilience needs to be enhanced through building regional, national, and institutional commitment, as well as technical and scientific capacity.

In this context, this paper provides a framework for adaptive capacity building of the most vulnerable sectors (agriculture, water and natural resources management). Based on the review of country experiences, it intends to describe key dimensions and suggest interventions for further explorations and serves as a basis for planning and mainstreaming climate change adaptation into sectoral planning.

Asia-Pacific countries have been making serious efforts to include adaptation strategies into sectoral and macro decision making processes. To understand the nexus between obstacles and outcomes, the Asia Development Bank Institute (ADB) conducted several surveys during its capacity building workshops. Overall 15 participants – senior level policy makers from Southeast and South Asian countries – responded to the surveys. Results suggest that the majority of sectoral agencies have undertaken internal awareness-raising measures on climate change (96%) and efforts to enhance cross sectoral cooperation between agencies, however in the absence of shared instruments (92%). When inquired about the status of policy endorsement at the sectoral and national levels, respondents reported that climate change adaptation is explicitly or implicitly contained within national policies. Initiatives range from agreements with broader environmental and development objectives, to specific agreements aimed at integrating climate change adaptation into developmental planning. On priorities to mainstreaming adaptation, respondents stressed the urgency of taking actions related to scientific and technical skills enhancement (24%), inventory of baseline data (17%), increasing awareness (17%), and promoting cross-border cooperation (17%). In respect to the assessment on climate change risk, 83% of the respondents had conducted assessment on implications of climate change on their activities, 92% had conducted assessment on documents, and 34% had conducted assessment on exposure of investments. The results highlight that the current attention of assessments is not climate change risk on financing but risk on activities and policies.

Enhancing adaptive capacity involves several stages, beginning with assessing causes of vulnerabilities, its impacts and identifying the multiple benefits of best practices beyond adaptation. Hence, generating accurate specific climate information and communicating to policy-makers as a basis for decisions; building awareness to understand potential climate impacts and devising responsive strategies; and creation of communication channels to support knowledge transfer at sectoral level are overriding priorities. In later stages, pilots programs are critical to test measures, to identify improvement opportunities, and to adjust implementation strategies.

Mainstreaming adaptation capacity of most vulnerable sectors into developmental planning entails the full engagement of relevant stakeholders, including policy making agencies, research institutions, private sector, and civil society. The specific role in catalyzing adaptation strategies, in a cost-effective way, depends on the specific context or the issue being addressed. In a generic sense, local and regional governments are likely to be the governmental entities most directly involved in adaptation activities, both in the coordination across several actors and in the implementation at local level. Economic planning agencies also play a major role in coordinating across different sectoral agencies, whereas sectoral agencies may facilitate implementation and identify trade-offs in specific sectors. Research and educational networks operating across and within sectors and interdisciplinary scientific and educational organizations are essential for cross-sectoral and international learning and link knowledge generation with major decision-making processes. These centers play an essential role in inventorying specific climate data, and developing models that predict climate risks and reduce climate change uncertainty. Since much adaptation will occur in the future and also in a pro-active way, involvement of the private sector is central to achieving impacts at scale, particularly organizations involved in designing adaptation infrastructures and financing adaptation practices. Civil society, local-based communities, and non-governmental organizations play a critical role in the innovation of new adaptation measures, strategies and pilot initiatives to support climate adaptation that can then be replicated at scale. They are also relevant in including local specific conditions and social protection initiatives, guaranteeing the successful implementation of adaptation actions. Finally, international organizations that combine know-out and financial capacity to support proactive adaptation measures with the explicit focus on vulnerable populations are vital. Due to the wide array of climate change issues and its cross sectoral character, partnerships that involve diverse stakeholders are likely to be important in supporting adaptation at local and national levels.

There are many starting points for innovation and experimentation on the measures that can strengthen adaptive capacity for addressing impacts of climate change. Concrete progress could be achieved by fostering synergies between three policy approaches of climate information, decision capacity and financing, bringing together all levels of analysis to reduce risks intensity and likelihood. The objective should be to foresee climate related threats and reduce their negative effects, as well as to minimize other side causes that also contribute to extreme weathers events. For instance, combining scientific climate instruments and cost-benefits analysis can be an appropriate support to decision making on adaptive measures at a scale, as policy makers will be aware of climate change disaster impacts and its cost to human systems and affected populations. There is also evidence that participation of multi actors in comprehensive capacity building programs can provide an opportunity for different stakeholders to come together, learn the risks and benefits, identify and prioritize the actions. Ultimately this facilitating information approach could be expanded in its scope, aiming to build country wide resilience, as well as get the attention of international organizations for funding. Further



actions include facilitating regional cooperation through the provision of expertise in the area of climate information. Sharing country experiences will help to build analytical, monitoring and decision making capacity, as well as moderating the requiring resources for enhancing the adaptative capacity. Such efforts will certainly include long-term economic strategies such as creating regional fund for adaptive capacity building.

### **Adaption to Climate Change: the Sustainability Challenge for Hong Kong**

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Climate change is one of the defining issues of our time. As the frequency of extreme weather incidences continues to rise in recent years, climate change has become one of the top priorities on the global policy agenda. Internationally, communities continue to define and redefine sustainable development strategies to cope with the dynamic impacts of climate change, from the 1972 Stockholm United Nations Conference on the Human Environment to the 2009 Copenhagen United Nations Climate Change Conference. The International Panel on Climate Change (IPCC) forecasts that during this century, the average global surface temperatures will increase by 2.8oC on average [1]. Hong Kong is a metropolitan city with seven million residents that has been contributing to and suffering from the impacts of climate change, but only recently has its government committed to join hands with the international community to move Hong Kong towards a low carbon economy [2]. According to a Technical Note issued by the Hong Kong Observatory, the average temperature in Hong Kong increased by 0.12oC per decade over the past 118 year period, but in the period between 1989 and 2002, the rate increased significantly to 0.61oC per decade [3]. United Nations Environment Programme's (UNEP) *A UN Guide to Climate Neutrality* [4] states that climate neutrality is defined as living a lifestyle that produces no net greenhouse gas (GHG) emissions, by reducing our own GHG emissions and using carbon offsets to neutralize the remaining emissions. Mobilizing the entire Hong Kong society to transform into a sustainable 'low-carbon' city is a formidable task, and implies that its citizens will need to reconsider their current lifestyles and behaviours in order to help reduce GHG emissions.

The Hong Kong Special Administration Region (HKSAR) Government has made climate change a higher priority in its policy agenda in recent years, and is gradually recognizing the need to respond promptly. In the 2009-10 Policy Address of the Chief Executive of the HKSAR Government, Mr. Donald Tsang overtly stated that the Government has attached considerable importance to climate change issues. The Government has commissioned a consultancy study to develop comprehensive strategies and measures to cope with climate change [5]. He further asserted that the Government has made building a 'low-carbon economy' a top priority for the HKSAR's policy agenda. Currently, the Government is launching a public consultation on Hong Kong's climate change strategy and action agenda [6]. It is clear that action must be taken, and the key challenge is to determine how Hongkongers can be mobilized to help transform the city into a more sustainable and climate-neutral society. The imminent question is whether Hongkongers are ready to support this agenda and to adopt a change in their lifestyle. If not, what should be done, individually and collectively? To this end, a public survey [7] was conducted in December 2010 to study people's perception towards climate change risk in Hong Kong. It also attempts to evaluate the extent to which people are willing to adopt a climate neutrality lifestyle. The followings are highlights of the preliminary findings of the survey.

Overall, the study revealed that the majority of respondents (over 95%) were aware of the challenges of climate change. Many of them (over 80%) felt that weather conditions have worsened in recent decades and are adversely affecting their daily lives. In particular, many respondents associated climate change with deteriorating air quality. The survey asked the respondents to compare the relative seriousness of climate change with other social problems, and the results showed that slightly more respondents were concerned about other social issues over climate change, such as medical, social security, natural disaster and income inequality. Similarly, respondents were more concern about conventional environmental problems such as air pollution, water pollution, solid waste disposal, and ocean pollution than the impact of climate change. Therefore, climate change was still regarded as a "distant concern" when compare to conventional social and environmental problems. The survey also assessed the degree of support on the Government's proposed adaptation strategies to combat climate change. Nearly all strategies and actions suggested were highly supported by the respondents, with the exception to the suggestion of revamping the fuel mix for electricity generation in Hong Kong. Although over 95% of the respondents were aware of the climate change issues, they held little confidence that the Government will be able to solve the problem. The majority of the respondents agreed that Hong Kong should take action to combat climate change issues, and suggested engaging people to change living habits as the most feasible way to tackle this issue at this time. Regarding lifestyle changes, the top three actions that respondents considered most effective and would consider taking are: (1) taking public transportation; (2) to supporting recycling projects/programs; and (3) using energy-efficient products at home and in their workplaces. On the other hand, one of the major barriers that hinder low carbon living development in Hong Kong is the lacking of support from key stakeholders such as the

Government, environmental NGOs, and leaders in the commercial/industrial sectors. Moreover, the materialistic lifestyle in Hong Kong also hinders the adoption of low carbon living.

To conclude, climate change is a global challenge that calls for global actions. The Hong Kong SAR Government is now committed to working closely with the global community to combat climate change. To ensure its success, the entire Hong Kong society is urged to take green actions in their daily activities. Conventionally, the social values of Hongkongers are dominated by the pursuit of economic returns and materialistic lifestyle. For more than a century, these values have contributed to the city's success as a commercial centre, but they have also contradicted the aspirations of being a climate-neutral city. Undoubtedly, Hong Kong's society as a whole is now more mindful of environmental problems. As citizen participation and lifestyle changes are necessary to tackle climate change issues, it is important to understand the extent of people's awareness of climate change risks, and their acceptance in adopting a shift in lifestyle. It is encouraging that the study revealed positive signs of a greener development and positive support from Hongkongers. However, the challenge to incorporate a green culture into a traditionally 'ungreen' society is a formidable task, [8] and the Government should work to overcome hurdles that may hinder Hong Kong from adapting to the 'low-carbon society'. It is a challenge to ensure that eco-friendly living practices can coexist with the modern, capitalist, and consumer driven society. This paper provides a detailed analysis of the data collected and aims to seek new breakthroughs that will be conducive to the long-term sustainability of the city of Hong Kong.

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## Posters

### Climate Change, Urbanization and Water Supply Challenges in Lagos State, Nigeria

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Man's remarkable advances in science and technology, his economic and social wellbeing depend on weather and climate. Different time and spatial scales studies on annual distribution and variability of climatic variables, urban land use and population has shown to have substantial impact on water supply. Nigeria annual rainfall ranges between 400mm in northeastern parts and 4000mm in the coastal area. The mean maximum temperature is between 30°C and 32°C in the far south, it is between 36°C and 38°C in the north. On the other hand, the southern mean minimum temperature is between 20°C and 22°C while is less 13°C in the north. In Nigeria, rainfall and temperature fluctuations are inherent characteristics of climate and such fluctuations have had diverse effects such as drought and flood. This also have adverse effect on water supply. For instance, availability of surface water or shallow groundwater depends on the precipitation.

Urbanization and fast growth in the population has been attributed to various factors which include; natural population increase and rural–urban migration. This has indeed put a constraint on available resources and resulting to unusual situation where too many people place too much demand on little resources especially safe water. One of the basic indexes of livelihood that clearly distinguishes the developing from the developed world is access to improved water supply. Spending most valuable time in searching for domestic water and queuing endless at standpipes by school children and housewives has become a normal scene in most Nigeria cities as in the case of Lagos. Inequality in the socio-sphere is also exemplified in access to potable water. In searching for sustainable safe water, on average, the poor suffer more than the rich.

The above scenario described the water situation in most parts of Lagos State. The provision of adequate supplies of safe water to the growing number of urban residents, especially the urban poor of Lagos State, will therefore be one of

the biggest challenges facing government and local authorities in the near future. Therefore, it is based on these facts that, the impact of such climatic variables, urbanization and population on water supply and demand in Lagos State Nigeria remained the objective of this research of interest.

Four climatic variables used for this research were collected from Nigerian Meteorological Agency (NIMET) Oshodi – Lagos. The variables included temperature, Rainfall and relative humidity between 1960 to 2006 (46years) and evaporation data between 1965 and 1999 (34years). The data were originally generated from the three synoptic stations in Lagos (Ikeja, Island and oshodi) on daily basis. It was later sorted on average monthly data for the purpose of the study. Land-use/Land-cover maps of 1975, 1995 and NigeriaSat-1 satellite imagery of 2007 adapted from the Remote Sensing and GIS Archives of the Department of Geography, University of Lagos were used for land-use analysis. On the other hand, population and water production data used were collected from the National Bureau of Statistics, Abuja-Nigeria and Lagos State Water Corporation respectively. The population data used for this research were the provisional census data for 1963, 1973, 1991 and 2006. For the population trend, the 1963, 1973 and 1991 figure were projected appropriately for the subsequent years based on the annual growth rate. Inferential statistics (Trend analysis) was used to generate the results for the study.

Concisely, the finding shows that urban area has increased from 230.8km<sup>2</sup> in 1975 to 538.2km<sup>2</sup> in 1995 and 734.2km<sup>2</sup> in 2007 i.e. an increase of about 235.9% within 46years. Between 1960 and 2006, the population increase by 2,427.5%. On the other hand, the results revealed that water demand in Lagos state has outpaced the supply over the years. From previous finding, potable water supply has increased by about 112.9% between 1977 and 2002. Although, the climatic factors shows a decrease in their trend between 1960 and 2006 but there is evidence of high thermal discomfort in the last few years. The fluctuation in the climatic factors (especially, the consistence increase in temperature since 1999 and decrease in rainfall since 2002), increased in population and rapid urbanization have been noted to have responsible for a wider gap between water demand and supply in the recent years.

For sustainable safe water supply, lots of efforts will be needed to bridge the gap if water demand in Lagos State should be met. The paper also discusses various future associated risks without addressing the threatening climate change, rapid urban expansion problems and fast growing population issues.

### **Future visions of climate adapted communities- stakeholder views from Sweden**

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Climate change is a fact and even with successful mitigation efforts the future weather will be different from now with e.g. more extreme weather events and a higher sea level. Adaptation is therefore necessary and in the research literature it is recognised that many important adaptation decisions takes place at the local level because that's where plans are made and implemented and that also where crises are managed and prepared for. At this point in time research about and execution of adaptation activities are in their infancy in many Swedish municipalities where the first national survey was published in 2007 about climate related vulnerabilities and opportunities. Since then, some municipalities have started adaptation activities to a limited extent, especially regarding inundation and used the information as an input in their planning documents and construction policies. It has been recognised that substantial inputs and support from the regional and national levels are needed if municipalities should succeed in adapting to climate change.

In this paper we attempt to shed more light on the constraints and opportunities for adaptation in municipalities by investigating what kind of images of the future well adapted municipality that local stakeholders (officers in key positions in municipalities) have in their minds today. Workshops were held in two municipalities in the Stockholm area using a back-casting approach including an idea generating workshop as a first step and a workshop where images based on these ideas were presented as a second one. These images were then analysed by the researchers for presumed or implied support from higher levels in society, for example, do the images imply very specific knowledge about the rate of sea level rise at a particular point in time? This would then mean that research concerning glacial retreat would have to make substantial advances in the future. Or do the images imply a supply of cheap electricity for cooling during heat waves? This implies that national authorities may have to change their energy taxes if visions of well adapted municipalities should be realised. The workshops with municipalities are scheduled to take place in March 2011 and the results will be reported at the conference and in a manuscript for submission to a scientific journal.

## The Role of the Informal Sector in Equitable Water Distribution: A Case Study of the Tanker Market in Ayn al-Basha, Jordan

Sarah Anne Hinkfuss

This paper investigates the extent to which the informal water market equitably distributes water to urban households. Stated differently, given a government monopoly that falls short of its purpose due to increasing resource scarcity, can the “invisible hand” intervene to equitably distribute a precious resource? Development economists commonly find evidence of ethnic discrimination—here defined as horizontal inequity—and regressive pricing—here defined as vertical inequity—in free market settings, while neoclassical analysis suggests that mutual self-interest will result in a naturally equitable marketplace. The paper theoretically and empirically probes this under-researched question by constructing a household water demand model with household-level data gathered during a field survey in July and August 2009 of 265 households in the Emir Ali neighborhood of Ayn al-Basha, Jordan. Additionally, more than 50 key informant interviews form the theoretical contours of the informal water market. The paper uses the household water demand model to analyze the equity characteristics of the local water market using Instrumental Variable methods. The results suggest that the informal market is non-discriminatory but exhibits regressive pricing, which implies that the informal market falls short of a truly equitable distribution. Possible policy interventions to address the vertical inequity include lowering the informal market’s capital barriers to entry and enabling poor families to coordinate purchasing.

This paper presents the first econometric inroads to understanding the phenomena of the informal market in distributing water to urban households. As climate change accelerates the aridity of already water scarce countries—namely those in the Middle East—establishing mechanisms that equitably distribute this precious resource will become matters of domestic political stability and global security. Most likely, higher water scarcity will mobilize the informal market to play a greater role in resource distribution. Development economists and natural resource practitioners must understand the informal market and find ways to improve its performance. The inter-disciplinary methods mobilized in this paper can be applied to other informal markets in the region.

The formal sector in Jordan inadequately distributes water due to the severe water scarcity facing the country. This problem is regional; according to the International Water Management Institute, the Middle East is the most water scarce region in the world (2009). In response to its extremely low levels of water, the Jordanian government rations water. To store water across periods of delivery, residents store water in household tanks. Local entrepreneurs capture residual household water demand by selling privately held spring water directly to households from water tanker trucks. The water tanker market exhibits the three characteristics of the market laid out by Adam Smith: the interaction of supply and demand, competition, and self-interest (1759). The tanker market is informal because the Water Authority Jordan, the national water regulator in Jordan, does not regulate the tanker prices, and the market thereby operates without meaningful institutional oversight or regulation.

There are two types of equity that pervade markets: horizontal equity and vertical equity. The extent to which these market features exist has life-changing implications for the market players. Horizontal equity concerns the similar treatment of all similar households and the dissimilar treatment of all dissimilar households. The designation of a similar versus a dissimilar household should only be made on the basis of willingness to pay differences among households, and not issues of race, ethnicity, or religion. Horizontal inequity is also called discrimination. Vertical equity occurs when pricing is progressive, like progressive taxation.

Household demand in the informal water market, let alone the level of equity in the market, is currently poorly understood. Two competing hypotheses exist on the ability of this special water market to equitably distribute the resource. On the one hand, neoclassical economic analysis suggests that the tanker market results in equity gains because it exists as a free market response to the inefficiencies of the public market. Both the suppliers and consumers voluntarily enter the market so even if there is inequity, it must improve welfare based on the assumption that households are rational economic actors. On the other hand, development economic analysis suggests that households have no choice but to enter the informal market to meet household water needs. As a result, these households exhibit extremely inelastic demand for water and must accept the price set by the suppliers. The tankers maximize profit by favorably distributing to households in their family network, which creates inequity in the forms of discriminatory distribution and a regressive pricing scheme.

In brief, the findings presented in this paper are based on empirical, qualitative, and quantitative case study research. The basis of the study is a randomized survey of households conducted in Ayn al-Basha during August 2009. The survey concerned household demographics, water use, and water satisfaction. The researcher also conducted in-depth interviews of key informants at the local and national levels, including in the health care sector, the local water authority, the national water office, and private firms that operate in the water sector. Despite detailed study of the local context of water service provision, the case study of Ayn al-Basha is necessarily a snapshot in time, as longitudinal studies were unavailable. This work is the first step into an under-researched field.

## Resettlement measures to mitigate land subsidence and flood impacts

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Populations in the northern part of Metro Manila, Philippines habitually suffer from floods due to heavy rainfall, high water level in rivers, poor drainage systems and high tide at Manila Bay. This area is composed of 4 cities: Kalookan, Malabon, Navotas and Valenzuela, collectively called the KAMANAVA area. Studies have shown that land subsidence has aggravated flooding in the area, of which the effect is more manifested when floods caused by heavy rains coincide with high tide. Land subsidence is highly attributed to excessive groundwater extraction. Assessment of different flood events reveal great damage when floods occur in combination of heavy rain and high tide. The cost of flood damages to household may seem minimal but when accumulated in a year added economic burden to households. Most of the money spent is for treatment of injury and illness during and after flood events. Because of the regularity of floods, households have also developed coping strategies and often spent money for improvements of their houses and lot to prevent floodwaters from coming in.

Due to the gravity of the flooding problem and urgency to alleviate people's conditions, one of the options being considered is voluntary resettlement of households frequently affected by flood. However, before any policy intervention, it is necessary to assess the probability of affected residents to accept this proposed solution, especially that there were unsuccessful resettlement programs in the past. A stated preference discrete choice method (SPDCM) is applied to determine the factors that can affect the probability of residents to voluntarily resettle to a flood-free area and to see tradeoffs if economic incentives are given. In this study we applied the mixed logit probability which can be derived from utility maximizing behavior. Applying this theory in resettlement, the individual decision makers choose an alternative (e.g. a location) from a set of alternatives that maximizes their utility. Utility is affected by the attributes present in each alternative. A number of choice sets describing incentives for the resettlement site were created using alternative scenarios and a series of economic attributes and attribute levels. The three alternatives include the option to choose the status quo or stay in the current location. The other two alternatives are (i) to resettle to a location which is 20 kilometers away from KAMANAVA, and (ii) to resettle to a location which is 40 kilometers away from KAMANAVA. Because the study placed importance on incentives to relocate, willingness to stay at the current location is related to a set of economic incentives, which include monthly amortization, the provision of grant, loan and job opportunities. The choice sets were administered through an interview survey among 516 respondents in the 4 cities of KAMANAVA area.

Results from the choice experiment indicated that residents do not want to resettle to another location, but they gave significant consideration to the economic incentives given in the choice sets. These results can be used in the formulation of alternative resettlement program and it should be emphasized that among the economic incentives offered, the provision of job opportunities, especially permanent job is a highly significant factor. This clamor for employment opportunities was also reflected in previous resettlement programs and the lack of it was the major reason of resettled people to go back to their original location.

## Climate Change Adaptation in Tajikistan

Payrav Masaidov

Let me introduce myself first. My name is Payrav Masaidov and I am a project manager in Risk Reduction & Climate Change Adaptation Program of NGO "Agency for Support Development Processes Nau" based in northern Tajikistan. The project aims to assist local community in Sughd province of Tajikistan to reduce risk of agricultural loss, prepare for emergency situations caused by climate change and implement adaptation measures to combat this challenging issue.

For last five years, my work experience has been devoted to develop social and civil society sectors. These spheres have enabled me gain solid experience in communication and intercultural dialogue between all layers of society. However, for a person who seeks to get professional skills and knowledge on global challenges as climate change, networking and participation in international workshops will be very useful since I would be able to be well equipped with necessary leadership and organizational skills in the mentioned field. I do believe this can partly be achieved when I take part in 17th Annual International Sustainable Development Research Conference which intends to unite professional & young leaders around the world to promote sustainable development by environmental care taking & combating climate change, hence contribute for better future.

Climate change, as known, is complex and many-sided area of crossing of different themes. Therefore, effective activity here assumes as division into components for work in concrete directions (such, as energy efficiency), and ability to see an overall picture.

I would like to highlight that Tajikistan with its difficult geographical conditions is one of the most vulnerable countries of the Euroasian continent to occurring climatic changes. For last 60 years the mid-annual temperature of air in the country has raised to 1 °C, the number of days with plentiful rainfalls has increased, drought cases have become frequent.

The Government of Tajikistan, international and local development actors have taken actions on a problem of climate change and working out of different programs on softening of consequences of climate change. There is a good experience on implementation of adaptation measures (solar-greenhouses, solar cookers, energy efficiency stoves, drip irrigation, composting, ecofarming, etc.), but the lack of resources and necessary support is often felt. Many NGOs in the country work in this field, but very there is a few positive examples on attraction of municipal authorities and a civil society to decision making. Answers to research questions speak about insufficient clearness concerning the most probable consequences of change of a climate: the shortage of water caused by melting of glaciers already became a problem in the countries of the Central Asia, and, it seems, the situation will worsen in the near future.

In this regard, regional collaboration on environmental issues, close collaboration and implantation of adaptation measures to support sustainable livelihoods in the Central Asia region and introduction of new technologies on agriculture, public health services, environment, an infrastructure, adapted for climate change, are necessary.

# Coherent land use planning

Peter Driessen & Arnim Wiek

## Oral Presentations

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### **An Improved Measure of Land Use Diversity and its Impact on Climate Change**

Sweta Byahut

Climate change is a global environmental problem that scientists, environmentalists, politicians and policy makers are dealing with today; and urban planners are increasingly concerned about the connection urban form and transportation at a local level have with climate change (Bestill and Bulkeley 2007, Blakely 2007, Frank et al. 2007). In the United States, the transportation sector is the second largest contributor to climate change, generating 28% of all greenhouse gases (GHG), and up to 32% of all carbon dioxide (CO<sub>2</sub>) emissions. The US transportation sector has a disproportionate effect on global climate change – the US population is only 5% of the world's population, it owns 1/3rd of all vehicles, but they contribute up to 45% of total CO<sub>2</sub> emissions from cars worldwide. US Environmental Protection Agency reports that within the transport sector, household passenger vehicles are the largest source of CO<sub>2</sub> emissions and account for 80% of all road travel, measured in vehicular miles traveled (VMT), and for three-quarters CO<sub>2</sub> emissions from all road travel. Since 1980, household VMT has grown three times the population growth rate, and twice the rate of growth in the number of registered vehicles.

Land development directly impacts travel behavior by determining where we live, and how, or how much we travel for work, school, family, entertainment, personal business, and social activities. Travel is directly related to fossil fuel consumption, and hence influences the amount of GHG emissions. Land use characteristics like density, diversity, design, access to transit, destination accessibility, and centrality of development, impact household travel pattern. Spatial planners are exploring how GHG emissions can be reduced through changes in the built environment and smart growth. The understanding of local to global causes of climate change has encouraged many local governments in the US to include a range of climate protection measures in city and regional planning.

Although there is a statistically significant link between different aspects of the built environment and the VMT, there is a lack of convincing studies and enough evidence to judge whether it is large enough to modify the built environment as a feasible tool for reducing VMT. My dissertation research will measure the impact of mixed land use / land use diversity on vehicular travel related climate change in the Greater Cincinnati region. Land use diversity is defined as the composition or heterogeneity of land uses within a given geographic area. Cincinnati is one of the most sprawling regions in the US, experiencing massive increases in land area without a parallel population growth. It also has a wide variety of urban form characteristics that makes it an interesting case to study.

The objective of my dissertation research (in progress) is to devise an improved method to measure the impact of land use diversity on climate change. Land use diversity has been identified as a key urban form characteristic that impacts travel behavior, besides density, design, access to transit, and location, or centrality of development. Land use diversity therefore has a direct impact on household travel related GHG emissions. It will test the hypothesis that mixed land use reduces household vehicular travel significantly, and therefore reduces GHG emissions. This relationship needs to be tested further as there are concerns about the extent of impact that urban form characteristics have on travel behavior. There are several research questions: How does increase in land use diversity influence Vehicular Miles Traveled (VMT) in households? Which mixes or combinations of land uses have the most beneficial impact on CO<sub>2</sub> emissions (residential and retail/ office and retail/ residential, retail and office)? Are there minimum and maximum thresholds of land use diversity that are most beneficial from the urban climate policy perspective? Is the impact of land use diversity significant enough to introduce changes in the built environment? Does increasing land use diversity reduce CO<sub>2</sub> emissions more when combined with other land use characteristics like higher density, improved neighborhood design and better transit? Literature implies that the interaction effect of different land use characteristics on household travel is greater than the sum of parts.

Current methods to measure land use diversity are debatable and not very sophisticated and have often relied on proxies like employment or broad land uses for analysis. In addition there are concerns about the extent of impact urban form characteristics have on household travel behavior. I propose to measure the impact of land use diversity on household VMT using the most recent household travel data from Greater Cincinnati Household Travel Survey 2009-10 and the

most detailed parcel level land use data for Hamilton County. In the first part of my research I will develop an improved measure of land use diversity which will be presented at the forthcoming ISDRC Conference. Computation of an appropriate land use diversity index will involve using spatial statistic tools in Arcview10. It will examine the surrounding land uses for a set of sample households covered by the Greater Cincinnati Household Travel Survey. The most recent parcel level land use data has been procured from the Cincinnati Area Geographic Information System (CAGIS) for detailed land use analysis. In the Conference I will present this first part of my dissertation research. Computation of the test variable of land use diversity is a key step for the latter part of my research, where I will analyze its impacts on travel related CO2 emissions.

Sustainability planners have a renewed interest in the relationship between land use characteristics and travel, with its explicit link to climate change becoming apparent. One of the main contributions will be to develop an improved method for measuring land use diversity using detailed parcel level land use data, My overall research will provide key insights on the impacts that different mixes of land uses has on climate change, inform the case for land use diversity as a long-term climate protection policy measure for cities. It will provide useful policy guidance to city and regional planners on its effectiveness as a climate protection policy.

### **The Research of the Agriculture Land Use Change Phenomenon in Urban Planning Zone**

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Recently, the overall economic structure change result in the change from agriculture to industrial and commercial industry. In addition, the affiliation of World Trade Organization (WTO) opened up free trade of agricultural products and reduced agriculture competitive ability substantially, further decreased the agricultural land use area and the serious change of agricultural land. The Agricultural Land Conversion Scheme and Agricultural Development Act have been proposed to review present agricultural land use in order to conserve high quality agricultural land and release inappropriate agricultural land complying with national economic development policy. The functions of agricultural land include living and ecological value, such as production, flood regulation, daily leisure area and green area etc. Nevertheless, the agricultural land has the land limitation and unrecoverable feature; therefore, the change of agricultural land should be considered cautiously and confirmed harmless to the environment. From the conservation of agricultural land point of view, the change of agricultural land should be based on sustainable land use notion and avoid land use unsustainable such as urban sprawl, land competition between agriculture and industry etc.

This paper attempts to investigate the effect of urban agricultural land change to the overall land use pattern in Tainan, Taiwan. First, the location features of land use change will be investigated to analyze the differences of urban environmental condition affect to agricultural land change. Besides, urban area will be categorized into municipality and rural and further mapped with post-change of land use type to find out the trend of agricultural land use change in research area and review the orientation of agricultural land in different type urban area to illustrate if the orientation is reasonable or not. This paper will proceed with present land use condition data of 1995 and 2006 to clarify agricultural land use change pheromone. Besides, this paper not only probes into the phenomenon of the change from agricultural use to non-agricultural uses but the post-change uses. The post-change uses analysis will imply the land development trend and can offer the actual agricultural land use change factors.

Afterwards, spatial autocorrelation analysis will be proceeded to detect spatial patterns of a point distribution by considering both the locations of points and their attributes. This method will search the spatial hot spots of the change of agricultural land and illustrate the feature of agricultural land change distribution. This paper manipulates GIS mapping method and spatial autocorrelation analysis to diagnosis the aggregation and the feature of agricultural land use change. The overall propose of this paper is to offer some notions of planning and regulation to release inappropriate agricultural land to urban development hinterland and conserve high quality agricultural land through accurate policy guidance.

### **Land Sustainability for Future Growth: Multi-criteria Spatial System for Evaluating Environmental Impacts of Land Use Change in Urban and Peri-urban Limits of a growing Indian City**

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This paper presents the research outcome of an ongoing project being carried out in Lucknow which is the capital city of India's biggest state, Uttar Pradesh. The urban and peri-urban area (2500 sq km from centre of city) around city of Lucknow is taken as the study area due to past and present expansion in population and ensuing transformation of landuse. To evaluate the suitability of land in study area for future development; a GIS-based process of Land Suitability Analysis (LSA) is carried out with predictive modelling for land transformation using Cellular Automata method. In the study area two major land use/cover trends between 1997 and 2009 can be discerned: (i) Intensification of urbanization in central/core areas where a few remaining open areas and water bodies were occupied and landfilled to accommodate residential developments, and (ii) urban expansion in peri-urban/ suburban areas, where the extension of urban core increased at the cost of agricultural land. Three future scenarios are proposed for year 2025 and 2050: (a) Business-as-usual: wherein the landuse change is simulated as per the trend of past decade .i.e. the factors and constraints work the same way as they have been observed to do during transformation analysis, (b) Conservation (Constraints): wherein certain developmental constraints are put marking some landuse categories like natural vegetation etc. as non-convertible to aid conservation, and (c) Conservation (Strict control): wherein strict control constraints are put on all recoverable landuse categories as non-convertible to aid conservation.

### **Pragmatic alternatives to reduce future demand for land to 2050 – A global quantitative approach**

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Continuing population and consumption growth will underpin the increase of global land demand for another 40 years at least (FAO, 2008). Growing competition for land to provide food, fiber, fuel, wood and shelter (Foley et al., 2005; Smith et al., 2010), in addition to the overexploitation of environment, will urge the requirement to reduce the impact on scarce land resources. Furthermore, on the account of pivotal ecosystem services terrestrial environments provide (MEA, 2005; IAASTD, 2008), there is a need to spare land for nature (Ewers et al., 2009; Edwards et al, 2010). Although other studies (Godfray et al., 2010; Wirseniuss et al., in press) discuss solutions to diminish future demand for land, to our knowledge, there is no comprehensive global synthesis on exhaustive alternatives across different research areas (e.g. sustainable intensification, food wastage, recuperation of degraded areas) and organization levels (e.g. household, institutional) in a quantitative way.

In this study, we compiled most recent published literature on land use and we identified actions that could be implemented with existing technology, which would reduce the future demand for land. We subsequently developed a systematic quantitative approach in order to convert distinct actions into a comparable unit (hectare) of land that can be spared from a particular initiative to year 2050. We adopted a Business-As-Usual (BAU) scenario (FAO projections, IPCC scenarios) to obtain future land demand to 2050. This year was adopted as a benchmark given that the future demand for commodities is predicted to stabilize after 2050 (FAO, 2008). Target scenarios were then derived, and the difference between the baseline target scenario and the BAU constituted the land needed to be spared. Both BAU and target scenarios are trajectories over time. We then reviewed quantitative information on each land sparing action and we calculated realistic targets for each action. Information that was available in different units (e.g. percentage increases in productivity; tonne of food waste reduced) was converted into the base unit of analysis (hectares of land) in a consistent way. The consistency and spatial overlap of activities were checked and peer-reviewed to avoid double-counting. Feasibility of practical implementation of the actions, being subject to socio-economic factors, was controlled throughout the study by continuous interaction with relevant stakeholders in the field (key informants) to provide realistic and pragmatic solutions.

Our preliminary results suggest that with existing technology it is possible to provide commodities for growing world's population without further conversion of additional land. We also found that not all options out of a portfolio of all possible actions are needed to be implemented to diminish demand for land to 2050. For example, increase in crop productivity (e.g. better cropland management), improved pasture management (e.g. cattle rotation) and multiple uses of land (e.g. silvipastoral) account for most significant land sparing potential. Among other scientific and practical applications, the results of this study primarily serve as an insight into land use trade-offs and a transparent portfolio of possible practical land-sparing solutions for different stakeholders, such as governments, local authorities and land planning institutions.

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## **Development of a participatory regional sustainability index using principal components analysis and Monte Carlo simulation: application to regional spatial plans**

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The role of spatial planning for sustainable development has been widely recognized. Monitoring spatial plans increases knowledge of whether they achieved their goals in guaranteeing sustainable development on a territorial level. However it is rather difficult due to insufficient methodologies, deficiencies in plans' contents and resource limitations (Mascarenhas et al., submitted). Indicators are suited for this task and could play an important role in determining the applicability or effectiveness of plans. Indicator selection is usually done by experts and/or through participatory approaches and often little is known about the robustness of the selection stage, its utility, accuracy, validity and feasibility (Bockstaller and Girardin, 2003; Cloquell-Ballester et al., 2006). Therefore, the contribution of indicator sets for effective strategic regional sustainability monitoring needs to be supported by an analysis of consistency and meaning at each stage of indicator development, from design to implementation. On the other hand, aggregating indicators to build sustainability indices is considered useful to facilitate communication with decision makers and general public (Mayer, 2008). However, several drawbacks related with building sustainability indices have been pointed out, which threaten the usefulness of the indices (Bohringer and Jochem, 2007, Mayer, 2008). These drawbacks might be associated with the weighting of indicator data or the aggregation methods. The main goal of this research is to evaluate, through a participatory approach, an indicator set for strategic monitoring of regional spatial plans, in order to obtain a subset of the most relevant indicators and propose a Regional Sustainability Index (RSI). Principal Components Analysis (PCA) followed by sensitivity analysis with Monte Carlo simulation (MCS) provides an effective way of determining a subset of the most relevant indicators, according to the engaged stakeholders. The RSI is based on indicators which are weighted according to several indicator selection criteria. The weight of each criterion for indicator selection results from scores attributed by stakeholders. This index has the following properties: i) its value is bounded by minimum and maximum values, being the maximum the strategic objective; ii) being RSI a random variable, several statistics may be calculated, making the interpretation of its temporal evolution more complete; iii) the uncertainty underlying the calculations is known. This approach is tested on a set of outcomes/effects indicators developed for the Algarve's regional spatial plan (southern Portugal). For that, a group of selected stakeholders was asked to score a set of previously defined indicator selection criteria and then use the criteria to score each indicator. Stakeholder mapping took into consideration the following: i) practitioners directly involved in the design and implementation of the regional spatial plan; ii) members of the accompanying commission for implementation of the regional spatial plan (including decision makers, practitioners and academics); iii) academics involved in strategic environmental assessment follow-up of regional spatial plans. The scores given by stakeholders were then used to construct a factorial space with PCA, from where a subset of indicators is extracted such that the sum of distances between the indicators is maximized. This subset of indicators is then used for calculating the RSI by MCS, using the scores as weights (normalized by the value of the strategic objective set for each indicator). The indicator values were obtained from a database of the regional sustainability indicator system (SIDS Algarve), described by Coelho et al. (2010). The resulting sensitivity analysis helps to further reduce the dimension of the initial set of indicators to only those that contribute most to the RSI. However expected difficulties in the application of this approach include poor stakeholder participation and absence of strategic objectives to normalize some indicators. However, its application could

be useful to collect and aggregate regional sustainability data, contributing to the reporting and ex post assessment of spatial plans, tailored to each particular territorial reality and stakeholders' perceptions, values, needs and concerns. For a successful use of such an index, it is fundamental to maintain transparency of the whole index building process, especially of the weighting factors, as attributed by stakeholders, of normalization procedure and of data quality.

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## **Enhanced Land Use Planning for the Agriculture Sector: Opportunities, Constraints and Options Moving Forward**

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Agriculture plays a major role in the global economy, in particular in developing countries, and is crucial to ensuring societal benefits like food security, energy security and economic growth. Recent global assessments have indicated that agriculture is one of the most important drivers of environmental pressures. It is increasingly a major consumer of resources such as minerals (fertiliser), biomass (through feed), land, water and energy. It also drives key environmental pressures, such as land use change, land degradation, habitat change, greenhouse gas (GHG) emissions, nutrient discharge and toxic emissions which lead to end point environmental impacts, such as climate change and biodiversity loss [1]. Trends indicate an expansion of agricultural land, and dietary changes that favour animal based products, which are connected with more intensive environmental pressures in total and per calorie.

This paper uses an extended version of the Driving forces, Pressures, States, Impacts and Responses (DPSIR) framework, which has been used by the United Nations Environment Programme (UNEP) and the European Environment Agency (EEA), to describe the interactions between society and the environment, to characterise the causal chain between agricultural activities and environmental pressures in two case studies in Indonesia and India. The extended DPSIR model offers a systems analysis view where social and economic developments on the one hand deliver societal benefits, but on the other hand, also exert pressure on the environment and increase the risk of environmental impacts. This causes impacts on human health, ecosystems and materials that may elicit a social response that feeds back on the driving forces, on the pressures or on the state or impacts directly through adaptation or curative action [2]. The framework describes a dynamic situation, with attention to the various feedbacks in the system. It serves as an effective means to organize information for policy makers.

In Indonesia, for example, fire is used extensively in the forest clearing process and as a management tool in agricultural areas as it provides fertility to soils and offers a low cost means to clear land for cultivation. This practice has serious impacts on public health, livelihoods, and conservation efforts, notably on the islands of Sumatra and Borneo, which are known for their peat deposits. It is estimated that these peatlands may contain 70 petagrams of carbon (Pg C) [3] and that the total carbon emissions from Indonesian fires in 1997 were between 0.8 and 2.6 Pg C, equivalent to up to ~40 percent of global fossil fuel emissions during that time [4].

India's Green Revolution introduced higher yielding varieties of crops, fertilizer and irrigation, which has successfully increased yields and buffered the effects of climate variability on the nation's food production. Agriculture intensification has transformed the state of Punjab and its surrounding neighbours into high contributors to the national food grain storage. However, intensive irrigation practices in this region have produced one of the largest groundwater mining operations on earth. Farmers that once pumped water from 5 to 10 feet (ft) below the surface are now drilling wells down to depths of 200-300 ft. It is estimated that the average annual energy dedicated to groundwater pumping in this region is ~40 percent of the total energy produced. In addition to the social issues caused by the declining water table, the energy used for irrigation represents a significant source of greenhouse gas emissions.

The case studies will evaluate both local and national settings and examine the driving forces, characterize the pressures, and evaluate impacts and benefits for current agricultural development practices. The authors will present options to enhance resource efficiency and alternative land management practices in the agricultural sector and present preliminary

evidence on how these options can maximize the benefits and minimize the costs associated with agriculture production. It concludes with a summary of key findings, which can be used by UNEP and other stakeholders in advancing coherent land use planning policies.

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## **Spatial planning, energy and sustainable development: How are they linked?**

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In many areas of society, developments resulting in an increasing energy use can be observed. Planning decisions, transport patterns and extensive domestic energy use are just a few areas where developments in the past were leading to a massive increase in the use of exhaustible energy resources. Environmentally favorable decisions were more the exception than the rule and some development paths with detrimental environmental effects were originally not even seen as environmentally relevant.

The influence of energy use on the environment is nowadays a well discussed topic whereas the underlying spatial dimension of energy use is a rather underdeveloped issue. Energy and land use have a mutual relationship (Walker, 1995): on the one hand, the production and utilization of energy has impacts on land use and on the other hand, the use of land determines energy consumption. The increasing demand for renewable energy sources gives an even stronger importance on the intertwined relationship and it prompts a multidimensional discourse including economic, organizational and social concerns.

Land needs and availability are the main constraint on various renewable energy resources not to use them endlessly. This means that the remedy of renewable energy sources cannot be regarded as sufficient to overcome the problems of an increasing energy demand. Moreover, using renewable energy does not necessarily mean producing energy in the most sustainable way possible. For example, the erosion of land by planting monocultures of trees for energy purposes (biofuels, biomass for heating) or the construction of large hydro power plants is attended by losses of biodiversity and by losses of living space for fauna and flora which is therefore not in line with the ecosystem.

Increasing energy demand runs also the risk of rising conflicts about the use of available land. This addresses the competition between different energy sources, land use for food or energy crops, siting decisions for power plants and agricultural versus living use. The scarcity of useable areas makes a pressure on a growing economy asking for more energy. The maintenance of energy use on a stable or even lower level may also act as a contribution to stabilize the economic circle on a lower level than today. Driven by natural limits of energy sources less energy use can be seen as a basic argument towards economical structures depending on less energy supply.

Spatial planning decisions, hence, provide the possibility to contribute to a more sustainable use of available energy sources. The organization and management of land has a special influence on the distribution of energy supply and demand because this is the level on which the decisions about who is able to use land for what purposes are made and implemented. Therefore, it is unavoidable to consider the impact of spatial planning authorities within regional governance structures aiming sustainability.

Within the project E-Trans 2050 it is explored what are the crucial aspects in regard to scarcity of land and their impacts on sustainable development. The influence and the possibilities of spatial planning decisions on energy supply and demand are investigated and the regional dimension of a sustainable energy system is also addressed.

The underlying method is manifold: Based on an extensive literature research and expert interviews the main arguments of the carrying capacity of a sustainable energy use are found. In a next step, a backcasting approach was chosen to investigate issues related to the spatial organization of the energy system. A backcasting process can be understood as a particular form of scenario process with an explicitly normative angle. In a participatory backcasting approach experts from the fields of spatial planning and energy and also planning authorities developed their conception of a transition to

less energy use. The results show the wide range of opportunities in changing the current basis into a sustainable system of energy and spatial planning.

Firstly, spatial planning decisions have the potential to influence energy use and demand by making use of the regional availability of renewable energy sources. The pressure of scarcity of resources makes it possible in the long run to implement a more sustainable energy system. The involvement of planning authorities, policy makers and citizens is needed to achieve an acceptance of a necessary decrease of energy demand and using non exhaustible energy sources according to the specific regional conditions. Conflicts in the use land are a challenge to be addressed in expanding renewable energy resources. A comprehensive compilation of the long term availability of energy resources is needed to be able to provide information for decision makers (Austrian Conference on Spatial Planning, 2009). The production and use of heat should be close which means that power plants should be sited where the necessary resources are available and near to the consumers to avoid long distances. It is necessary to distinguish between the energy production for heat or electricity and to consider it in the long term energy plans. The individuality of every region should be stressed on the one hand and on the other model energy regions can act as examples and should stimulate other energy regions.

Secondly, spatial planning on a regional level involves also authorities deciding about specific site utilizations which include decisions about the location of settlements and industries, and its related infrastructures. Structure of settlements is a determining factor of energy demand depending on the existing infrastructure especially for transport, regarding the type of occupancies and its specific conditions. Settlement structures with a more functional infrastructure providing shops, medical care, working places and educational institutions within walking distance lead to a less energy intensive life style. Multifunctional settlement structures concern settlement consisting of single occupancies, settlements within existing small-town structures and regional centers. Settlements of single occupancies could improve in using community gardens and their related facilities and in the organization of community work (child care, carpool, gardening etc.). The additional strengths of regional centers can be found in a suitable mix of branches, multifaceted employment possibilities and various educational and recreational facilities.

Thirdly, sustainable development can also achieved through a change in mobility behavior which means a strong reliance on public transport. Depending on the infrastructure of public transport there still exist challenges like first and last mile problem. Infrastructure of transport creates its demand. Therefore, it is necessary to combine all means of possible transport and to involve spatial planning decision-makers to secure mobility without a growing individualized transport based on fossil fuels. By strengthening regional centers they also could serve as nodes of public transport combined with a reasonable and flexible price policy and park and ride solutions. Further improvements of mobility structures include e-mobility and information technologies.

Combining the knowledge of extensive energy use with available energy resources in spatial planning decisions is a main challenge towards a long term sustainable development.

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## **Path-dependency, planning regime for sustainable development in Asian cities: A comparison of Singapore and China**

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Sustainable development in Asian cities is critical within their own territories and at the global level, as Asian cities are facing a sooner, faster, and more simultaneous environmental deterioration in their instant urbanization process. Meanwhile, Asian cities differ in economic, social and environmental terms. The search for a “singular” sustainable solution may lead us to nowhere.

Using the diagram of “planners’ triangle” which illustrates the relationship among the three fundamental fields of economic, environment, and social sustainability, Campbell argues convincingly that the effectiveness of sustainable planning stems from more sharpened debates around the conflicts. It is an enduring process to manage the changing conflicts at different stage of urbanization; therefore, dynamic and divergent pathways are expected. First of all, the proper scale at which to measure environmental sustainability differs according to respective economic stage of the given city. While a healthy ecosystem within the city is given priority in less developed cities, the responsibility to global

ecosystem has to be taken into account in advanced economies. Secondly, the effectiveness of sustainable strategies, from its regeneration to implementation, rests in the correspondences with the current socio-economic regime.

Based on the two concepts, this paper attempts to develop a framework to evaluate sustainable initiatives in urban planning in Asian cities. The focus of this research is on the relationship between land and economy. Since the advocates of post-modern society that centered on human capital, there appears a hope to see convergence of land and economy, which used to be the major source of conflicts. Restructure of zones based on the philosophy of land efficiency creates a wide range of more flexible opportunity areas to attract diversified knowledge-intensive enterprises. Value of land now is combined with economic growth of a given territory.

Many Asian cities saw a vast expansion of state intervention and particularly the de-regulation and re-regulation of urban development and redevelopment. Zoning plan, smart growth and development control, building codes, ownership, a wide range of other planning regulations was reformed to transform the contested terrain of urban space requested by the neoliberal way of production. The role of planning becomes extremely important for an entrepreneurial state. The work of planning now starts from vision shaping, long-term strategy making, to communicative skills to establish dialogue among and coordinate the cooperation between different actors for a commonly accepted norm, rule and policy, and to design and carry out instruments to ensure the implementation. Innovative ideas arise from a creative appropriation of the traditional institutions that have long been used in planning: zoning, density control, and ownership. In this research, we attempt to build up a planning regime with special attention on four points: 1) the whole process of designing a city master plan, from vision, to strategy, and to instruments; and how the vision is translated to institutional reform; 2) the institutional reform that removes barriers in land intensification and refilling development; 3) the communicative rationale that seeks new (forms of) partnerships, and establish common interests for stakeholders; 4) the impact of institutional reforms or discursive adjustment on the urban space.

Instead of looking for a perfect solution, We aims to explore the enduring negotiations to manage economic-environmental conflicts arising from different stages and thus lead to divergent solutions. The cases of Rizhao sustainable experimental zone in China and Singapore concept plan 2001 are selected to represent developing and developed economies for analyses. By linking empirical initiatives, institutional structures, and respective conflicts, the study aims to provide useful information to planners and policy makers to build up socio-technical regime that facilitates knowledge generation and implementation in sustainable development.

## Posters

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### **Can Urban Planning be An Effective Means to Reduce Transportation Impacts on Environment? An Exploration on the Links between Urban Land Use and Mobility in Bandung Metropolitan Area, Indonesia**

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Some researches have emphasized that travel patterns and their impacts on the environment are strongly related to the land use. In general, especially in cities of developed countries, their conclusion is that along with the increasing urban density travel distances decrease. That is why policies such as compact cities which propose higher density of urban areas and mixed-use development are encouraged.

However, this research discovers that in the case of Bandung Metropolitan Area (BMA), the second largest metropolitan in Indonesia which has more than 7 million inhabitants, the growing population density goes side by side with the increasing travel distances. During the last 10 years, for instance, there is 15% growth of urban mobility for school and shopping purposes with more than 4 km distance travel despite a significant increase in urban density. Thus it raises a question whether such policies as developing compact cities is effective to reduce urban mobility which in turn may lower the impacts on the environment.

This research then tries to investigate why it happens. Why increasing urban population density of BMA is not accompanied by declining travel distances. Here household survey data are used as the basis for analysis, together with additional, complementary data taken from authority datasets. The findings can explain whether such policies need to be followed by other policies in order to reduce the distances of urban travels and their impacts on environment.

## **Precarious Land Use Practices and Institutional Factors Affecting Accessibility Sustainable to Safe Underground Water in Informal Residential Districts in Akure**

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Water is widely recognized as universal solvent and a peculiar class of food playing prominent role in human well being and survival. Its' role in ensuring good health and productivity cannot be de-emphasized. Despite its' abundance covering about ¾ of the earth surface, accessibility to safe water delivery have remained a huge challenge in Nigeria, Sub-Saharan Africa and many third world countries where cholera, water borne diseases and water induced death cases are rife. Although water is a renewable resource whose extinction has been made impossible by its cyclical flow, its' availability and accessibility in qualitative term is a major source of global concern specifically to people in the developing countries. Man's impact on land and the environment impinged negatively on the ecological balance of the ecosystem. The imbalance is more pronounced in developing nations where enforcement of urban planning principles is at the lowest ebb. In Nigeria, land administration is a major challenge with different land tenure systems operating parallel to the statutory tenure system. Although the land use act of 1978 was promulgated to override other customary tenure arrangements and eliminates it concomitant problems by putting in place a formal land market where in developments are subject to land use planning and development control measures. Contrary to one of the cardinal objectives of the Act, families still own land leading to booming informal land market and informal residential districts in many urban centers in Nigeria. Efforts of the Nigerian government to improve access to safe water supply remained largely ineffective. WHO and UNICEF (2010) joint monitoring program revealed that accessibility to safe water delivery in Nigeria Via pipe on premises is low and yearly declining, statistics showed that 32%, 20% and 11% were recorded between 1990, 2000 and 2008 respectively. The implication of this is that most urban dwellers depend on accessibility to improved water via underground source in their premises. In Nigeria, studies revealed that access to improved water supply via piped on premises is 11% confirming that a large number of the Nigerian populace depend on private landlord arrangement via shallow well. The key goals of development which find expression in positive change in; reduction in infant mortality rate, reduction in diseases epidemic, high literacy level through universal primary education, improve maternal health general well being and environmental sustainability, appears elusive in Nigeria and other developing countries owing to paucity safe water delivery and improved sanitation system. Nigerians' vision of becoming one of the largest 20 economies in year 2020 is in abeyance. Recently, cholera epidemic engulfed 14 states with over 700 resultant death cases. It is pertinent to state that most of the cholera cases were recorded in informal residential districts or slum where there were no development control measure to restore sanity. Smout (2010) discovered that basic water hygienic improvement could eliminate 3% to 4% of global region diseases. He stressed that the commonest water and sanitation related diseases (Cholera, arsenicosis, fluosis, guinea worm, intestinal worms, schistosomiasis, typhoid and trachoma can be potentially avoided with the provision of improved water supply and sanitation. Furthermore, people living with HIV/AIDS can more readily avoid opportunistic infections associated with the disease if they have access to improved water supply and sanitation. Therefore this paper examine and analyze harmful land use practices and institutional elements militating against access to sustainable underground water delivery in selected informal residential housing districts in Akure, Ondo state capital. The paper revealed harmful onsite sanitation practices, graves in residential dwellings, institutional factors, poor policy implementation, unhealthy as major factors threatening access to qualitative water supply in the study area. It recommends triple prongs remedial approaches embedded in land allocation via the formal market, vehement land use policy implementation and participatory water project delivery approaches in the study area

### **Land-use Planning and the obesogenic environment: can the problem become part of the solution?**

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There can be no dispute that obesity rates have risen phenomenally over the last 20 years to the current situation of an 'obesity epidemic' on a global scale and no country has managed to reduce the burden of obesity solely by using public health approaches.

Research has demonstrated that the aetiology of obesity is multi-faceted and complex and that although lifestyles and personal choices are a major contributory factor and should not be ignored many other factors also make a contribution to the condition. Research claims that one of these factors is the built environment.

This research aims to understand why health, particularly obesity, is not considered by the UK planning system and why the uptake of using Health Impact Assessments (HIA) and developing Healthy Urban Planning (HUP) processes is slow and virtually unheard of.

This paper argues that it is time to confront the global obesity crisis through the planning system in order to attain sustainable development.

It is widely accepted that health is a fundamental component of attaining sustainable development. The UK Government have produced their vision for a sustainable development strategy in the document 'Securing the Future' which was launched by the Prime Minister in 2005 which embeds sustainable development in policies, practice and operations. This document reaffirms the goal of sustainable development as a global challenge to ensure all peoples of the world secure basic needs to achieve a better quality of life now and for future generations and this strategy builds on the 1999 strategy 'A Better Quality of Life'. The UK Government is committed to promoting the health and wellbeing of the population through sustainable development.

The dramatic rise in obesity rates is a huge financial burden on the UK National Health Service (NHS) as the annual cost of overweight and obese individuals is estimated to be £4.2 billion and is forecast to more than double by 2050 if no action is taken.

Current research demonstrates that the built environment has a negative effect on health and wellbeing. In order to find solutions to the negative effect of the built environment on obesity and, more holistically, health and wellbeing, it is important to reflect on the evolution of the UK planning system and public health. There is an historical link between health and planning and the origins of town and country planning in the UK can be traced back to the early health acts of the 19th century. However it is also clear that the link which has steadily weakened throughout the 20th century needs to be re-established in order to address the obesity crisis today.

The primary function of the UK planning system is to protect the environment from inappropriate development and to regulate land-use for the benefit of all people and communities. Research suggests that through the advancement of obesogenic environments the UK planning system consistently fails to achieve this goal.

To understand how health is currently assessed in development and land-use proposals a survey was undertaken to determine the use of Health Impact Assessments (HIAs) by the local planning authorities (LPA) in England which was then followed by the use of 2 UK cities as case studies to evaluate the World Health Organisation's (WHO) Healthy Cities approach to land-use planning. The concept of the Healthy City approach was inspired by the WHO European Health for All Strategy and the Health 21 targets. The approach seeks to put health high on the political and social agenda of cities and to build a strong movement for public health at the local level.

The survey data requested was the number of HIAs submitted as a supporting document from 2005 to date; if the HIA was submitted on a voluntary or compulsory basis; the description and reference number of the planning application each HIA applied to; and an electronic copy of each HIA.

The survey was sent to the 354 local planning authorities and the response rate was over 98% and a total of 11 HIAs were declared.

The Healthy City Coordinators and 2 planning policy officers were interviewed as part of this research. They were asked about the use of Health Impact Assessments and how Healthy Urban Planning has been promoted in their cities.

The main outcome of the interviews was the different approaches regarding the use of Health Impact Assessments. The participants all agreed that health needs to be a top consideration and priority in policy development although there was a wide disparity between the participants regarding the use of HIA in the planning process.

The built environment has been shown to be the consequence of development and facilitated the assessment of the connections between obesity and the UK planning system. It is important to recognise the relationship between the built environment and obesity. Tackling and promoting sustainable development are a core component in attaining sustainable communities, a priority of the UK Government, which has at its nucleus the health and wellbeing of people and the population. It is clear that policies to secure sustainable development will have a positive impact on obesity.

The results of this research demonstrate that the historical connection between health and planning, through the early health acts of the 19th century which afforded local authorities the power to clear slums and install sewers to address the health issues created by the industrial and agrarian revolutions, has become detached.



## **A Floodplain Analysis using HEC-RAS and GIS: Implications for Sustainable Urban Development**

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In this research, we use HEC-RAS model integrated with HEC-GeoRAS in GIS for floodplain analysis to delineate flood extents and depths within an urban area of Neka River plain in Iran. A devastating flood event occurred in August 1999 in this area and caused many losses of life and property destructions. The aim of this paper is to present a methodological framework to map flood hazard zones for evaluating spatial urban development options for adapting to extreme storm events and sustainable planning in this urban area. For the determination of flood hazard zones, first, HEC-RAS simulations are performed to generate water surface profiles throughout the system. Floodplain maps include flood extents and depths within the floodplain are reproduced using HEC-GeoRAS by overlaying the terrain model and the corresponding water surface TIN in different return periods. The results of the study indicate that integration of HEC-RAS with HEC-GeoRAS in GIS provides an effective platform for both flood hazard mapping and urban planning purposes. The combination of the river hydraulics simulation model and GIS allows identifying mitigation and managerial measures to be implemented in the context of urban development policies. This paper discusses some lessons learned from devastating flood event in 1999. In addition, the GIS capability in floodplain analysis highlighted, which provides spatial information as guidance for urban development as well as early warning for real time flood events.

## **Terra Nullius and the Backlash against Private Foreign Conservation Investment in South America**

Yogi Hale Hendlin

This paper researches the last 20 years of private conservation investment, predominantly from foreign investors, in South America. It examines the various incentives and disincentives countries provide for conservation rather than extractive investment, focusing on existing hurdles to private conservation investment and how these might be attenuated. Focusing on land purchase histories in Brazil, Argentina, and Chile, these countries cover the vital ecosystems of Patagonia and the Amazon forests, locations that have received conservation investment attention proportionate to the ecosystemic services they provide. This research has immediate and direct implications for Reduced Emissions from Deforestation and Degradation in Developing Countries (REDD) and environmental land conservation efforts in general.

In the case of the environment, the failure of governments as the traditional authorities responsible for managing public goods has launched private initiatives worldwide, mostly uncoordinated, to fortify environmental stewardship. A new wave of private foreign conservation investment has emerged strategically, using private capital to buy up large tracts (often more than a million hectares) of ecologically valuable and biodiverse land. Private land purchases by wealthy individuals, environmental NGOs, corporations, and other private investors of resource rich land or land claimed as territory of indigenous peoples has opened up an assemblage of conundrums. These relate to environmental land use policy through the struggles between native peoples' land rights, the sovereignty of states, and inherited notions of private property that have implicit substantive requirements.

This project's theoretical element examines land use policies and claims during the era of New World colonization during the sixteenth through the eighteenth centuries and identifies the crucial concept of terra nullius (or "empty land") that was used as the legitimating idea behind taking land for the colonizing country from the existing native peoples in the Americas. The doctrine of Terra nullius meant that land not altered sufficiently either by permanent buildings or extensive agriculture – which was often the case for nomadic tribes and many native peoples – signified a legal carte blanche for colonialists to declare American land unoccupied and claim it as their own. Many countries still have incoherent land use policies that trace back to biases against what John Locke called letting land lay "fallow." The concept of landed property indeed is tied up with the idea of developing the land in some way rather than permitting the property to remain wild. Wild, untamed land holdings are often contested as property as such, off-limits to others who wish to extract resources or somehow otherwise use the land. Yet in the "post-Lockean" twenty-first century, it makes no sense to develop and mark every last acre of productive land, even though ownership continues to be the criterion used for conserving strategic (e.g. biodiversity-rich, carbon-sink providing, or old growth) land. Reconciling private ownership of land while allowing the land to remain wild challenges conventional property rights laws and mores, yet is required for effective environmental conservation to proceed in the current international climate.

My analysis concludes that different countries have a wide range of incentives and disincentives for private conservation investment, with some countries preferring de facto or de jure unsustainable development to conservation investment,

even if the price offered for the land is the same. I hypothesize that this is the case for several reasons. First, states can exact rents from extracted materials and thus receive a continued income after the initial purchase or lease. Second, extractive development temporarily creates jobs for local people, making such projects popular politically. Third, a common belief among leaders of developing countries is that their countries should not be required to forego development opportunities that developed countries have already enjoyed, thereby losing-out on the economic benefits of exploiting their natural resources. Fourth, the issues of sovereignty, national pride, and self-determination arise when foreign entities, state or private, influence national land use policy (which it could be argued, large-scale foreign private conservation investment in effect does).

In order to reorient states more favorably to conservation investment, both in taking increased responsibility as state entities and fostering warmer conditions for public-private conservation, the socio-cultural aspect of such types of land use must be addressed.

## **Public Open Spaces: Utility, Sustainability, and Everything In-Between: A Case Study on one Town's Development**

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This paper reveals a case study in the developing town of Yeruham, located in the southern Negev desert region of Israel. A purpose of this paper is to defend the argument that a demand for more public open space- an Israeli and global architectural trend- does not necessarily make a development more ecologically sustainable, but can be rather useless and wasteful depending on the population of space dwellers. This has been done using a methodology consisting of interviews with community leaders who have dwelled in Yeruham for at least a decade, as well as several casual park observations to accompany the information from interviews. Throughout the course of research, the aim was to better understand the answer to the following question: *Do the community members of Yeruham value and utilize their public open spaces?*

Foremost, it is important to present an overview of the demographics of the town of Yeruham.[1] 70% of the residents were of Moroccan origin and immigrated to Israel in the late 50's and early 60's. About 20% of the Yeruham population was of Indian origin, primarily consisting of immigrants who arrived there during the 60's and 70's. The remaining 10% were Persian immigrants, Anglo-Saxons, and Ashkenazi Israeli's who relocated to Yeruham. (Shinar, 1980)

Now let us discuss the issue at hand: there are minimum standards around the world to mark the framework for the amount of open space allocated to a given population in a built environment. In Israel specifically there are environmental activists, NGO's, and the Ministry of the Environment who campaign for more public open space per square meter to be implemented in the planning and development of cities and towns. Yet, the experience in many Israeli cities is plenty of open space that is unused and uncared for. (Rofe, 2007) If the public open spaces are not desired by the community, and the community members feel no personal relationship to these places, then the neglect of that space will counter the purpose of the initial goals to increase the amount of open space.

There are many different public open spaces in Yeruham, the majority of which are either not used at all or used with a different intention than that which the designers had in mind. The town is littered with examples to prove that most of the designs of the built environment demonstrate wasteful use of space. Based on observation coupled with the ideas contributed by all three interviewees, it can be stated that the large centrally located park: (1) has a high volume of users, (2) is «properly»[2] used and (3) is well maintained; while the rest of the public open spaces, namely parks, within the perimeters of Yeruham demonstrate neglect from various angles. The reasoning behind this conclusion may be double sided. First, it could be in agreement with the general conclusion about human behavior, "What attracts people most, it would appear, is other people[3]" (PPS 2007); or it could very well be that the majority of the population does not prefer and/or is unfamiliar with «park culture». I would hypothesize that it's a combination of the two, and that both are a result of lack of consultation by planners with the community members. Consequently, it can be inferred that there is at least a minor depletion of water as a result of (unnecessary) hydration of the neglected green-spaces.

A reoccurring example of an unsuccessful public space design in Yeruham is that of the «Sheked» neighborhood. Four upper class community members[4] brought up the subject of this neighborhood during their interviews. The Sheked neighborhood is designed in such a way where the houses are arranged facing each other forming a half circle around a communal center area. The homes are closed in and away from the streets, where the children can play without the disruption of vehicles entering, and neighbors can share a common space outdoors. Originally these clusters were predominantly soft, permeable surfaces with greenery. Today most of these areas have been paved over with concrete per the request of the Moroccan population who believe that the trees and greenery are dirty and/or messy. Personally, as an American Ashkenazi, I believe that it's a brilliant concept. It's hard to understand why anyone would think otherwise, because it is difficult to step outside of oneself for the sake of understanding another's cultural and

traditional upbringing. It is in fact just as a great a concept as I believe it to be, assuming that the population of the space where the plans are executed is of the same general mindset as myself. Again, in Yeruham this was not the case. From the facts I've gathered, it is suggested that the cultural upbringing of the planner(s) is not the same as that of the majority of the population of Yeruham. The concept and execution of the Sheked neighborhoods did increase the amount of public spaces. However, people didn't use the spaces for their intended purpose. They didn't appreciate the shade nor prefer the positive effects of a microclimate (which could be particularly significant in the heat of a desert landscape). Concluding the topic, one interview subject states "it's a [deep] cultural thing". Of the Moroccans: while they'll meticulously sponge the floors in their home twice a week, they don't seem to attend to anything immediately outside of their home. "There are two ways to look at private domain: it's nobody's or it's everybody's"[5]. When asked whether environmental education would be effective, the subjects agree that education will not change anything. They explained that such disagreements have potential to change but it is something that will take generations.

It is clear that there has been frustration and animosity building up due to the cultural differences. Yet, let's consider the demographics and timeline of Yeruham again: the Moroccans are those who make up the majority of the population, and the Moroccans were the initial group of immigrants to populate Yeruham. So if pavement is what they prefer, there's nothing wrong with it. What is wrong is when the developers design plans according to their own beliefs without consent from the majority that is Moroccan. Among the results of such practices include: wasted space development, wasted natural resources, wasted work effort, a frustrated group of upper class community members, cultural conflict, increased segregation, and the conundrum of dependence on outsiders as developers.

I hypothesize that it is in fact true that most of the physical development was executed without enough collaboration. As I've mentioned, this is a problem for reasons beyond the sociological. While Yeruham may be an extreme case and has plenty of demographic outlying factors, it can still be considered a relevant example portraying several common trends of other towns and cities. Developers, in order to achieve the utmost sustainability, ought to take into consideration the values and interests of the majority of community dwellers.[6] Furthermore, advocacy for more green-spaces does not always necessarily amount to environmental stewardship.

- [1] Note that the facts from here forth regarding demographics is based on the development plans that were produced in the 1980's, and therefore the information will be spoken of in the past tense.
- [2] "Properly": the provided equipment and design is used by the public as intended, rather than for other purposes; ex: picnic tables used for sitting and eating at picnics rather than a fort made by children looking for adventure after school hours.
- [3] Quote taken from website for Project for Public Spaces; said by White (19)
- [4] A language barrier limited my ability to interview a mixed group from the community, therefore presenting a potential bias. Interviews were conducted with English speaking, upper class, Ashkenazi and Anglo-saxon community members.
- [5] Statement made by one interview subject.
- [6] It can be argued that this is not the responsibility of developers. The fact is however, that often times their intentions are unethical, taking into consideration a future population of elite individuals rather than the existing majority.

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## **Green Urbanism and Cultural Landscapes Revitalization - an experience carried out on a riverside area in the Centre Region of Portugal**

Afonso Nuno Martins

This communication focuses on the new territorial green culture perceived as a mixed one i.e. permeable to rural and urban ideas and practices. This new culture is expressed by changing landscapes and these are shaped by a new economy of resources.

The experience of the re-evaluation of cultural landscapes underlines a renewed physical dimension of the territory based on a sustainable management of resources - energy, water, land, and building materials.

In times of crisis of the city identity, the urban form is called again; this time to respond the challenge of consolidation of the fragmented city. This has to be done by means of interpreting urban landscapes transformation and by using responsive urban design. Apparently, we are facing a favorable moment because the sustainable discussion has matured and it's not exaggerated to state that green cities are definitely in vogue.

While cities, no matter their size, turned to green politics and to Eco-solutions, imposing suspicious Eco-quality-standards, the cultural, old living landscape (which has been transformed in balance with nature by man for ages) has become, suddenly, according to the new standards, underdeveloped in terms of sustainability. It is urgent to clarify this misunderstanding by repositioning landscape on urban studies and particularly on both regional and urban planning. Landscapes culture is alive and its role on the green Urbanism debate is one of the goals of this research.

Observing continuity and interaction in city-country relationship, beyond the dominant optic that emphasizes the antagonisms, the cultural landscape concept has historically refused the urban-rural dichotomy, connecting urban and natural process.

Following the original United States of America experience of revitalizing heritage areas, in Europe, over the past few decades, there has been an increase in initiatives to rehabilitate so-called cultural landscapes by using new territorial sustainable both projects and managements instruments.

Focusing on several themes, according to the characteristics of place (industrial, agrarian, rivers, military landscapes,...) heritage parks have been recognized as an appropriated concept to understand multifunctional landscapes and to aggregate local resources and services.

As an argument for the discussion we take the Portuguese project of the Mondego River Heritage Park (MRHP). Focused on heritage local resources the MRHP tries to rescue memories and identities by revitalizing tradition and it is physically structured by a system of cultural, pedagogical and touristic routes. The land and routes design of the MRHP is based on Kevin Lynch's space interpretation syntax and follow a green approach, using concepts such as continuity, cycle of life and sweet mobility (walking, cycling, boats, horseback,...). MRHP also introduces: a strong use of technology to park management and visitor's interface (a special communication system to dynamically guide visitors through calculated routes while providing them with useful information), a model of rural tourism accommodation provided by the stakeholders adapted from the Italian Albergo Diffuso, and an Ecomuseum which presents a diffuse form of a spread, but constituting also an articulated set of territorial nodes along the Mondego River.

Proposing the comeback of historical labour activities, MRHP joins environmental practices, leisure and tourism, in order to conserve the character of the cultural landscape and to bring back ecological status to both riverside area and city scenery.

The research which led to MRHP project took as working hypothesis the following points: heritage as a project axis to achieve sustainable development; productive identity as central idea to synthesize landscapes transformations; Heritage Park as an instrument for a regional development based on endogenous resources; the role of intelligent systems in both heritage routes design and landscape management.

One of the most important output research is the construction of a new map of the hole riverside area; a dynamic map structured by several heritage routes designed according to green principles; a map that comes out as a result of historical narrative reinterpretation. This map is supposed to inform urban and regional planning establishing a new level of interaction and giving consistence to different scales of land use planning.

Conclusions highlight new possibilities of definition, understanding, appropriation and use - perhaps more attractive, dynamic, flexible, and sustainable - of the territory.

Cultural landscapes revival and heritage park's implementations teach us several lessons on how to approach green Urbanism practice. One of them is the importance to achieve a balance between cultural and natural matters. Both green plans and projects go further in terms of sustainability if they incorporate a dual dimension, human and nature. The interpretation of urban landscapes transformations seem to play a key role in green methodology and certainly can be used as a modus operandi for projects and plans.

The ongoing process of landscapes revitalization, confirms that the more green Urbanism reflect simultaneously both natural-environmental and cultural concerns the more it will be assumed by society; and, therefore, the more it will prevail in the future.

## **Application of Landslide Susceptibility Zonation in Rural Planning Decision-Making through Multiple Linear Regression Model; the Case Study of Narmab Basin (Iran)**

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Landslide is a form of slope process which points to the transmission and downward movement of materials, such as soil and rock mass. *Narmab* basin is situated in the southern part of Minūdasht Township in Golestan province. Every year landslide takes a heavy death-toll and damage to property. For instance, *Nishak*, *Saran* and *Takht* villages which are situated in *Narmab* basin are destroyed completely or they face to the risk of landslide. Therefore, in order to have sustainable future, landslide susceptibility mapping is become one of the most important concerns of rural planners and decision makers in Iran.

Till the present day, various methods have been introduced to Landslide Susceptibility Zonation (LSZ), each of which considers a number of parameters such as slope, aspect, lithology, landcover, rainfall, distance to fault, distance to river, and distance to road have been used in this study for modeling and zonation. Ilwis, Arc View, Statistical Package of Social Sciences, and Excel softwares have been used for zonation, and statistical analyses respectively. In this study, layers are evaluated with the help of stability studies used to produce landslide susceptibility map by Multiple Linear Regression Model. Finally, an overlay analysis is carried out by evaluating the layers obtained according to their weight. The study area has been classified into five classes of relative landslide susceptibility, namely, Very Low, Low, Moderate, High, and Very High susceptible classes respectively. Furthermore, the landslide susceptibility map and the landslide inventory map were compared to determine whether the models produced are compatible with the real situation resulting in compatibility rate of 60.96 percent.

According to the results after overlay of main factors in rural planning, we achieved to probability losses in High and Very high classes of LSZ maps: Agriculture area (63.79 %), Forest resource (10.73 %), Rural Roads (62.76 %), Dwellings (71.93 %) and Population (70.90 %). This is to conclude that according to the results the most susceptible zone which should be considered by decision makers and rural planners is dwellings zone.

## **Sustainable Industrial Areas in the Mediterranean: building the MEID model**

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Well planned and equipped Industrial Areas (IAs) stimulate the relocation of industries and help to relieve congestion and pollution in metropolitan areas. The successful development of a region depends fundamentally on the region's capacity to support and sustain the competitiveness of its local firms by creating a rich milieu of synergies. The present work is the result of a project financed by the European Commission which involves different actors from six countries of the Mediterranean region.

Thanks to a multidisciplinary approach, Mediterranean Eco-Industrial Development (MEID) model will reach the debate on sustainable development providing innovative figures and a decision-making model to plan, build and govern a more competitive and less expensive Sustainable Industrial Area (SIA) in the Mediterranean region. The common aim is to reduce environmental impacts in the wider optic to sustain Small and Medium Enterprises (SMEs) competitiveness. The enhancement of transnational cooperation is the mean for reaching a unified standard of principles to ensure sustainability in IAs, introducing clean technologies and necessary tools to implement the proposed innovative solutions. Decision tools will be developed for Competent Authorities in order to integrate environmental friendly solutions into Development Strategies for Industrial and Productive Policy. Thanks to this "green approach", SMEs will be the final beneficiaries, fostered to eco-innovation, competitiveness and transnational cooperation.

To concretely reach these objectives, the project has been planned in order to correspond to a coherent solution following the results of the SWOT analysis of several target IAs. Firstly, it has been fulfilled a state-of-the art analysis of the Best Available Technology (BAT) within IAs; technologies, practices of management, estate planning methods currently used in IA sto reduce environmental impact. All the information is analyzed and after that, a SWOT analysis

protocol divided in five sections is produced; Legislation, Rules for industrial areas planning, Environmental management of industrial areas, Infrastructure and centralized services, Environmental and architectural quality of the buildings. The protocol has a transnational approach to grant a common and replicable methodology. Action's aim is to analyse possible risks and difficulties in the implementation of environmental solutions for the maximization of the IAs performance. Thanks to the results of SWOT analysis it is possible to define the most relevant aspects aiming at sustainability of IAs in the Mediterranean area. Consequently, the following actions are foreseen; definition of the MEID model, sustainable construction rules and detailed recommendations for applicants. Furthermore, integrating, improving and jointly adapting the existing results on sustainable IAs, the achieved MEID model is assessed and tested in pilot areas. At the same time, SMEs of traditional construction sector are introduced to Life Cycle Thinking approach, to assess their environmental impact and improve their capacities to grow into the economic and industrial field. SMEs located in the involved areas take advantage of planned sustainable services and common facilities. Moreover, cooperating at international level SMEs become more and more competitive.

The setting-up of a permanent trans-national network helps to develop and strengthen coordinated initiatives of territorial cooperation; on the other hand, involving all public and private actors related to the planning, building and management of SIAs allows the participation in the model definition phase of all related stakeholders. This can be reached by identifying innovative methods, tools and technologies currently available at local, European and international level based on a green approach for reducing environmental impact and supporting the development and use of clean technologies in the industrial areas of Mediterranean countries. The definition of the exact processes for the implementation of SIAs, including a clear matrix of responsibilities-tasks and better roles-skills-competences favours the effective implementation and performance of a SIA. The model introduces or encourages the continuous improvement of environmental performances of the industrial areas located in the Mediterranean in the following fields: integrating production and dismissal of solid waste, energy saving and use of renewable energies, reducing water consumption, better viability and avoid the deposit of dangerous material. MEID model defines common environmental standards and creates tools for assessment.

The main technical solutions developed can be summarized in the following points: innovative "scale economies" concept; a suitable and transnational IAs model; an integrated database with all new technologies and applicable BAT (Best Available Technology).

The MEID model can improve SMEs innovation in energy, sustainable building and environment protection with the production of specified guidelines and by boosting suitable sinergie. Collaboration and eventual agreement of local authorities on the subject, have the aim to reach a joint sustainable industrial strategy in the Mediterranean area. Enhancing the collaborative atmosphere and effective relations among local authorities, citizens and enterprises can create favourable conditions for raising growth, employment and environmental protection.

# Free trade, globalization, development, and consumption

Anastasia O'Rourke & Walter Vermeulen

## Oral Presentations

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### Mainstreaming environmental enterprises – a strategic longitudinal analysis

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The transition towards a sustainable society will require not only the transformation of existing organisational models but also the creation of enterprises that are 'born' considering a holistic balance of environmental, social and economic concerns. The concept of sustainable entrepreneurship as a way to promote this transition is gaining increasing attention (Hall et al., 2010; Ivanko, 2008; Schaper, 1995), with social and environmental enterprises considered key to the development of a more sustainable society (Creech and Pass, 2008; Pastakia, 1998). However, little longitudinal analysis exists that considers the evolution of environmental enterprises, especially of those that have ridden the wave of increasing societal awareness of environmental and social issues apparent within public discourse over the last two decades (Barkemeyer et al., 2009).

The early 1990s saw the emergence of the concept of ecopreneurial businesses and the business creation opportunities that might exist associated with this increased awareness of social and environmental issues by consumers. Many of the best practice examples of the time were profiled by Bennett (1991) and Berle (1991). This paper builds on from previous analysis of a sample of such environmental enterprises (Holt, in press; Holt, 2010) to consider the enterprises that are still operating in some form twenty years later, or those that were acquired as branded product(s).

The purpose of the paper is to examine in detail the 223 enterprises identified in the 1991 sample of environmental enterprises, in particular the 87 that are still trading and the 27 that were sold or acquired over this period. The business conditions faced by this group of mature environmental enterprises and their founders or owner/managers may have fluctuated over this time period but there has also been a clear mainstreaming of environmental and social issues within society during this time (Barkemeyer et al., 2009). In the 1990's these businesses were considered to be innovative and at the cutting edge of potential business creation opportunities but as these issues have mainstreamed has this influenced the strategic direction of these businesses and their survival? This paper considers this research question by considering the 114 companies that have survived, or were acquired by other businesses.

The initial sample was identified using content scanning of the first two publications of 'good practice' ecopreneurial examples from 1991 (Bennett, 1991; Berle, 1991). Each business was tracked using news media and online coverage to establish their business history and current status (see Holt, in press). In the second stage of the data collection semi-structured interviews were undertaken with a sample of the original founders to discuss their personal recollections of the business history of their enterprise, and also to explore their personal motivations and values. The interviews should be considered exploratory at this stage given the small sample size. However a number of interesting themes emerge from exploration of the data.

The first emerging theme is the acquisition of these small innovative enterprises by larger traditional businesses to extend their geographical and or/product ranges, with some of the 1991 firms now existing as branded product ranges. This is typically associated with the so-called 'green' products in the food and garden/home sectors. The second finding that emerges is the strategic shifts that appear to have emerged in the product and service offerings in these environmental enterprises in response to mainstreaming of environmental issues in society. The findings are mapped against a series of strategic models including Blue Ocean Strategy (Kim and Mauborgne, 2005) and Ansoff product/market growth matrix (Ansoff, 1988).

This paper is an important contribution to the knowledge base on sustainable entrepreneurship. It presents one of the first longitudinal assessments of how enterprises born out of an environmental and, to some extent, social agenda have survived and thrived over a twenty-year period. It offers insights into how the nascent 'greener' businesses that the

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## The use of buying power and government credit to promote sustainable practices

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Trade has had an important role in human history, shaping development in the historical process of globalization. As markets became solid structures and pillars of many societies, above all western, they create rules and interfere in the daily life of communities. Link small villages to large urban conglomerates and governments of various countries in economic transactions of all kinds. Market and information make the cities more connected and more dependent, forging a complex dynamic. At the same time, environmental problems take on global proportions and reveal their beyond borders characteristics, especially through the phenomenon of climate change that has no physical barriers between countries, affecting everyone.

Solutions for environmental problems, in times of globalization, require mechanisms adjusted to our times - instruments of the market and information tools. Both have adequate instruments to be used in order to promote sustainability. Considering social structures, it is necessary to associate state regulation with encouragements to the market. The role of information in this case is to establish and disseminate scientific and theoretical basis, share guidelines to good environmental practices, traceability to the environmental supply chain, create a consumers environmentally conscious, and sensitize communities for responsible relationship with the environment. Thus, the market shapes itself to the new requirements, and has been shaping the tastes of consumers, throughout the centuries.

Buying power has been a relevant tool to obtain effective results in terms of sustainability. It applies directly to individuals as consumers and to governments alike, being the last ones consumers who purchase robust goods through public bidding.

Initiatives linking ethical constraints and encouraging good practices have taken specific contours: (a) by the lenders, mainly banks, through the so-called «Green Protocol» for granting credit, (b) by the governments, through the «green procurement», also known as «sustainable procurement» (c) by the conscious consumer, choosing to buy products that fits the initiatives of «green labeling», «eco-design», «environmental certification». In all these cases, what lies behind is the buying power or the credit of those involved. Buying power is being used in favor of environmental compliance products and processes and it has been shaped by concepts of environmental ethics. Regulation through laws alone have not shown results as those that can be glimpsed through good practices and incentives.

One of the notorious cases of using buying power applied to an environmental issue refers to the soybean moratorium in Brazil. Under pressure of Non Governmental Organizations, the two Brazilian associations responsible for the largest volume of exports of soybeans signed an agreement in which they undertook not to trade soybean from areas of recent deforestation in the Amazon biome. The soybean moratorium is recognized as an example of success in attaining sustainable practices involving the market.



Recently, Brazil took a major step in terms of “green procurement” through the publication of the Normative Instruction n. 01 from the Brazilian Ministry of Planning, Budget and Management, dated January, 2010, which establishes environmental sustainability criteria in procurement of goods, contracting for services or products directly by the federal government agencies and foundations. The importance of this statement relies on the great amount of investments made by the federal government on public buildings and materials: in 2009, the Brazilian government invested more than \$ 11 billion in public works and facilities and more than 3 billion in equipment and permanent material, according to the Brazilian Ministry of Mines and Energy.

The granting of credits by banks is another sector which is starting its environmental commitment through initiatives of the «Green Protocol», which aims to apply environmental criteria on financing trades. One example is again the issue of soybean moratorium. In December 2010 the Bank of Brazil joined the campaign. Resulting of such initiative, one of the major financiers of agriculture in the country will not grant credit for farmers who are planting soybeans in newly deforested areas in Brazilian Amazon. Through this example, one can see that to ensure the effectiveness of actions it is essential to reach the strategic economic sectors and their funding sources.

In the Brazilian context, an important sector is booming due to good economic performance: the construction industry. New enterprises of all sizes are scattered throughout the country favored by the Brazilian growth economic program - Programa de Aceleração do Crescimento (PAC), launched by the federal government. Among the investments there are hydroelectric power plants, affordable housing, road paving and improvements in sanitation system. However, despite the meaningful improvements, Brazilian politicians and technocracy demonstrate lack of understanding of environmental contextualization of the national ventures they lead. The first major steps taken by the government to encourage sustainable practices in construction began to be taken recently. However, while developed countries are advancing in Green Design, Brazil still lags behind in this aspect, especially in the issue of technical standards for materials. In 2003, The National Program for Electricity Conservation - PROCEL, under the Brazilian Ministry of Mines and Energy in conjunction with Eletrobras (publicly traded company controlled by the Brazilian government), launched the program “PROCEL Edifica - Energy Efficiency in Buildings”. This program aims to encourage research and partnerships for the rationalization of energy consumption and for the combat the waste of energy. Recent small scale and isolated initiatives have been done regionally - as for example, the energy company of the state of Minas Gerais (CEMIG) in conjunction with the housing company of Minas Gerais (COHAB-MG) initiated a project to install solar water heaters under the program of low-income housing of the state government. The program, initiated in 2009, hopes to install 5000 solar water heaters per year.

One of the largest financiers of construction in the country, Caixa Econômica Federal, a Brazilian government bank, extends credit to finance the purchase of dwellings of various types, as well as for the construction of houses and commercial buildings. The program «My House, My Life” grants financed low-interest credit for the acquisition of popular property for families with income restrictions. In 2009, more than 47 billion reais (about US\$ 28 billion) were applied on credit to finance construction, which corresponds to 71% of the entire amount of credits available on housing market (John & Prado, 2010). Considering the importance of the bank for the Brazilian construction industry, it is necessary to establish a credit policy that is conducive to sustainable construction practices linked to reduced use of natural resources.

A first major step was taken through the launch of the “Selo Casa Azul CAIXA” in 2010, a green label for buildings, which aims to recognize the projects of construction companies which are committed to sustainable practices. Through the use of the label, the adoption of environmental practices in construction is encouraged and the entrepreneur can use the label as an object of advertising for your business. Consequently, the increasing availability of sustainable building projects and their dissemination help to increase the number of conscious consumers who tend to opt for sustainable housing. However, the adoption of the green label for buildings is completely voluntary by those enterprises that are submitting projects to be funded by CAIXA. Thus, even though the green label for building can be considered as a great step taken by the government, more advanced steps should be taken.

Long term actions should be conducted towards effective adoption of green practices. At the beginning, a reduction of the interest rate on credits should be done in order to encourage the enterprises to adapt their projects. At the same time, government should incentive the survey and standardization of construction materials to be developed according to the concepts of eco-design. In future, the adoption of sustainable criteria should become mandatory for all projects to be funded by government credit.

In terms of government, the return will be mid-term cuts in funding to treat solid waste, in power generation and water supply. Lower demand for water and energy means less area to be impacted by the construction of dams for water supply and power generation. It means saving strategic resources to be applied on effective sustainable development instead of wasting. Also, actions adopted in large-scale in the construction field would impact the social imaginary leading to a green consumption.

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## **Deceptive Game of Today's Capitalist Globalization: Evidence from Malaysia's Experience**

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Globalization is the economic policy of integration of national economies with global economy on the basis of free market competition. It is a strategy of outward looking industrialization to enjoy the benefits of production for wide world market, specialization, and economies of scale. In that sense globalization is a natural outcome and the end result of economic development processes in any nation. But today's globalization is a 'capitalist' globalization and an agenda of neoliberalism which seeks to transfer control of the economy from public to the private sector and which is described as a project of restoration and consolidation of world capitalist class (global rentier class) power to enhance and protect capital accumulation (Harvey, 2005:2 and 2009; Crotty and Dymski, 2001:3). It is a neoliberal prescription for industrialization and growth of the emerging economies of the South and a project of capital accumulation for the capitalist North through a process of disproportionate sharing of benefits at the expense of the developing South – charging highest price for their exports and charging lowest price for their imports.

The strongest economic argument for promoting economic globalization has always been the 'gain from trade' - added income for the trading partners - arising out of specialization and economies of scale. Under a perfectly competitive market structure they are expected to share this gain equitably. But to many of the developing countries it has not brought the promised economic benefits; instead it generated higher profits for some multinational firms and banks, and much higher returns for rentiers throughout the world (Stiglitz 2002:5; Crotty and Dymski, 2001:4). Balaam and Veseth (2008:459) observe that instead of narrowing the gap between rich and poor countries, globalization, in fact, has widened the gap to reinforce the North- South divides. At a dialogue at Dhaka on inclusive globalization, attended by Nobel laureates Sen and Yunus, and global financier Soros, globalization has been criticized in various ways (Ahmad, 2007). Soros has leveled it as a market fundamentalist project, placing ultimate reliance on market; it leads to monopolistic tendencies by promoting international business cartels; it hardly offers any playing field between the rich and the poor, talk less of any level playing field. As a result, inequities, instead of healthy inter-dependence, are growing between nations. Sen and Yunus criticized it as moving in a wrong direction as a majority of the nations are denied the privileges and are becoming weaker while the rich countries are getting stronger with the prerogative of giving the global economy the shape they like.

The dialogue noted with shock that two percent of people possess 50 percent of the world's total assets. Apparently in an unusual move, the British Prime Minister Mr. Gordon Brown has recently talked about the dark side of capitalist (unregulated) globalization which is seen as inherently a scheme for widening the income gap between the developed and developing countries.

The capitalist trading partners by virtue of their economic strength and bargaining power always insist to set the prices of their exports and imports closest to the autarky prices of the developing countries for maximizing capital accumulation. Therefore the dark and deceptive side of globalization is so glaring that it overwhelms all its bright aspects making it misfit for a New International Economic Order (NIEO) of the larking contemporary vision of social market economics transforming the 'free' to 'fair' market perspective.

For the industrialized nations economic globalization is fundamentally to facilitate acquiring of their imports, mostly the primary products, at the lowest prices from developing countries and selling their industrial and financial products to those countries at the highest prices to generate maximum capital accumulation. Since the real world is divided into widely unequal North and South, by pursuing a strategy of globalization of economy under the present capitalist framework, industrialized powerful countries and industrializing weak countries enter into a centre-periphery relationship in production power structure in which the industrializing periphery countries become dependent on the industrialized centre countries for their production and trade.

Another feature of the deceptive nature of globalization is that it is a 'one-way traffic' re-enforcing dependency of the South to the North. Unfortunately it appears that in the South 'West is best' to emulate is a generally accepted

concept on the table. The late president Julius Nyerere of Tanzania called this as 'catching up with the North syndrome'. Westernization is symbolized as globalization. As a result, in most developing countries North-pushed consumerism and globalization have become the accepted norm. . Consumerism, the unbridled urge for consumption (as if 'we only live to eat') is the product and teachings of capitalism of the affluent economy. One of the most important objectives of the north-pushed globalization is to promote and spread this consumerism to the developing countries to make their economies become dependent (by a centre-periphery relationship) on the industrialized economies.

Malaysia has approached its economic globalization very cautiously, selectively, and prudently through a strategy of export-oriented industrialization with internal and external investments, but without yielding to any pressure and influence of the dominant nations and international organizations. 'Look east' and 'Malaysia-centric' autonomous identity have remained its themes. Results from a recent study on Malaysia's economic globalization by Molla et al. (2009) show that from the context of national macroeconomic indicators like per capita GDP, GNI, growth, employment, inflation, industrial competitiveness, distribution of equity capital, poverty level, etc., Malaysia has made significant and commendable achievements during the study period from 1970 - 2007, suggesting that Malaysia has effectively enjoyed the positive effects of globalization.

However, the income convergence analysis of Malaysia with its two major trade and growth partners - USA and Japan - show that the three economies are diverging and Malaysia's income gaps with both US and Japan are increasing over time. This may signify (subject to confirmation by future studies on terms of trade) that Malaysia is having very unfavorable terms of trade with the USA and Japan and has been sharing the benefits of globalization proportionately far less than its rich trading and growth partners. General findings on income convergence studies show that lower income industrializing countries are 'catching up' to the higher income industrialized countries, even when the developing countries as a group does not have income convergence with the rich industrialized countries as a group (Hubbard and O'Brien, 2006:312). In that sense Malaysia's globalization has unexpectedly failed even to match with the general findings on income convergence studies. In spite of the fact that Malaysia has pursued globalization very selectively in a regulated manner, yet it has failed to realize the goal of reducing its income gap with richer countries. This tends to confirm the strength of deceptive nature of capitalist globalization. Therefore, to make globalization work towards creating a new global economy in which growth is not only more sustainable and less volatile but the fruits of the growth are more equitably shared, it needs to be reformed and managed with all countries having their voices in policies affecting them (Stiglitz, 2002:22). This may be called inclusive globalization. Where capitalist globalization is a project of efficiency that works for benefits of the most efficient and the strongest, the 'inclusive globalization', is a project of effectiveness that works for equitable sharing of benefits. It is a pursuit of a new international economic order. It is a guided & regulated globalization. Its underlying themes are internationalization of the economies rather than globalization of trade, production for need fulfillment rather than for profit maximization, replacement of greed and competition based on the philosophy of 'survival of the fittest' by the humanity of cooperation based on the philosophy of 'live and let live', and replacement of the 'free market' by 'fair market' perspective.

The content analysis and Malaysia's globalization experience, poised to support the hypothesis that globalization has high potential to contribute to industrialization and growth of the emerging economies. But the way it is practiced (i.e. capitalist globalization), it works as a deceptive game of the capitalist North for exploiting the South. Thus it cannot be trusted wholeheartedly and taken for granted for emancipation of the emerging economies. This paper suggests for a policy of target oriented 'inclusive globalization' to ensure equitable sharing of gains from trade and growth.

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## **Sustainable Consumer Behavior – Theoretical concepts and empirical investigation of consumer behavior in Europe and in the U.S.A.**

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A. Posch

Consumer behavior plays an important economic role in society. In purchasing decisions, consumers are able to express their values and beliefs. Despite the influence of firms and governments, every individual ultimately has the power to cast his or her economic vote. «Economic voting» can be pursued basically in two forms: boycotting and positive buying. Both methods are regularly used by consumers to achieve certain social or political goals. They can also be applied together. However, it remains unclear when, to what extent and how sustainability related consequences of buying decisions are actually taken into consideration by consumers.

The first main objective of this contribution is to discuss theoretical frameworks that aim at modeling the respective decision-making processes for ethical consumption, i.e. purchasing decisions for (more) “sustainable” products. One such theory is the Theory of Planned Behavior (TPB) which constitutes basically an extension of the Theory of Reasoned Action (TRA). The construct of perceived behavioral control was added as the resources and opportunities of an individual have an impact especially on intention and behavior. Thus, attitude, subjective norms, and perceived behavioral control are the factors describing intention, which is considered to be the predictor of behavior (Ajzen 1991: 179, 181-184). From this perspective, ethical consumption strongly depends on certain values and beliefs. Perugini and Bagozzi (2001: 79-85) introduced the Model of Goal-Directed Behavior (MGB) to broaden and deepen the TPB. Constructs such as anticipated positive and negative emotions, frequency and recency of past behavior, and desire were added. Goal desire was then added to form the Extended Model of Goal-Directed Behavior (EMGB) (Perugini and Conner 2000: 709-710). The second main objective is to present and discuss results of a theory driven empirical investigation of consumer behavior. For this, first insights in consumers’ perceptions and values were derived from focus group discussions. On this basis, an electronic survey was sent to roughly 18,000 students enrolled in universities located in Austria, Germany, or Switzerland (AGS) or the United States of America (USA). During the investigation period, a total of 966 responses were received. However, only a bit more than seven out of ten questionnaires were completed, which was a requirement for inclusion. The resulting «total eligible sample» comprises 660 responses (3.7 percent of the estimated recipients of an invitation for survey participation).

The empirical research reveals that respondents from Austria, Germany and Switzerland consider monitoring environmental and social impacts of businesses, the pursuit of stakeholder orientation, and responsible corporate conduct, more important than respondents from in the United States. In addition, they Austrian, German and Swiss respondents are more sceptical towards companies in general and require more information to make responsible purchases. These trends apply equally to men and women in each geographical region. In general, respondents believe they can influence corporate conduct through their actions in the marketplace. They regularly apply economic voting or use word-of-mouth to inform others, but rarely contact NGOs, companies or governmental agencies directly. When it comes to evaluating the amount of available information about the company’s or product’s environmental and social impact, consumers are generally dissatisfied. In addition, they rank external sources about sustainability such as non-governmental organizations (NGOs), government agencies and the media more favourably than retailers and producers. If such information is nevertheless provided by the producer, the preferred format is product communication rather than online communication, point-of-sale communication or corporate reporting. Sustainability-related facts that consumers would like to receive with the products they purchase, i.e. on the packaging or an attached leaflet, include primarily product-centred information such as ingredients, genetic modifications, geographic origin, nutritional value, product impact, and sustainability labels. Overall, respondents show low levels of awareness of specific companies’ sustainability policies and appear to have difficulty differentiating corporate performance in this respect. It is concluded that on-product communication needs improvement to provide the information consumers need for sustainable purchasing decisions.

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## Sustainability in global commodity trade: successful responsible entrepreneurship or fallacious market capture?

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International trade is usually considered a prime engine of growth and can contribute significantly to the reduction of poverty and hunger in developing countries, if it actually enables communities in disadvantaged regions to take part in this global economy. Products could be sold for better prices than given on local markets and the growing international demand can enable further job creation and improvement of living conditions.

But such benefits are not evident. Established businesses may very well pick the fruits of growing international economic cooperation, enabling production at the lowest costs and ignoring social and environmental externalities. In many cases foreign investment contributes to the creation of new pollution heavens chains. In these cases the positive socio-economic impacts remain limited, adding to the welfare of a small economic elite, but not contributing to the achievement of the UN Millennium Development Goals.

In the last decade we have seen a very promising counter development emerging in international trade. Civil society in western countries has increasingly been pressing spearheaded firms to bring their corporate social responsibility into practice, especially in this international context. In response to this European and American producers and retailers are increasingly applying new forms of *cooperation and self-regulation*, either with firm-to-firm supply chain management or with the help of private standards (with third party auditing) to assure that their practices at the developing world side of their supply chain can be labelled as socially and ecologically responsible, as described in (Vermeulen 2010) under the heading of *sustainable supply chain governance systems*.

In essence businesses are increasingly posing detailed demands on their suppliers in developing countries, addressing their environmental and social-ethical performance. In this way they are using their market power to enforce change. Examples are Forestry Stewardship Council (FSC), Marine Stewardship Council (MSC), Fairtrade, organic standards, GlobalGAP, Utz Certified, Ethical Trading Initiative (ETI), Business Social Compliance Initiative (BSCI), Rainforest Alliance, and numerous other standards for specific products. Key actors in these new arrangements are businesses in the supply chain, often affiliated with environmental and development NGO's.

Such eco-labelling originally has been fairly marginal in its market shares during the last two decades. However, the last few years show major breakthroughs in some products markets after different systems started to compete in the same product market. In a recent report we showed that both in the timber and the coffee market in the Netherlands, the market shares of sustainable products are peaking up to 50% in 2009 (Vermeulen et al. 2010).

We also see increasing attention in scientific literature for these forms of self-regulation in complex international markets. Scientists have been supporting this development by suggesting new methodologies for sustainable supply chain management and have provided critical analysis of such new practices. A multi-faceted debate is growing in the international literature. In this paper we will present an analysis of all scientific literature presented in scientific journals covered in Scopus. We see a strong growth and inputs from many different relevant disciplines and up to 298 articles in 2010. Most of the academic work is either theoretical or based on single case studies or case comparisons. The debate illustrates that the emergence of supply chain sustainability standards in international trade can be seen as the symptoms of two competing economic trends:

- either the dominant trend of global economic supply chains governance as a strategy of cost reduction and as market capture;
- or the emerging trend of sustainable business and corporate social responsibility as conscious corporate response to global long term ecological challenges.

We will identify the main issues in this new field of research, the conditions for successful governance for sustainability in global supply chains and the level of consensus or disagreement about this route for contributing to the reduction of poverty and hunger in developing countries. From this we suggest an interdisciplinary research agenda and present consequences for policy makers.

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## Addressing Climate Change: the Challenge and Opportunity for China's Foreign Trade Development

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Climate change, a scientific issue, both political and economic, is essentially related to national sustainable development and international competitiveness. Both developed and developing countries attach great importance to the influences of climate change measures on their industry competitiveness. These measures are decisive for one country not only in maintaining sustainable development under limited fossil energy, but in winning the competitive advantages in the intense changing of international situation.

Recently, China's exports grew prodigiously, boosting rapid economic development, whilst huge consumption of domestic energy. Importing countries could enjoy these cheap energy-intensive products without additional energy and CO<sub>2</sub> emissions. Main questions to be answered in this paper are: what is the proportion of energy used in exports to China's total? Whether there is a serious imbalance between exports embodied energy and imports in China? What are the influences of exports on China's GDP (gross domestic product) energy intensity?

This paper is based on China's non-competitive input-output model, life cycle assessment, which can trace all direct and indirect energy consumption of final products. We considered China's special conditions-import and export processing trade accounts for nearly 50% of total foreign trade. Import processing trade products, after simply processed, have been re-exported as export processing trade products. And more than 3/4 of import non-processing trade products go to intermediate production, while some of them as raw materials for export production and then been re-exported. Besides, localization coefficient is included to adjust consumption coefficient in the input-output model. Using this model, we could calculate the exports embodied energy, exports embodied value-added and CO<sub>2</sub> emissions intensity. As to imports, the Japanese input-output model has been established to count the imports embodied energy and CO<sub>2</sub> emissions. Whereafter, we can obtain the amount of net exports embodied energy and emissions which had been taken away from China by international trade.

1. We estimated that China's exports embodied emission is 1.4 and 1.6 billion t-CO<sub>2</sub> in 2005 and 2007 respectively. Subtracting imports embodied emission, the net exports or transfer emission is 870 and 890 million t-CO<sub>2</sub>, accounting for 16.5% and 14.8%, great amounts. On one hand, developing countries need to rely on exports to drive economic development; on the other hand, these countries bear high transfer emissions mainly by exporting low-technology, high pollution, labor and resource-intensive products along with international industrial division. China's coal-dominated energy structure has made exports intensity higher than that of developed countries. In 2005, China's exports value is 1.2 times of imports, while the ratio of exports embodied emissions to imports is 2.6 to 1. As to China, it is a long way to change the exports structure, energy mix and upgrade the industrial structure. Therefore, we would continue to undertake a large number of transfer emissions in the future.

2. While prescinding processing trade and imports intermediate inputs, the proportion of exports embodied value-added to GDP is 22.4% in 2005. And exports energy intensity is 1.16 tce/104 Yuan, higher than GDP intensity 1.23 tce/104 Yuan and lower than industrial value-added intensity 2.07 tce/104 Yuan. It shows that exports have not increased industrial energy intensity, but they have enlarged the proportion of industry to the total GDP, which leads a bigger GDP intensity. Another important reason is large exports of manufacture products continuously expand the proportion of secondary industry.

3. As China is a net exporter of embodied energy, coal-dominated, low rate of renewable energy, the CO<sub>2</sub> emission factor per unit of primary energy is about 30% higher than those in developed countries. The differences between exports embodied CO<sub>2</sub> emission and imports are bigger than those of embodied energy. In 2005, net exports embodied energy accounts for 9.37% of China's total energy consumption, while the corresponding net exports CO<sub>2</sub> emissions accounts for 12.14% of the total. In recent years, with the fast development of renewable energy, nuclear energy and continuous optimization of energy mix in China, the CO<sub>2</sub> emission factor is declining. In the future, the net exports embodied energy and CO<sub>2</sub> emissions in foreign trade would also be gradually reduced comparatively.

4. There should be a correct understanding that climate change is both a challenge and opportunity for China's economy and foreign trade. It needs to orderly adjust China's trade policies, strengthen the regulation of energy-intensive industries. In the sectoral level, emphasis on the control of energy-saving for industries such as processing of petroleum and nuclear fuel, construction materials and basic chemical raw materials, where the exports value is far more than imports. And as to coking with serious environmental pollutions, it is necessary to strictly limit the exports. At the same time, for large total exports value sectors, such as textile and manufacture of machinery, do not need to intervene or restrict too much on the

total volume, but encourage them to upgrade and improve the value-added of the products. There are also great needs to guide the transformation and upgrading of processing trade. Through the above measures, improve the competitiveness of low-carbon exports and then realize coordinated development between the trade and environment.

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## Posters

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### Sustainable Supply Chains: Moving Chinese Garment Manufacturers Towards Sustainability

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Increasing global population, sharply declining eco-system services, declining biodiversity, lack of accessibility to clean water, and societal inequalities are just a few of the many complex challenges facing civilisation in the 21st century. Industry's upstream choices in materials extraction, design, production methods and volume are systematically depleting resources to fuel economic development, while the pollutants and wastes associated with this development and consumption systematically increase in the biosphere. And with growing trade agreements and globalization, these negative impacts are often exported with production to less economically developed countries. In order for industry to turn these challenges into opportunities, and pursue a path of sustainable development, business decisions must be made with a greater scope, beyond current parameters of cost, lead time and quality.

One such context is the global garment industry. This industry employs over 26 million people world wide, with an annual turnover of US\$1 trillion (over half in China), and plays a significant role in the economic development of developing countries as a result of globalized supply chains. However, though it provides a very necessary product for an exploding population, at present the industry is inherently unsustainable due to the heavy dependency and exploitation of natural and social capital throughout its supply chain.

The fashion industry is just beginning to understand the need to move strategically towards sustainability. A brand's location at the crossroads of consumer conduct downstream and production upstream make it a potent leverage point in changing behaviour in both directions. Brands can move from externalizing negative impacts associated with their products, to externalizing positive change, for both consumers and developing economies. Yet there appears at present little coordination between global fashion brands and their supply chains to pursue strategic sustainable development and ensure the long-term resilience of their business. Current strategies are formed with a brand-centric focus, often missing fundamental challenges at the producer level that prevent initiatives from having a lasting effect. In order for a fashion brand to create an efficient strategy to work with its supply chain rather than on a case by case basis, we felt a greater understanding of the challenges facing factories in moving towards sustainability was needed. We asked: If a fashion brand wants to move its supply chain towards sustainability, what does it need to know about its first tier suppliers in China to help inform its strategy? What challenges do Chinese garment manufacturers face in this shift?

We utilised a scientific, principle-based definition of sustainability and a Framework for Strategic Sustainable Development to frame our research and identify the gap between how an existing multinational brand and its supply chain currently operates, versus that same system in a sustainable future. Research draws on literature, and interviews among industry experts and with a major fashion brand. Primary research in Chinese factories utilising various participatory techniques, such as workshops and interviews, was made to gain a more specific understanding of exactly where a typical Chinese garment factory stood compared to a sustainable future and what challenges they face.

The results revealed challenges for factories that were varied in depth and scope including: lack of clear direction from brands, lack of communication with the brand, the rigidly hierarchical nature of management, difficulty recruiting and retaining staff, a lack of awareness and understanding, and varying levels of provincial legislation and enforcement. In total, the results of our research indicate that the specific challenges that factories face are commonly associated with three underlying categories: the factory's internal corporate culture, the fashion brand's directives, and the regulatory environment in China.

Understanding the root cause behind each of the challenges facing Chinese garment manufacturers enabled the identification of three strategic guidelines for fashion brands to add to a strategy and address the challenges in moving towards sustainability. These guidelines can be used by fashion brands to avoid a reactive approach, and instead address challenges proactively and collectively from a strategic vantage point:

1. Does the action 'Broaden Purchasing Priorities'?
2. Does the action encourage 'Greater Collaboration'?
3. Does the action 'Build Awareness'?

It should be noted here that while these guidelines squarely address brand directives and factory culture, the regulatory environment is more difficult for brands to effect directly and independently. But as shown by some retailers, setting their own internal standards higher than those of the Chinese government can circumvent these challenges.

*At present most brands consider only three short term criteria, product cost, quality and lead time, when placing an order. These leave no room for the factory to directly add value or differentiate through sustainability initiatives. Its essential that a metric is incorporated within purchasing priorities that acknowledges a long term vision of value.*

*Creative collaboration between brand and factory is at the moment, a rare occurrence. A deeper partnership between fashion brands and their suppliers must be formed in order to move together towards sustainability. The interdependence between both parties means that neither can take meaningful steps towards sustainability on their own. Their efforts must be coordinated, mutually beneficial, build trust, and open communication and information channels.*

*Lastly, in factories in China awareness of the socio-ecological impacts of operations is often non-existent. Suppliers need to have a basic, cognitive understanding of the environmental and social challenges facing global society, including how factory operations link with, and impact, the systems of which they are a part. This awareness needs to be embedded to help factories understand not only the need, but also the business case for sustainability.*

In most cases, the fundamental challenge lay with the fact that, as individuals, people don't see the connection between immediate actions and distant effects. Therefore, a focus of a strategic approach should be upon stimulating awareness of sustainability. This can come in many forms, including compliance with regulation. Once compliance, and a sufficient level of awareness, has been achieved, factories can then begin to empower employees and create ownership around a sustainability strategy. A focus on empowerment and ownership will provide individuals with the tools and capacity needed to instigate change towards sustainability. To create real buy-in and ownership in a move from a reactive to proactive mindset is an important transition for factories to make in moving 'Beyond Compliance.'

The results provide a clear understanding that the majority of challenges facing Chinese garment manufacturers in a move towards sustainability. By understanding the issues at the core of the challenges, a brand can on its own, directly address most of these challenges from a higher, strategic vantage point, by integrating new guidelines into its supply chain strategy.

Results further show that there are several key challenges associated with Chinese government regulation that the fashion brand will struggle to directly influence. Policy, enforcement, and infrastructure are a direct result of decisions by the Chinese government, and are for the most part outside the sphere of influence for a brand. Further research needs to be conducted on how a fashion brand can best address these regulatory challenges. In addition, end consumers and raw material suppliers are key pieces of the supply chain that must play an active part in the move towards sustainability, and also require further research.

Understanding that the fashion brand has the most leverage in the supply chain, and that many of the decisions and processes in place upstream are the direct result of brand directives, this paper shows that the challenges in a move



towards sustainability are diverse and complex. By understanding these challenges, and their true causes, from the factories' perspective, we identified strategic guidelines a brand could employ to tackle these challenges as part of a broader strategy, rather than dealing with them on an ad-hoc basis.

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# Industrial ecology, sustainable production, and sustainable global product chains

Rupert Baumgartner & Vasilis

## Oral Presentations

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### **The role of external collaborations to improve companies' environmental performances: a study of the largest U.S. companies**

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Natural resource constraints, volatile energy costs, regulatory uncertainty, and increasing stakeholder expectations make environmental sustainability a strategic issue for firms. Even in some of the most difficult economic times, companies have expanded their sustainability initiatives and have been integrating them into their core business strategies, so showing that sustainability is no longer being questioned as a passing trend (e.g. MIT Sloan Management Review and Boston Consulting Group, 2011; Nidumolu et al., 2009). However, the complexity of environmental issues requires that firms embracing environmental sustainability into their strategies and activities collaborate with a wide range of external parties and include a broad range of stakeholders that can be a source of environmental knowledge and competencies outside the firm's main domain (e.g. Arts, 2002; Hartman & Stafford, 1997; Seuring & Müller, 2008; Srivastava, 2007).

The aim of this paper is to investigate whether and to what extent external collaborations, with different types of actors, can help companies to improve their environmental performances. To this aim, the behaviour of the 500 largest U.S. companies has been analyzed. These companies, ranked by the Newsweek Green Ranking 2010 on the basis of the sustainability of their practices, belong to different industrial sectors: bank and insurance; basic materials; consumer products, cars; financial services; food and beverage; general industrials; healthcare; industrial goods; media, travel, and leisure; oil and gas; pharmaceuticals; retail; technology; transport, aerospace; utilities.

The dependent variables of this study are companies' environmental performances, as reported in the Newsweek Green Ranking 2010. In particular, in this ranking, companies were evaluated on three areas: Environmental Impact Score (a measurement of the total environmental impacts of a corporation's global operations and disclosure of those impacts), Green Policies Score (an assessment of how a company manages its environmental footprint), and Reputation Survey Score (based on an opinion survey of corporate social responsibility professionals, academics, and other environmental experts). Based on the scores obtained in all these three classes, suitably weighted, a composite indicator was developed on the basis of which the final ranking was determined: the Newsweek Green Score.

On the other hand, the independent variables of this study are collaborations in environmental projects undertaken by companies with several types of actors: suppliers, customers, other companies (e.g. partnerships with competitors, or collaborations with other companies through consortia), NGOs, GOs, and universities and research institutions. Data for the independent variables have been collected through the content analysis of companies' environmental/sustainability reports and/or their website section devoted to environmental sustainability (data related to environmental activities were publicly available for 347 out of the 500 companies of the Newsweek Green Ranking, and, thus, this represents the effective sample size of our study). The independent variables are, thus, represented by the number of occurrences of the considered type of collaboration within reports and/or websites sections. Two control variables have been included in the study, too. These are: the number of employees, and companies' revenues. Furthermore, 14 dummy variables have been included in the analysis to take into account the industrial sectors' effects. To ensure causality between dependent and independent variables, a one-year time lag has been considered: dependent variables refer to companies' environmental performances during 2009, while data for the independent variables have been collected referring to companies' behaviour during 2008.

Collected data have been analyzed through regression analyses. In particular, four different regression models have been tested, one for each type of environmental score of the Newsweek Green Ranking.

Preliminary results show that collaborations with actors both within and outside the supply chain are beneficial to improve companies' overall environmental performance as well as the management of the environmental footprint: in fact, both collaborations with suppliers and customers and collaborations with GOs and NGOs showed to have a positive and significant effect on the Newsweek Green Score and on the Green Policies Score. Furthermore, collaborations with customers, NGOs, and GOs show a positive effect on the Reputation Survey Score. On the contrary, collaborations with external actors do not seem to influence the Environmental Impact Score. With regard to control variables, results show that company size, either in terms of revenues or number of employees, has a positive and significant effect on all environmental performances measures. Finally, results show that there is an influence of the industrial sectors on environmental performances. For example, companies belonging to pharmaceuticals seem to have the highest Newsweek Green Score, while the ones operating in the utilities industry seem to have the lowest one.

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### **Focal organisations: stimulating eco-innovation within production and distribution systems**

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The challenges of sustainable development call for eco-innovation in systems of production and distribution. Much rhetoric over recent years has exhorted major purchasers to pursue environmental improvement by inducing changes in their supply-chains. At the Manchester Institute of Innovation Research ([www.mbs.ac.uk/research/innovation](http://www.mbs.ac.uk/research/innovation)), in a two and a half year project funded by the Sustainable Consumption Institute ([www.sci.manchester.ac.uk](http://www.sci.manchester.ac.uk)), we are studying empirically the role of organisations with significant purchasing power (we call them 'focal organisations') in stimulating eco-innovation beyond the boundary of the organisation, to shift entire sectors or value-chains towards more environmentally-sustainable states. We argue that focal organisations can stimulate eco-innovation through: 'responsive demand', where they identify and adopt best available technologies; 'triggering demand', where through procurement they stimulate the development of eco-innovation within or beyond their existing supply chains; and 'interactive supplier-buyer innovation', where they collaborate with suppliers and customers in the development and implementation of eco-innovations. We explore how different food production and distribution systems have evolved to have the structural characteristics they currently exhibit, which organisations have the power in that system to drive accelerated eco-innovation and whether any reconfiguration of the system – for example, with respect to the supply chain arrangements or institutions that underpin the current system – is necessary to facilitate change. This presentation presents empirical evidence from one of the project work-packages that explores eco-innovation in the UK bread production and distribution system. The empirical analysis is informed primarily by more than 20 in-depth interviews with key actors across the UK bread production and distribution system.

Despite being a staple purchase and (if you include biscuits and cake) the largest manufacturing group in the UK food sector, bread is relatively under-studied vis-à-vis other food products and has received less policy attention in the UK with respect to its environmental impact. Many food products experience environmental 'hotspots' at different stages of the system (see the 'Shopping Trolley' report by Foster et al, 2006), and many share path dependent, co-evolutionary innovation features and 'locked in' routines of downstream production and distribution (see Atkins, 2010 for a long view of milk, for instance). Bread is typical of these products: PAS 2050 compliant life cycle analysis studies (BSI, 2008) tell us that wheat cultivation accounts for around 35% of system GHG emissions; and bread manufacturing accounts for 16% (Espinoza-Orias et al, forthcoming). Emissions at the consumption stage are significant too (25% of system GHG emissions according to Espinoza-Orias et al, *ibid.*), but arguably the major environmental impact here is waste: the Department of Environment, Food and Rural Affairs (DEFRA, 2010) estimates that 40% of edible bread purchases in the UK are wasted (a figure that does not include bread crusts).

The modern UK bread industry is a product of technological, societal, institutional and regulatory change over the last half century. The rapid diffusion of the Chorley Wood bread-making process in the early 1960s catalysed larger-scale, more controlled and efficient baking of standardised bread products. Automation, robotics and incremental improvements in equipment and techniques at the baking and milling stage facilitated the up-scaling of production and led to power struggles and consolidation and concentration in the industry. Later, retailer power and, to a certain extent, food safety regulation reinforced standardisation in the product and the way in which it was made. Critically, the Chorley Wood bread-making process made more efficient use of wheat protein. So, for a given quality of bread, lower protein wheat could be used, which could be met increasingly from UK sources. Until the mid-1960s, imported wheat typically accounted for up to 65% of bread making requirements; today, around 80% of wheat used by bakers is from UK. Levies on non-European wheat varieties provided an initial spur, but the substitution from overseas to UK wheat required considerable innovation at the wheat growing stage. Generic trends such as increased mechanisation and the widespread introduction of fertilisers and agrochemicals was important, but the rapid expansion of plant breeding as a commercial enterprise (triggered by the 1964 Plant Varieties & Seeds Act that introduced a system of royalty payments on individual plant varieties) and the continued improvement in farming practices were crucial in facilitating domestic wheat supply.

In our analysis we argue that some large (so called 'plant') bakers are focal organisations in the current UK bread production and distribution system. Through their market power they have the potential to stimulate eco-innovation where the three major environmental impacts arise. First and foremost, they specify the 'quality' of wheat, award the contract, test the wheat and pay the agreed price (or a price that reflects the quality of the grist). In other words, plant bakers occupy a position in the supply chain in which current exchange relationships with upstream actors could be harnessed to express a requirement for particular qualities of wheat. On that basis, they are uniquely positioned to 'trigger' demand for varieties of wheat which assimilate nitrogen more efficiently. Moreover, through their long-term supply chain arrangements they work closely with a dedicated set of farmers both in the field (as one leading plant baker told us: "...we know each of the farmers; we know where they farm, what acreage they farm from and we have an agreement with the farming standards that they use; we agree the types of wheat that they plant....we monitor the nitrogen application through growing and harvest") and through Forums, where they bring their contracted farmers together with key environmental stakeholders and customers to share knowledge and good practice of sustainable land management: an example of 'interactive supplier-buyer innovation'.

Secondly, the large plant bakers can tackle their 'direct' emissions through technical and organisational eco-innovation within the firm. A Carbon Trust (2010) report on industrial energy efficiency in the bakery sector identified areas for potential carbon reduction through technological and behavioural change. Through 'responsive demand', they can adopt best available technologies in heat recovery, combustion efficiency, integrated electric control of ovens and coolers and baking tins. The plant bakers are also addressing behavioural change (e.g. occupancy control of lights, turn-off campaigns, scheduling changes to maximise shutdown) as part of initiatives to embed environmental considerations in the organisation, using both contractual and relational means to achieve their ends.

Thirdly, because the plant bakers account for the vast proportion of bread sales in the UK they are powerfully placed to reduce waste at the consumption stage through their own new product development (e.g. different sized loaves), by adopting or 'triggering' innovation in packaging and ingredients (e.g. to increase the lifespan of bread) and through collaboration with customers and consumers in the implementation of behavioural changes (e.g. labelling or point of sale information). Importantly, to maintain their public image as trusted brands, the large plant bakers recognise that whilst environmental considerations may not be top of their consumers' minds when buying bread currently, they may well be in the future.

The concept of 'focal organisations' and the role of the baker will be expanded upon in the presentation and lessons central to the third theme of the conference will be drawn from the case study. In particular, these relate to the importance of innovation in addressing problems created by continued development of a growing world population; the ability of focal organisations to co-ordinate wider system-level change through demand-led innovation; and the strong influence on the production-distribution system of other, less material-based, 'innovation systems' in which it is embedded (institutions such as government policy, regulation and standards; networks of knowledge generation and diffusion; physical infrastructures such as transport and energy networks; and societal regimes such as life styles and consumption behaviour).

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## Sustainability Metrics for Photovoltaics Growth to Terawatt Levels

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Photovoltaics as fuel-free energy sources inherently will be sustainable unless they are too expensive to produce, the materials required for their manufacture are depletable, or they are environmentally unsafe. These criteria demand investigations of three measurable aspects: cost affordability, resource availability, and environmental impact minimization. I will discuss cost-reduction learning curves for PV production, economics of scale, and trends in production and device efficiencies that point to solar electricity costs reducing to grid parity levels in four years for the best sites and financial conditions, and for the whole U.S. by 2030. Then, the availability of elements necessary in the second generation of PV (e.g., Ga, Ge, In, Se, Te) is evaluated based on global production data and forecasts of demand to mid century. Lastly, environmental and ecological impacts of large-scale (e.g., 250 MW -500 MW) PV plants on desert regions are evaluated and the efforts of the PV industry to minimize impacts will be discussed. It is shown a proactive approach is necessary for reducing conflicts with wild-life in the desert, for improving the extraction of minor metals from base metal production circuits, and developing efficient and inexpensive recycling technologies. Stable markets and advance planning are needed for photovoltaics to grow to terawatt levels of cumulative production and satisfy a major portion of the global electricity needs by 2030 and most of our electricity needs by mid-century.

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## Consumption and Obsolescence: The Consumer Link to Sustainable Global Electronic Product Chains

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Sustainable production and consumption is one of the key challenges of a growing aspirational global society. Electrical and electronic products – from mobile phones to music players to televisions and computers – are some of the most widely available and aspirational products globally. While the advantages of these products are evident, there is growing recognition of their environmental impact given their mass production and intensive use of increasingly scarce resources. For example, by some estimates, the global material supply of critical metals in the manufacture of electronics such as Indium might be exhausted before the end of the decade (UNEP, 2009).

Thus, to move towards a sustainable future, it is vital that production and consumption of electronics not only uses fewer resources more efficiently, but also that it is done in closed material loops. There is already considerable research on greening supply chains of electronic products through upstream interventions which has led to the development of less toxic products (for example lead-free solder), using more recycled materials (for example recycled plastics in printer parts), requiring fewer resources (for example lighter packaging). Other scholars have focused their efforts more downstream, in improving recycling technologies to maximise recovery rates of valuable resources from waste streams. There has also been a strong policy thrust to encourage and incentivise the development of cradle-to-cradle systems for products, such as the Waste Electrical and Electronic Equipment (WEEE) Directive of the European Union.

Eco-design, efficient recycling technologies and progressive policies are no doubt essential in the creation of a closed-loop system. However, the overall efficiency of any closed-loop system is determined by the weakest link in the chain. A sophisticated closed-loop system with the most efficient recovery rates can only be as successful as the amount that is returned to it. In many ways, the consumer is the weakest link in creating sustainable global electronic product chains, with consumer behaviour influenced by many, often unknown, factors.

Factors influencing consumer behaviour in the purchase of durable goods has been the focus of a significant body of research, in particular the diffusion of new products (see Mahajan et al., 1995; Meade & Islam, 2006). More recently, there

are an increasing number of scholars studying consumer demand and motivation to purchase greener products (Peattie, 2001; Michaud & Llerena, 2010). Yet, consumer disposal behaviour of electronic products has received little attention by researchers. Among the few studies on consumer attitudes towards electronic products one is by Cooper (2005) who studied British consumers' attitudes in relation to lifespans of household products and factors that influenced the market for longer lasting products. Cooper described the three main reasons why people replace products as product failure, dissatisfaction with product functionality, and change in consumer needs. Some authors of WEEE estimation models (Elshkaki, 2004; Oguchi, 2008) have hinted that technological advancement and social acceptability may also be factors that influence disposal. However, their models do not include these factors as there is no research yet to suggest specifically what these factors are and how significant their influence may be. Another conceptual limitation of their models is that they assume that the average lifespan of the durable product remains the same through the entire period. Such an assumption is inconsistent with reality, especially for electric and electronic equipment in the face of studies indicating the shortening usage period of products such as computers and mobile phones are used before being replaced.

This research contributes to the understanding of consumer disposal behaviour, investigating the factors that influence consumer behaviour with respect to disposal of consumer durables. Specifically, the link between consumption and obsolescence is made with the hypothesis that the emergence of new technologies directly influences obsolescence, significantly accelerating the disposal of existing products.

The changes in consumer behaviour are a result of interacting social and market driven factors. In turn, obsolescence of consumer durable products is often discretionary in nature rather than technical. This research builds on the extant literature on demand forecasting of new products based on well documented diffusion models which form the conceptual basis of this research. It proposes that the dynamics of disposal of consumer durables is not dissimilar to the diffusion of new products. A consumer's decision to dispose of an existing product could be due to technical malfunction or for discretionary reasons such as perceived obsolescence compared to newer technologies, compatibility issues with complementary products, peer-pressure etc. Through primary consumer behaviour research, the influence of both technical and especially discretionary disposal will be studied. The case study for this research is the replacement of cathode ray televisions (CRT TVs) by flat panel televisions (FPDs TVs) in Switzerland.

FPD TVs, comprising largely of Liquid Crystal Display TVs (LCD TVs) and more recently Light Emitting Diode TVs (LED TVs), were introduced into Switzerland in 1998, with only a couple of thousand being sold in the first couple of years. However, following their introduction, sales of FPD TVs doubled almost every year, surpassing the CRT TV sales in 2005 and completely wiping out the CRT TV market by 2009.

An initial model estimating the disposals of TVs through 1950-2015 shows that the disposal of CRT TVs increased dramatically in the period following 2006. It is argued that this accelerated disposal of CRT TVs is a direct result of the arrival of a new TV technology. As FPD TVs dominated the market for new sales, CRT TVs were considered obsolete, and the less desirable they became (conversely, as FPDs became more desirable), the more CRT TVs were disposed to be replaced by FPD TVs.

Consumer behaviour is key to the impact that society has on the environment. The actions consumers take and choices they make regarding the disposal of their durable products determines the infrastructure required for safe disposal as well as recovery of resources from these anthropogenic mines. Therefore, understanding consumer disposal behaviour will not only be able to provide insights for motivating better behaviour, but also inform models for forecasting waste flows to more accurately estimate and improve collection, recycling and resource efficiency. This research at modelling consumer behaviour by linking both consumption and obsolescence will, it is hoped, lead to the development of more sustainable global electronic product chains.

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## Fast carbon footprinting for products and services of large companies

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Life cycle analysis (LCA) has been practiced since the 1960s [1]. When in 1969, The Coca-Cola Company commissioned a comparative study of traditional, re-usable glass bottles vs. plastic bottles [2], this arguably marked the debut of LCA as integral to product development even for mass market consumer goods and services companies. More recently, the more widespread public awareness of the risks of global warming and the role of anthropogenic green house gas (GHG) emissions has prompted a renaissance of LCA concepts in the form of standardized carbon footprinting of products and services [3].

Companies usually seek to quantify carbon footprints for one or more of the following reasons: (i) internal transparency and identification of carbon reduction strategies; (ii) communication of results to external stakeholders such as environmental monitoring groups, or to apply for certification [4]; or (iii) requests from a company's corporate customers for scope 3-relevant data, to use in their corporate carbon accounting [5].

While recent years have seen tremendous progress in carbon footprinting in the area of standards/protocols [6, 7] and emission factor databases [8], quantifying the footprints for hundreds or thousands of individual products/services is currently impossible, short of a massive buildup of a company's dedicated personnel and LCA expertise. Specifically, companies today face two fundamental obstacles when performing footprinting at the scale of large companies:

- Required time and expertise: Collecting, organizing, and validating LCA inventory (easily hundreds of data items for a single product/service), as well as identifying emission factors, typically takes hundreds of staff hours and specialized knowledge [9].
- Lack of uniformity and integrated platform: Based on our experience, carbon footprinting today is usually performed as a series of one-off efforts, e.g., using non-interlinked, separate spreadsheets for each new product/service. Once the practitioner has completed data entry and calculation for one product, to the desired accuracy, the practitioner moves on to the next product, often without maximizing the re-use of any previously collected information [10].

These obstacles result in missed opportunities that currently prevent carbon footprinting from realizing its full spectrum of possible benefits, namely:

- What-if impacts across products, carbon management, and cost-benefit evaluations: Arguably, one of the greatest opportunities of footprinting is to enable a company to identify and prioritize GHG reduction strategies. However, because the footprints for a set of different products are usually calculated in a set of non-integrated files, it is difficult to quantify the combined impact of a reduction strategy: For example, counting all impacts on raw materials, transportation, and disposal, what would be the total company-wide GHG reductions if all plastic packaging were made 15% lighter? What if all factories in a country moved 30% of their primary energy consumption to hydro-electricity? Which LCA stages in the supply chain - measured across all products or by business line - offer the largest reduction potential? Given an assumed carbon price, would the costs for required upgrades (e.g., modified energy mix, packaging, or ingredients) be a worthwhile investment?
- Flexibility vis-a-vis regulatory change: Standards for carbon footprinting are still evolving [11]. With current practice, a future change in the «accounting rules» would mean tremendous time and resource effort on behalf of a company, to essentially fix the manual calculations for hundreds of products/services. This poses significant «regulatory» risk.
- Synergy with corporate carbon accounting («corporate footprint»): There is a direct relationship between the various LCA stages that count toward a product/service footprint and those that count towards a corporate footprint. Therefore, there are significant synergies between the data collection and analyses for product/service footprints and the scopes 1, 2, and 3 of corporate footprints [5]. Current practice often lacks the coverage, uniformity, or transparency that would enable companies to make use of such synergies.

Data framework and statistical techniques were developed based on an LCA dataset covering 1137 products from a leading packaged consumer goods company. Emission factors were used from Ecoinvent (v2.0 & v2.01), Franklin USA, and OpenIO (others, as noted). Footprints were calculated using Microsoft Excel, SimaPro (v7.1), Gabi (v4.3), and customized software, following protocols PAS2050 and the current WRI draft protocol.

Our approach lays out general organizational techniques of managing and calculating LCA data. While these were developed for carbon footprinting, principle elements of the approach are applicable to other LCA impacts (e.g., sustainable agriculture, water, toxicity, biodiversity, social). The overarching philosophy of the approach is to (i) leverage

shortcuts and approximations wherever possible so long as they do not materially affect the accuracy of carbon footprints; and (ii) harmonize the data structure such that GHG reduction measures can be more easily identified and company-wide impacts quantified and evaluated against the measures' costs.

Fast Carbon Footprinting is based on three techniques [12]: (1) Each footprint is based on a single, uniform data framework that applies to all products/services. Rather than manually, data is entered, wherever possible, via auto-feeds from existing enterprise resource planning data, e.g., bill of materials and energy usage at company-controlled factories. This technique minimizes the number of data items that require manual input. (2) Particularly for remaining data entries, concurrent uncertainty analysis points the user to those activity data or emission factors where additional data or improved accuracy would most improve the accuracy of the calculated footprints. This technique helps to further limit manual intervention to those data entries that materially benefit the accuracy of footprints. (3) A statistical model approximates emission factors, thereby eliminating the manual mapping of a product/service's inventory to the vast selection of emission factor databases. This technique enables non-LCA experts to calculate footprints.

Using live data, we demonstrate how above techniques enable more expedient footprinting, showing examples for entire portfolios as well as the gradually more accurate footprinting of individual products.

In summary, for companies and practitioners, fast carbon footprinting dramatically reduces the required technical expertise and number of manual data entries vs. current practice (from hundreds of thousands to only hundreds of datapoints, for large companies with ~1000 products). This enables companies to uncover portfolio-wide GHG reduction strategies much faster and more systematically than previously possible, while at the same time quantifying protocol-compliant, individual product footprints for consumer communication purposes.

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## Corporate Energy Management in a Sustainable Maintenance and Plant Asset Management

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Sustainable production and manufacturing is an emerging concept for commercially successful performance. The proceeding elaborates on the important business of "Maintenance and Plant Asset Management" and its high significance in capital and manufacturing asset intensive producing industries. The optimal economic arrangement of the production factor asset is the basic challenge of maintenance and plant asset management. Beside the basic input factors of a production process - manufacturing equipment, material and personal - the operation supply item energy and its efficient and effective use becomes more and more important (e.g. Al-Ghanim (2003), p. 26).

Plant asset management as a corporate activity focuses on the tangible fixed assets (plants/manufacturing equipment) (Neb/Prüß (2006), p. 35). It covers the asset lifecycle phases of investment (including asset design and asset provision), operations and maintenance (including improvement and administration) and decommissioning of tangible fixed assets. Asset management activities have to be designed, implemented and controlled through appropriate decision and management processes. Fields of action include planning, accomplishment, control and improvement of all activities related to plant asset management. Derived from the main objective of a company (particularly the long-term increase of the corporate value), asset management sub-goals have to be formulated in order to make a significant contribution



to the operational and sustainability performance of a company possible. In sequence of the asset life-cycle it requires an aligned management framework, which considers optimal human needs as well as environmental requirements (Schröder/Baumgartner (2010), p. 2). So a three-fold criterion sets the basis for sustainable business performance in maintenance and asset management (Liyanage (2007), p. 307).

Energy management can also be beneficial for industry due to economic, environmental and social reasons (see, e.g. Christoffersen, Larsen et al. (2006)). Within the framework of energy management the integration of energy efficiency into plant asset management is one important lever to enhance production systems towards energy efficiency (Bunse, Vodicka et al. (2011), p. 668; Al-Homoud (2000)).

To date numerous plant asset and maintenance management approaches target to increase the performance of the production system by eliminating waste caused by the above mentioned basic input factors. Managing energy in an efficient and effective way is not considered in most of these models or only plays a minor role. Studies have identified a low status of energy management as a barrier to energy efficiency. (e.g. Thollander/Ottosson (2010)). In literature examples for barriers on implementing and integrating an energy efficiency improvement management are: decisions based on short termed payback periods instead of an asset life-cycle cost management, underestimated priority of energy efficiency by the management (Eichhammer (2004)) or lack of information (Sardianou (2008)).

Controlling the production factor energy is cross-sectional, since all functions of the traditional management process are affected. Generally within a company there is competition for limited financial, time and human resources. The allocation of these resources is usually carried out in the observed dependence of suggestibility of business goals through the area. In terms of ideal use of corporate resources the synergistic effects of both management disciplines, energy as well as maintenance and plant asset management could be an important opportunity to achieve corporate targets in terms of corporate sustainability. To achieve the goal of minimization of resource inputs, the production factor energy is to control in a holistic frame.

However, specifications, guidelines and/or frameworks to outline how performance of important business processes such as plant asset operations and maintenance can be linked to the cooperate energy management in terms of a sustainable business framework are missing.

The assumption is that managing the production factor energy is a major discipline in a sustainable maintenance and plant asset management. In most traditional concepts of maintenance and asset operations the (loss) factor “energy” is underestimated. A complete analysis in terms of energy management and its integration into a sustainable maintenance and plant asset management is missing.

So the purpose is to discuss possibilities to integrate aspects of corporate energy management into a sustainable plant asset and maintenance management looking at a normative, strategic and operative level by additionally considering the conditions of the European Union. The authors want to answer the questions:

- Why is corporate energy management of relevance to companies and what impact has the EU's energy strategy on energy-intensive companies?
- How far is corporate energy management an integrated part of existing maintenance and plant asset management concepts and to what extend deals plant asset management with corporate energy management in current practice?

Our presentation will give a reflection of so far existing concepts and recognizes the occurrence of energy management within these concepts.

At least the contribution provides a generic framework to explore and specify the spheres of activities for an integrated energy management into the important business of asset operations and maintenance in perspective of sustainable development.

To respond the question, why corporate energy management is of relevance to companies, we analyze the corporate environment on the example of energy intensive industries in the EU, by concentrating on legal frameworks and other relevant stakeholders.

To meet the object, in which extend corporate energy management is an integrated part of maintenance and plant asset management concepts, we will discuss approaches from literature. To answer the question, how far plant asset management deals with corporate energy management in current practice, the results of a survey based empirical research will be presented.

We think that this discussion will contribute to existing work in the field of a sustainable plant asset management.

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## Organizational Forms and Likelihood of Industrial Symbiosis from the Perspective of Transaction Cost Economics

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The research conceptualized intra-firm waste recovery, inter-firm waste exchange, and commercial waste recycling/disposal as the hierarchy, hybrid, and market modes of industrial waste management. For the empirical testing of the relationships between transaction attributes and organizational forms of waste recovery and disposal practices, I spent nearly three years compiling a dataset that contains 123 energy, water, and material related waste recovery/disposal activities at the plant level in a leading eco-industrial park in China - Tianjin Economic-Technological Development Area (TEDA).

TEDA was founded in a salt pan in 1984 in China. TEDA is located 130 kilometers southeast of Beijing city facing the Bohai Bay. TEDA has an area of 41 square kilometers, divided into an industrial zone (26.4 km<sup>2</sup>), a residential zone (11.3 km<sup>2</sup>), and a campus and forest park zone (3.1 km<sup>2</sup>). Symbiotic exchange was first formed in 1992. Altogether, 81 symbiotic exchanges were identified as having been formed surrounding the utility and four key industrial clusters of TEDA. Among which, 7 are energy-based synergies, 12 water-based exchanges, and 62 material-based synergies. In 2008, TEDA was nominated as one of the three national eco-industrial parks in China.

Ordinal logit regression analyses were carried out to test the hypotheses concerning the relationships between asset specificity (divided into physical asset specificity, site asset specificity, human asset specificity, procedural asset specificity, and brand name capital asset specificity), frequency of exchange, and organizational forms of waste recovery/disposal practices.

The findings of the empirical research show that physical asset specificity, site asset specificity, and human asset specificity are significant determinants of organizational forms of waste management practices while procedural asset specificity, brand name capital asset specificity, and frequency of exchanges do not have definitive impacts on the organizational forms of waste recovery/disposal activities.

## Islands as Examples for Global Sustainability: An Initial Consideration of Strategic Sustainable Development in the Island Context

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Globally islands are home to approximately 10% of the world's population, but their average population density is about three times the mean of the continents (Baldacchino, 2006, Baldacchino, 2010). Coupled with this fact, islands are also known to display characteristics such as isolation, insularity, smallness, and scarce resources, which have rendered them vulnerable to global pressures. Dependency on massive importation of goods and threats from global environmental phenomenon are examples. In this context Deschenes and Chertow (2004: p203) have defined "An island as a system that is subject to internal dynamics as well as pressures from the larger system in which it exist" and have postulated the island context "... an isolated system with scarce resources" (p 203). As a consequence compared to their continental counterparts, sustainability is a more critical goal and greater challenge for islands. Lenzen (2008: 2018) states,

“Regarding sustainability, most island communities face two major challenges: energy [resource] supply and waste disposal”. Islands therefore, can be excellent examples for global sustainability, acting as “... potential laboratories for any conceivable human projects, in thought or action” (Baldacchino, 2006). Finding the optimum balance between what Baldacchino (2010) refers to as the ecological-economic development paradigms, is important for the survival of islands.

As such the main focus of this paper is to present an adapted framework for strategic sustainable development in the island context. The literature review drawn from the doctoral thesis of the principal author will be discussed. This proposed island experiment will focus on adapting the framework for strategic sustainable development, by incorporating strategy content, process and context into and applying industrial ecology concepts and tools to the framework. The tourism accommodation sector in the small island Grenada, a member of the Organization of Eastern Caribbean States (OECS), population density: 192 persons per km<sup>2</sup>, will be used as an example. The key research questions spawned from the literature review will be presented.

Grenada, with a population density of 262 persons per km<sup>2</sup> published its first tourism master plan and policy in 1997, which recognized the economic benefits from tourism, with cognizance of the environmental degradation that can result from accommodation development. The ‘Plan’ however, fell short on addressing material and energy flows associated with the operations of these units.

Island economies, especially those located in warm climates are an important part of the global tourism system, as they exploit their sun, sea and sand allure to attract tourists to their shores, thus contributing to the demand and explosive growth in tourism observed over the last few decades (Sharpley, 2010). Since the 1960’s islands shifted their economic development towards tourism. But although tourism has contributed significantly to the development of these island economies, many negative environmental impacts were observed (e.g. Gössling & Wall). Specifically, the negative impacts associated with the flows of materials, energy and waste generation in the accommodation sector are exacerbated by the large numbers of tourists that flock into islands. Confronting these flows can lead to finding the optimum balance at the ecology/economy nexus.

The widely accepted but equally contested sustainable (tourism) development approach was proposed as the solution to this developmental conflict, and can challenge the linear flows of materials in economic systems. Sustainable tourism development (STD) however, was critiqued on the basis, that its practical application has only been a micro solution “... to what is essentially a macro problem” (Liu, 2003 citing Wheeler, 1991). Similarly, Baumgartner & Korhonen (2010: 71) proposed that “... one of the main explanations [for the failure in the applications of sustainable development] is that the approaches used... are reductionist and often lead into problem shifting and problem displacement”. They further proposed that ‘strategic thinking’ and its incorporation into sustainable development work is needed to address this failure.

The framework for strategic sustainable development or FSSD (see Robèrt, et. al, 2004: 29) was chosen and adapted for developing a strategic approach to the solution of the problem identified. The framework consists of five interdependent and hierarchical levels. This ensures that the solution contributes to sustainability (Baumgartner & Korhonen, 2010), since its ultimate intention is to move the island on to a path of sustainability. The framework provides the appropriate strategy content. This was the main reason for choosing this framework to be applied in the island context.

The strategy process is guided by the five task of strategic management proposed by Thompson & Strickland (2001: 7). All primary stakeholders would be included in the data gathering stage of the research, to ensure that the “... formulation and construction of the framework achieves “... the intended content and purpose” (Baumgartner & Korhonen, 2010: 74).

At level 1 of the framework, an understanding of how the island system functions as a complex adaptive system will be developed. The research question to be answered at this level is: how can the island system be conceptualized in terms of material flows and how are they utilized in the island context? Stemming out of the system comprehension, four sustainability principles, based on the socio-ecological laws that govern the way man lives in the island system are adapted for consideration by key island actors (Robèrt et al, 2004). These system conditions or principles of sustainability are at level 2 in the framework. The research question proposed at this level is: what are the stakeholder views on the sustainability principles and why are they appropriate for defining island sustainability?

Level 3 of the framework is referred to as the strategy or the principles of sustainable development. At this level a vision for sustainability in the tourism accommodation sector and the understanding of the material, energy and waste flows in the sub-sector are considered. As it relates to the strategy process and content, the answer to the following research question will be sought: what are the material flows in the tourism accommodation sector and are the actors willing to agree to a triple win strategic vision for managing these flows?

It is further proposed that at this level of the framework the engineering/physical sciences side of industrial ecology can be linked to its social sciences aspects as proposed by Baumgartner & Korhonen (2010: 73), an important consideration

for rendering industrial ecology a more strategic concept and for ensuring that its applications lead to the sustainability outcome.

Finally, the last two tasks in the strategy process and content development considers the implementation of the strategy and the monitoring and evaluation of its implementation. At level 4, consideration will be given to the concept of industrial symbiosis and the actors willingness to act collaboratively or individually to implement actions for minimizing resource and waste flows (Chertow & Miyata, 2010) and to consider factors that are necessary for making such decisions (Wolf, et al, 2005). Secondly, at the fifth level socio-ecological indicators, the operations stage of the building life cycle and four principles of sustainability would be formulated into a matrix adapted from Azar et al (1986: 109). Policy interventions that may drive social, ecological and economic indicators that can be used within the matrix for measuring the sectors' contribution to island sustainability will form the final content of the framework. The research questions for these levels are: what concrete actions can be taken by the actors regarding material flows and are they willing to act individually or collaboratively to implement them? What factors must be considered for making the decision? What indicators can be used to measure the social and ecological actions of the actors?

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## Posters

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### Transparent Production Chains and Sustainability Accounting

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Human demand has placed an unprecedented loading upon the natural and social environment. This has led ecosystems toward irreversible damage levels, threatening various interconnected natural domains. Industrial capitalism and the corporate drive to both mechanize the workforce and deny the remaining workers acceptable wages and working conditions have a primary role to play in the pursuit of higher margins. For these reasons amongst many others, it is imperative to establish a new concept of economy that revolves around sustainability and one such mechanism that has been suggested is «Radical Transparency» in the production chain (D.Golemann, «Ecological Intelligence», 2009).

Transparency provides, for corporations and consumers, the necessary awareness to make informed purchasing or business decisions: consumers will have the option to lead a more responsible lifestyle and this will incentivise the industry to offer more sustainable alternatives. Numerous eco-labels and standards exist today. However, they offer fragmented coverage and sometimes can even generate confusion especially amongst consumers and thereby cause an inability to act decisively. Therefore an overall platform is necessary to reconcile these issues - a common language or framework that could link all stakeholders in production chains - ultimately building the path to a sustainable economy.

The solution we propose is built across two main categories, «People» and «Earth» and involves various criteria across socio-environmental domains. A complete multi-stakeholder process was conducted during the course of over two years, using input from institutions, non-profits, commercial and governmental sectors to produce the «People 4 Earth Global Sustainability Standard.» The common language of the Standard is built upon four pillars:

- Pure (health and safety, authenticity, transparency),

- Fair (workers' rights, education and personal development, fair trading practices),
- Life (biodiversity, animal welfare, natural resources conservation),
- Renew (energy and GHG reduction, waste reduction, clean air, water and soil).

Under each pillar, a set of principles articulates the essence of the concepts in relation to the sustainability of products and companies. The Standard has been designed to be applicable to all products and services, and becomes increasingly specific when applied to each product category.

Having published the Standard in April 2010, we had the possibility to test its practical implementation as a framework, and to collect feedback from a few pilot projects (conducted with major Dutch retailers) and from the academic sector (feedback from conferences such as ERSCP-EMSU and CSR-Asia). This experience granted us critical insights towards identifying ways to improve our primary framework (the 'Standard') and create a platform of communication that is accessible to businesses and consumers. This in turn can allow for more consolidated leverage in realizing a higher demand and quality of sustainable products and services.

Since 2010, People 4 Earth developed a product supply chain tool that allows for transparent management of a company's product at every level. A current practical implementation of the People 4 Earth framework is the Sustainability Accounting Management System (SAMS). This online tool offers a common platform where all companies can assess their sustainability by filling in a questionnaire, based on the People 4 Earth framework. Sustainability, especially with respect to business, is an ambiguous term that leaves companies confused about where to begin evaluating their own products or what the most relevant issues are. Therefore the framework can provide a reference point from which companies can evaluate their sustainability performance and forge a plan to improve it effectively.

SAMS automatically tunes the self assessment depending on industry sector, product type and other background information of each specific company. Since the framework is built upon commonly accepted standards and certifications, these are also harmonized in the self-assessment, so that companies already awarded with a specific label do not need to enter the same information again.

From the primary producer through to the brand owner, each step is taken into consideration reported through the SAMS. This has recently been implemented through pilot projects with major Dutch retailers.

The most recent release of the SAMS is based on the same IT platform that is used by major certification programs and supply chain management systems. This facilitates integration of different standards as well as the sharing of information along the supply chain. In essence, the People 4 Earth framework "connects the dots" among existing product labelling and certification schemes so that the process can be more efficient for companies and more comprehensible to consumers.

Evaluations were sent to all suppliers who participated in the pilot projects. From these, valuable insight into the needs of the industry and their subsequent levels of understanding of sustainability issues was gained. In the future we hope to customize the depth and type of assessment preferred depending on the company scope. Here are some key challenges for the path ahead:

- Correct classification of each stage in the supply chain – i.e. the scope of the company
- Establishing universal nomenclature in supply chains
- Interpretation of the questionnaire and guidelines
- Ensuring the integrity of a product chain

All actors in a particular product chain are required to fill out the self-assessments. The introductory screen asks each of them to identify themselves as one of the following seven groups: Primary producer, Auxiliary Services, Processor, Logistics, Packaging, Brand Owner, and Retailer. However not all of these terms are recognisable, and/or applicable, to all of the necessary parties and may be too limiting. This highlights the fundamental need to establish a common language in this regard.

The phrasing of the questions can still be misinterpreted depending on the intended audience despite our best efforts to unify the language and meaning. Finally we must ensure that each member of the product chain has a unique identification code yet maintains its "heritage." This means that no matter the number of suppliers for a given product, they must all align correctly to the same parent product, thus maintaining the integrity of the product chain.

Once roles have been identified in the product chain (via a classification system) the assessment can begin, with each link in the chain completing their part in the assessment (and that of their immediate suppliers if possible/applicable). Concurrently, verification should occur throughout these assessments and following are three proposed mechanisms.

The first is through direct supplier engagement using a so called “level-up/down” verification system. Whereby, two very similar assessments are sent to the 1st and 2nd tier suppliers of a particular product chain. Both parties are required to include some information regarding their immediate suppliers independently into SAMS. Where the data matches can then be verified and where it does not can now be analysed as to why not.

A second mechanism is via an independent 3rd party verification, a more expensive approach but one that is traditionally recognised.

Finally as more products become transparent, more data will be available to do a comparison with market averages. This way, anomalous results can be identified, providing an opportunity for particular companies in the product chain to be aware of how they are performing and make improvements where necessary, as this has implications on the final product upstream and beyond.

One of the most significant conclusions that can be drawn from the pilot projects is that companies have limited knowledge about sustainability. That is not only because a holistic coverage of sustainability is difficult to attain or implement nor due to resource availability. It is also due to a conventional way of thinking concerning profit which fails in light of the *new* concept of economy as mentioned in the introduction.

On the other hand, some companies already employ relevant and well-established methodologies that address similar issues (e.g. Environmental Impact Assessment, Life Cycle Assessment (LCA), ecological or carbon-footprint, Risk Assessment, etc.). Therefore a harmonizing sustainability system should make use of this knowledge and aggregate it all into one platform. LCA, for example, can be simplified and integrated into such a system, highlighting “hot-spots” in the production chain while leaving aside controversies that exist for more subjective assessment methods. This way companies will see their true impact on society and environment, enabling them to establish a roadmap to tackle these issues.

Other societal aspects of sustainability, while equally important in the eyes of stakeholders, are more difficult to quantify. Contributions from the Social LCA Methodology (e.g. Unep/Setac, K. Benoit) are a clear step in the right direction. The value in the People 4 Earth concept is that it aspires to create a versatile framework that can assimilate various types of information regarding sustainability, while interfacing with existing standards and certification schemes as mentioned earlier.

One should not overlook the fact that one of the main reasons that companies do not take the leap of using such methodologies is their complexity and pre-requisite expertise. An integrated system such as People 4 Earth that is based on simplicity and compatibility will help accelerate improvements in sustainable performance and stakeholder value for companies of all sizes.

# Corporate sustainability and investment, with a developing country focus

Pontus Cerin, Peter Dobers & Richard Welford

## Oral Presentations

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### **The Property Value of Energy Efficiency in Swedish Housing**

Professor Rob Bauer, Maastricht University, the Netherlands

Associate Professor Pontus Cerin, Umeå School of Business, Sweden

Assistant Professor Nils Kok, Haas School of Business, University of California at Berkeley, USA

Do homeowners in Sweden capitalize information on energy efficiency – including energy labels, heating and insulation measures – into the price of their prospective home?

The aim is to explore the economic implications of energy performance, as specified in the mandatory Energy Performance Certificates – read energy declarations – at the time of sale of private houses in Sweden. The outcomes of this research are important for making informed policy decisions that aim to stimulate investments in energy efficiency improvements of the housing stock, as a well-functioning private market substantially enhances returns to such investments. This study also offers the potential to include other aspects of "green building," such as the type of energy consumed, suggested costs for energy improvements, heating technology, materials and radon.

According to the Lawrence Berkeley Lab of the US Department of Energy (LBL, 2009), buildings account for about 40 percent of total U.S. energy consumption and greenhouse gas emissions, approximately costing USD 350 billion per year. More than half of these emissions derive from residential properties. Accordingly, the private housing market constitutes an important pillar for successfully cutting down on society's anthropogenic contribution of substances with global warming potentials to the atmosphere.

The major share of the energy consumed in residential homes is heating, followed by water heating, lighting, cooling and refrigeration. Consequently, heating, including insulation of the house constitute an important aspect to explore, especially in a Nordic country like Sweden. Also, information on energy generation technologies that lowers the costs of heating and the estimated costs for energy improvements will be accounted for in the assessment.

Information on Swedish energy declarations/annual survey results, for example on the energy consumption per building and building technology, can help to provide insight in the economic implications of their energy performance, per house class, will be explored.

Investors in property, especially private individuals owning their home, will be able to use the projects' output in establishing a long-term investment strategy with respect to energy efficiency of their property. The project will shed light on the relation between implemented energy technology, technology improvements (generation or insulation) and the value of homes (controlling for age, location and other characteristics). The outcomes of this research are important for making informed policy decisions that aim to stimulate investments in energy efficiency improvements of the housing stock, as a well-functioning private market substantially enhances returns to such investments. Moreover, the insights can be used to engage with property funds (public and private) on issues related to energy efficiency and other ESG-related factors.

### **Challenges of venture financing sustainability business innovations in built environment**

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The climate change mitigation is one of the greatest challenges of sustainable society. Climate mitigation has boosted the fastest growing new investment market in the world with over 140 billion dollars yearly investments (Bloomberg 2010). Inside the market, built environment and especially the real estate and construction (REC) industry is assessed to offer a

wide scope of opportunities for cost effective sustainability business innovations (SBI) – innovations that bridge the gap between business, social, and environment actors to achieve sustainability. Perhaps the most challenging aspect of the climate mitigation is the short time frame for corrective actions, specifically in built environment for example to produce almost zero energy buildings by year 2021 – in ten years.

Paradoxically, the latest research suggests (Kajander et al 2010) that despite the sustainability opportunity there is little SBI activity in REC industry. In particular, there is a lack of fast customer-oriented radical innovations that are expected at the moment in sustainability markets. In spite of this, the very few radical SBIs already in the market have great difficulties in raising funds from potential investors (Rennings 2010).

A potential key aspect of the innovation dilemma in REC industry is the lack of venture capital (VC) finance that could facilitate and accelerate the commercialization phase of the SBI process. Earlier research has documented VCs role as key equity financiers and catalysts of innovation (e.g. Gompers and Lerner 2000), recognized importance of green VC for SBI in terms of market development competencies and long-term ownership committed to sustainability (e.g. Scholtens 2006), and explored the issues in VC investing in SBI such as the disparity between the time orientation of sustainability and traditional VCs, lack of VC sustainability expertise and eco-entrepreneur's business skills, and regulatory authorities (Rennings 2000, Randjelovic et al. 2003, Moore and Wüstenhagen 2004). However, although VC seems to be an essential part of a successful SBI process, it has not been discussed in REC industry innovation context and literature (e.g. Slaughter 1998, Manley 2008).

The purpose of this paper is to identify the key challenges of venture financing for SBIs in built environment. In order to capture the industry-specific factors at play in the financing ecosystems for SBI in built environment, empirical data was collected through a two-round interview and case study process.

In round-one, the data was collected through theme interviews in five VC and financing expert organizations that invest in SBIs in built environment. The target of these interviews was to find out what are the key challenges of venture financing SBIs in REC industry. The challenges identified from earlier literature were used as grounding structure of theme interviews. All the interviewees were at top managerial and board of directors -level. Three interviewed experts come from venture finance organizations based in Finland that have altogether over 480 Meur of funds allocated in investments in SBIs in built environment. In addition, two interviewed professionals are leading venture investment experts at REC industry and academia.

The round-one interviews suggested that the key challenges to VC investor investing in SBI in built environment are complex value networks, team-building, and long-term R&D required for SBIs. All of the respondents in round-one interviews stated the complex REC industry value network as the key barrier to VC investment in SBI. Taking new SBIs, especially radical, to market is difficult due to REC industry fragmentation. Multiple stakeholder commitment and acceptance are required to go further in the innovation process. Team-building was also brought up by every respondent as a problem especially in terms of lack of innovation management competences and lack of people with drive for development in REC industry. Moreover, the interviewed experts underlined the long-term research and development (R&D) background of many SBIs as a barrier to VC investments. All respondents expressed that start-ups in built environment are still often product-based and the product cycle is longer than service-oriented innovations such as “dotcoms”.

The round-two interviews were conducted around a case study by interviewing the chairman of the board and CEO from two successful growth companies based in Finland, which have created award-winning SBIs with high global market potential and managed to raise venture financing from both private and public sector VC investors. The case company A develops radically innovative modular products for new building and repair projects and case company B provides REC industry LCM design methods, software products, and related services.

The round-two interviews revealed that while the case companies had received valuable contribution from VCs in terms of expertise and networks, the three challenges identified in round-one interviews – complex value networks, team-building, and long-term R&D – were present at different stages of the case companies' fundraising process and business development. The respondents described several business practices the companies had developed to enable company growth and attract VC investments.

To tackle the complex value network issue, the case company A had developed a value network management strategy that consists of three components: 1) a tool to partner with the innovation-oriented players in REC industry, 2) a multichannel communications plan inform and convince building users, owners and developers on their innovation and it's business logic, and 3) a systematic approach to influence the public bidding processes in advance. Moreover, case company B utilized an ownership strategy to motivate its main stakeholders to develop company's innovative offering and create win-win-win situations to accelerate the diffusion of its innovations within the REC industry.



The team-building challenge was addressed in both companies by focusing on creating a core team of 10-15 multidisciplinary experts and exceptional enthusiasm – mania – to take the company first to local markets, convince the investors, and then to global markets. Both case companies' SBIs have required long-term R&D and related risks and investor doubts have been managed through a commercialization strategy with multiple routes – manufacturing, licensing and spin-off creation – to markets.

An interesting aspect brought up by the respondents was the fact that a SBI company operating in built environment needs to find the right kind of VCs, who value and are experts in sustainability contributing to the development of the company and invest in longer-term industrial renewal.

The main findings of this paper suggest that venture financing for SBI in REC industry has great unleashed potential, which is currently constrained by the challenges related to complex value networks and team-building in REC industry and long-term R&D required for SBIs.

Based on the empirical observations in this paper, it would seem that the key venture financing challenges for SBI in REC can be addressed. It seems beneficial to SBI companies to target their fundraising at the right kind of VCs that have expertise and patience relevant to SBIs, and give more attention team-building, value network management and commercialisation strategy. In addition, new SBI screening, due diligence, market analysis and business development tools for VC investors need to be developed in order to improve measurability of SBI returns and to enable better hands-on management support to SBI companies. In turn this would enable the SBI companies to better attract venture finance from specialist VCs.

In future, it would be highly interesting to study further the role of VC in creating SBIs in built environment. Moreover, more research attention should be given to the fundraising strategy of SBI companies and sustainability investment tools for VC investors.

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## Investments and Energy Efficiency in Colombian Manufacturing Industries

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This paper investigates the effects of investments on energy efficiency performance using data from Colombian manufacturing industries. These industries were analysed as a whole and as energy intensive sectors (EISs) and non-energy intensive sectors (NEISs) between 1998 and 2005. Using a simple factor demand model, we estimate the structural parameters of the model using both time-series and cross-sectional dimensions of the data, and we include the effect that investments have on energy efficiency in Colombian manufacturing industries. The results showed that in Colombian manufacturing industries overall, as well as in NEISs, the main variables that determine energy efficiency performance are energy prices, machinery and equipment investments and foreign investments. Whereas electricity prices show lower significance levels, investments in research and development (R&D) are not statistically significant. In contrast, for EISs, only energy prices and foreign investments are statistically significant. Therefore, these results demonstrate the close relationship between energy prices and investments with respect to energy efficiency improvements in Colombian manufacturing industries. These findings have important implications for policy makers aiming to encourage governments to adopt strategies that combine energy prices and technological change, as well as those policy makers wishing to strengthen foreign investment in order to improve technology development, productivity and energy efficiency in manufacturing industries.

The model is applied to inter-sectoral data from Colombian manufacturing industries from 1998 to 2005. The study covers all industrial sectors and EISs at three digits of aggregation level as well as NEISs at two digits of aggregation level. EISs and NEISs were identified by taking into account German energy tax law and by using cluster analysis.

To analyse the effects of investments on energy efficiency, a factor demand model is estimated. Taking advantage of both time-series and cross-sectional dimensions of the panel, the model was estimated using a panel model with fixed effects for industry as a whole and EISs and with random effects for NEISs.

Data necessary to conduct econometric analysis include energy consumption (Et), gross output of production (Yt), the price of electricity (PEI), the price of energy (PE), production price (Pt), machinery and equipment investment (IMQ) R&D investment (IRD), foreign investment (IF) and total investment (It). These data were provided by the Departamento Nacional de Estadística (Colombian Department of Statistics, or DANE) and the Unit of Mines and Energy Planning (UPME).

Between 1998 and 2005, manufacturing industrial energy consumption in Colombia has increased 6%, while the gross production of Colombia's industrial sectors has increased 127% over the same period. The average inter-annual variation rate is 16% for gross production and 0.75% for energy consumption. The behaviour of energy intensity has been relatively homogeneous, with the decreasing trend a result of improvements in energy efficiency (UPME, 2007).

During the sample period, the investments in Colombian manufacturing industries increased more than 50%; these investments were particularly focused in machinery, equipment and buildings. In addition, foreign investment showed consistent growth for the sample period; these investments encouraged the diversification of the economy, job creation and new opportunities for technological transfers. Moreover, energy intensity decreased in Colombian manufacturing industries.

The estimation results for Colombian manufacturing industries for three estimations (i.e., all industrial sectors, EISs and NEISs) as well as for the explanatory variables show similar results, and the energy prices and foreign investment variables have a statistically significant effect on energy intensity. However, R&D investment is statistically insignificant. For Colombian manufacturing industry as a whole and for NEISs, the main variables determining energy efficiency performance include energy prices, machinery and equipment investments and foreign investments, whereas electricity prices show lower significance levels. R&D is not statistically significant. In contrast, for EISs, only energy prices and foreign investments are statistically significant; electricity prices show a negative effect on energy efficiency, but it is not statically significant.

The results indicate that a close relationship exists between energy prices and investments not only with respect to the improvement of energy efficiency, but also regarding additional benefits such as increases in productivity and competitiveness in Colombian manufacturing industry.

These results have important implications for policy makers, focusing their attention on the manufacturing industries of developing countries. The results suggest that such policy makers should encourage governments to adopt strategies that adequately combine energy prices and technological change by promoting technology transfers through an appropriate enabling framework.

In this paper, the effects of investments on energy efficiency performance were investigated using data from Colombian manufacturing industries; these industries were analysed as a whole and as EISs and NEISs between 1998 and 2005.

The results indicate that for Colombia's manufacturing industry as a whole and for NEISs, the main variables that determine energy efficiency performance are energy prices, machinery and equipment investments and foreign investments, whereas electricity prices show lower significance levels. R&D is not statistically significant. In contrast, for EISs, only energy prices and foreign investments are statistically significant; electricity prices show a negative effect on energy efficiency is not statically significant. Therefore, energy prices and investments have a close relationship not only with improvements in energy efficiency but also with additional benefits such as increased productivity and competitiveness.

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## Corporate Sustainability and Shareholder Wealth

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Word sustainability has undergone a long way in the past years – from the Club of Rome's Report "The Limits of Growth" presented in 1972 to widespread existence in contemporary business world and public agenda around the globe.

Many market participants now pay close attention to firm's environmental, social and financial (ESF) or corporate social responsibility (CSR) policies. No company or industry can afford to ignore changing external social conditions, natural resource management pressures, and rising expectations for long-term financial policy implementation. Activities in the above mentioned areas that entail a short-run cost to achieve an appropriately greater shareholder gain and profitability in the long-run are therefore not a departure from the economic objective and conduct of the corporation.

Addressing sustainability issues at the micro level requires well defined and measurable concept of corporate sustainability (CS). Scholars and practitioners often treat CS and CSR as being nearly synonymous. This is common misunderstanding - these two concepts have different backgrounds and different theoretical paths. This paper provides new way of corporate sustainability assessment as a combination of proper management of all major areas of firm's activities – financial, social and environmental – at the same time. In order to achieve sustainability the company must be able not only to overcome conflict of goals between the above mentioned areas but also to implement appropriate tools which enable this multidimensional concept to become a matter of corporate management and core business strategy. From the financial perspective it means that assets and revenues growth is balanced with corporation's operating and financing policies. Environmental perspective means that company includes ecological aspects in all its core competencies. Implementation of coherent environmental friendly management system (EFMS) is necessary. Social perspective can be described as an achievement of business goals in the way that meet ethical standards and respect identifiable stakeholders welfare. The corporation must be able to develop internal processes that ensure that these values are supported and promoted within its business activities.

The conduct of business activities with a view to enhancing corporate profit and shareholder gain is the canonical objective of the corporation. This does not mean that above target must be realized in the short-run period. The opposite is true. Long-run profitability and shareholder gain are at the core of the economic objective. Activities in the areas of social, environmental and financial aspects of corporate sustainability that entail a short-run cost to achieve an appropriately greater long-run profit are therefore not a departure from the core economic objective of the firm. Many authors have argued for this much wider view. Numerous studies have empirically examined relations between firm's environmental, social and financial policies and maximization of shareholder wealth. However, the results of them are highly fragmented and unequivocal. This paper attempts to fill a gap in the ongoing debate on the impact of corporate sustainability on shareholder wealth.

In this study we made an attempt to establish a measurable concept of corporate sustainability, which covers all major areas of firm's activities at the same time. This concept can be seen as a transfer of the overall idea of sustainable development to a business level. Using our corporate sustainability criteria for S&P 500 firms, we build a sample of 85 sustainable companies. We then analyze the empirical relationship between corporate sustainability and selected aspects of shareholder wealth in the years 2006-10.

We examine these relations in a sequence of six hypothesis. First, we attempt to ascertain if implementation of sustainability into corporate strategy leads to abnormal returns (Hypothesis 1) and lower stock price volatility (Hypothesis 2). Then we try to find out if corporate sustainability is related to comparable revenues growth rates (Hypothesis 3) and lower revenues growth volatility (Hypothesis 4). Finally, we attempt to find some evidence on cyclical patterns of investment in sustainable companies within usual stock market cycle (Hypothesis 5). We also examine if implementation of sustainability into corporate strategy leads to different economic crisis resistance (Hypothesis 6).

An investment strategy that bought firms with CS would have earned abnormal returns of 7.4 percent per year during the sample period. We find that firms with balanced financial, social and environmental activities had comparable revenues

growth, lower growth volatility, and lower stock price volatility. These results are consistent with the idea that firms benefit from investing in corporate sustainability and that these practices are reflected in their stock prices. The results also indicate that investment in sustainable companies do not show anticyclical patterns within usual stock market cycle, however it is connected with higher stock market crash resistance. The empirical evidence of this paper is particularly pronounced for public firms that consider to implement sustainability into core business strategy. It also contributes to better understanding of this concept in the contemporary capital markets.

In our paper we consider relations between corporate sustainability and selected dimensions of shareholder wealth. Our results suggest that firms and shareholders generally benefit from investing in sustainability. It is also possible that these results, are driven by some unobservable firm characteristic. These multiple causal explanations have different corporate policy and investment strategy implications and stand as a challenge for future research. Our paper can be seen as an attempt to address this challenge.

## **Rightsizing Business: The Need and Means for Corporate Degrowth**

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Sustainability can be observed as a problem complex arising from ecological demands of economic activities exceeding the Planet's carrying capacity. Probably the most crucial economic issue in this regard is economic growth, if it can be decoupled, and what might be alternatives (Alcott, 2005; Polimeni et al., 2008; Alkemade, & Hekkert, 2010). One alternative is given with the concept of degrowth, calling for both physical and economic reduction of human impact on the Earth's natural environment, while at the same time striving for social equity within and across societies of the global North and South (Latouche, 2004, 2010; Martínez-Alier et al., 2010). The main focus within the degrowth movement is on macroeconomic policy and civil society activism. What is missing in the discourse is a clear concept of the role of firms within a degrowth economy and society. This contribution aims at closing this gap and providing for an outline of how degrowth and the firm can be conceptualized by focusing on measures, strategies and organizations for degrowth business models.

First, the connection between economic well-being of the firm, profits and their relation to growth needs to be examined. There are at least two different views on growth and profit (Reichel, O'Neill, & Bastin, 2010). The first view denies a strong connection whereas the second sees direct implications from profits towards growth via interest on lent money for investments. The stance taken in this contribution is on a weak connection between profits and growth that depends heavily on the firm's market environment and its legal form. The minimum condition for economic well-being, the matching of profit and capital costs, will be explained and substantiated by examples for low- and no-growth companies. However, in order to arrive at an idea about the right size of business activities, a robust indicator for ecological well-being of the firm's natural environment has to be developed: ecological allowance (Reichel, & Seeberg, 2010). With ecological allowance, a measure is exploited that tries to deal with absolute ecological impact of the firm's activities, focusing on carbon dioxide and the budget approach (Messner et al., 2010) and allotting emissions via gross value added. From a small case from a German automotive company, the size of «ecological excess» can be made visible.

Then, out of the two minimum conditions for both economic well-being of the firm and ecological well-being of its environment, a sustainable strategy matrix can be constructed with four context situation. These contexts are (1) rightsize business, (2) ecological excess, (3) economic loss, and (4) eco-eco disaster. Each of these strategic positions implies different strategic moves in order to establish a truly sustainable business in line with both economic and ecological minimum conditions for well-being. Rightsize profits are the long-term sustainable state of a company, when both minimum conditions are reached. In fact, rightsize profits are synonymous with what can be termed as a sustainable business or a sustainable company (Reichel, O'Neill, & Bastin, 2010). Present day corporate strategy is blind towards this type of profit, only taking into account economic well-being and not ecological well-being. For each of the other three context situations, degrowth strategies can be deduced, namely the need for refocusing away from sales (output) to product us (services), but also the new competitive arena of ecological space, in which firms in an ecological economy will compete (Reichel et al., 2009).

However, all of these strategies and even the measure of ecological allowance can run into the trap of efficiency induced growth if not accompanied by a suitable legal form for organizing businesses. Managerial decisions are not taken in a vacuum. They are depending on past decisions, on external opportunities and threats, and of course they depend on the organizational structure of the firm. Hierarchical organizations have different decision processes than non-hierarchical, and family-owned organizations differ from investor-owned ones. Especially the distinction between capital-owners and decision-takers is heavily emphasized in the literature (cf. Hansmann, 1996). At least, three forms for aiding in corporate degrowth can be identified: co-operatives, foundations and low-profit liability limited, as well as combinations of these

and traditional corporations. Especially cooperatives have been associated with a crucial function for society, namely the internalization of market externalities as well as serving as laboratories for social innovation with specific relevance for local sustainable development (Novkovic, 2008; Franks, 2010). All these legal forms remove the growth impulse on a structural level, loosening the connections between growth and profit and ensuring private business beyond the growth paradigm.

Taken together—ecological allowance, degrowth strategies, and legal forms for degrowth—an outline of a conceptual framework for corporate degrowth can be sketched. The “missing link” between macroeconomic policy and economic action for degrowth can be described on the firm level and a new research agenda for management and organization science that goes beyond mainstream corporate sustainability approaches is developed.

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## **Sustainable Banking and incorporating sustainability risks into lending decisions: a global comparative study**

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How do banks report about the integration of sustainability risks into corporate lending compared with their global peers and where are banks generally located regarding sustainability issues compared to their global peers? In this paper we report about the analysis of banks and financial institutions with respect to their sustainability performance.

A number of academic surveys have identified a positive correlation between environmental performance and financial performance (see Margolis & Walsh, 2001; Pelozo & Papania, 2008). Studies have been done on the chain of cause and effect between environmental performance and financial performance (amongst others Bansal & Roth, 2000; Lankoski, 2008) as well as on factors that influence the strength of the correlation (Russo and Fouts, 1997). Other scholars suggest that a positive environmental performance can be associated with neutral to positive economic (amongst others Schaltegger & Figge, 2000) or financial performance (amongst others Elsayed & Paton, 2009). On the other hand there are empirical studies that do not show a clear positive relation between sustainability performance and financial performance (see Wagner & Schaltegger, 2003).

A second group of studies analyses the influence of sustainability performance on different equity portfolios, funds or indexes and thus try to bridge the gap between the sustainability performance of a company and the reaction of the financial markets (see Scholtens, 2008).

A third, group of studies concentrates on the integration of environmental and sustainability risks of into credit risk rating. Scholz et al. (1995) analyzed those cases and found an impact on the probability of credit defaults. Based on those findings Weber et al. (2010) found that integrating environmental issues into credit risk management improves credit risk prediction, prevents credit defaults and provides a financial benefit for the lender. Thus the integration of environmental issues into the credit rating process could be interpreted as precautionary action (Coulson, 2009) with respect to both, sustainable development and financial risk. A survey on European banks by Weber et al. (2008) showed that this argument found entrance into the practice of credit management of a number of banks.

The presented research shows that there is an interaction between the environmental or sustainability performance of a firm and the financial risk for a bank or financial institution lending to or investing in a firm. Furthermore, there is pressure

coming up on the financial industry to (1) recognize their responsibility for environmental and sustainability impacts of their borrowers, financed projects, etc. and (2) regulations like carbon markets, or carbon taxes or stakeholder pressure influence the financial risk of borrowers and corporations financed by banks and financial institutions.

We analyzed the ranking of 189 banks and financial services institutions globally with respect to their environmental and social performance using statistical analysis. We conducted the analysis regarding business ethics and product responsibility, labor issues, environment, human rights and corporate governance.

The statistical results showed that banks from Asia-Pacific performed significantly lower than those from Europe with respect to their overall sustainability performance. North American Banks performed significantly higher than European and Asia-Pacific banks regarding business ethics and product responsibility. While European banks performed significantly higher than banks from Asia-Pacific concerning labor issues, performed higher than their North American counterparts regarding environmental sustainability and significantly higher than Asia-Pacific banks concerning human rights issues. Corporate governance is the only sustainability section where we found differences between all three regions. The best performing banks are from North America, before Europe and Asia-Pacific.

Furthermore we analyzed the integration of environmental issues into credit risk management processes. Globally only a minority of banks (32.8 per cent) reported about the integration of environmental risks into the lending business.

Thus the results suggest that there are significant differences in the sustainability performance of banks and financial institutions in different world-regions. Many of these institutions take sustainability issues into account, but it seems that a strong connection to their core businesses like credit risk management is still missing.

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## Evaluating the Environmental Performance of Suppliers: A Case Study

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Measurement of supplier performance is a commonly-cited challenge to the integration of environmental issues in the supply chain [1- 4]. Organizations from around the globe have struggled to develop robust supplier evaluation models. The literature provides few examples of existing performance evaluation models and tools that cover green practices [5 - 7]. Supplier evaluation models that take into account environmental criteria can help organizations link supply chain and corporate environmental strategies, and communicate them at inter-organizational and intra-organizational levels [8- 11]. However, in order to be useful, such models must be modified to the circumstances and needs of the individual corporation. The purpose of this paper is to present a model for evaluating the suppliers of a major Canadian electric utility on the basis of environmental criteria. Although the case utility has thousands of approved suppliers, environmental criteria are not currently an explicit part of their selection and evaluation. The methodology, results, and conclusions are briefly presented below.

The development of the supplier evaluation model at the case utility consisted of four key steps: (1) conduct detailed process planning, (2) develop a draft supplier evaluation model, (3) test and adjust the model, and (4) integrate the model with existing infrastructure. Details on each step are provided below.

The first step focused on developing a detailed action plan for the development of the model. Key issues addressed included: (1) Who needs to be involved in this process? (2) Who will use the model? (3) How will the model be used? (4) What types of supplier evaluation frameworks are currently available? (5) What are the major gaps in the existing evaluation system? (6) What other indicators, standards, and/or evaluation criteria should the model include? (7) What are some of the key challenges anticipated? This step required several consultations with internal experts at the case utility. These experts represented the corporate supply chain, commodity sourcing, demand planning, and sustainability departments. During the initial consultations, particular attention was devoted to identifying the key internal stakeholders that must be consulted at the case utility, and the timing and level of involvement for each identified stakeholder.

The second step focused on the development of a draft supplier evaluation model. The development of the draft model involved completion of six sequential tasks: (1) identifying preliminary key priority areas through a review of Canadian corporate sustainability reports, (2) tailoring the key priority areas to the case utility, (3) preparing a model prototype with draft indicators, (4) normalizing the indicators, (5) weighting the indicators, and (6) presenting the results in an automated Excel spreadsheet. Each task involved extensive consultations with 8 internal experts. These experts represented the corporate supply chain, commodity sourcing, demand planning, and sustainability departments.

The third step focused on critically reviewing the draft model. This was done through consultation with 10 key internal experts representing the corporate supply chain, commodity sourcing, demand planning, and sustainability departments. The agenda items for the consultations included the following: (1) introduce the model and brief the participants on the rationale, (2) demonstrate the application of the model to two of the case utility's major suppliers, (3) have the participants conduct a pilot test of the model with one of the company's major suppliers, (4) obtain feedback from the participants to provide a basis for further refinement of the model. Based on the feedback received, the model was updated.

One of the key considerations throughout the development of the model was how it related to existing internal infrastructure at the case utility. A final consultation was conducted with an expert from the utility's sustainability department to discuss how the model may be incorporated into its existing decision-making processes.

The key finding from the first step was that, although the case utility employed a variety of supplier selection criteria on areas such as health, safety, and quality, no tool or model to evaluate the environmental performance of its suppliers existed. Therefore, a practice-oriented, objective model that was applicable to all of its suppliers was needed. The model would be used by buyers, commodity specialists, material analysts, and contract engineers in the company during supplier selection, preparing and maintaining supplier contracts and agreements.

The development of the draft model was supported by an extensive review of published literature, including a content analysis of over 100 Canadian corporate sustainable development reports. Over thirty environmental indicators were considered for inclusion in the model. Based on a series of consultations with internal experts, 10 key indicators were ultimately incorporated into the model. The indicators were organized around 3 key themes: (1) environmental strategy, (2) environmental impact, and (3) environmental management. The first theme included 4 indicators, the second included 5 indicators, and the third included 1 indicator. Using the budget allocation method, weights were assigned to the indicators based on consultations with the internal experts. A prototype of the model was developed in Microsoft Excel, with the results being visually presented in radar plots and column charts.

Following the development of the draft model, the model was critically reviewed in consultations with 10 key internal experts to finalize it. The consultations resulted in several requests related to the weighting of the indicators, the application of the model in practice, and the presentation of the model in Microsoft Excel. All of the comments received in the critical review were addressed in the final, updated version of the model.

The final step in the process was identifying the ways in which the model could be integrated with the existing infrastructure in the case utility. Consultation with internal experts resulted in identifying two key points. First, it was recognized that the company needed to obtain the majority of buy-in at the director level of all business units within the supply chain department since that is where the model would ultimately be owned. Second, it was suggested that the application of the model would need to be phased in over time, starting with high-volume suppliers.

The potential benefits of the model to the case utility are wide-ranging. The development of the supplier evaluation model that specifically addresses environmental criteria will: (1) provide a means of evaluating the case utility's thousands of approved suppliers on the basis of environmental criteria, (2) provide stronger justification for green procurement-related decisions, (3) help further link environmental issues with other strategic initiatives in the company, (4) further

demonstrate the utility's commitment to the Canadian Electricity Association's Sustainable Electricity Program, and (5) enhance accountability to stakeholders through the provision of greater transparency on supply chain issues. Given the increasing need for corporations to address sustainability issues, the model will also provide a needed example for other organizations on incorporating environmental criteria into the management of their supply chains. Further, the model will address a key gap in the academic knowledge base related to the measurement of environmental issues in the supply chain and provide a basis for future studies.

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## Does it pay to be Clean? Evidence from the global Renewable Energies equity indexes

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The growth of Renewable Energies equity indexes around the globe has resulted in demand from investors, institutions, and other stakeholders for rigorous scientific research on the financial outcomes of investing in companies engaged in the manufacturing, development, distribution, and installation of clean-energy technologies such as wind power, solar photovoltaics, biofuels and fuel cells, among others. In response to that need, we analyze the financial performance of the most relevant Renewable Energies equity indexes at a global context and it is compared with the achieved by their market benchmarks. This study represents, on the best of our knowledge, the first attempt to assess the risk-return performance of this type of investment, focused on public companies whose activities demonstrate the greatest potential for mitigating immediate and long-term causes of climate change. In addition, this paper introduces a methodological innovation and applies a state-space Capital Asset Pricing Model in order to allow Renewable Energies equity indexes systematic risk to vary over time. This provides crucial information for carrying out accurate active investment strategies. The main results indicate that, in general, there are no risk-adjusted returns penalties as a consequence of investing in these environmentally-oriented equity indexes. Furthermore, the risk levels experienced by the Renewable Energies stock indexes are lower than the obtained by their benchmarks. This result refutes the principles established by Modern Portfolio Theory, which predict negative financial consequences of investing in Renewable Energies Equity indexes and Socially Responsible Investment in general. In this line, the results of this work do not support the frequently expressed hypothesis that there is a risk disadvantage of investing in alternative clean energies resources. These results have some important implications both for investors and the stakeholders in general because they have the opportunity to fit their ethical values and principles with their investment strategies without being financially penalized and contributing to the environmental preservation and social well-being.



### Ecosystem Approach to Impact Assessment of Activities of the Oil Industry on People of the Niger Delta

Omolara Comfort Adedoyin

The complex interaction of economic, social and cultural determinants presents a challenge for developing a holistic comprehension of environmental degradation and its impact on humans. Studies on activities of oil industry have used unidimensional approach which provided insufficient representation of impacts on the people. The ecosystem approach recognizes the inextricable links between humans and their biophysical, social and economic environment to define and evaluate the priority determinants of human well being. The impact of activities of the oil industry on people of the Niger Delta was investigated using the ecosystem approach.

Edo and Delta States were randomly selected out of the eight states in the Niger Delta. An urban community, Warri, where oil refining activity is undertaken, was selected, while four rural communities where oil exploration is conducted were, also, selected based on the 4 major oil- producing companies in the two states. Using a map, 7 out of the 14 cluster areas making up Warri metropolis, were randomly selected from which 10% of 1,670 households were randomly selected. In the rural areas, 50 households were randomly selected from each community and a respondent randomly selected per household resulting in 367 respondents. Eight Focus Group Discussions (FGDs) were conducted for men, women and youths and 6 In-depth Interviews (IDIs) for community leaders. Parameters measured included Perceived Health Status (PHS), Livelihood Activities (LAs), Social Interaction with oil companies (SI), Perceived Environmental Quality (PEQ), and Perceived Impact of Activities of the Oil Industry (PIAOI). Data were analyzed using descriptive statistics, Pearson correlation and Linear regression model.

The educational qualifications were similar in both rural and urban areas with 33.5% and 38.3% having post secondary education respectively. Similarly, 70.0% and 64.7% of urban and rural respondents were married respectively, and the mean age was 40.3years, (SD + 3). Major LAs of the respondents were oil industry employment, 26.3% in the urban, while fishing 34.0% and farming 29.5% in the rural areas. Fifty-nine percent urban and 65.5% rural respondents perceived air and water pollution respectively as major environmental impact of activities of oil exploration. Furthermore, 61.7% urban and 67.0% rural respondents indicated community agitation as a major cause of establishment of community projects. The FGDs corroborated this by citing community projects in rural areas and development of infrastructure in urban areas. The major perceived health problem from activities of the oil industry was malaria attack by 26.9% urban and skin nodules by 22.0% rural respondents. Significant relationships existed only in rural areas between LAs ( $r = 0.31$ ); SI ( $r = 0.32$ ); PEQ ( $r = -0.18$ ); PHS ( $r = -0.40$ ); and PIAOI ( $p < 0.05$ ). Significant contributions ( $R^2=0.28$ ) of PIAOI were from LAs ( $\beta=, 0.21$ ), SI ( $\beta=, 0.23$ ), and PHS ( $\beta=, -0.31$ ), in rural areas, and ( $R^2 = 0.05$ ) only from PHS ( $\beta=, -0.198$ ), in the urban area ( $p < 0.05$ ).

Oil industry activities affected people's livelihood activities and social interaction in rural areas, but affected perceived health status in both rural and urban areas.

### Green buildings and organizational changes in the construction processes

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International programs and policies indicate green building as one of the most promising sector for sustainable development. In fact, buildings contribute to one third of global annual greenhouse gas emissions (GHG) and consume up to 40 percent of all energy, primarily through the use of fossil fuels during the operational phase. Moreover, the building construction sector contributes to 5 and 7 percent of USA and China Gross Domestic Product (GDP), respectively, and it represents in any country's economy a wide and important sector. Finally, according to the Fourth Assessment Report of the IPCC, given the elasticity of its requests, the building sector has the greatest and cheapest potential for delivering significant GHG emission reduction for all countries.

Green technologies for buildings are the object of a large amount of research, and materials and products for sustainable buildings already exist worldwide. However, the actual diffusion of green technologies is still low. Many studies have investigated barriers to the diffusion of green buildings, generally represented by economic and knowledge factors.

In this paper green building is considered from an organizational perspective. The research aims at investigating how relationships among stakeholders of building construction processes are changing as the sector is moving towards

successful green practices. The organizational model is described by five features. These are the integration level of a general contractor firm and its suppliers, the specialization degree of a construction firm and a design team, the integration between a construction firm and a design team, the sustainability rates and qualifications of the actors, and the coherence between general contractor and suppliers motivations. The assessment of each feature is based on proxy variables. These are the time and the phase of the process in which a supplier is involved and the frequency of transactions between a construction firm and suppliers, the green building portfolio over the total activities of the design team and construction firm, the frequency of transactions between construction firms and design teams, the percentage of stakeholders with an environmental-related certification, and the similarity degree among their motivations.

Organizational features have been analyzed through structured interviews. The main stakeholders of 20 building projects have been chosen, generally selecting the general contractor, the head of the design team and the main suppliers. The sample of projects is based on residential buildings since the complexity and the fragmentary of this sub-sector makes more difficult the introduction of sustainable practices. Moreover, the sample only includes mean size projects with number of apartments from 20 to 200.

Organizational features have been assumed to be dependent on the greenness level of innovation in the building. This is measured through the number and size of adopted green innovations. The integration level among green and brown innovative technologies is used as control variable to assess the innovations. The paper aims at comparing the organization of traditional and green building processes.

Preliminary results suggest that successful green buildings are obtained through higher integration level between a construction firm and a supplier. Design teams and construction firms with focused portfolio on sustainable projects seems more successful in green building practices. Moreover, the sustainability qualification and successful previous practices often lead to repeated collaborations among the same actors of green buildings. Finally, sustainable rating systems and suppliers' qualification increase the diffusion of sustainable practices improving the mutual understanding about sustainability and the stakeholders' perception of green values.

## **Unpacking Chinese Bilateral Aid to Africa: Motives, Policies, Practices and Potential Impacts**

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Following three decades of per capita growth averaging almost nine per cent annually, China is transitioning from a recipient of official development assistance (ODA) to a major bilateral aid donor and actor on the world stage. Since the establishment of the Forum on China-African Co-operation (FOCAC) in 2000, China has increasingly funneled resources into Africa and has become a major contributor of bilateral aid through its own set of policies and practices. However, China nor recipient African countries are required to report any information of the volume or forms of this bilateral aid. Further, rather than being coordinated by a centralized aid agency, it is dispersed by numerous Chinese government ministries, departments, and state-owned enterprises without a consistent definition of "development aid".

Development scholars are struggling to make reliable estimates of Chinese bilateral aid to Africa. For instance, 2005 estimates have ranged from US\$861 million to US\$2 billion (Brautigam, 2008a; Lancaster, 2007). Regardless of the exact figures, there is a strong consensus that China is rapidly becoming a major development actor in Africa. Any attempt to unpack contemporary foreign aid in Africa thus must examine the motives, distribution, policies, and development agenda of Chinese bilateral aid.

China's approach to economic cooperation with African countries has involved an inter-play between bilateral aid, trade, and FDI. Chinese exports to Africa have risen in value from 3.3 percent of total African imports in 2000 to 13.4 percent in 2009 and Chinese imports from Africa have risen in value from 2.9 percent of total African exports in 2000 to 11.2 percent in 2009 (IMF, 2011). Consequently, China has recently overtaken the United States as Africa's largest trading partner. Chinese FDI outflow to Africa has also increased substantially, from less than US\$25 million in 2002 to US\$351.5 million in 2005 (UNCTAD, 2007). Further, Chinese loans and bilateral aid are sometimes provided as part of bilateral trading agreements. A Chinese US\$2 billion loan in 2004 to Angola for infrastructure reconstruction was part of an agreement in which Angola would supply China with 10,000 barrels of crude oil per day (Christensen, 2010).

On the one hand, China has portrayed its economic cooperation with Africa as one premised on mutual benefit and altruism. On the other hand, critics have tied Sino-African relations solely to China's search for oil security (see, for example, Zweig & Bi, 2005; Jaffe & Lewis, 2002). In an effort to overcome these simplifications, China's interests in Africa can be more accurately attributed to three major factors: resource security, trade and investment opportunities, and forging strategic partnerships to further its political objectives.

First, resource security has become an ever-increasing concern for China, as three decades of near-double-digit economic growth have increased its demand for a wide range of commodities. Natural resource exports from Sub-Saharan Africa to China have grown from just over US\$3 billion in 2001 to US\$22 billion in 2006 (Foster et al., 2008). In particular, oil has accounted for 80 percent of total exports by value from Africa to China from 2002 to 2006 (Foster et al., 2008).

Second, China has recognized that the African continent is ripe with investment and trade opportunities. Bilateral trading agreements have allowed Chinese products to edge out local producers and retailers through low-value consumer products, such as textiles and light industrial products (Alden, 2005). In recent years, high value-added products, such as machinery and electronic products have increased in share, now accounting for more than 50 percent of the total value of Africa's imports from China (Christensen, 2010). From 2000 to 2008, trade between the two regions increased more than tenfold from US\$10 billion to US\$106.8 billion (Lagerkvist, 2009; Alden, 2005). In addition, Chinese construction firms have successfully outbid Western firms for large infrastructure projects all over the continent, making Africa an important market for Chinese construction and engineering firms.

Third, forging strategic partnerships in Africa is important to China since African countries control large blocs of votes in many multilateral settings, such as the World Trade Organization. Further, China has developed partnerships with African countries as a means to promoting its "One China" principle, asserting there is one Chinese state encompassing the mainland (including Tibet) and the island of Taiwan. As of 2006, China maintained foreign embassies in every African country, except for the six that had ongoing diplomatic relations with Taiwan (Christensen, 2010).

In 2006, China's Ministry of Foreign Affairs published "China's African Policy" to provide the various Chinese departments, ministries, and state-owned enterprises involved in this rising bilateral aid, trade, and FDI in Africa with a single set of general principles to which to adhere. Five are explicitly listed: reliable friendship, sovereign equality, non-interference, mutually beneficial development, and international cooperation (Ministry of Foreign Affairs of the People's Republic of China, 2006).

In particular, China's endorsement of the principle of non-interference - refraining from intervening in the internal affairs of another country - has been heavily criticized by traditional bilateral and multilateral aid donors for undermining their efforts to reduce corruption and improve governance in Africa. In recent history, much Western aid has been provided with conditionalities, upholding recipients to standards of good governance, environmental sustainability, respect for human rights, and good economic and fiscal policies.

In contrast to this conditional paradigm, China's model of non-interference places no such requirements on recipients, with the notable exception of not recognizing Taiwan or Tibet as independent countries. Thus, countries with poor human rights records and histories of corruption that are systematically overlooked or rejected by traditional aid donors, such as Angola, Sudan, Chad, and Zimbabwe, welcome Chinese aid enthusiastically (Samy, 2010; Tull, 2006). China's bilateral aid distribution has raised serious concerns in the West that the aid is not wisely spent, in turn placing pressure on China to re-think its policy of non-interference. In addition, it has been argued that China's non-interference policy has not only been inactive in removing corrupt governments, in some cases it has supported and exacerbated situations of corruption and human suffering (see, for example, Samy, 2010; Patey, 2009; Large, 2008).

For a nation looking to be respected as a responsible global power, the challenge for China is to find the right balance between non-interference in internal affairs and the support of good policies for social and economic development in African countries. So far, traditional aid donors have failed to create an open dialogue with China on development aid. The contributions of China and other emerging donors will become increasingly important for achieving the Millennium Development Goals (MDGs) and other development targets; thus, it is crucial that China be incorporated into mainstream development aid discourse.

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## **Southeast Asia: Renewable Energy Investment Strategies**

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Because of the growing population and dispersion of wealth in Southeast Asia, the demand for energy is increasing, as well as a dependency on oil and coal imports. This paper seeks solutions to lower Southeast Asia's carbon emissions, as well as decrease the dependency on energy imports, through renewable energy development. In general, competing in the energy market against fossil fuels is extremely difficult. Renewable energy is still developing and currently more expensive than fossil fuels, creating stiff competition. In Southeast Asia, potential projects face not only competition, but also the daunting tasks of dealing with a lack of universal electric grid infrastructure, no comprehensive transmission system, and in some countries, no extensively developed transportation system.

Significant capital investments are required to establish, complete, and maintain renewable energy projects in Southeast Asia. This paper focuses on developing strategies to promote both foreign and domestic investments with the goal of creating an environment suitable for renewable energy market growth. The strategies will be developed through analyzing government structure and policy, current economic and energy market conditions, renewable energy resource potential, and market barriers in the Philippines, Cambodia, and Vietnam. These three countries have a population growth greater than the global average and a variety of structural characteristics, making strategies applicable to a wide range of countries and encouraging a positive economic impact across the entire region of Southeast Asia.

Each of the three countries has a different governmental structure. Government type has a significant impact on the investing environment either limiting or encouraging market growth based on its involvement in state affairs. For instance, Cambodia's government system is a multiparty democracy under a constitutional monarchy, while Vietnam's government system is a socialist republic controlled by the Vietnam Communist Party. These countries are going to have completely different sources of investment, as well as different processes of how to acquire capital. Other countries in Southeast Asia exhibit similar characteristics to the Philippines, Cambodia, and Vietnam, but these three have relatively underdeveloped technology and legislation, allowing them to have a greater potential for growth.

Certain government policy approaches are more effective than others are. Through evaluating the specific government policies, or lack thereof, strategies for a better investor environment can be developed. Other more developed countries, such as members of the European Union, can serve as policy models. Some policies to be considered are feed-in tariffs, credit trading, and energy efficiency and conservation. The Philippines has already instated some incentives to encourage investment in renewable energy through the Philippines Renewable Energy Act of 2008, but this legislation is just the first step. Continued government support will be necessary for further development.

Each country has a different renewable energy resource potential. For example, one of Cambodia's main exports is rice, which has a potential for biomass energy development from the industry's waste. Currently, only about 25 to 30 percent of the harvested biomass is used to create a product, leaving the other 70 to 75 percent to be discarded. This extra biomass could be collected and used to develop biofuel. By evaluating each country's potential, more strategies can be developed to meet investor needs because each opportunity will have a different level of risk, allowing for investors with different risk tolerances to participate in the market.

By also considering both the current economic and energy market conditions, some of the risk investors will have to sustain can be determined. All three countries have a growing energy demand, but the energy supply is growing at a slower rate, which creates investment opportunities. However, there is a greater risk investing in these three countries because their economies are not as developed as other international regions. Developing strategies that address this risk will create a better investor environment.

Only through evaluating each of these aspects will effective strategies be developed and implemented for the creation of a better investor environment and economic growth for the entirety of Southeast Asia.

## **Biodiesel as an alternative to Petroleum diesel- A case study of Hassan district, India**

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One of the renewable energy sources that come to the forefront for replacing if not partially substituting petroleum diesel globally is biodiesel. The hazards such as environmental pollution, global warming, climate change etc. caused by the use of conventional sources of energy like petroleum fuels and coal has already been well documented and proven. To the contrary, biodiesel is a clean fuel that can be produced from both animal fat as well as plant oils (edible and non-edible) by a chemical process known as Transesterification. Further this fuel can be used in existing diesel engines directly or with little modifications and also in generators for electricity production. Since animal fat and other plant based edible oils such as sunflower, soyabean, palm etc. go for mainly human consumption; non-edible plant oils such as *Jatropha curcas*, *Pongamia pinnata*, *Madhuka Indica* etc. are a better bet for biodiesel production since there would be no competition with food. In spite of being replenishable, biodiesel could also provide mainly environmental and economic benefits especially to the poor. This is exactly what needs to be understood by taking the case study of a mega model being developed in Hassan district, Karnataka state in southern India.

However, the introduction of biodiesel as an alternative source of energy is a challenge by itself as it involves a number of factors that are interlinked. These include technical, environmental, economic, social and political factors which need to be integrated in such a way that biodiesel production and its use is sustainable. Sustainability requires answers to a number of questions such as: what are the ideal biodiesel crops, on what kind of lands would these crops be grown, who would cultivate these crops and further extract the oil, what are the benefits and who would get these benefits (men or women or both) and how could they avail of these benefits, how could the biodiesel be marketed, what role could the local/state government play are some of the several important questions associated with the introduction of biodiesel in rural day to day life.

The paper outlines a biodiesel model (in line with India's famous Milk Union model) which indicates how different kinds of land holding patterns of farmers (bunds and hedges of farmers' agricultural fields and the their household backyards) along with different kinds of intercropping practices as well as efficient water usage can help in biodiesel generation and in the process provide much needed income to the farming community mainly focusing the women folk without impacting their basic source of livelihood and at the same time help in substituting for petroleum diesel leading to foreign exchange savings for the country. The biodiesel model takes in to account several factors (mentioned below) and is implemented in four major steps namely initiation of Awareness programmes, provision of Training programmes, setting up of Farmers association in the respective villages and finally monitoring the progress. These activities are carried out by the Biofuel Park, a Government based institution in Hassan.

Hassan is one of the few places where a number of agro climatic zones (5 zones in total namely wet, semi wet, transition, dry and dry with irrigation) are present within its territory. Since each zone is different both in terms of climate as well as the kinds of crops grown and soil fertility, the study involved carrying out surveys and assessing the various factors such as the types of farmers (large, medium, small, very small and landless) and their income, the kind of lands they owned and their area, the extent of waste lands present in different zones, the kind of crops they grow and the places where they can be grown without impacting food production, activities of women and their income and farmers interest in cultivating biodiesel crops.

The study involved choosing villages randomly across the five zones. A questionnaire was prepared involving the above mentioned response factors. One of the major outcomes of the study was the realization of the financial plight of farmers and the various activities performed by women. The project study included 33 villages as a part of the survey.

The study showed that the biodiesel quantity produced depends completely on the crucial participation of both men and women alike as well as the extent of acceptance of biodiesel crop cultivation by the farmers (both men and women) which in fact vary from village to village, apart from the potential areas available for growing biodiesel crops. Thus, the mindset of the farmers (both men and women) as well as the co-operation between the two genders belonging to the same class as well as the different classes of farmers continue to remain one of the major challenges for the success of the model.

Estimating the income potential of the model for Hassan district depends on the sale of the different types of produce such as from biodiesel, oil cake, plant prunings sale and potential carbon savings.

The study also showed that the possible roles that rural women could play in the field of biodiesel are quite vast. The women are versatile and they are involved in harvesting the seeds from the biodiesel plants, de-shelling seeds, expelling the oil from the seeds to ultimately marketing the final produce which could be oil, oil cake etc. It can be thus said that women in the rural areas are best suited to make the model a success.

The final outcome is to depict the approach adopted in determining the extent of sustainable production of biodiesel based on the land availability and the income it is most likely to generate for the farmers of Hassan district by the year 2020 taking into account several factors which form the basis of the model.

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## **Jatropha Plant Based Biofuel as a Cleaner Alternative to Commercial Diesel: A Case Study of Nepal**

Maya Shrestha

Research interest on the importance of *Jatropha* plant based oil as a substitute for commercial fuel and its positive impact on the environment has significantly increased in recent years. The use of such plantbased biofuel especially in developing countries like Nepal, which heavily relies on imported petroleumbased fuel, can be very promising. This can not only reduce the reliance on imported fuel but also provide an opportunity for earning emission credits under Kyoto Protocol's Clean Development Mechanism.

To study the impact of this plant-based biofuel on carbon dioxide (CO<sub>2</sub>) emissions, the transesterified oil from this plant was blended with commercial diesel in varying proportions and each blend was used in turn to run a single cylindrical diesel engine. Tests were done at 4 different load conditions (480 kW, 960 kW, 1440 kW and 1920 kW) and the resulting CO<sub>2</sub> emissions from each blend at each load condition were measured with gas analyzer at the Center for Energy Studies laboratory in Kathmandu.

Our test results showed that CO<sub>2</sub> emission reductions from all three blends: B10 (mix of 10% biofuel and 90% petroleum-based commercial diesel), B20 and B30 relative to commercial diesel without blending were significant. Similarly the emission reduction with B20 and B30 relative to B10 were also noticeable. However the emission reductions with B30 relative to B20 was insignificant, especially at higher load conditions. Our experiment also showed that B20 reduced emissions as much as B30 without much compromising the calorific value found in commercial diesel. Given its commercial fuel consumptions, Nepal could have reduced 7.7 million tons of CO<sub>2</sub> emissions in 2008 had it replaced commercial diesel with B20. Besides, the plantation of *Jatropha Curcas* in Nepal can sequester over 55 million tons of carbon dioxide.

# Local and regional institutions and governance

Simon Bell & Manoj Joshi

## Oral Presentations

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### Decision Tools for Sustainable Adaptation Planning: A Case Study from the Swedish Municipality of Botkyrka

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Decision-making concerning adaptation to climate change often involves choosing between different options, each of which can have important implications for the achievability of other goals and policies. To avoid producing negative impacts on other goals – goal conflicts – local decision makers must have a good understanding of the long- and short-term (environmental, economic, social and ethical) consequences of their decisions. In the Climatools research programme ([www.climatools.se](http://www.climatools.se)) a decision tool – “Adaptation Sustainability Analysis” – has been developed with the aim to help decision makers identify and evaluate goal conflicts that arise in local adaptation work. The tool consists of a simple checklist and a user’s guide. The checklist has two parts. The first part consists of a questionnaire aimed at identifying (environmental, social/ethical, and economic) consequences of different adaptation options and potential goal conflicts therein. The second part consists of monetary valuations of the most important costs and benefits of the different options. A prototype of the tool has been tested in a workshop concerning adaptation in the drinking water sector. The workshop was held in the Swedish municipality of Botkyrka where a regionally valuable ground water aquifer is located – the Tullinge water source. Through an application of the prototype, the participants in the workshop were instructed to evaluate three types of adaptation strategies relating to Tullinge water source: “defend” (involving technical, planning and regulatory adaptation measures), “wait-and-see”, and “retreat”. Preliminary results from the workshop are presented and discussed.

The case study was carried out in collaboration with:

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### The urban sustainable development in European Union through ranking: a tool for governance or a report of territorial disparities

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Integration of environment in urban policies is arisen under multiple forms for more than a century. At the beginning, it was only a question of emphasizing the living environment. For around thirty years, the questions linked to urban environment are more connected to economic growth which characterized the twentieth century and the impact it had on environment. We arrived, in 1987, at the institutionalization of the “sustainable development”, concept with environment as a main element in the same way as economy and social well-being even if the same concept was evoked from the beginning of the same decade. The governance is considered as the fourth element of sustainable development as well as the transversal thematic but its place is just as much dominating as far as it is connected to the politics itself acting on the three main elements of the Brundtland report definition (ONU, 1987).

This concept had to be declined to cities and after setting the sustainable development, concept of “sustainable city” has emerged but it remained hardly obvious to define it because owing to issues of cities. Some authors defined it as an “eco-city” (Register, 1987) or an example of “green urbanism” (Beatley, 2000) but it is a more complicated topic. “Sustainable city” seemed to be an utopia and we could reach this ideal “step by step” through implementation of one or more sustainable development dynamics (Emelianoff, 1999). It could be wiser to develop the concept of “city for sustainability” (Lehmann, 2010) or a “city turning on toward sustainable development” (European Union, 1996).

However, all the cities do not act in a simultaneous way whether it is on the temporal level and of the general action with visible significant differences. Some cities integrate «eco-districts» or “sustainable districts” into their planning policies. Some others bet on the participation of their inhabitants or prefer the environmental performance, for example, by public transportation development, waste recycling or energy efficiency all that with the aim of improving quality of life of the inhabitants but also in the optics of an efficient political communication with the purpose of making sustainable development, an electoral argument. Local representatives would like to demonstrate that a city is active in term of urban sustainability although it often involves considerable differences between rhetoric and reality.

These differences confront at the same time in the action but also in the type of actions developed by cities. We measure it in particular in European Union scale where some cities late set up the sustainability with regard to the ones in the North of Europe. We have chosen many indicators for fifty-three cities of more than 400 000 inhabitants in the aim to estimate the political action, political characteristics and environmental results of these last ones but also, at the same time, to observe the territorial disparities about urban sustainability in Europe, especially in the former Europe of fifteen countries because these ones have seen the beginning of European strategies and have more perspective concerning the results whereas Central and Eastern European countries have integrated European Union later as well as sustainable development which was not the first priority of these countries.

Finally, we could rank these cities as far as their sustainable development policy is concerned, in the same way of other rankings established by environmental or economical organizations in different countries as Sustainlane in United States, Forum for the Future in United Kingdom, Corporate Knights in Canada, the Australian Conservation Foundation in Australia or the Economist Intelligence Unit and Siemens about European capital cities.

Those indicators correspond to the action of cities in favor of sustainability and results of cities about some environmental or sustainability themes which sometimes correspond to diverse logics often independent from the political action. Although several methods are possible to estimate the action of cities, the results are not really different from one method to another one. It is however necessary to underline the difficulty as far as the choice of indicators is concerned which could return these risky interpretations.

We opt for qualitative indicators (binary data), that is to say, if one city has implemented some policies like, for example a local agenda 21, an air quality policy, structures of local governance or a green strategy (bypassing an Agenda 21). We also choose quantitative indicators (statistical data) like, among other things, local transportation fees, solid waste recycling, annual number of pollution days or number of representatives by inhabitants. As far as local officials are concerned, we would also observe impact of “green political parties” members in the local council in the field of sustainability. Indicators are chosen among key issues in European cities and the most common policies viewed in the same cities. It is also fundamental to choose discriminating indicators and those which are too general and viewed in all cities are removed.

After that, we develop statistical treatments about all data concerned, like Principal component analysis (PCA), Correspondence analysis (CA) or Classification, all these methods to gather cities by their profile concerning sustainability. After this stage, we create an overall ranking linked to results on all indicators. Each city earns some points by indicator and we add all results by indicators, therefore, each city obtains a global score through its results which is transformed in a sustainability index.

In the aim to elaborate a ranking, we have two options. The first is to standardize data for indicators being equal and above all, more comparable. The other one is, as other methods existing did, elaborate a ranking for both types of data (qualitative and quantitative) and mix the two ones. Through that communication, we would like to show disparities concerning sustainable urban development on the national, regional and international scale with European examples and that the comparison or the evaluation of the policies of sustainable urban development can give contradictory results because dependent on choice of indicators and on methods of analysis. We can notice that voluntarism would be more consequent in most populous cities because of a higher exposure but the sensitivity concerning environment and sustainability is the result of geographical and above all, political arguments and geographically, urban sustainability is more integrated in the Northern part of Europe and in German speaking-countries. We also observe that the geography of sustainable urban development in Europe doesn't correspond to a regional or cross-border reason but often corresponds to the main political orientations or sensitivities of mayors and local elected representatives. However, we have regional disparities across European scale with some parts of Europe which seem to have a wider awareness than other regions but unlike some ideas, Southern part of Europe is not really less aware of sustainability issues than Northern Europe countries, in each part of Europe we have the necessity to nuance interpretations. After these elements, we could plan a “geography of urban sustainability” across European Union.

Why using this method and why evaluating and ranking cities? We can answer in the following way: we have a global competition between cities and confirm this fact at a more local scale. Being first or well-considered concerning



sustainable development or action for the future is always a real argument of attractiveness for any city. A ranking like this one could be a tool for cities to develop and improve themselves in all fields of sustainability. They would observe sectors where they are weaker than others and where they have to act to become “more sustainable” or “greener”.

This “tool” could help local organizations or more generally, all scales of power, even international in this case, it mainly concerns European Union which skills are really substantial and beyond elaborating reports about urban sustainability and even sustainable development in general (through, for example, the European strategy for Sustainable development elaborated in 2001 and reviewed twice or the Leipzig charter for sustainable cities in 2007), could regulate state, regional and cities policies in this field, in harmonization with its main directions which. It could strengthen cooperation and interaction between different governance scales in the way of increase urban sustainable development policies, as a major topic.

Governance, although it seems not as important as the three main issues of sustainable development, is perhaps the main lever of sustainability because without a strong political awareness and without involving citizens, sustainability would remain a meaningless word.

### **Preserving Village Identity in the city of Georgetown: the case study of Dodol Village (Kampong Dodol) in Penang, Malaysia**

Sharifah Rohayah Sheikh Dawood

Suriati Ghazali

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In the wave of globalization the identity of village is diminishing due to efforts in achieving urban development and national inspirations. Kampong Dodol (Dodol Village) is amongst the traditional Malay village in urban Georgetown, thriving and challenged against Penang’s need for contested urban landscape for more land spaces. Urban areas are popularly viewed as ‘sites of conflicts’ or ‘contested space’ between groups of people with divergent motives in the city. While we must consider the need for spaces for development, an integrated approach towards sustainable urban development with a view on village (kampong) heritage is a must and valuable in our urban jungle. Using Kampong Dodol as a case study, the study focuses on people’s views on sense of place, its heritage value and sustainable livelihoods which influence their opinion on whether and how the kampong should be preserved. As many theorists have noted, places and structures within the built environment provide tangible connection to the past that enables social memory. Tuan’s (1977) view is that place is a space endowed with meaning and value and the role heritage plays is in the construction of a sense of place: heritage as a place, may not only be conceived as representational of past human experiences but also of creating an effect on current experiences and perceptions of the world. Thus, a heritage place in the context of a Malay kampong may represent a place identity and attachment for particular individuals or groups. Only with proper place identity, we would be able to realize that our heritage is part of us and what we do now will become part of our future and that of our future generations. From there we would be able to endeavor to advocate for a sustainable development for a village in a city. Our finding is that the concept of a village as a heritage should incorporate sustainable livelihood model and village identity within the village in the city context that emphasizes place identity, sense of community and place dependence. The collaborative actions between all parties including the city and kampong residents and local authorities are important to preserve the heritage of the kampong.

### **Local and regional institution and governance: Good Governance as a Catalyst for Development—A case of Transformation of a Backward State in India**

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This paper aims to explore the role of regional institutions and governance as a causative factor for sustainable development. The region of study is Bihar, a perennially backward state in India owing huge regional disparity, inhabiting more than 8% of the country population on less than 3% of land. The state has witnessed a major social, political and economic paradigm shift and recorded a phenomenal growth rate of more than 11% in last five year vis-a-vis less than 4% in last decade. For a historically laggard state like Bihar with feudal moorings, plagued with innumerable problems and the presence of aggravators like dysfunctional governance, weeding out persistent parasitic elements of crime, clan, caste, corruption and eventually disseminating the seeds of sustainable development by the previous state government is no less than a miracle. The landslide victory of erstwhile government in recently concluded state assembly election with more than three fourth of majority on the plank of good governance and development, bears testimony to the remarkable work done by previous government under the leadership of Chief Minister Nitish Kumar.

This would be a qualitative analysis including narrative and in-depth interviews with spectrum of people involved with Bihar. The analysis and findings have been presented in four parts. The first part deals with the pitiable past of follies, decades of standstill economic development and the sordid saga of perpetual misgovernance that eventually culminated into drought of growth and stability.

The second part deals with a decisive mandate against last fifteen years of Lalu Yadav led debilitating government, favoring National Democratic Alliance (NDA) and resulted in the accession of Nitish Kumar as the 31st chief minister of Bihar on 24th November 2005. The new government's clear agenda was the creation of enabling conditions for equitable and sustainable society by mainstreaming marginalized. It started with indefatigable pursuit to establish law of land, as Bihar inherited the legacy of misgovernance, the idea of social justice and economic development seemed farfetched without efficacious governance.

For resurrecting the state authority fast track courts were created and between January 2006 to June 2010, 8,000 criminals were flushed out through convictions vis-a-vis 10,000 in last decade 1995 to 2005. The menace of corruption was contained with the introduction of "Bihar Special Court Act", first one of its kind in India. It gave power to investigating agency to confiscate immovable property of public servant enmeshed in corruption. Almost moribund cabinet meetings were regularized and a space was created between people for readdressing grievances through "Janta Ke Darbar"(Court Of People). These small result oriented interventions helped to dispel the miasma of crime, fear and corruption and evoked a sense of safety, security, relief and assurance among the people. The biggest testimony of that is number of foreign tourists visiting the state skyrocketed to 356,000 in 2008 from 95,000 in 2006.

The next notable area has been expeditious creation of the physical infrastructure. In the last four years road expenditure increased by tenfold and road construction by six fold. The all weather roads boosted rural connectivity, gave market access to 90% rural folks for their farm related perishable products, lessened school dropout rates, integrated the public healthcare, increased real estate value. It also bodes well for food processing industry, a next big step for making Bihar a food processing hub.

As floods and droughts have been continually ravaging Bihar, a full-fledged Disaster Management Department has been created, State Disaster Management Authority (SDMA). Improved governance and better infrastructure made ambience conducive for investment, till November 2009, 245 proposal bringing investment tune of \$ 30 billion has been approved by "State Investment Promotion Board" creating 0.13 million jobs. Another major thrust area has been creation of social infrastructure for advancing the agenda of social inclusion. The state embarked on a mission to empower women by being the first in India to reserve its 50% of seat for women in urban local bodies and panchayats. The scheme for free school dress and bicycle to every 8th pass girl to promote girl education is revolutionizing social landscape, 870,000 cycles brought down the girl dropout rate from 17.6% to 6% and attendance shot up to 490,000 from 170,000 in just three years. Cycle serving as catalyst equipped young girls with sense of independence and purpose. A separate category of Mahadalits was created from the most backward and marginalized within Dalit, 18 of the 22 Dalit sub caste has been identified constituting 31% Dalit population of Bihar and a package of \$76 million was earmarked for their socioeconomic development. More deprived people were included in the below poverty line (BPL) category by enlarging the base to 12.5 million from existing 6.6 million.

These interventions with added emphasis on the health care and education by massive recruitment of teachers and creation of health centers have revolutionized the state in more than one way. The massive increase in institutional delivery helped to bring down child and maternal mortality. The average footfall at government hospitals increased many fold in last five years. The immunization also got doubled and in 2010, polio cases saw very drastic drop comparing last few years. The third part of paper deals with the strategies and challenges for the government to maintain present growth momentum. The proposed Right to Service Act, which will ensure delivery of some essential public services to people within fixed stipulated timeframe sans bureaucratic bottlenecks, emphasizing accountability, if implemented properly, can potentially revolutionize the way the government services are provided. One interesting and brave decision recently has been scrapping of Local Area Development Fund, given to 318 legislators but reportedly always misappropriated. Some challenges like specter of Naxalism, agricultural growth at a snail's pace, energy crunch and land reforms are still looming large on the horizon of Bihar.

This study establishes not only co-relation but also causative relationship between governance and development, witnessed distinctly in the extraordinary odyssey of Bihar from the bleakness to the brightness.

JEL CLASSIFICATION-R50, R58, R59

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## **Death & Life of Venezuelan Cities and Local Government: Governance strategy to re-create the hybrid-sustainable city and government**

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Venezuela, the fifth world oil exporter, with reserves within the top ten of the world and a privileged location in northern South America, is facing a critical crossroad that combines radical political changes – Bolivarian revolution - with the old oil-based rentistic model, which in practice both have proven to be incapable of solving the key problems of citizens and to lay the ground for a prosperous-sustainable future, free of poverty and its unsuitable-inequitable consequences. This emerging scenario of multiple - political-territorial and participatory mutations-, which imply the citizens organization in Community Councils (CCs), functional and financially independent of the municipal government, tends to re-centralize the process of city building in the Presidential Commission of Popular Power (PCPP), by diluting the city and its government in multiple, diffuse and disarticulated -formal and informal- fragments -CCs, [hybrid dispersed city] self-administered by citizens assemblies (gated communities?), changing the way of conceiving-visioning the city, impoverishing the quality of life-living conditions and hindering urban governance and sustainability [death & life of the city and its government?] (hypothesis). Framed in this context, the paper describes the method (creative technovation) and results of a doctoral thesis that evaluates the sustainability of Maracaibo's (Venezuela) local government urban praxis, using urban governance indicators (UGI). Different authors, study cases, the Venezuelan system of laws and the government-citizen's participation formulas were revised-contrasted and questionnaires (delphi) applied to select governance indicators, comprehend and describe the praxis-production of the hybrid city, built the Venezuelan and local government "governance models" [GM] and to evaluate the stakeholders' interaction-connectivity -governance practices- in the process of city building and decision-policy making and management. The paper concludes noting that, there is relation between governance [considering and expressed by the UGI: transparency, efficiency, participation, cooperation, trust and accountability] and the sustainability of the "form of city building -formal or informal" and its government; the perception of governance-sustainability by the experts improves when consulted about the production of the formal city and decreases -is less sustainable- in the case of the informal production. To overcome the tendency towards the "diluted city and local power" and recover the governance-sustainability of Maracaibo's hybrid city, an «innovative governance-sustainable management evaluation strategy" [IGMES] is proposed, to fill the gap of the local urban management planning process by assuming the IGU and principles of sustainable development-management, as a coordinated and continuous governance and sustainability culture building effort. The IGMES braids- through a continuous socio-political interaction process (GM) and within a postbureaucratic multiactoral Local Strategic Management Council (LSMC)-, in successive multilayered-relationaltransversal loops, the process of "HYBRID-SUSTAINABLE city BUILDING" [HSCB] with the processes of formulation-management of urban policies and projects (FMUPP), to co-recreate Maracaibo and its municipal government as a collective, cooperative and shared project, recognizing the existence of multiple spaces [CCs] and sublocal governments (citizens assemblies) and the mutation of the city into a hybrid-sustainable archipelago landscape.

## **Adaptive Ecosystem Management and Sustainability of the Everglades Ecosystem**

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Adaptive ecosystem management is the leading theory of natural resource management and environmental governance (Meffe et al. 2002; Norton 2005). Adaptive ecosystem management has three main tenets that distinguish it from previous management paradigms: governance should be integrative, adaptive, and ecologically protective (Cortner and Moote 1999). The first two tenets aim to provide a better fit between ecosystem characteristics (as complex, adaptive systems) and governance organizational structures and decision making processes. The third tenet imparts an ethic of "strong sustainability," i.e., the belief that humanity's survival is dependent upon functioning ecological systems.

The ideals of adaptive ecosystem management guide environmental decision makers to reformulate governance to be more integrative, adaptive, and ecologically protective. Tangible expressions of adaptive ecosystem management include

the convening of interagency coordinating committees, development of adaptive management plans, and consensus support for ecological restoration goals. The premise is that by adopting the adaptive ecosystem management approach and corresponding organizational, procedural, and ethical changes, that regions will become more sustainable. This is a tall order, however, given tremendous economic development pressures and signs of degradation in ecosystems around the world. Some scholars even suggest that the common methods of adaptive ecosystem management, such as collaborative decision making, management experiments, and flexible policies can unintentionally foster even greater development and ecological degradation (Amy 1987; McLain and Lee 1996).

Theory and practice can potentially yield divergent outcomes. This paper tests the premise that governance adoption of the adaptive ecosystem management approach improves regional sustainability, as compared to traditional natural resource management, by examining the performance of governance of the South Florida watershed, including the globally significant Everglades wetlands. Beginning many decades ago, when the negative environmental impacts of water diversion and wetland draining in South Florida first appeared, governance leaders have adopted an increasing number of elements of the adaptive ecosystem management approach (Light et al. 1995; Boswell 2000; Frank 2009).

The result has been scores of collaborative decision making processes and coordinating bodies, major investments in scientific research and modeling, and several multi-billion dollar restoration plans. There are indications of governance failure, however, as implementation of the restoration plans is favoring projects to meet the needs of development more than ecological improvements, and governance has been slow to respond to projections of sea level rise (due to climate change) that will inundate much of the region in the coming decades (e.g., Cave 2008).

This paper will ask whether the indications of governance success and failure in South Florida are a result, at least in part, of the adaptive ecosystem management approach, or whether success or failure are due to forces beyond the control of these governance innovations. If the adaptive ecosystem management approach shares any of the blame, the paper will consider if and how this could be mitigated. Evidence for these conclusions comes from the author's extensive case study of a century of South Florida governance, with progressively more detailed analysis of decision making processes and institutions over the case history up to present day.

The conceptual framework for the study identified different forms of decision making (political, bureaucratic, judicial, and collaborative) and hypothesized their interactions and impacts on policies, projects, and governance capacity. Data sources included hundreds of primary documents, interviews of South Florida governance leaders, and secondary sources such as regional histories and case studies of individual decision making processes. The extensive data and carefully developed conceptual framework and analytic methodology ensure the quality of the findings (George and Bennett 2005).

Answering these questions will give more realistic, nuanced expectations of adaptive ecosystem management and suggest strategies of governance improvement that range from marginal adjustments of practice to radical paradigm shifts in natural resource management and environmental governance. This study differs from previous research that has focused on individual governance initiatives, such as a collaborative decision making processes or adaptive management programs. Alternatively, this study synthesizes observations of many initiatives occurring over decades, including the policy and project implementation phases. Due to this study's well developed conceptual framework and data, the findings have improved validity and insights compared to other studies that have sought a holistic perspective on adaptive ecosystem management (such as Layzer 2008, and Gunderson and Light 2006). It is vitally important that we research and innovate in the areas of governance institutions and decision making processes, since many theorists believe that ecologically protective governance is a necessary condition of sustainability, rather than placing most of the responsibility on technological innovation.

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## Utrecht2040: regional governance for sustainable development

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Scenario explorations enable us to anticipate future worlds which are likely to unfold. With this future exploration we can develop a long term strategy. This strategy will help to develop more coherent medium term policies. These are the main reasons for the province of Utrecht to develop a strategy until 2040 for its territory and society.

We have analysed the current weaknesses and the policy deficiencies of the region (the so-called «red cards») and the future trends. This analysis was the basis for defining the future challenges. Utrecht is a very attractive region under high pressure in the economic core area of Europe. The success of Utrecht is at the same time its pitfall. Utrecht is a centrally situated meeting point of knowledge and culture, situated in an attractive and varied landscape. However, the strong appeal leads to growth in various areas. At the EU level, the region is number one in the regional competitiveness index. At the national level, the region beats them all when it comes to population increase and economic development. This puts spatial planning under enormous pressure. From a social viewpoint, the participation of citizens is a cause for concern: there are many people who stay behind or drop out.

Future trends will cause new challenges:

- the meeting point threatens to become a bottleneck due to its economic success;
- the landscapes are threatened by urbanisation and climate change;
- the core qualities of knowledge and culture seemingly remain reserved for only a part of the Utrecht community.

This situation requires a long term strategy.

The vision for the future is clear. Utrecht strives for sustainable development and for the preservation of the attractiveness of the region.

Sustainable development for Utrecht means:

- the continuation of a good quality of life for all residents of the province;
- decreasing, compensating and ultimately preventing the negative impacts of our choices on other stocks, on the next generations and on other areas on earth.

Sustainable development in Utrecht is almost synonymous with the preservation of economic attractiveness. This ensures great political support for the strategy.

Our future exploration is distinctive because, in exploiting the opportunities that the future may bring, we took the so-called core qualities that Utrecht has to offer into account. These core qualities (location, landscape, culture and knowledge) are quite unique compared to surrounding regions.

We have defined long-term goals for six policy areas. The main goals are:

- to have room for an excellent living and working environment, and excellent nature;
- with an innovative knowledge-based economy;
- that is accessible in a better environment;
- that is climate neutral and climate proof;
- in which all people matter and are able to participate;
- with a beautiful nature and a varied landscape.

It is clear that not all goals can be achieved simultaneously, there are trade-offs. There is, for instance, between profit and planet a tension between growth and resource depletion. Between profit and people there is for instance a tension between promoting the knowledge-intensive economy and creating employment for everyone. Between people and planet for instance, we have to deal with the tension between individual needs and collective nuisances.

In the search for synergy, some general directions could be: to further develop the core qualities, to pay attention to the local and regional scale and to make use of the economical opportunities of sustainability.

In the coming years the search for synergy will continue. In making policy choices it is a major challenge to reduce the trade-offs and to remain effective at the same time.

Utrecht2040 also wants to be innovative in governance. Is it possible to develop an adequate form of regional governance in steering towards sustainable development? We think so.

Sustainability issues require governance on different scales, but there is plenty to achieve at the regional scale. With authorities, businesses, NGO's and educational institutions we have formed a network. In this network, in an organic way, we strive for a strategy that is supported by our partners. We seek cooperation with regional partners, based on equality. We use the principles of co-design and co-creation. Alliances are formed for executing projects. The challenge here is to find synergies in the strategic goals of the organizations involved. We think that this is very promising. Especially the regional orientation of the network brings a strong societal commitment of the partners.

### **Creating Green Milieu's For Sustainability: Lessons from The New York City Watershed Collaboration**

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A green milieu is an economic environment which nourishes sustainable development by enhancing the necessary learning and providing appropriate incentives to move the economy towards sustainability. Watershed collaborations are potential models for such green milieus because they are built on cooperation. Sustainable development requires cooperation because environmental processes do not recognize political boundaries. New York City's watershed collaboration is of particular interest because it combines cooperation and regulation, and was designed to encourage sustainable development with regard to water in order to avoid building a \$6 billion filtration plant. This paper draws on and extends the research of a recently published 10 year study of the economics of the New York City Watershed Collaboration (The Cooperation Challenge Of The Economics Of Protecting Our Water Supplies: A Case Study Of The New York City Watershed Collaboration Routledge 2010). The book included an explicit analysis of the Collaboration as a model for sustainable development and analyzed the Collaboration as a green milieu for promoting economic activity compatible with sustainable development. This paper considers the lessons of the Collaboration for creating a green milieu in light of past and current research.

The expanded research includes three parts. First, the capacity of the collaboration to address recent threats to sustainability are analyzed. Second, data not previously available is used to analyze the water and carbon footprint of the industries in the watershed economy and the impact of the Collaboration on those footprints. Third, recent evidence of the capacity of the Collaboration to create positive green milieu effects of fostering more sustainable economic activity in the Watershed and in the City is examined.

Analysis suggests that those interested in fostering green milieu's to promote sustainability efforts should pay attention to the New York City model of both involving local people in voluntary activities and including regulatory controls. The research confirms that the collaboration's engagement of the local people for their knowledge and support of programs is vital for sustainable stewardship. However, recent experience also confirms effective sustainability programs cannot rely on voluntary cooperation alone and require legal support from the highest level of government. For instance, the effort to protect the Watershed from the effects of hydrofracking was necessitated in part by the City's lack of legal protection against exploitation of natural resources underneath the Watershed. The effectiveness of efforts to postpone and perhaps prevent hydrofracking has depended on the efforts of engaged local citizens from both upstate areas and in the City. The importance of higher level governmental support for sustainability is reinforced by a number of factors including ongoing export of pollution beyond collaboration boundaries and continued conflicts, such as how flooding is handled by the City. Although the Collaboration provides a method of conflict resolution, conflicts have regularly involved the court system as an active component of the cooperation process.

The impact of the collaboration on economic activity provides lessons of interest from two perspectives. One perspective is the analysis of the environmental footprints of local economic activities, and the other is the creation by the Collaboration network of green milieu effects that help move economies towards sustainability. The water and carbon footprints of local economic activities identify various Watershed businesses as having high footprints, and confirm the importance of those Collaboration programs which, in effect, reduce those footprints. However, experience with the pace of change among small operators who have high risks, suggests that sustainability efforts will require both regulation and financial support to overcome coordination failure and scale problems that prevent switch to more sustainable methods. The green milieu learning network of the Collaboration has continued to contribute to new green business methods being promoted in the Watershed and in the City. While these milieu effects are valuable, they are not sufficient for sustainability. Many steps taken by the City to improve its own environmental stewardship in economic activities have been motivated by protective federal laws. Further, a recent City initiative, the Foodworks program, which proposes to work with small farmers such as those in the Watershed to create a healthy food economy and culture in the City, acknowledges some of need for protective laws and subsidies needed by the local farmers to help with such barriers as lack of access to local markets, distribution problems and need for slaughtering facilities.

In sum the Collaboration experience demonstrates the advantages of local cooperative organization in promoting sustainability and also the needs for a wisely crafted legal framework and appropriate subsidies for education and desired economic activities in order to inspire and support those efforts. An effective green milieu will need all of these ingredients.

### Potential Possibility of Emission Trading among Local Communities

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Under Kyoto Protocol, Japan is obliged to reduce its greenhouse gas emission by 6% on average during 2008 and 2012 from the 1990 level. As a chair country of COP3 held in Kyoto in December 1997 where the Kyoto Protocol was adopted, and also a country claiming itself to excel at environmental protection, Japan has responsibility to reach the target as close as possible. If the current situation will continue, however, it is quite difficult for Japan to reach the target. The CO<sub>2</sub> emission from social and transportation sectors[1], which together shares 52% of Japan's total emission, has increased from the 1997 level while that from an industrial sector accounting for 35% has decreased owing to its voluntary and independent efforts. Taking into account of an increasing cost in the CO<sub>2</sub> reduction in the industrial sector, further efforts must be made in social and transportation sectors. In addition, Japan should strategically manage its forest, which shares 67% of its total land, since the CO<sub>2</sub> absorbed by the forest can be counted as a part of 6% under the Kyoto Protocol.

Emission trading, as one of the measures to reduce greenhouse gases efficiently, already started in EU and the U.S., while it also started in Japan though only a limited number of businesses participated in under the supervision of the Japan's Ministry of the Environment. In all of those emission trading systems, the actors who are engaged in trading are businesses. As a result, the targeted sectors are mainly industrial and energy sectors. In the emission trading among local communities, which is addressed in this paper, the actors who are directly engaged in trading are local governments while those who actually bear the costs and benefits involving the trading are businesses and individuals making up local communities. The emission trading among local communities targets at social and transportation sectors. Since all the actors making up local communities such as businesses (businesses managing and running offices and commercial facilities), individuals and local governments are directly and indirectly involved in emission trading and influenced by emission trading, they are likely to have strong incentives to reduce CO<sub>2</sub> emissions. Currently, the efforts in the CO<sub>2</sub> reduction in social and transportation sectors are made mainly at a voluntary and independent basis. However, under a voluntary and independent basis, not only are the results ambiguous, but also are the public incentives to reduce CO<sub>2</sub> weak. To reach the national target in the CO<sub>2</sub> reduction the measures as well as the targets should be lowered from a national level to community levels so that firstly the issue of reducing CO<sub>2</sub> would become a serious daily life issue for all of local community members and secondly local communities could adopt the measures to reduce CO<sub>2</sub> that are suitable to the characteristics and conditions of local communities. From this point the emission trading among local communities is worth to be considered since it could make our society shift from a voluntary and independent measure to a more comprehensive measure to reduce CO<sub>2</sub>.

The purpose of this research is to conduct the case study of Japan' Chubu Area to investigate a potential possibility of CO<sub>2</sub> emission trading among local communities, which targets at the reduction of CO<sub>2</sub> emission in social and transportation sectors (particularly automobiles) at local community levels. The data on emission targets, actual emission and forest absorbing emission of 134 local communities (cities, towns and villages) in three prefectures (Mie, Aichi and Gifu) of Japan's Chubu Area are used for this case study. This research sheds lights on the importance of the measures at local levels for the steady change in individual lifestyles and business styles moving towards low carbon society and on the emission trading among local communities as a system to promote such a change. As far as the research on similar studies is concerned, the studies on the emission trading among local communities are very limited. There are one domestic study on the similar topic[2] and one foreign study not on the similar topic but referring to the topic[3].

For each of 134 local communities both its emission ceiling and allowed emission ceiling (emission ceiling plus the quantity to be absorbed by forest) in the year 2010 were estimated. Then, those figures were compared with the actual emission in the year 2003. In terms of emission ceiling basis, 84 local communities showed the surplus that emission ceiling exceeds actual emission while 50 showed the deficit that actual emission exceeds emission ceiling. In terms of allowed emission ceiling basis, 113 local communities showed the surplus while the 21 showed the deficit. In the end, it was found that at both emission ceiling and allowed emission ceiling bases the emission trading would be likely to take place between the surplus and deficit local communities in Chubu Area.

[1] A social sector covers households, offices and commercial facilities.

[2] Yuasa, Michio (2003) Rehabilitation of Forestry for the New Local Government Revenue: A Case Study in KYOTO OHOI RIVER Forestry Region, The Kwansai Gakuin economic review, 34, 151-167.

[3] Rapaport, E. & Lind, T. (2003) Steps Towards Integrating Carbon Dioxide Sources and Sinks into Local Environmental Planning, Journal of Environmental Planning and Management, 46(6), 803-816.

## **Local and regional institution and governance: Good Governance as a Catalyst for Development: A Case of Transformation of a Backward State in India**

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This paper aims to explore the role of regional institutions and governance as a causative factor for sustainable development. The region of study is Bihar, a perennially backward state in India owing huge regional disparity, inhabiting more than 8% of the country population on less than 3% of land. The state has witnessed a major social, political and economic paradigm shift and recorded a phenomenal growth rate of more than 11% in last five year vis-a-vis less than 4% in last decade. For a historically laggard state like Bihar with feudal moorings, plagued with innumerable problems and the presence of aggravators like dysfunctional governance, weeding out persistent parasitic elements of crime, clan, caste, corruption and eventually disseminating the seeds of sustainable development by the previous state government is no less than a miracle. The landslide victory of erstwhile government in recently concluded state assembly election with more than three fourth of majority on the plank of good governance and development, bears testimony to the remarkable work done by previous government under the leadership of Chief Minister Nitish Kumar.

This would be a qualitative analysis including narrative and in-depth interviews with spectrum of people involved with Bihar. The analysis and findings have been presented in four parts. The first part deals with the pitiable past of follies, decades of standstill economic development and the sordid saga of perpetual misgovernance that eventually culminated into drought of growth and stability.

The second part deals with a decisive mandate against last fifteen years of Lalu Yadav led debilitating government, favoring National Democratic Alliance (NDA) and resulted in the accession of Nitish Kumar as the 31st chief minister of Bihar on 24th November 2005. The new government's clear agenda was the creation of enabling conditions for equitable and sustainable society by mainstreaming marginalized. It started with indefatigable pursuit to establish law of land, as Bihar inherited the legacy of misgovernance, the idea of social justice and economic development seemed farfetched without efficacious governance. For resurrecting the state authority fast track courts were created and between January 2006 to June 2010, 48,000 criminals were flushed out through convictions vis-a-vis 10,000 in last decade 1995 to 2005. The menace of corruption was contained with the introduction of "Bihar Special Court Act", first one of its kind in India. It gave power to investigating agency to confiscate immovable property of public servant enmeshed in corruption. Almost moribund cabinet meetings were regularized and a space was created between people for readdressing grievances through "Janta Ke Darbar"(Court Of People). These small result oriented interventions helped to dispel the miasma of crime, fear and corruption and evoked a sense of safety, security, relief and assurance among the people. The biggest testimony of that is number of foreign tourists visiting the state skyrocketed to 356,000 in 2008 from 95,000 in 2006.

The next notable area has been expeditious creation of the physical infrastructure. In the last four years road expenditure increased by tenfold and road construction by six fold. The all weather roads boosted rural connectivity, gave market access to 90% rural folks for their farm related perishable products, lessened school dropout rates, integrated the public healthcare, increased real estate value. It also bodes well for food processing industry, a next big step for making Bihar a food processing hub.

As floods and droughts have been continually ravaging Bihar, a full-fledged Disaster Management Department has been created, State Disaster Management Authority (SDMA). Improved governance and better infrastructure made ambience conducive for investment, till November 2009, 245 proposal bringing investment tune of \$ 30 billion has been approved by "State Investment Promotion Board" creating 0.13 million jobs. Another major thrust area has been creation of social infrastructure for advancing the agenda of social inclusion. The state embarked on a mission to empower women by being the first in India to reserve its 50% of seat for women in urban local bodies and panchayats. The scheme for free school dress and bicycle to every 8th pass girl to promote girl education is revolutionizing social landscape, 870,000 cycles brought down the girl dropout rate from 17.6% to 6% and attendance shot up to 490,000 from 170,000 in just three years. Cycle serving as catalyst equipped young girls with sense of independence and purpose. A separate category of Mahadalits was created From the most backward and marginalized within Dalit, 18 of the 22 Dalit sub caste has been identified constituting 31% Dalit population of Bihar and a package of \$76 million was earmarked for their socioeconomic development. More deprived people were included in the below poverty line (BPL) category by enlarging the base to 12.5 million from existing 6.6 million.

These interventions with added emphasis on the health care and education by massive recruitment of teachers and creation of health centers have revolutionized the state in more than one way. The massive increase in institutional delivery helped to bring down child and maternal mortality. The average footfall at government hospitals increased many fold in last five years. The immunization also got doubled and in 2010, polio cases saw a very drastic drop comparing last few years.



The third part of paper deals with the strategies and challenges for the government to maintain present growth momentum. The proposed Right to Service Act, which will ensure delivery of some essential public services to people within fixed stipulated timeframe sans bureaucratic bottlenecks, emphasizing accountability, if implemented properly, can potentially revolutionize the way the government services are provided. One interesting and brave decision recently has been scrapping of Local Area Development Fund, given to 318 legislators but reportedly always misappropriated. Some challenges like specter of Naxalism, agricultural growth at a snail's pace, energy crunch and land reforms are still looming large on the horizon of Bihar.

This study establishes not only co-relation but also causative relationship between governance and development, witnessed distinctly in the extraordinary odyssey of Bihar from the bleakness to the brightness. JEL  
CLASSIFICATION-R50, R58, R59

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### **Assessing the effectiveness of environmental regulation in SIDS: How important are political economy factors?**

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This paper empirically examines environmental regulation politics with special reference to small island developing states (SIDS), which has not been attempted in the literature. Nevertheless, empirical research on the impact of political economy factors on the effectiveness of environmental regulation is fairly recent and fast-growing. Eliste and Fredriksson (2002) focus on the relationship between trade, environmental regulation and the behavior of agricultural lobbies. Agricultural share in GDP and agricultural labour are employed as proxies for farmer group power. Using cross-country data on stringency of environmental regulations, the authors find that environmental regulation has influenced production subsidies allocated to agricultural producers as compensation for rise in costs associated with pollution taxes. Two-SLS estimates reveal that agricultural share significantly lowers environmental stringency and environmental stringency increases producer subsidies. Agricultural labour which would prefer regulation however is not significant in their models.

A rapidly expanding literature exists investigating the relationship between institutional failures and environmental regulation. The direct negative impact of corruption on degree of environmental stringency finds support in the literature (for example, Damania, 2002; Fredriksson and Svenson, 2003; Damania et al., 2003). The complex indirect channels of influence of corruption have also been explored and tested. For instance, Fredriksson and Svenson (2003) develop a theoretical framework which predicts that the effect of corruption on the stringency of environmental policy would be conditional on the degree of political instability. An interaction variable between instability and corruption is added to their models to test this contention. With stringency of environmental regulations in the agricultural sector in 1990 as dependent variable, they find that corruption significantly reduces the stringency of environmental regulations, but the effect is lowered as the degree of political instability increases. This would imply that the incentive to offer a bribe is reduced when its expected return falls in the presence of political stability. Bribery becomes less attractive when a producer perceives that there is little likelihood that the government would remain in office throughout the implementation stage.

Damania et al. (2003) explore the relationship between environmental policy, corruption and trade liberalization by developing an endogenous model of environmental policy determination. Their framework predicts that the effect of trade on environmental stringency would be conditional upon the level of corruption. The interaction depends on whether protectionism and corruption are complements or substitutes in environmental policy distortions. The authors employ panel data over years 1982 to 1992 and grams of lead content per gallon of gasoline as proxy used for environmental stringency to test their hypothesis. They find that more stringent standards and regulations are adopted when a country becomes open. Moreover, the significantly positive sign on the interaction between corruption and openness indicates that corruption amplifies the positive effect of international trade on regulatory stringency, ceteris paribus. Distorted trade policies (corruption) increase the effect of a reduction of corruption (trade liberalization) on lead content in gasoline. Thus, protectionism and corruption appear to be complements in the creation of environmental policy distortions.

Findings on the effects of democracy and freedom as institutional measures are found to be inconclusive and sensitive to specifications used and methods of estimation. For instance, Eliste and Fredriksson (2002) find that democracy and the civil liberties index are found to enter insignificantly in all their specifications. Fredriksson and Svenson (2003), on the

other hand, obtain weak negative impact of democracy on environmental regulatory outcomes in some models while in some others, the coefficient on democracy does not differ insignificantly from zero.

We postulate two environmental damage functions that are derived from supply of regulations, namely an environmental legislative damage function (ELDF) and an environmental quality damage function (EQDF). In the proposed models, effectiveness of environmental regulation is captured by (i) level of stringency of environmental regulations, (ii) the degree of enforcement, and (iii) the achievement of environmental performance and sustainability goals. The principal objective of this exercise is to examine the role of sector-wise lobbies in circumventing the legislative and enforcement policies resulting in lower environmental performance.

Cross-country regressions confirm that the perceived degree of enforcement and stringency of environmental regulations are adversely impacted by corruption in SIDS at the legislative level while better rule of law and government effectiveness would be conducive to stronger legislations. Moreover, our results highlight the importance of the industrial sector in SIDS as an important lobby power in dampening the effectiveness of regulations. This finding supports the capture theory where small size of the industry and trade group and availability of resources would render them more powerful at the legislation level. Results from interactive models confirm our suspicion about rent-seeking behaviour of the industry lobby channeled via corrupt practices. However, this negative impact is effectively dampened by the high dependence of small island countries on international trade. The exposure to trade apparently acts a compliance promoting factor. Better governance and rule of law emerge as additional constraints to capture effort by industrial lobbies. Contrary to industry, agricultural and tourism sector lobbies are not found aiming at environmental legislative damage.

At the implementation level, we find that both industry and agriculture contribute to environmental degradation. The impact of tourism on environmental performance is not clear and is sensitive to specifications used. However, the behavior of agricultural lobby needs explanation. The lack of environment damage activity of the agricultural sector at the legislative level may be explained in terms of extensive government support to that sector in SIDS (in the form of subsidies, etc.). This support serves to dampen or nullify any increment in cost borne by farmers due to stronger environmental regulations. Thus, stronger regulations do not necessarily lead to better environmental performance outcomes.

The upshot of the paper is that industrial lobbies are pro-active both at the legislation and implementation levels and there is a sectoral level non-compliance strategy at work. Agricultural lobbies appear inactive at the legislative level but proactive at the level of implementation. The paper finally discusses the environmental policy challenges in island economies in the light of empirical results. As against command and control policy instruments, market-based incentives may offer more chance of success. Moreover, subsidy policy needs to be linked to environmental performance of the agricultural sector. The seemingly environmental friendly behavior of tourism even though inconclusive can be explained by the high environmental intensity of tourism activities. It can be conjectured that maintaining the quality of environment is part of the international tourism business strategy.

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## The 'Governance Check': Assessing the adequacy of governance structures by '3-D Sustainability'

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Adequate governance structures form the basis and a precondition towards a sustainable development. This paper describes the contribution of a new concept called '3-D Sustainability' (Mauerhofer, 2008) to the assessment of governance structures for making them more sustainable. This approach aims to objectively assess priority setting in the relationship between environmental, social and economic sustainability within a sustainable development. The paper focuses on the competence distribution between and formal relationship among political stakeholders. The practical application of the "Governance Check" is implemented on the example of an assessment of governance structures in Austria as a part of the European Union. Governance, in this connection, can be defined as the structures and processes by which people in societies make decisions and share power (Lebel et al., 2006). Keeping in mind the geographical scale, institutions and organisations play a crucial role in governance. The current paper applies North's (1990) demarcation between institutions and organisations. Institutions are the 'rules of the game', consisting of both the formal regulatory rules and the informal social norms that govern individual behaviour and structure social interactions. Organisations are groups of people and the facilities they create. Some examples are firms, universities, governmental bodies and unions.

3-D Sustainability provides a main part of the theoretical framework of the assessment. The methodology applied consists of two parts.

The first part analyses the basic distribution of competences within a political unit on the example of institutions and organisations in Austria. Therefore, the institutionally provided competences particularly of the federal level of different organisations are allocated to the different basic elements of 3-D Sustainability. These elements are capitals, capacities and carrying capacities in environmental, social and economic terms (Mauerhofer, 2008). This allocation is then evaluated regarding coherencies and conflicts of interests.

The second part assesses the relationship between the political stakeholders based on secondary institutions of selected sectors (e.g. water, biodiversity, air, forests). The relationships found are divided in different categories such as the rights to prepare a legislative and/or administrative act, the right to participate, to be heard, to be coordinated with or to veto that act. Then these relationships are evaluated regarding coherence and the distribution of the burden of proof such as applied within 3-D Sustainability.

The analysis shows regarding the first part a partly incoherent distribution of competences. The correct geographical scale of the environmental issue is not addressed by an adequate political scale within Austria. This is in particular valid for the sector of nature conservation. Regarding this sector, the competence of legislation and implementation is solely distributed to each of the nine provinces respectively. Although the wild species and habitat types covered do often occur in more than one province.

Coordination mechanisms regarding competences between different stakeholders are lacking at all and/or not taken use of. For example, in the nature conservation sector no compulsory coordination mechanism does exist for the whole national level of Austria. Coordination mechanisms are solely available on a voluntary basis, are only used in few cases and have never been used till now by all nine provinces together. This situation might change in the future due to the European Union (EU) as an institution of regional integration. Through the influence of the European Commission and the European Court of Justice the nine provinces will have to coordinate their conservation activities especially concerning certain species protected by legislation of the EU.

One political stakeholder is equipped with competences that should be distributed to more than one sector according to 3-D Sustainability. In this sense, competences dealing with the environmental capital as a source (and its carrying capacity as limit) are provided to a political stakeholder who also deals with the exploitation of that capital in terms of an economic capacity of companies. Until 2000 the Austrian Federal Ministry of Environmental Affairs, Youth and the Family was especially responsible for the following environmental issues: general environmental policy, co-ordination in all fields of environmental protection, waste management, pollution control, affairs of the environmental ombudsman's office, environmental impact assessment, measuring, evaluation and documentation of measured values in the field of environmental protection, affairs concerning the protection of nature and the countryside, and of natural caves. In 2000 this Ministry has been disbanded and its environmental issues have been within the remit of the Federal Ministry for Agriculture and Forestry, Environment and Water Management (Ministry of Agriculture). In comparison to the former situation, only one Ministry is now competent for the environmental capital as a source (and its carrying capacity as limit) as well as the exploitation of that capital. Formerly, decision criteria had to be at least discussed between two ministers

(and got most likely also known and discussed in the public). Thus, clear conflicts of interest occur within Federal Ministry for Agriculture and Forestry, Environment and Water Management when it comes towards making sustainable decisions whether to use or to protect for example water or forests. This is for example valid when it comes to the decisions in how far the agricultural sector should be incriminated by measures of greenhouse gas reduction or in how far bio-fuels (produced by the agricultural sector) and/or solar power should respectively contribute to renewable energy creation (and receive public support). Hence, currently decision criteria for the justification of the use of a certain environmental option are less – if at all – transparent in comparison to the former situation of two Ministries.

Similar, competences that deal with the social security of people are given to political stakeholders being competent for the increase of the economic capital too. Also in such situations, clear conflicts of interests occur within this single political stakeholder when it comes towards making sustainable decisions. Opposite, 3-D Sustainability promotes a divided distribution of competences for the capital as a source (and its carrying capacity as limit) as well as for the exploitation of that capital (in the sense of using its capacity).

The analysis shows regarding the second part that formal relationships introduced between different stakeholders often constitute dependencies in political terms which are incoherent with the concept of 3-D Sustainability. For instance in the water sector, the competent federal authority has to gain for several activities such as emission reduction, data collection and implementation of protection measures particularly related to companies the consent in advance of authorities competent for (other) economics interests. Opposite to the principles of 3-D Sustainability, these authorities could refrain from providing their consent without having any burden of proof that their interests will not adversely affect the natural capital 'water'. Other formal relationships, but with less influential power, are e.g. rights to be heard. These rights were found in the water sector on behalf of the provinces in advance of the release of federal water-economical framework ordinances or on behalf of concerned provincial government in advance of the release of federal interim measures in the case of imminent danger.

In comparison, for instance in the biodiversity sector, the federal authorities do not have any formal possibility to influence the provincial legislation or administration (except by concluding multilateral environmental agreement which should be implemented by the provinces). But the federal authorities can be given influence, sometimes depending on financial contributions, by the competent provinces. This happens only regarding the institutional framework of National Parks where the federal authorities contribute have of the costs of the administration of National Parks if a Park is established and managed in conformity with the criteria of the International Union for the Conservation of Nature – IUCN (so called National Parks of the IUCN category II). This situation is leaving the other natural capital 'biodiversity' on the overall space solely under the governance of nine provinces which do not even cooperate in a binding way, such as has been already described above. In this case, only the European Union provides overall strategic aims and adequate rules concerning the burden of proof towards an effective conservation of the biodiversity in the sense of 3-D Sustainability.

In summary, the paper shows by means of the 'Governance Check' based on 3-D Sustainability regarding both parts, the institutional distribution of competences and formal cooperation between authoritative organisations, innovative and practical pathways towards a more sustainable type of governance in order to overcome existing incoherencies, conflicts of interests and inadequate cooperation.

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## **Testing the possibility of incorporating climate adaptation into existing public decision-making processes**

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Experience from climate adaptation work emphasises that climate adaptation should be incorporated into existing decision-making processes. However, there have been few attempts of identifying suitable processes as well as of suggesting how to do the incorporation. Instead, many organisations propose generic frameworks as a help for climate adaptation which require the creation of new processes or modifications of the framework by the stakeholders to fit existing processes.

In this study we have taken the existing decision-making processes in Swedish municipalities as a starting point and analysed if it is possible to incorporate local climate adaptation into these. We have specifically identified one

mandatory process, the risk- and vulnerability analysis process. The aim of this process is to identify measures both to handle extraordinary events when they occur, and to reduce the society's vulnerabilities to such events. From a climate adaptation view, this process is suitable for handling the future consequences of climate extremes, which are predicted to occur more frequently and to be of higher magnitude as a result of climate change. On the other hand, there are several aspects of the climate adaptation that are less suitable to be handled in the process. Such aspects include consequences for the municipality on a very long term and the ability of taking care of opportunities that may occur.

Based on interviews with safety coordinators and officials in different municipalities, on participating work in one municipality (Stockholm) and on literature studies, we have formed a hypothesis of how to incorporate climate adaptation into the existing Swedish risk- and vulnerability analyses. Based on the hypothesis we have written a guide for the municipalities where we point out important questions that the municipalities must consider. We also suggest approaches and tools that can be used in the municipalities own work of incorporating climate adaptation in the analysis. This guide is now tested in Swedish municipalities in order to strengthen or discard the hypothesis of the value of incorporating climate adaptation into the risk and vulnerability process.

The first part of the guide discusses which aspects of the municipal climate adaptation process that can be incorporated into risk and vulnerability analyses and which aspects are better covered by other processes. The municipal authorities are in the choice of extending the analysis to areas such as mean value changes, opportunities, non-critical society functions and a long term perspective, but whether they do so or not, they have to make the choice explicit. In the next step, we suggest the municipalities to start to analyse consequences of future climate events on today's society, and after that, if possible, future climate extremes on a future society.

The second part of the guide gives advice of how to identify critical climate extremes to be included in the analyses. The choice depends on a number of factors such as historical climate variability, current vulnerabilities of the society in question, ongoing and long-term climate change and known future vulnerabilities of the society.

The third and last part discusses how the analysis can benefit from the use of geographical information systems (GIS). It also discusses the trade-off between measures to handle crises and measures to reduce vulnerabilities.

Although the guide helps to illuminate important questions and phases when incorporating climate adaptation into an existing Swedish process, the way of thinking may easily be transferred to other processes.

The aim of this paper is to introduce and discuss the preliminary content of the guide and the tools included, and also to present the result from the tests in the Swedish municipalities. The test will answer on the following questions:

- 1) Is it possible to demarcate one part of the entire municipalities climate adaptation work and to treat it within one specified decision-making processes?
- 2) Is it desirable to expand the process to include a larger part of the climate adaptation work?
- 3) Will the result from the risk and vulnerability process be communicated to other processes in the municipality and will the process get input from other process so that the climate work is well communicated within the municipality?

## **Measuring Support for Policies for Sustainable Urban Development: Environmental Governance in the New York Metropolitan Area**

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Research in the area of sustainable development demonstrates that the realization of climate protection calls for the integration of practices among three policy areas: land-use planning, transport planning, and energy management. Pointing to changes in civic values toward – and relying on increases in public support for – protecting the climate, local authorities seek to incorporate the principles of these policy areas into programs of strategic planning. This article examines the relationship among individuals, institutions, and policies: among citizens, local governmental authorities, and sustainable urban development.

The present study shows that institutionalized processes at the local level are significant to support comprehensive policies to implement sustainable urban development, and that popular support is significant in ensuring that there are institutions to implement policies of sustainable development. I argue that the influence of – and reliance upon – interest groups at local, state, and global levels are necessary to frame issues, to legitimize political actions, and to provide environmental governance; I look at the characteristics of individuals that act to promote policies for sustainable urban development. Selective indicators are quantified in studies of sustainable urban development policies of five (5) local governmental authorities that share combinations of geographic, political, and economic

characteristics: the City of Larchmont (NY), the City of New Brunswick (NJ), the City of New York City (NY), the City of Newark (NJ), the City of Stamford (CT), and the County of Monmouth County (NJ). The case studies comprise interviews and surveys of local governments to analyze local approaches to define, to establish, and to implement programs of sustainable urban development, and of local institutional efforts to integrate policies of land-use-planning, transport-planning, and energy-management.

### **Better Government for Better Governance for Sustainable Development: The Steering Role of Local Sustainability Indicators**

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The last two decades have witnessed a growing debate around sustainability indicators, where countless proposals for specific indicators, conceptual frameworks, methodologies, communication methods or participative tools, etc., have been discussed. Three broad approaches to these indicators have sprung: the 'technical', the 'participative' and the 'governance' approaches. This paper aims to contribute to this recent and less explored 'governance' approach, focusing on Portuguese local experiences. It considers crucial to understand how and in what circumstances and contexts the role of sustainability indicators can be diminished or enhanced, particularly at the local level. It places the study within the scope of institutional analysis and tries to assess if and how those indicators have been changing or challenging local governance settings in Portugal towards sustainable development and if and how they have been used in those contexts. Three case-studies representing the oldest and 'most successful' local experiences in the country were analysed in detail. The study looked for particular and contextual factors in each one, but also aspired to develop a more comprehensive comparative approach framed by a normative position towards good governance for sustainable development. The findings have shown that local sustainability indicators have not been a significant contribute to strengthen the dialogue between different levels of government, to expand networks or to improve the communication and participation mechanisms between local governments and local citizens and actors. Nevertheless, evidence suggested that sustainability indicators actually challenged and changed crucial government capacities for sustainable development. The major challenge remains so in the transposition and dissemination of these outcomes to the outside of the local government sphere.

### **Conceptualizing Sustainability Dynamics: Towards a framework to reflect the contextual features of human-natural systems that influence the system's sustainability/unsustainability path**

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The earth system as a whole and its subsystems are highly complex entities, where understanding and planning for them become extremely challenging especially in the face of their inherent changing and unpredictable nature. Among them the socio-economical systems that are embedded upon ecological bases or in different terms, coupled human-natural systems of various scales and kinds are important entities in the discourse of sustainability. With many turbulences, changes they go through and the conscious/unconscious adaptive choices and decisions made in the interface of human-natural system, the path that joins their past present and future is being formed, while deciding whether they may appear sustainable or unsustainable at a certain point in history. Thus the current study is built with the proposition that the sustainability of these systems need to be regarded as a continuous process itself which evolves over time along with the systems themselves on which they are embedded, than just a set of stable conditions of a state with which they ought to be recognized and evaluated.

Furthermore once this process is conceptualized many variable conditions which defines the system's position and movement in a metaphorical sustainability space depends not only upon readily visible and analyzable conditions (referred as hard conditions in this paper), such as availability of resources and technologies, but on many other soft endogenous conditions often linked with contextual features as traditions, cultures, perceptions, belief system etc. These later conditions have a considerable capacity to affect the change processes by continuously reinforcing or damping these changes (which often are triggered by changes in former conditions), influencing the new adaptations or paradigm shifts the system goes through. Further in relation to sustainability, it is recognized that playing both positive and negative roles at many different levels and scales, they have a profound impact upon defining overall direction, hence become an important facet in maneuvering these systems' future path.

In order to supplement this view the paper analyses the historical socio-economic transition in a village system of Sri Lanka where the different stages of transition have been highly influenced by resource limitations, external stresses as globalization, internal stresses as population increase and its continuous intrinsic need for development. In addition to that currently the context is faced with the dualistic choice of features reflecting tradition and modernity. Further it is observed that along with many system conditions, system actors' perception on sustainability too is being changing over the years, which affects many choices they make within their system. In this paper conceptual framework is built to reflect the linkages between these contextual hard and soft conditions and their role on overall system evolution, while discussing implications of such patterns for its future sustainability/unsustainability path.

Further it is recognized that such a process of re-observation through a sustainability lens and conceptualizing accordingly may provide a directional basis to link numerous, rich but scattered existing insights on human-natural system pathways, with newer evolving perspectives on principles of sustainability, within a common framework that can aid in understanding and planning for sustainability of these systems.

## **Public Participation and Social Sustainability of High-rise Apartment buildings of Dhaka city, Bangladesh**

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The burgeoning high-rise residential culture for two decades or so has changed the tradition of urbanization and urban dwellings in Dhaka city. This system is significantly different from that of the past. Some high-rise residential buildings are just for living with little scope for social interactions and social gatherings. This scenario is not compatible with our traditional culture. It ignores our social values such as sense of community, neighborliness and friendliness. The main focus is to analyze the spatial organization of the community space of high-rise apartment buildings in relation to the high-rise community based organization that are responsible for managing, maintaining and keeping the social harmony through various active performances.

The study will try to analyze the socio-spatial context of high-rise apartment buildings and evaluate the findings regarding the issue of social sustainability. Two high-rise apartment buildings in Dhaka city have been chosen (one with quality community space and active social organization and the other with community space but without active social organization). The study will try to show how quality community space and active social organization can maintain and promote social sustainability within high-rise apartment buildings in Dhaka city of Bangladesh.

## **Renewable energy villages and regions in Germany: The Goettingen approach of sustainability science in action**

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Since the industrialization the growing energy demand is met mainly by fossil and nuclear fuels. It is well known, that this type of energy use is associated with serious problems, like the climate change, the environmental destruction and the limited deposit of these energy sources. Regarding a safe and sustainable energy supply, an increasing use of renewable energy is necessary. In addition to the fluctuating energy of wind, sun and water, bioenergy may contribute a stable offer of heat and electricity. Therefore, it is actually a very important part in the renewable energy mix of Germany. Especially the rural areas gain in importance as locations for a decentralized, consumer-oriented energy supply. Currently there are about 5800 biogas plants in the rural areas of Germany. Consequently a growing number of people feel affected directly or indirectly by this increasing development of bioenergy utilisation. In many cases, however, bioenergy plants are built mainly under economic aspects, without involving the local population and other stakeholders. Increasing fears caused by a lack of information's to the local population often lead to conflicts, resistance and a declining acceptance with regard to bioenergy projects. Main arguments are apprehensions that the current quality of life of local residents could be affected. Regarding protests against biogas plants, especially odor nuisance are in the focus. Rising costs, losses in immovables and other tangible value provides additional brisance (Mautz, Byzio, Rosenbaum, 2008, p.107). Also traffic nuisance by biomass transport, the effect on landscape by monocultures or the danger of accidents are fears that are increasingly mentioned regarding the discussion about bioenergy development.

The increase in conflicts concerning renewable energy and especially bioenergy is also associated primarily with the development of the centralization of renewable energy projects. Especially with the large-scale industrial production of biogas by pooling several individual bioenergy plants to bio-energy parks, which are area- and transport-intensive, an increasing reactance of the population can be expected. In this context the participation of local citizens in industrial-

scale biogas production is rather unlikely, so that the profits from the use of local raw materials not remain in the region, but mainly benefits for the foreign investors (Mautz, Byzio, Rosenbaum, 2008, p.105).

An important element of a socially acceptable usage of bioenergy is the involvement of the local population and other local stakeholders during the implementation of a bioenergy or other renewable energy project. Zoellner, Schweizer-Ries and Wemheuer (2008) could show that there are significant correlations between the perceived fairness of an implementation process and the social acceptance. Furthermore, the transparency of the implementation process is relevant. Therefore, citizens are against a realization when they are not involved in the planning and decision-making processes (Zoellner, Schweizer-Ries & Wemheuer, 2008, p. 4140).

In this context a very successful and sustainable opportunity to convert the energy supply from fossil fuels to biomass of a small town or village by involving the residents in planning, funding and implementation is the "bioenergy village" concept. In 2000 the first bioenergy village has been initiated as an action research project by a scientist team from the University of Goettingen and was realized by the residents of the village Juehnde in southern Lower Saxony. In addition to the technical feasibility, an essential point of this project was the "social implementation". That means the process of creating and fostering the motivation of individuals and groups in the village to participate in such a sustainability project. (Karpenstein-Machan & Schmuck, 2007, p. 149).

Meanwhile there are about 50 established bioenergy villages in Germany.

In the context of the ongoing interdisciplinary research project "Sustainable use of bioenergy – Bridging conflicting demands of climate stabilization, resource conservation, society and economy", funded by the Ministry of Science and Culture of Lower Saxony (from 2009-2012), we analyze the social acceptance for bioenergy utilization and the success factors for the establishment of decentralized, communal bioenergy projects like bioenergy villages with the goal of applying these factors in own action research.

The Goettingen approach of sustainability science bases on a multi-step procedure, generally starting with a problem analysis, formulating a sustainable solution, implementing that solution in a pilot project, transferring the solution and analyzing the consequences of the new alternative as compare to traditional paths. Here we focus on some of these steps:

1. A qualitative interview study analyzes the success factors for the establishment of decentralized, communal bioenergy projects. The interviews were accomplished with initiators or participants in 25 bioenergy villages in Germany. This study focuses the question how to convince people to participate in a communal bioenergy project and the changes of individual and social well-being during the process of planning a bioenergy village. The interview study was analyzed using the Grounded Theory method.

The results of the interviews show, that there are different ways to achieve a self-sustaining village or town with complete supply of electricity and heat based on local renewable energy.

2. A quantitative study using a standardized questionnaire focuses on the attitudes of 680 inhabitants in the rural area of Germany and Austria concerning bioenergy.

In the second part a transdisciplinary and interdisciplinary action research project will realize the development of three counties of Lower Saxony (Hannover, Goslar and Wolfenbuettel) to integrative bioenergy regions by supporting sustainable bioenergy projects in cooperation with all local participants. In moderated "planning-workshops" the scientists team is discussing the opportunities of a sustainable usage of bioenergy and other renewable energies in this three counties with all important stakeholders, e.g. the county administration, conservationists, farmers, local politicians, citizens' initiatives, tourism organizations etc. The stakeholders are formulating own goals, developing new projects and discussing the way to realize these ideas, supported by the scientists with specific information.

In the finishing phase of the action research, interviews with the stakeholders in this regions will focus on success factors and problems of the action research procedure itself to enable the transfer of the positive aspects of the procedural know how to other regions in Germany and worldwide.

Results from the interview study, the questionnaire study and the action research activities will be reported at the conference.

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### **Institutions, informal dynamics and adaptive management of climate risks: Case of Angat Reservoir, Philippines**

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An anticipated increase in the frequency of extreme weather events as a result of climate change presents a considerable challenge to sustainable development. As resource demands rise through population increase and economic development, extreme events can exacerbate conflicts over resource use. Increasing competition over water resources is an important example of this. Globally, urban areas now represent over half of the world's population. Urban water demand is growing, and combined with other pressures, this can lead to increased tensions in local contexts (Lenton and Muller, 2009). Given the serious livelihood impacts – and often, political consequences – of droughts and floods, urban water managers tend to be very risk-averse.

Building a sustainable future in the context of a changing climate will require increased ability to manage such extremes. For water resources, possible responses include new or improved infrastructure, such as building additional water storage capacity, as well as new policy measures, including to increase efficiency of water use or re-allocate water rights. One aspect being explored is the possibility of *adaptive management*, using climate forecasts and environmental information, to enable resource managers to act in advance of extreme events to optimize use and minimize impacts (Armitage et al., 2007). However, the ability to implement such anticipatory measures depends upon local institutions with sufficient flexibility to adjust management strategies when needed, and with adequate capacity manage the risks, given the uncertainties inherent in climate forecasts.

In managing complex systems in the face of uncertainty, research in adaptive management and collaborative planning has emphasized the importance of iterative, informal interactions among stakeholders, as well as the need for direct engagement with and questioning of scientific information (Innes and Booher, 2010; Pahl-Wostl, 2007). This literature provides a framework to examine the qualities of local institutions for adaptive management, and to also help gauge the limitations of adaptive approaches in the management of climate risks. We explore these issues in the context of Angat Reservoir management in the Philippines. Since 2004, researchers at Columbia University and the University of the Philippines Los Baños have worked with Angat water stakeholders and relevant government agencies in an effort to develop ways to integrate improved climate forecasts into decision-making. This effort included a detailed analysis of policy and institutional arrangements guiding Angat water allocations, revealing important lessons with respect to opportunities and constraints in implementing adaptive management.

Angat is the primary water supply for metro Manila's 11 million people, and also provides irrigation water for rice farmers and hydropower to the island of Luzon. The region's rainfall is strongly influenced by the El Niño Southern Oscillation (ENSO), resulting in high year-to-year variability in water levels. Angat offers a powerful example of how increased water demands, combined with a highly variable climate, can lead to increasing conflict over resources. In dry years, there is insufficient supply for all users, while in wet years, water must sometimes be spilled from the reservoir. These situations have led to crop losses by farmers, water shortages in metro Manila, and impacts on power supply. According to the Philippine Water Code, priority for Angat water resides with the farmers, who first asserted rights to this water. However, in times of "scarcity," priority shifts to urban water use. Over time, urban water demand has gradually increased, and "scarcity" conditions have occurred more frequently. Although formally the Water Code allows for compensating the farmers when they do not receive their allocation, in practice, no procedures exist for doing this.

The National Water Resources Board (NWRB), the lead water management agency in the Philippines, is responsible for managing Angat water. NWRB is guided in this by a "Technical Working Group," (TWG) consisting of representatives of water users, including irrigation, hydropower, and urban supply, as well as the meteorological agency. The TWG meets at least monthly, and often more frequently, to discuss current Angat reservoir conditions and climate forecasts, and to agree upon an allocation to recommend to the Board. These discussions have offered an opportunity for staff of these agencies to discuss climate forecasts, debate issues of data reliability, and bring their own views (and grievances) to the table.

Our analysis suggests that TWG interactions, along other informal dynamics of the stakeholder institutions guiding Angat water management, are crucial in determining the degree to which forms of adaptive management are considered and

undertaken in a cooperative manner. We find that the frequency, relative informality, and participatory nature of TWG meetings have enabled stakeholders to consider ENSO forecasts and their likely effects on Angat reservoir water levels, and to negotiate over compromises. We explore the role of TWG dynamics in adaptive management, as well as the limitations posed by current institutional structures. These limitations have led to attempts by key stakeholders to pursue non-cooperative strategies outside the framework of adaptive management, such as construction of new water sources, and legal proceedings to force compensation to farmers for lost water. We examine how these different strategies, both cooperative and non-cooperative, have played out in the context of rainfall extremes.

Our research is based upon detailed analyses of Angat stakeholder institutions, a review of TWG discussions and a range of policy documents, and numerous meetings with stakeholders between from 2004 and 2009. Our findings help to illuminate the crucial role – as well as limitations – of institutions for the adaptive management of climate risks in the context of sustainable development.

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## Lobster Houses as a Sustainable Fishing Method

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The Caribbean Spiny Lobster (*Panulirus argus*) is overexploited throughout its range, primarily due to failures in fishery management. In addition to contributing to overexploitation, the primary lobster fishing methods used in the Caribbean are harmful to the environment and the health of the fishers. However, one method, lobster houses, shows particular promise for promoting sustainable lobster fishing, but only under certain environmental conditions and using the recommended management practices. Lobster houses have been used for over half a century by fishing communities in Punta Allen, Mexico; and Batámano Bay, Cuba; which are two of the most successful spiny lobster fisheries in the Caribbean. Success in these two communities has led to the expansion of lobster house projects throughout the region with varying levels of success. The objective of this study is to determine which factors contribute to the sustainability of lobster house fisheries by examining lobster house case studies (Punta Allen, Mexico; Batámano Bay, Cuba; and Miches, Dominican Republic) and reviewing the literature concerning the sustainable management of *P. argus* fisheries. I conclude that environmental conditions, proper placement, management practices, and the presence of certain socioeconomic factors all play a role in supporting a sustainable lobster house fishery. The fishery must meet certain environmental conditions, which include the habitat requirements for all of the lobster's live stages and currents favoring the settlement of larvae. The proper materials, design, and placement should be used to minimize environmental impact and increase the chance of occupation. Additionally, the adherence to certain management practices is elemental in achieving sustainability and should include organization from the local to the regional level, the establishment of territorial fishing rights, the adoption of certain regulations, regulation enforcement, and standardization of regulations throughout the Caribbean. The socioeconomic factors that may affect the sustainability of lobster houses include access to a market for sustainable lobsters, the availability of alternative livelihoods, and the openness of the community to adopting new management strategies.

## Firm Response to Environmental Regulation in the Russian Federation: The Impact of 'Excessive Regulation'

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The UK Economic and Social Research Council Grant RES-061-25-0002-A funded the research presented in this paper.

The contributions to this paper of Dr Peter Rodgers, Ms Sarah Hall and Mr Chris Moore are also acknowledged

Much has been made in the literature of the need for regulators to generate the correct 'type' of environmental regulation (Porter and van der Linde, 1995), so as to elicit the right strategic response (Rugman and Verbeke, 1998; Crotty and Smith, 2006). Though contested in the literature, (Jaffe et. al., 1995; Smith and Crotty, 2008) it is also posited that 'correctly formulated' regulation will allow firms to fully or partially offset compliance costs through innovation, efficiency gains and risk reduction (Ambec and Lanoie, 2008; Lankoski, 2006). Yet regulators regulate differently in different locations, and firms respond differently to different types of regulation in those different locations. Perceptions of 'correctly formulated' regulation will therefore differ in different locations as will firm response. Thus the potential 'benefits' arising

from regulation in these locations are also likely to be different or perceived by managers in different ways. With this in mind this paper examines the strategic response to environmental regulation in the Russian Federation, a country with a lamentable environmental record (Weissenburger, 1989).

During the Soviet period, protecting the environment was subjugated to economic development, with catastrophic consequences (Pryde, 1991). During early years of transition, the environment continued to be largely ignored. While overall rates of industrial pollution declined as a result of economic collapse, pollution intensification increased (Crotty, 2002). Yet the resignation of El'tsin from the presidency in December 1999 triggered a period of fast-paced economic and regulatory change, culminating in the 'excessive regulation' of all spheres of Russian life. The environment was no exception.

As Putin assumed the presidency in 2000 it was clear that the experiment to transform Russia into a functioning, market-based economy had failed. 'Over withdrawal' (Sil and Chen, 2004) from areas where it had previously been responsible, had led to the 'capture' of the state by so-called 'oligarchs', (Hellman, 1998; Solnick, 1999) with the ability to shape regulation for their own gain (Gustafson, 2000; Frye, 2002). Putin therefore sought to remodel this relationship, taking some strategically important industries back into state ownership (Vahtra et al., 2007) and forcing some oligarchs into exile and others into prison (Puffer and McCarthy, 2007). As a result, business-state relations moved first from 'state capture', to 'elite exchange' in which firms receive favourable treatment in return for providing benefits to state agents (Rutland, 2001; Frye 2002), and then to 'business capture' (Yakovlev, 2006).

This was achieved by creating a milieu of excessive regulation (Yakovlev, 2006) wherein no Russian firm could avoid breaking the law. In order to evade excessive punishment, firms had no choice but to acquiesce to this 'excessive regulation', facilitating the state's 'absolute dominance over business' (Yakovlev, 2006, p 1054). At the same time Putin also sought to rejuvenate Russia's economic fortunes by facilitating a 'dirty recovery' (Bobylev, 2005; Bykov, 2005). To facilitate this, Russia's State Ministry for Environmental Protection, Goskomekologiya, was merged into Russia's Ministry for Natural Resources, Minresursov. This move subjugated Goskomekologiya's structures to natural resource extraction, created a serious contradiction within the State legislature, and fundamentally weakened the process of inspection and enforcement of environmental standards on individual firms (Cherp and Golubeva, 2004). This move drew widespread criticism from within and outside the Russian Federation, (Peterson and Bielke, 2001) as it was felt that this 'withdrawal' of the state from environmental protection would allow firms to pollute with impunity.

However, following this merger, a multiplicity of changes designed to make the process of environmental regulation and control more opaque and thus more difficult for firms to challenge emerged. Functions of the newly merged State Ministry for Natural Resources were moved away from the regions and divided into five new separate Federal organs. Simultaneously, responsibility for different areas of inspection, regulation and control were transferred from regional and municipal, to Federal, to the executive and back again (Crotty and Rodgers, 2011). The result was an over-complicated, overly burdensome, constantly changing regulatory environment; namely 'excessive regulation'.

In order to assess the impact of this 'excessive regulation' on firm behaviour, this paper assesses qualitative data collected from firms in three regions of the Russian Federation. Data from this unique environment indicates that firms are over-burdened by the increased demands of this regulatory framework and associated scrutiny. Moreover, as the focus of this scrutiny was not on environmental improvement but, in line with the ethos of 'excessive regulation', on levying fines and raising revenue, managers' viewed this approach as lacking legitimacy. In response, managers stated that irrespective of efforts directed at compliance, it was impossible to achieve. Their sole aim was to keep the level of state interference, and associated fines to a minimum. Accordingly, firms not only failed to realise any innovative or efficiency gains from compliance with regulation, as compliance was not possible, they also exhibited no interest in seeking them out. In addition, managers also showed little interest in reducing their environmental impact by other means, dismissing other forms of non-mandated or 'voluntary' (Aragon-Correa and Sharma, 2003) greening as legitimate activity for their firm. These findings are of note to both scholars and managers alike, as they indicate that while it is possible to construct environmental regulation to elicit a certain strategic response, an overtly punitive regulatory milieu may result in an absence of greening of any type within the firm. Being unable to achieve compliance or being unable to 'off set' the cost of compliance reduces the incidence of greening, not just as a reaction against the regulatory process but because firms also reject 'proactive' or voluntary greening because of the way the regulatory process is constructed.

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## REDD+ and Local Institutions

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Reducing emissions from deforestation and degradation (REDD+) has taken the central stage in climate change discourse since 1997. It is likely to evolve as the key mechanism for carbon conservation in post-Kyoto regime. There is, however, a widespread debate on the compatibilities of current decentralised forest institutions in addressing critical issues of REDD+. Comparing and contrasting India's joint forest management and likely pre-conditions of REDD+ institutions to meet social, technical and market challenges, this paper argues that forest decentralisation in its current form is not attenuated for undertaking forest carbon mitigation. By nature, regulations under REDD+ is going to influence the livelihoods of the forest-fringe poor much more than that of JFM. REDD+ will further be legally binding with regular monitoring and verification by third parties. In addition, REDD+ is likely to channel significant economic benefits at a cluster level. Hence, issues related to intra and inter villages transparency, accountability and equity will be critical for successfully addressing REDD's poverty benefits. There has also been an emphasis at the policy level to integrate REDD incentives with overall rural development schemes. Thus, big money and emphasis on integrated development models will raise the issue of who will implement the programme at local level. In this context, the paper seeks to indicate the opportunities for convergence of REDD+ institutions with elected local government known as Panchayat in India. I studied the govt. and local bodies partnership in Panchayat to understand how the elected representatives interacting with the government at various level. Involvement of Panchayat, on the other hand, has also been contested by many by arguing that politicisation of forest management will weaken regulatory control and make forests more vulnerable to deforestation and degradation. This paper also seeks to explore threats and gains for forest management by making it political.

The paper will be written based on the information collected through ethnographic study of two forest protection committees in West Bengal state of India. Mixed methods have been used to collect information. Quantitative data include livelihood analysis of families living in two forest villages in India. Qualitative research covers ethnographic analysis of institutional assessments and key informant interviews with community leaders, policy makers, academicians and NGO representatives.

## The EU ecolabelling scheme: a problem of legitimacy?

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In 1991 a European Union (EU) wide ecolabelling scheme was established to "encourage the sustainable production and consumption of products, and the sustainable provision and use of services" (Commission of the European Communities 2008). Implemented as an ISO type 1 ecolabel it aims to do so by enabling consumers to make informed environmental purchase choices and encourage businesses to market greener, officially licensed, products (Commission of the European Communities 2008). Since then the regulation has been revised twice but influence on behaviour across the supply and demand system has remained limited. Using the concept of legitimacy as a framework this paper analysis

the causalities behind this limited influence based on an extensive literature review and in depth interviews with different stakeholders. Findings are relevant not only in terms of the EU ecolabelling scheme itself but also the broader labelling agenda.

Even though the EU ecolabel has been initiated and driven by a supranational governmental organisation its effective outcome mainly depends on the voluntary support from the stakeholders whose behaviour it aims to influence including consumers, NGOs and businesses. Despite increasing environmental awareness, consumers' knowledge of and demand for EU ecolabelled products has remained low. Likewise, public purchasers and retailers have shown limited demand and producers, even if able to meet the requirements, have been reluctant to apply. Many scholars argue that stakeholders support can be increased through achieving consent with the legitimacy of an institution as it introduces a subjectively binding force on the part of those engaging as well as a publicly symbolic force (e.g. Beetham 1991).

Enhancing legitimacy is a complex process consisting of moral, input and output related, pragmatic and cognitive dimensions. Moral legitimacy is among the most essential determinants of the support of labelling schemes especially from societal demand actors. Important stakeholders forming this societal demand are not only individual consumers but also (and one might argue even more importantly) opinion leaders such as non-governmental organisations (NGOs), civil societal groups or media. Moral legitimacy mainly depends on the compatibility of a scheme with norms that are morally accepted (Bernstein 2005). Even though there seems to be a general agreement among societal demand stakeholders with the basic aims of the EU ecolabel, especially NGOs have criticised insufficient stringency and actively opposed some of recent criteria developments for example for copying paper (Tebert 2009). Such opposition has been mirrored in negative media coverage of the EU ecolabelling scheme (see eg. Pearce 2010) resulting in the respective negative influence on the wider moral legitimacy of the scheme.

For Risse (2004) crucial factor is not only the belief in the moral validity of the norms themselves, but also the belief in the validity of the procedure by which they had been worked out. To assure such validity it is important that those who have to comply with or support the rules are included in the rule-making processes through deliberative decision making that tries to find a reasoned communicative consensus (Risse 2004; Bernstein 2005). The EU ecolabel addresses an array of environmental issues and product groups across the whole of the EU. Such a wide scope enlarges not only the diversity of interests that need to be included but also the ground for controversies. One measure with which the EU ecolabel has tried to meet this challenge is an increased academic involvement and use of scientifically based methodology. A science based approach is not a guarantor for finding a socially robust consensus however. In fact scientific input has been mobilised in different ways by opposing parties and the scheme has been accused for a lack of uniformity in the methodology used for example to develop criteria across different product groups. Another challenge relates to the EU ecolabels decision making procedure. Its main authority body consists solely of governmental actors with final decision making often being a lengthy political bargaining, which has been difficult to influence especially for stakeholders with fewer financial and human resources. This lack of inclusion has been repeatedly highlighted not only by NGOs but also business and national government as negatively influencing their support.

At the same time such a complex political process is a problem for the cognitive legitimacy of the scheme which rests on transparent and easy to understand structures (Cashore 2002). Cognitive legitimacy is further impeded by a rather lengthy and complex certification process and the wide scope of the label which risks that stakeholders lose sight of what they are getting at. One way for labelling schemes to countervail such legitimacy shortcomings is to increase their achievement of stated or assigned objectives, referred to as output legitimacy (Koppell 2008). So far only limited research has been conducted on the actual environmental benefits of the EU ecolabelling scheme. The rare exceptions have found some environmental product improvements along the supply chain of current users and the use of the labels' criteria by some non participants for example to derive minimum requirements (IEFE- Università Bocconi 2005). In the light of the currently low uptake of the label in the market however, these achievements remain rather small and the scheme sees itself in a vicious circle where a lack of output negatively affects the schemes' legitimacy which in turn negatively affects its output.

To avoid being caught in such a vicious circle other labelling schemes have tried to achieve large scale supply chain modifications by gaining support and legitimacy from businesses holding the lead position within the supply chain. Support from such businesses is largely influenced by the pragmatic judgement of these stakeholders as to what extent a labelling scheme serves their own interests. At this point the EU ecolabel sees itself in a similar vicious circle: due to a lack of legitimacy from societal demand stakeholders most manufacturers do not judge the EU ecolabel as a vehicle for enhancing their environmental image or increasing market access and decide against participation and support. At the same time retailers, who inhibit lead positions in many supply chains, are reluctant to demand EU ecolabelled products due to a lack of supply but also fears to confuse the consumer and threaten their own image by only offering some ecolabelled products. This lack of buy in from the supply side results in a lack of visibility of eco labelled products which discourages any attempts of basic awareness rising among societal demand stakeholders.

The analysis shows that the EU ecolabel currently finds itself in different but related vicious circles preventing it from effectively influencing the supply and demand system. The most immediate measure to break this circle appears to be the improvement of deliberation and inclusion during final decision making in order to increase support among stakeholders that shape societal demand. Facing challenges also in terms of its cognitive legitimacy however this is surely a difficult and partly contradicting task, which is further complicated by the broad scope of the EU ecolabel. More research seems to be needed on how to improve deliberation and inclusion in a way that the EU ecolabel can ensure legitimacy from its most essential stakeholders.

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## Managing Evolving Regulations in the Oil Sands: Learning by Looking Over the Fence

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Our paper will examine how companies cope with regulatory uncertainty in what is considered to be one of the most environmentally contentious industries in existence today: Canada's oil sands. Companies are struggling to understand the scope of their compliance obligations while working to shape the future regulatory demands on their industry. Resource-constrained regulators are being forced to craft regulation in a time of extremely high growth and technological uncertainty. Both are doing so under the constant scrutiny of an increasingly engaged public and pressures from campaigns and threats for boycotts from around the world. We answer the question: 'how do you manage evolving regulation in a situation with new technology, environmental vulnerabilities, and high demand?' both from industry and regulatory perspectives. Our analysis provides concrete direction for managers on how they can make better decisions in times of regulatory uncertainty.

We present a 'he said / she said' from two perspectives: that of the regulators and that of one of the largest players in the Canadian oil sands industry—Suncor Energy. Coping with environmental regulatory uncertainty is critically important for managers, and as this case will illustrate, environmental compliance represents a major source of potential operational risk. Furthermore, regulatory bodies are faced with additional scrutiny about their role in protecting the environment and mounting pressure to craft regulation and subsequently enforce it. Thus, both the company and the regulators need to manage evolving regulations. The problem is that actors on each side of the regulatory fence face different challenges, cultures, attitudes and views of each other. We examine the tensions between these two perspectives and draw lessons for how managers can best cope with them.

On April 2, 2009, Suncor Energy Inc. ('Suncor') was convicted of two offences under Alberta's Environmental Protection and Enhancement Act. The Crown and Defence Counsel made a joint submission to the Court for a creative sentence to fund a research project on regulatory compliance.

We have conducted 46 interviews within the company and 21 interviews with external regulatory stakeholders. We divided our data gathering and analysis among two separate teams: one with an internal focus on the perspective of the company, and one with an external focus from the perspective of regulators and the prosecutors on the case. Initially, each team separately analyzed their interview data to answer the question "how do you manage evolving regulation in a situation with new technology, environmental vulnerabilities and high demand?" When we compared our findings, we noticed striking differences in approach between the two sides, and an opportunity to learn powerful insights from the two contrasting perspectives.

We have undertaken a preliminary analysis of the key tensions between the company and regulator views of managing evolving regulations in this industry (see Table 1). The full paper is built around these tensions by first explaining the root of the tension and then presenting quotations, vignettes and examples that show how the company and the regulator make decisions under regulatory uncertainty.

While our ‘he said / she said’ analysis is interesting, the real question we set out to answer is: what does this mean for managers? In the second half of our paper we will derive at least five lessons for what managers can do in periods of regulatory uncertainty:

- Take the time to know your business and technology.
- Know what information you can share.
- Leverage relationships with regulators and competitors.
- Develop a culture of compliance inside the organization.
- Step outside of your shoes to try understand the regulator’s point of view.

We provide a unique perspective; a view ‘over the fence’ to illustrate the issues faced by both industry and regulators as they attempt to ensure compliance and protect their reputations amidst changing technologies and high pressures for growth. More importantly, we go beyond raising these tensions to provide prescriptions that begin to answer our main question: What should managers do?

## **Exploring boundaries of sustainability: spaces of the Venice Lagoon**

Elena Gissi

The present contribution discusses the relationship between environmental policies and regional development in the case of the Venice Lagoon (Italy), considering the hypothesis that natural resources management is not just an issue of ecosystem preservation, but consists of exploring the boundaries of sustainability according to which policies are constructed to achieve regional development.

The purpose of the paper is to assess the efficiency and effectiveness of regional policies with respect to constitutive dynamics of the lagoon environment, where morphology results from the negotiation between sedimentological balance and human uses. Since anthropogenic installation in the Lagoon, little is natural, and what little is natural is a man induced product.

The Venice Lagoon is undergoing a long term transformation of its governance and management system, due in 2050-2100. Latest Morphological Plan of the Lagoon (Magistrato alle Acque di Venezia – Special Water Authority, 2010), and a redefinition of the general planning system (regional, provincial and municipal), will accompany the development of the lagoon on themes like Venice Port, lagoon environmental preservation and sea defense.

In view of such changes, the present study proposes a critical review of the current model of planning of the lagoon, considering the fact that each development strategy should comprehend a portfolios of interventions where economic, environmental and social components are considered and assessed simultaneously. In terms of economic scenarios, the Venice Lagoon is not only the living space of the historical city and islands, with its world-wide patrimony recognized by UNESCO, but it is also the ground of Venice Port activities, both commercial and tourist traffic, as well as Porto Marghera related industries, located on the border of the Lagoon. Venice Port Authority, founded in 1995 as a public institution with administrative, budgetary and financial autonomy, operates through the Port Development Plan (the new one expected in 2011) in order to strengthen maritime infrastructures and land access, dock logistics system and distribution, encouraging the growth of port traffic and related activities. Some of these activities involve interventions that act incisively on Lagoon morphology, as excavation of the port berths, canals and port access dredging, according to traffic changing characteristics, but also artificialization of lagoon drainage basin because of port back infrastructures. Port expansion forecasts should be considered along with the definition of the general morphological balance of the lagoon, so to assess externalities and risk allocation along with environmental protection investments.

Moreover, the empirical evidence of climate changes in the Lagoon drainage basin strives to reconsider the definition of the planning praxis, since its ineffectiveness is underscored by the need to resort to emergency interventions. The assumption of the drainage basin, from the inland to the sea, beyond Venice Lagoon border by Law 366/63 (on which environmental protection policies are based) is proposed, as to define a coherent framework between policies domain and the lagoon environmental one. The analysis discusses on the legal frames and on the planning system of the Lagoon, underlining frictions and inertia between apparatus, agents and environmental dynamics. Some specific observations about environmental balance approach are put in place according to the perspective proposed, based on environmental protection costs and emergency intervention costs comparison.

## Environmental leadership: Environmental technology sector in Sweden from ecoentrepreneurship perspective

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The development and application of innovative new technological solutions are crucial in the ecological modernisation. Economic actors and entrepreneurs, since they introduce innovation, adaptations and new ideas, are central agents of change in the process of transformation needed to solve environmental challenges (Hajer, 1995; Murphy, 2000). In the last two decades the emergence of alternative forms of entrepreneurs and entrepreneurship can be observed. The growing recognition of social and environmental issues has provided entrepreneurs with new opportunities, resulting in the emergence of environmental entrepreneurs /ecopreneurs/ green entrepreneurs (Isaak, 1998; Schaper, 2002), social entrepreneurs (Dees, 2001), and more recently, sustainability entrepreneurs (Yung and Tilley, 2006; Dean and McMullen, 2007; Schaltegger and Wagner, 2010). Conventionally understood entrepreneurship is primarily guided by logic of self-interested profit-seeking (Campbell 1992; Casson 2003). There is a common understanding that many of the alternative entrepreneurs operate their business in ways that run counter to popular perception of entrepreneurial behaviour (Hart, 2006). The ecopreneurs and sustainable entrepreneurs demonstrate interest for environmental causes, employee-friendly working conditions and wider social issue that bottom-line profits. The green and sustainability entrepreneurship has potential to be a major force on the transition to a more sustainable business paradigm because of the leading role which they provide to other firms (Schaper, 2010; Tilley and Young, 2009) by demonstrating economic benefits which come from being greener (Schaper, 2010) and by example in creating social and environmental health (Tilley and Young, 2009). The ET sector is an important area within the field of green entrepreneurship. The business model of environmental technology companies focuses on delivering solutions that contribute to improving the environmental performance of their customers which means the 'greening' in the ET sector is product related (Guziana, 2011). The environmental responsibility and environmental leadership of this sector should also include production related greening.

The purpose of this paper is to investigate the character of ecopreneurship in environmental technology business, with focus on environmental responsibility and environmental leadership. The major focus in the ecopreneurial literature is on the level of firm. Still, ecological modernization requires not just changes at the level of firms but also broader sectoral and institutional shifts (Gibbs 2010). Therefore this paper considers ecoentrepreneurship both at company as well as at branch level. The survey was directed at Swedish companies and branch organizations listed at a national centre for environmental technology Swentec, created in 2005 by the Swedish government. Previous, online survey on the enterprises listed at Swentec found that depending on the specific subsector, only between 21% and 45% of companies provide information about their environmental work on their websites (Guziana, 2011). This survey, based on telephone and personal interviews aims to further illuminate how the individual entrepreneurs and branch organisations understand their entrepreneurial role in the work with the environmental issues in the ET sector. The companies listed on Swentec are divided to 20 subsectors. Four subsectors: Waste Management & Recycling and Bioenergy Fuels as a mature sector and Wind Energy Technology and Solar Energy Technology as examples of new technologies are studied in this survey. The representatives for branch organisations and the CEO's of 2 companies within each sector were interviewed. The results from interviews are completed with results of the survey on environmentally related information and statements on the websites.

As a basis for the analyses the overview of the literature in the ecoentrepreneurship field with focus on typology of environmental/sustainability entrepreneurs and drivers for ecopreneurship is made. The literature review shows that there are different approaches to categorise ecoentrepreneurs and sustainability entrepreneurs and there are different criteria for these categorizing. While some of typologies consist of one criterion, the others are two dimensional. The values and motives of ecopreneurs is a key dimension. For example Pastakia (1998) distinguished between commercial and social ecopreneurs, Linnanen (2002) distinguished between a desire to change a world and a desire to make money. The dichotomy between accidental ecopreneurs, opportunists, and those driven more by nonprofit value is well established. It should be added here that according to Wally and Taylor (2002) even 'opportunistically green' or 'accidentally green' entrepreneurs contribute to a sustainable society. Example on others criteria are: market failures, markets effects, dimensions of sustainability and environmental aspects of products and production. Furthermore, the drivers of environmental entrepreneurship can be divided to: internal, such as personal values and competitive advantage of eco-friendly products and external: power of stakeholder and the power of legislative and regulations policies (Pastakia, 2002).

The results show that at the firm level the environmental related entrepreneurial opportunity recognition is a very important factor. Accordingly, the interest for environmental issues is important in the process of the opportunity recognition although there are also examples on entrepreneurs who happen to be in the environment related sector. The results also show that there are examples on more intentionally green entrepreneurship as well as on more 'opportunistic' ecoentrepreneurship.



Furthermore, there is a common understanding that the ET subsectors contribute to a better environment through customers using their products. There is also a common understanding that this product related environmental profile obligates to production related greening, although in the reality “it is the economy that counts”. With exception of companies within solar power energy all other interviewed companies has own environmental work or are planning to start one. At the branch level the environmental leadership is not well established. Only two branch organisations have an internal environmental policy, the Swedish Wind Energy and Swedish Recycling Industries’ Association. The Swedish Recycling Industries’ Association is the only one branch organisation which has a voluntary commitment containing ethics and environmental guidelines for the members. The members should as soon as possible - two years at the latest from the acceptance of this obligation - have introduced ISO 14001, EMAS or its equivalent.

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## **Sustainability within the local public sector – An integrative approach**

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There is a striking imbalance between private and public sector organisations regarding both respective research and the implementation of measures that support sustainable development. Meanwhile 85% of the fortune 500 companies are implementing sustainability management strategies and programs and report on sustainability issues according to the indicators of the Global Reporting Initiative, the systematic institutionalization of sustainability approaches in the public sector is still in its infancy. Even though some countries have developed national sustainability strategies, programs and realized some institutional innovations over the past years, a consistent institutional framework for sustainable development, which goes beyond environmental sustainability towards an integrative model aiming at the co-optimization of economic, social and ecological developments, has not been realized on the different policy levels from subnational to international. In order to facilitate the institutionalisation of sustainability policies, scientists and practitioners often advocate for a “bottom up sustainability” emphasizing the relevance of the local level.

Three generally unconnected developments at the local level, in Germany as well as in other countries, can be observed:

Efforts to foster sustainability focus on social and environmental aspects and are characterised by LA21 programmes and environmental management instruments.

Endeavours to modernise the public sector aim at improving its efficiency, effectiveness, professionalism, representativity, and its democratic character.

Reacting to massive financial distress and the lack of transparency in local budgets, the German interior ministers decided to switch the accounting method of the public sector to double entry accounting.

So far there is no concept of integrated sustainability governance in municipalities that accounts for environmental protection, community well-being and economic prosperity equally and that focuses on administrative functions as well as on intra-organisational aspects of sustainable public sector organisations. Within a problem-oriented, inter- and transdisciplinary study, involving local administrations, we currently explore the development of such an integrative concept of local administrative sustainability governance, achieved through the conjunction of insights from corporate sustainability management, administrative modernisation and public sector accounting within its local political contexts. In our presentation we will focus on our conceptual-analytical framework and we will discuss the technical, political and organisational-sociological requirements for the successful implementation of the concept of integrated sustainability governance for local administrations within the context of multilevel governance for sustainable development.

## **Measuring the Effectiveness of a Voluntary State Environmental Program On Sustainable Business Practices**

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The purpose of the research is to determine the impact of an innovative voluntary state program designed to promote sustainability in organizations, Green Tier, from multiple perspectives: the economic and environmental impact on the region and on the participating organizations. We measure impact on both a macro and micro basis through the use of both quantitative and qualitative data. As part of the analysis, we also establish a regional sustainability index to provide a comparison point for the companies and the region.

There is a definite need to establish a baseline or benchmark for companies before they can pursue strategic green initiatives. The same translates onto economic regions as well, driving the purpose for this study. Once a region establishes its baseline, it can begin to build its strategic plan for how it can become more sustainable on the whole. Applying the Triple Bottom Line (TBL) approach we believe that it is possible to measure, in some part, the sustainability of a region. Triple Bottom Line (TBL) ideology shifts the focus of an organization simply from creating profit to a focus that is inclusive of impacts on the environment and both the local and global community in which it operates.

Green Tier is a program of the Wisconsin Department of Natural Resources that uses a collaborative system of contracts and charters in an attempt to streamline environmental requirements and encourage new environmental technologies. The programs stated goal is to "provide credible, creative ways to enable your business to be a powerful, sustainable force for environmental good and enhance your productivity, cut your costs and strengthen the health of your culture and community".

Approximately 50 organizations are participated in the program during the time of the study comprising a wide range of Wisconsin businesses and organizations— manufacturing, building and construction, printing, boat building, health care, agriculture, retail food, electricity transmission, energy efficiency, real estate development, municipal government and higher education. Semi-structured interviews were conducted with 24 of the participating organizations. Questions asked during the interviews included the following:

1. Why did you join Green Tier? What was the intent?
2. In general, how has it worked?
3. What kind of regulatory incentives have you received?
4. Do you perceive a "more limited liability"?
5. Have you had "less" inspections?
6. Would you characterize your relationship with the agency as "closer"?
7. Did you successfully implement an EMS in year 1?
8. Describe your EMS and results
9. What activities did you do or implement in order to achieve "Sound" environmental performance?
10. What did you contract to do? Why? How has this worked out? Has participation in GT resulted in or sparked other activities in the firm? Describe.
11. Has participation in GT resulted in a change in your culture? Explain.
12. Would you characterize your firm as a leader in your industry Vis a vis „sustainability"?

13. Are the concepts underlying the Triple Bottom Line (TBL) embedded in your strategic and operational planning? Explain.
14. Could any employee/customer/supplier explain how your firm utilizes TBL in action?
15. Have you “established yourself as stronger and more accomplished environmental innovator?” Explain.
16. How would you gauge the value of your participation in GT? Explain.
17. What are specific issues that could be improved in the GT program?

In addition, questions were asked that pertain directly the Regional Sustainability Index we created including:

1. Do you publish an Environmental Report?
  - a. If yes, describe its utilization.
  - b. If no, how do you track and publish environmental gains?
2. Do you publish an Corporate Social Responsibility report of some type?
  - a. If yes, describe it. Are there specific programs?
  - b. If no, how do you account for social issues?
3. Do you utilize GreenHouseGas or energy reduction tools/audits?
  - a. If yes, describe the tool, why it was selected and how it is utilized
  - b. If no, why not?
4. Do you calculate your firm s carbon footprint?
  - a. If yes, what tool is used? Why was it selected? What are the boundaries of your footprint
  1. analysis? How is this information utilized?
  - b. If no, are you considering this? If not, why not?
5. Do you utilize any type of facilities management tools to track energy use, water use, or
  2. transportation impact?
    - a. If yes, describe
    - b. If no, are you considering any? Why or why not?

While interviews and analysis are still being conducted, results to date indicate that Green Tier companies are consistently and significantly outperforming other Wisconsin companies across a wide range of objective environmental measures. For example, Green Tier pilot companies have reported a 30 percent reduction in emissions of hazardous air pollutants since the year 2000, bucking an overall statewide trend that shows a more modest 12 percent decrease. In addition, Green Tier pilot companies decreased SOx emissions 40%, NOx emissions 40%, and VOC emissions 35% since baseline (year 2000). More troubling, however, are the responses from the interviews which seem to indicate a mixed level of impact on sustainability initiatives within the organizations themselves. For example, 20% are participating in the program for the notoriety alone; 50% think it has helped with internal initiatives by giving it executive visibility; and the remaining 30% are not sure if it has been worth anything.

### **Governing the future Danish biogas development**

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Present article discusses the economic, environmental and technological implications associated with the implementation of the Danish Renewable Energy Action Plan (NREAP) and the Green Growth Strategy. The political goals for the biogas sector in Denmark are thus, according to the Danish Government’s Green Growth Strategy from 2009, that 50 % of the animal manure must be digested in 2020, contributing to 20 peta joules (PJ). Another political goal is formulated in the NREAP from 2010, and aims at achieving 30 % renewable energy implementation by 2020, hereof a 12 PJ contribution from biogas relative to 4 PJ by 2009. This article discusses the options for speeding up the development of the biogas technology, with the present relatively limited implementation in mind. It outlines the technology innovations required, the organizational and economic development needed, in order to reach the political goals for the biogas sector in Denmark.

The article concludes a need for enhancing the business concept of biogas plants to reduce the capital costs connected to implementation of the technology, as for instance to develop technical turn-key solutions instead of expensive customized solutions. It is also concluded that technical improvements still are necessary, especially in relation to operating the plants on manure only due to lack of industrial biomass waste. Thus, new types of gas boosters (enzymes, biomass etc.) must be developed, just as flexible operating temperatures (e.g. both mesophile and thermophile) will be

required in order to digest new and different types of biomass etc. more efficient. A larger system-integration with the surrounding agriculture are also a necessity in the future, in order to secure the supply of biomass and to develop multi-functional plants; not only handling a waste problem but producing energy, fertilizer and other byproducts while at the same time creating economic and environmental benefits for the local community. New organizational models for implementing the technology are also addressed, e.g. piping the manure from smaller plants to a larger centralized plant, or upgrading the biogas to natural gas standards to supply the energy through the national natural gas pipelines.

### **Open Data Kit: Using Smartphones to Collect Facility Level Data in Nigeria**

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In 2005, Nigeria negotiated debt relief off the back of key economic and political reforms taking place in the country. But fears were expressed as to whether savings from the deal would be well-used to benefit people and not misspent or embezzled. The Office of the Senior Special Assistant to the President on the Millennium Development Goals (OSSAP-MDGs) was therefore charged with establishing a credible monitoring and evaluation (M&E) framework that would track and report on just how debt relief gains were spent.

In December of 2010, researchers from the Earth Institute of Columbia University working with OSSAP began using a new surveying system based around Open Data Kit (ODK) Collect. ODK Collect is a free, open source, application for collecting survey data in low connectivity settings. In two weeks, thirty surveyors collected information on approximately 1400 facilities in Nigeria. This was a solid first step towards collecting a full inventory of schools, health facilities, and water distribution points. This paper will discuss the technical implementation of this surveying platform.

ODK Collect is an application written for Google's Android operating system that allows surveyors to collect data, photos, and GPS coordinates with relatively inexpensive equipment, smartphones. Using smartphones eliminates the need for data entry and cuts down on printing paper surveys. Data can be uploaded to a central server when cell coverage is available, when coverage is unavailable surveys can be saved to phone until coverage is found. Finally, surveys can be programmed to skip questions based on previous answers, and enforce data constraints. Both of these features help surveyors collect clean data.

The Earth Institute team designed its own survey builder to convert specially formatted Excel files into surveys for ODK Collect. This tool allowed surveys to be easily shared between colleagues; and making use of the functions provided in Microsoft Excel, we were able to write complicated surveys quickly.

Finally, we needed a central place to store the data collected. Using the Django web framework, the Earth Institute designed a web application to receive survey data from the phones in Nigeria and allow researchers to explore the data through maps, pictures, spreadsheets, and summary statistics. All of the software developed by the Earth Institute is free and open source, and we are very interested in sharing these tools.

### **Devolving resources and power in times of land and water reform: The case of the Little Thukela catchment, KwaZulu-Natal, South Africa**

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A significant international drive for comprehensive institutional reforms for the management of natural resources has been at the core of development policies in the last two decades. The promotion of local governance and the transfer of management to user groups have been central. Participation has been considered as *the way* to operationalize decentralization for democratic transformation and empowerment. Despite significant claims on the little evidence of long-term effectiveness of participation in materially improving the conditions of the most vulnerable people or as a strategy for achieving social change, "participation has become an act of faith in development" (Cleaver, 1999: 597)[1].

In South Africa, land and water reform programs target a core principle: the structure. The postapartheid government involved in the participation paradigm, has defined it as its cornerstone to redress past policies. With the reformulation of the Constitution in 1994, new legal frameworks were introduced. The National Water Act (NWA) defined the creation of

new water management organs at local and regional level: water user associations (WUAs) and catchment management agencies (CMAs). It has been assumed that with the devolution of resources and the inclusion of black Africans to water management platforms and institutions, sociotechnical water systems and relations of power may be changed.

This paper discusses the experiences of two rural communities - Amaswazi and Potshini – in establishing their own land and water institutions to manage devolved resources and their integration in the WUA of the Little Thukela catchment in the province of KwaZulu-Natal, South Africa. It addresses the difficulties and challenges that current reform processes face to translate inspiring legal frameworks and public policies into concrete realities. The study is based on empirical research carried out between April and August 2010 through 60 in-depth interviews amongst smallholder farmers, community members, WUA's management committee members and government officials in KwaZulu-Natal. Emphasis was placed on understanding how land and water reform have been addressed, managed, circumvented, and/or delayed. Studying implementation processes at the ground-level allowed a better understanding on the opportunities, constraints and the adequacy of the present institutional decentralization processes in the catchment.

It was found that in rural communities, efforts have fallen short before customary traditions and traditional power structures that contest and circumvent the rules established by decentralized formal institutions. New hybrid institutional arrangements (which combine elements of the traditional/customary set with newer, more formal arrangements initiated by the State) to manage devolved resources are also complex, ambiguous and conflictual. As a result, transfers of land and water resources have not yet transformed historical disadvantaged individuals (HDIs) livelihoods, nor their participation in the WUA.

The study shows that contrary to achieving equity and redress objectives printed in the NWA (1998), the establishment of the WUA under the participation and empowerment paradigm, has rather empowered commercial farmers. The WUA has been dominated by commercial farmers and HDIs are under-represented. The WUA was established in a socio-political unlevel playing field setting it to fail and therefore, the capturing of the institution by commercial farmers could have been anticipated. Despite governmental efforts to establish a balanced platform, both inclusion and representation are unbalanced. HDIs have been instrumentalized rather than empowered. This may be translated in unfavorable consequences for the emerging farming sector and black communities in the WUA, but also in other platforms like the forth-coming CMA of the Thukela River Basin.

The paper concludes that former rural structuring policies along its derived socioeconomic set up, still dominate the agrarian rural society in the Little Thukela catchment. The transfer of resources and the ad-hoc of HDIs to unbalanced platforms would not by itself transform the inequitable distribution of resources. Thus, there are visible contradictions between legislation, public policy and the capacity of execution in concrete realities. On one hand, new institutional arrangements to manage devolved resources at community levels are complex, ambiguous, conflictive and insufficient. On the other hand, commercial farmers have been able to neutralize the vehicles of change and not surprisingly, the WUA it is a successful negotiating platform for future use, but only for commercial farmers. In short: the nature of any water reform that depends on land reform as well as on the institutional structures through which it could be implemented, face complex challenges that cannot be solved just by devolving resources and/or decentralizing government decision-making. Finally, the paper discusses possible policy-driven measures needed to ensure the establishment of equitable and sustainable institutions in the catchment.

[1] Cleaver, F. (1999). Paradoxes of Participation: questioning participatory approaches to development. *Journal of International Development*, 11, 597±612 (1999).

## **The Role of Informal Institutions in Sustainable Development**

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The term “discourse” which is used by Fairclough is similar to term “mental model” used by North. In recent years, many of scientists and scholars asserted that «institutions matter». The term «institution» has widely spread in the disciplines of the social sciences such as economics, political science, sociology and even philosophy and geography.

Many scientists distinguish between formal and informal institutions. According to the scientists, formal institutions are explicated or written rules such as constitutions and law (Kingston and Caballero, 2009, 154). On the other hand implicit rules are known as informal institutions such as religion, norms, values, beliefs, ethics, custom etc. Many scientists such as North (1990, 2005), Williamson(2000), Shirley(2005), Grief (2006), emphasize that informal institutions have critical role on performance of formal institutions. Also, alteration of informal institutions is crucial for

change in society and enduring changes in society occur when informal institutions change. For instance, Change in legal laws is not sufficient to decline the politics and religious violence. Even it's not possible till the masses of people have a belief of tolerance.

In developing countries radical beliefs about religion, population growth, income distribution, etc are generated, deliberated, and legitimated by public actors such as religious leaders and politicians. Many people accept these beliefs which hinder sustainable development. However, to achieve good results in population policy or environment protection policies, violence reduction, etc a change in belief is necessary. In other words change of beliefs is critical to achieve sustainable development, but how do these beliefs change?

To answer this question we point out the explanation provided by Douglass North. He points out the mental model (1995, 2005) in his analysis. North believes that individuals develop mental models to explain and interpret the environment and these models strengthen or redefined by feedback that received from environment (North,2005,25).He asserts that when feedback that have been received from environment confirm one mental model in several time it became stabilized and we call it beliefs (Mantzavinos, North, sharig,2004, 76). North believed that institutions are external manifestation of beliefs (North, 2005, 49). North refers to different factors in his various texts that provide institutional changes. Especially he refers to the role of experience and contacts with other ideas in mental model changes (North, 2005, 25).

Although North's definition of institutions and explanations about institutional change is very unique, some problems are still remained. Aoki asserts that North's explanation about the process by which beliefs change to shared behavioral beliefs is inadequate (Aoki,2010, 141).Also Schmidt points out that many of institutionalists neglect the process that idea generated, deliberated, and legitimated by public actors (Schmidt, 2008,306).

To overcome this problem we want to make alterations to North's theory about institutional change with some terms that we gain from discourse theory. Therefore our analysis framework has some similarities with the theory that Vivien A. Schmidt (2006) presented at Annual Meetings of the American Political Science Association. But our analytical frame work is somehow different. We point out the other theory of discourse that named critical discourse theory which is provided by scientists such as Fairclough. Fairclough (2006) points out that mass media, organizations or even international agencies have important role in achievement discourse[1] to hegemonic status. In real world a large number of new beliefs can be provided but only one of them can become hegemonic. When new beliefs proposed opponents and supporters of existing order criticize it. In this process media and civil society play critical role. Opponents of new beliefs and their rival use media and civil society to promote their beliefs. Both group criticism of rival beliefs and this issue affect on them and cause rivals revised and modify their beliefs.

Although in developed countries free media and civil society exist, in developing countries we confront weakness of civil societies and mass media. Some states suppress the civil society and mass media. They restrain opposition and they don't let opposition criticize the radical beliefs. We believe that It is the key to promote the radical beliefs in developing countries.

To illuminate our theory, we focus on the issue of population growth in Iran during the 1980s. Planning for controlling the rate of population growth began in 1967.Before the Islamic Revolution in 1979, state prompted the control of population and even abortion was legal (Erfani, McQuillan, 2008, 112). Although contraception is not prohibited in Islam (Hoodfar, Assadpour, 2000, 20), but some religious leaders censured this policy. They believe this population policy is prohibited in Islam and also it is western tools to reduce the number of Muslims (Vahidnia, 2007, 260). Because some religious leaders and many of politicians and intellectuals supported this policy and religious leaders that censured it was in a minority the control of population was successful.

But, After Islamic Revolution in 1979 a theocratic state came to power. These leaders considered the control of population as an interference in *God's affairs*. In this circumstance state not only scrubbed the control of population but also supported population growth. Also In this period state suppressed mass media and civil society, therefore opposition can't censure this policy. Therefore very fast growth of population occurred and over 3.5 over annual population growth rate during 1979-1986 reported (Iranian Statistical Center).

After a while media and civil society gradually have been strengthen and some opposition gradually criticized this policy and some media broadcasted them. After some public debate religious leaders accepted that it is not prohibited in Islam (Hoodfar Assadpour, 2000, 20). After it the government started to promote the population control policies and that caused a reduction in the birth rates. Although other factors such as education, urbanization etc. have effect on rate of growth, my researches do not show ample changes in these factors.

Although the rate of birth was reduced, the impact of baby boom affected sustainable development in Iran. As mentioned above after some public debate religious leaders accepted that it is not prohibited in Islam. If media and civil society weren't suppressed after revolution and could have been censured, modification in religious beliefs occurred earlier and population growth rate could have been reduced earlier.

We show that civil society and mass media play critical role in change of beliefs and consequently in sustainable development. Although we point out the population growth, beliefs especially religious beliefs played important role in democracy, terrorism, governance and etc. Change in these beliefs is a key to sustainable development, but we should notice that in developing countries we face different circumstances in comparison to developed countries.

[1] The term “discourse” which is used by Fairclough is similar to term “mental model” used by North.

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## The effect of spillovers and congestion on the segregative properties of endogenous jurisdiction structure formation

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In most countries, local public spending accounts for a large share of the public spending (almost 50% in the USA), and this share is increasing since the end of the Second World War. As a consequence of the growing role played by local governance, another phenomenon appeared: local communities belonging to the same urban area seem to be more and more differentiated in terms of their inhabitants' wealth. Economists, sociologists and other social scientists have strong intuitions about this segregation by wealth having an impact (positive or negative) on social welfare. Since Tiebout (1956), economists have developed local jurisdictions formation models, in which households living in the same location produce a public good through a local tax. Households are freely mobile, and can «vote with their feet», which means they can leave their jurisdiction for another one according to a trade-off between the local tax rate and the amount of public good. The belief that such an endogenous process is the main cause of segregation is widely held among social scientists.

Westhoff (1977) was among the first economists to provide a formal model based on Tiebout's intuitions. In this model, households can enjoy 2 goods, a local public good, financed through a local tax on wealth, which is a pure club good (only households living in the jurisdiction that produced it can enjoy it), and a composite private good, whose amount is equal to the after-tax wealth. He found a condition that ensures both the existence of an equilibrium, and at the equilibrium, the jurisdiction structure will be wealth-stratified. The condition to ensure the existence of an equilibrium is to have the slope of individuals' indifference curve in the tax rate-amount of public good plan to be ordered by their private wealth. If this condition holds, not only an equilibrium will exist, but at equilibrium, the jurisdiction structure will be segregated.

But his article was pretty unrealistic:

- Households can live in their jurisdiction without consuming any housing,
- Local public goods can be consumed only by households living in the jurisdiction that produces it,
- Local public good does not suffer from any congestion.

Nechyba (1997) developed a model with housing, but contrary to Rose-Ackerman, housing is modeled as a discreet good, which differ on type, and households own their house, so wealth is not anymore exogenous, since housing price may vary. In his model, spillovers between jurisdictions were allowed, because households' utility depends not only on the amount of public good in its jurisdiction and a national public good, but also on the amounts of public good in all jurisdiction. After having ensured the existence of equilibrium under certain conditions, he identified sufficient conditions

for a stable jurisdiction structure to be segregated. Unfortunately, one of these sufficient conditions was the absence of spillovers between jurisdictions, which is a pretty strong assumption that might not be necessary.

This paper analyzes the effect of spillovers and congestion of local public goods on the segregative properties of endogenous formation of jurisdiction. Households living in the same place form a jurisdiction and produce a local public good, that creates positive spillovers in other jurisdictions and suffers from congestion. In every jurisdiction, the production of the local public good is financed through a local tax on household's wealth. Local wealth tax rates are democratically determined in all jurisdictions. Households also consume housing in their jurisdiction. The housing prices are competitive: at the equilibrium, in every jurisdiction, the housing price equalizes the demand of land and the amount of housing supplied by the absentee landlords. Any household is free to leave its jurisdiction for another one that would increase its utility. A necessary and sufficient condition to have every stable jurisdiction structure segregated by wealth, for a large class of congestion measure and any spillovers coefficient structure, is identified. The condition is for the public good to be either a gross substitute or a gross complement to the private good. This condition is equivalent to have, for any given parameters, households' preferred tax rate to be a monotonic function of their private wealth. Although an example provided in the paper tends to show that congestion favors segregation while spillovers limits the segregative properties of endogenous jurisdiction structure formation, this condition, tht identified by Gravel & Thoron (2010), remains valid.

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## **Sustainable Development Programs In Rio de Janeiro: Assessing Conflicts Between the Environment, Society, and Industry**

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This paper seeks to unravel the consequences of sustainable development projects in the urban area of Rio de Janeiro. I take a poststructuralist stance as I break down the theoretical framework of Arturo Escobar and others, to demonstrate how it relates to the organization of these projects. I have chosen to illustrate several projects of different concern to outline the conundrums that have resulted from improper ideologies following the development discourse in this urban area. By viewing multiple projects, I hope to exemplify the wide range of problems that arise out of ineffective procedures, as well as reveal the various types of people and ecologies negatively affected by the development process.

Development programs in Rio are more difficult for outsiders to undertake because they underestimate the situation of poverty and its consequences in the city. Also, they tend to have different ideas about economic and social priorities, and misunderstand local systems of knowledge. The poor should be given the opportunity to properly define their condition, and thus set up their own system of priorities to better their situation. Chambers suggests that professionals should encourage community involvement to make priority decisions, and welcome their modification throughout the development process. He advocates policy based on three key aspects: poor people first, sustainability, and feasibility. An addition problem occurs when defining local participation. Many define this aspect as pressuring the local people to agree to a project previously designed, and working under an outside manager on the project. This type of participation does not establish any rights for the locals, implement their needs, or give them a voice (Chambers 1989).

For sustainable development projects to be beneficial to the environment, society, and economy, awareness is key on all levels. I have dissected several sustainable development projects in Rio de Janeiro, in order to demonstrate the constraints forced on developing areas through Westernized ideologies and top-down approaches. It is key to focus on local members of the community and their needs before initiating a sustainable development project. Instead of the transference of ideas and projects from the



Westernized nations, it is detrimental to embark upon the different cultural, social, environmental, political, and economical constraints that could produce undesirable consequences. Bottom-up approaches allow grassroots involvement and knowledge to maximize benefits of sustainable development, so that the local population and environment are at the heart of all projects. Urban sustainability is key in this growing industrial and capitalist phase of development, and the shift of focus to these different approaches will not only eliminate the conundrums in the city of Rio, but also create sustainability throughout the world as a whole.

### **Adapting Governance for Sustainability on Rapidly Eroding Portuguese Coasts**

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This paper analyzes local, regional and national responses to rapidly eroding coastlines in Portugal. In so doing, it will consider how adaptive governance for sustainability can be characterized (O'Riordan & Milligan 2006), how the Portuguese society is responding to the opportunities offered by adaptive governance for sustainable coastlines, and what institutional options for future coastal care in Portugal are actively being considered by key actors in 3 case study settings.

The design of this research combines: 1) state of the art scenarios of possible future coastal erosion and flooding based on the best scientific estimates available; 2) how these scenarios are interpreted in coastal policy making and planning, based on evidence from a series of empathetic and interactive discussions as to the political, economic and cultural feasibility of adaptation strategies for sharing burdens in the search for sustainability. These interviews will also reflect the local circumstances of the case study locations, as adaptive coastal governance for sustainability has to be locally situated within agreed national and regional policy and decision frameworks.

Since the 1970s, Portuguese coasts have experienced intense pressure from real estate developers, propelled by local authorities, selling ocean views as the ultimate "quality of life" dream. This poorly regulated process has led to continuous urban sprawl along the shore lines of the Iberian Peninsula, as well as large scale tourism-based settlement (Schmidt et al., Schmidt & Prista, 2010).

The shift to the coast in terms of port development, major urban settlement, the emergence of a mobile leisured society for Portuguese residents and visitors, and the continuous commitment to settlement for economic survival, lucrative tourism, and the joys of coastal living had set the case for a "cultural momentum" in favor of a viable iconic coast as a center piece of Portugal's sense of modernity and attractiveness. The Portuguese experience is specially challenging as it has some of the stormiest coastal stretches of the European continent, with rates of retreat over 220m in the last 50 years.

According to all scenarios, whether climate change based (Santos et al., 2002) or not, these erosion rates will accelerate in the coming decades. This toxic combination of aggressive physical factors and tumultuous settlement dynamics has led to profound unsustainability in terms of very expensive and escalating coastal protection investments. Threatening adaptive sustainability even more is the present context of the Portuguese financial crisis, with its promises of austerity and reduced public spending, as well as the forecast reduction of European Union (EU) coastal protection funding arrangements after 2013.

All these factors combine to make the Portuguese coastline an unmatched laboratory for testing new designs for adaptive governance for sustainability in a hostile economic atmosphere. Lessons from Portuguese innovative coastal designs should prove highly relevant for many other regions of the globe.

Our paper offers an in-depth analysis of the evolving institutional assemblages formed around pressing coastal erosion processes in Portugal. Using creative conversations with key stakeholders we explore the relations and tensions between decision-makers, experts, economic agents and local actors in forging visions of future coasts that shape the current coastal planning maze. Two fundamental contradictions emerge from the analysis of current policies. First: while coastal change in human occupation and erosion has been very fast, the legal framework and related political actions have been very slow, and mainly reactive, with a clear lack of continuity and ability to take into account future credible coastal scenarios. Second: there are multiple entities ruling over the coastal zones at local, regional and national scales, all experiencing limited and declining funding and intervention capability, which raise serious accountability problems. There are at least 30 central and regional government agencies and 62 municipalities disputing one of the most fragile stretches of coast in Europe.

We identify two possible current coping tactics seeking to create sustainable options arising from these contradictions: a calamity coast adaptation, with the existing coastline protected at all costs through top-down decision making in order to ensure the continuity of economically essential port and transport infrastructure as well as tourist-based activities, and a faustian bargain adaptation, where politicians, planners and developers demand ever more elaborate coastal protection in order to safeguard their investments despite the inevitability of eventual surrender.

In both of these formulations any mention of coastal erosion threat due to storminess, unusually high tides and sea level rise will be denied, resisted and challenged, if only because the blight of property price potential lowering would be too catastrophic for this carefully cultivated iconic image.

At present, therefore, the adaptation process reinforces coastal protection and continued economic and leisure based development, and the procedures of both coastal risk assessment, as well as planning to permit infrastructure and buildings, even though recently there have been attempts to put into place more strategic coastal plans, and regionally designed risk sensitive planning procedures.

Our paper seeks to explore why these contradictory adaptations are being pursued in the context of sustainability governance and the brooding economic crises. We recognize that there are economic imperatives that promote increasing investments in Portugal to wealth creating and leisure generating coastal settlement for a nation blessed by budget air fares and splendid climate and scenery. We also take into account the need for maintaining vital coastal infrastructure in a time of considerable economic sensitivity. And we take note of the new changes in coastal planning policies in favor of more risk based assessments with regard to future climate change effects.

The purposes of this paper are:

1. To reflect on the Portuguese history of coastal settlement, economy and culture over the past 50 years;
2. To consider the case for a commitment to both a calamity coast and a faustian coast in modern Portugal;
3. To examine the scope for more sustainability- sensitive adaptive governance of the future coast in Portugal; and
4. To receive the views of key policy players in judging these themes and in offering their proposals for effective adaptive governance for the Portuguese coastlines.

We suggest that an innovative design in sustainability governance should be based on an in-depth knowledge of local circumstances provided by social scientists. Insightful descriptions of ongoing processes offered by sociologists, anthropologists and historians, when cross-bred with scenarios of possible future coastal erosion and flooding based on the best modeling available, are essential to develop locally tailor made solutions instead of just applying the usual one size fits all adaptation measures. What is new about our analysis is that we envisage the possibility of burden sharing as a mean of ensuring that both the calamity and faustian bargain approaches to coastal management incorporate means for transferring the benefits offered by enhanced protection to finance more adaptive and resilient coastal design, and with these, more economic opportunities for the vulnerable localities concerned.

Our research examines how a range of key players confront the need to move from crisis coastal protection to comprehensive coastal adaptation, propelled by limitations on national and EU funding streams in the years to come, and encouraged by an emerging policy and planning framework favoring a spirit of burden sharing through imaginative participatory procedures.

This transition will not be easy. There are huge sunk physical, economic and political investments at stake. But the coastline cannot be maintained against all odds. This offers the scope for exploring a series of innovative approaches to risk based planning on a regional scale. There is also the opportunity, as budgets are tightened, for new means of financing sustainable coastal futures bases on cross subsidization of the wealthy protected towards the relocated newly protected. This arrangement, which will be explored in interviews, would herald the emergence of an innovative adaptive coastal governance process for sustainability in Portugal, where the stakes of failure are very high, but where apparently non-sustainable approaches can effectively and equitably be mitigated by sustainability offsets. This is why we explore the innovative institutional arrangements that will carry the much troubled Portuguese coastline towards more socially fair, reliably prosperous, and locally endorsed pathways to greater sustainability.

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## **Achieving Sustainability in Small Water Systems through Active Community Involvement, A Case Study from Sri Lanka**

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During past several decades, many Rural Water Supply and Sanitation (RWSS) projects have been implemented in Sri Lanka, a developing country in Asia, by various organizations in order to address the issue of safe drinking water and sanitation facilities. However studies have revealed that the anticipated results of these development efforts have not been accomplished, mainly due to little or non-involvement of target communities in the decision making and implementation process. Community Water Supply and Sanitation (Pilot) Project (CWSSP) Sri Lanka assisted by the World Bank introduced a participatory development approach by actively involving beneficiary community's right from the project inception. Under this innovative approach, the user communities select technological options and service levels, contribute towards capital cost, manage construction and more importantly undertake responsibility for scheme operation and maintenance. Under this approach, all procurements related to water supply scheme construction are carried out by the target communities. Community Based Organizations (CBOs) established by user communities are in the forefront of the entire project implementation process. Unlike in previous projects focused only on improved WSS services, the CWSSP based itself on a broader concept of the provision of WSS services as an entry point to realize a larger goal of poverty reduction through diversified rural development activities. In every village selected for project intervention, complementary sanitation and hygiene education programs have been implemented as an entry activity. These programs stimulates community demand for safe drinking water, thus raise the community demand for improved water.

CWSSP approach has become a lank mark and a turning point in the sector development in Sri Lanka. After studying the success of this approach, the Asian Development Bank and the Japanese Bank for International Corporation have come forward to assist Sri Lanka to adopt this approach as a National Program.

With the success of the pilot project, The World Bank has made a grant of US \$ 39.8 million towards implementation of 2nd CWSSP. The innovative feature of the 2nd CWSSP is its highly decentralized implementation mechanism which supports the Government's devolution of power and sector reform policies. The progress made under the 2nd CWSSP is impressive. Participating local authorities have already completed construction of WS&S facilities in over 750 villages covering approximately 900,000 people. CWSSP has become a national program and has already provided safe drinking water to over 3.5 million rural people.

The project's community capacity building programs are not limited to provision of project specific implementation support training. It targets development of social capital to sustain assets created by the project and to support the community livelihood development. Attention is given to diversify CBO activities to rural credit programs, entrepreneur skill development, welfare and cultural activities and rural infrastructure development. The ultimate target of the capacity development program is to strengthen the CBO to undertake village level economic and social development in order to enhance well being of rural poor communities. This approach has resulted transforming CBOs in to "Village Development Centers" which could undertake the implementation of rural development activities as they have already established a sound flat form at grass root level.

The project's experience is that active involvement of CBOs for village level development activities can effectively reduce the burden of the government in rural development as CBOs are in a better position to identify, plan, implement and manage such programs. Already there are more than 3000 CBOs functioning in the country, providing safe drinking water to rural communities.

CWSSP has made a radical change in the Rural Water Supply and Sanitation (RWSS) sector and significant improvement in lives of the people. CWSSP stood out from the other projects not only on account of its impressive physical achievements, but also on account of the innovative and creative approach it developed. It was the pioneer in using the "participatory community development approach" from the very inception of implementation thus creating a sense of ownership ensuring the sustainability of the facilities constructed. Success of the participatory development approach can be best seen by the voluntary contribution of 31.9 % of the capital cost by the beneficiaries as against the mandatory requirement of 20% under the project.

The key lesson learned is that if the government is ready to provide guidance and assistance, rural communities can undertake implementation and management of development programs in a sustainable manner. What the project should target is to change the mindset of the people from dependency to self reliance, through social mobilization that unleash the dormant potential of rural communities and also give the right guidance, managerial and technical skills. Then we are able to see wonders where a passive community takes the leadership to manage their own affairs.

## **Role of Community Based Organizations and Village Panchayats in Natural Resource Management: A Case Study from Tamil Nadu, India**

Dr. P. Maduraiveeran

The main objective of this paper is to discuss the need for establishing viable linkages between village panchayats and community based organizations for effective use and management of natural resources. This study is based on empirical data collected from Church Auxiliary for Social Action (CASA) an NGO functioning in Tamil Nadu in India . The Core Programme of CASA (direct intervention) initiated focused on building and strengthening Community Based Organizations (CBOs) of the marginalized sections. These organizations are the pivot for addressing issues affecting the life of the reference communities through a process oriented approach and are owned and managed by the community itself.

Natural resources have been managed by rural communities since time immemorial by maintaining a delicate balance between use and overuse. This ensured sustainable use of these resources, till recent times when overuse has led to their depletion. The time tested traditional natural resource management systems have served the communities well.

It is important to involve the local communities in all stages of natural resource management. This is required for the following reasons:

- For long-term sustainability as natural resource management interventions made without people's participation tend to return to the pre-intervention stage once external support is withdrawn.
- The participating community owns the natural resource management interventions.
- For sharing of costs and benefits.
- For operation and maintenance of various interventions.
- After the panchayat raj institutions were given constitutional status through 73rd Amendment Act in India, in 1993 various governments' departmental policies gave direction on involving panchayat in the management of natural resources. But the local management setting had undergone changes by then. A large number of CBOs were engaged in the task of natural resource management (NRM). Obviously, under the given circumstances, involvement of panchayat in NRM largely depends on linking panchayat with local CBOs in a meaningful way. But controversies galore on the issue of such linkage.

As a policy, panchayat has been contemplated to be the grass root unit for ensuring community participation in developmental activities in the countryside. In the sphere of NRM, this intention has been more pronounced with the introduction of the 73rd Amendment of the Constitutions, which confers a number of crucial responsibilities on the panchayat concerning village development including management of land, water and fisheries. In contrast to this policy intention, the conservative bureaucracy has been promoting Community Based Organizations (CBOs) at sub-panchayat level for managing various natural resources through sharing of responsibilities. It is argued that panchayat is needed to be disaggregated for effective management of natural resources. It is pleaded that the need of the hour is to identify a precise social organization which can provide adequate social structure for undertaking NRM activities with a bias towards shared values.

After the enactment of 73rd Amendment , though various departmental policies gave direction about involving panchayat in different stages of implementation of NRM programmes, in reality, the CBOs are functioning as parallel bodies to the panchayat under the control and supervision of conservative bureaucracy. Following is a brief account of the experiences on CBOs-panchayat relationship in the process of NRM.

It is apparent from the foregoing discussion that, at present, the linkage between political decentralizations, in the form of CBOs constituted by the user groups, is in jeopardy at the field level. It will into be out of context here to specify that the development process in the country is yet to attain a participatory mode. It is, at best, in the incremental and manipulative modes where in the government has the ulterior motive to support community participation for reducing up the policy and administrative ineffectiveness. To this effect, the government puts pressure on the conservation bureaucracy to elicit its response towards creating a participatory environment at local level for NRM.

Experiences indicate that the linkage and confidence between two social units is established better through interdependence rather than patronizing by one over the other. Some is the case with panchayat and CBO. Several measures can be adopted to build up the interdependence between them. The panchayat should have control over public funds made available for implementation of NRM schemes. On the other hand, for preparing the investment plans, the concerned CBOs under the jurisdiction of the panchayat should have equal stake.

# Global institutions and governance

Bharat Desai & Van Miller

## Oral Presentations

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### Green Marketing or Green Washing: A study of Textile Sector in India

Himanshi Tewari  
Arun Sahay

India is an emerging market is well established. Some even consider it as emerged market with more than 250 million consumers from the middle class. The marketing world in India has undergone a sea change. Any organization whether it is airlines or railways, automobile or tobacco manufacturer, textile manufacturing or printing, thermal power generator or distributor, hotels or restaurants claim to have gone green. Marketers of all hue and color have resorted to green marketing. Looking around, however, we see that the pollution levels are going up by the day. The communications from the firms, on the contrary, attempt to make us believe that their activities have positive impact on the environment or at least they have reduced the negative impact. One wonders whether firms are really limiting themselves to green marketing or they are green washing the market.

Green washing, in many cases, is a deliberate effort to create a more environmental friendly image of the company than its competitors. No doubt, the firms have a right to differentiate their products or services for getting competitive advantage; they are also responsible to the stakeholders to give them correct information. They may make immediate gains through green washing but in the long run they are likely to lose.

The paper attempts to understand and evaluate this phenomenon in the context of textile industry in India. Secondary data as well as those derived from focused group discussions, the interviews of the concerned executives and responses from consumers have been used for the study. The analysis of the data leads us to believe that though the firms, to some extent, have taken to green marketing, in majority of the instances green washing is taking place.

### Government Actions in Implementing Clean Development Mechanisms in Brazil: An Assessment of the Bandeirantes Landfill Project

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This paper analyzes the Bandeirantes Landfill, a Clean Development Mechanism (CDM) project implemented by the city of Sao Paulo, Brazil. Bandeirantes Landfill is one of the biggest in the world. It was started in 1978; it occupies 1.5 km<sup>2</sup> and has a capacity of more than 30 million tons of garbage. The landfill is divided into five cells of which three were simultaneously opened in 1978 and closed in 1995. The two remaining cells were used in the CDM project beginning in 2003. The project capture the CH<sub>4</sub> produced by decomposition of ground garbage and generates renewable electric energy. In using the methane to generate energy, the project has enabled the reduction of 7.178.800 tonnes of CO<sub>2</sub> equivalent as of 2010. The CDM project was implemented through a innovative public-private partnership and involves a participation of international, national and local stakeholders, including the local community which will benefit from the project. Sao Paulo municipality decided to invite bids from private sector firms to design and implement the CDM project in exchange for half of the funds generated through the sale of Certified Emission Reductions (CER). The paper provides an assessment of the design of the CDM project, the barriers encountered in its implemented, the stakeholder participation and the benefits realized. Stakeholder participation helped in a choice of implementation options. Public policy strategies formulated in a top-down mode risk failure during the implementation phase because local conditions have not been taken into account. This study involved interviews with the Executive Secretary of the Committee for

Climate Change and Eco-economy and the Chief of the Department for Participation and Public Policies Stimulation both of the Municipality of Sao Paulo. The CDM project held two CERs auctions on the Sao Paulo Stock Exchange which produce revenue of R\$ 70.000.000,00 (€\$ 26.000.000,00). The first involving GHG credits from Bandeirantes Landfill and the second using credits from Bandeirantes Landfill and another landfill (Sítio São João Landfill). The resources generated from the first sale of carbon credits were divided equally between the government and the private sector operator of the landfill project. The government part was used to implement environmental management projects in the area of the Bandeirantes Landfill. From the second auction, resources were used for revitalization of urban areas near the two landfills sites. A major barrier in the implementation of this CDM project was the complex and bureaucratic approval process. It is very time consuming to obtain approval of the various levels of government, including regional, state and national and ultimately final approval by the United Nation. This reduces the possibility of getting a Certified Emission Reductions (CERs) approval in a reasonable project schedule and substantially increases overhead costs. Brazilian municipalities do not have technical staff trained to meet the requirements of this approval process and face difficulties in adopting new technology or new procedures. From a local perspective the requirements are criticized as unnecessary in the sense of not being essential to the project. Empirical results suggest that this project was achieved only because of the public-private partnership which made possible an organization focused entirely on meeting the requirement of the project. A second major barrier related to decisions on the use of REC funds. Local stakeholder saw this fund as an opportunity to compensate the population for the inconvenience of living near the landfill. During public hearings conflicts emerges between CDM investment policy that the funds should be used only for environmental projects and the views of the local populations that CDM projects should be useful not only to reverse environmental degradation but also to ensure dignified living conditions for the population through building hospitals and schools. Local stakeholders emphasized that the population around the landfills was affected by the activities and impacts of these landfills, such as movement of trucks loaded with seven tons of garbage daily, stench, and health risk public. After a long process of discussing at public hearing a compromise was reached which involved building a veterinary hospital, focusing on local fauna and a wood working handicraft school to improving incomes of the local population and which also relate to environmental sustainability. In spite of these barriers the CDM project has achieved the reduction of seven and a half million tons of carbon dioxide equivalents which are no longer released into the atmosphere, the generation of renewable energy and the application of CER funds in the local community. The paper concludes there is a need for new forms of funding and that the CDM should be extended beyond 2012. There is a perception that the CDM procedures should be substantially simplified and embedded in public policies with less formal mechanisms and a broader range of expenditure to include social and environmental projects appropriate to developing countries. The research proves the utility of applying public-private partnership in other regions of Brazil and other developing countries. The partnership was based on criteria, activities and responsibilities clearly defined for each party to the contract. The negotiation process enhanced the role of the government organization not only as an enforcer of regulations but also as a promoter of sustainable development.

### **The legitimacy and effectiveness of global public-private partnerships for sustainable development**

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Global environmental governance studies a range of new mechanisms of multi-stakeholder deliberation between government, market, and civil society actors. Transnational public-private partnerships for sustainable development are frequently advanced as policy innovations that simultaneously can reduce the implementation, governance and legitimacy deficits in global governance (Haas 2004). They are conceived as more adequate and effective instruments compared to traditional regulatory mechanisms of tackling global environmental problems. Public-private partnerships are framed as win-win solutions that increase the democratic credentials of global governance while simultaneously strengthening environmental performance (Benner et al 2003; Streck 2004). This paper critically synthesizes debates on the emergence, legitimacy, and effectiveness of public-private partnerships for sustainable development. The aim is to provide a meta-assessment of existing studies of partnerships by reviewing the rapidly expanding scholarly work on transnational partnerships for sustainable development (Andonova 2010; Biermann et al 2007; Hale and Mauzerall 2003; Schäfferhoff et al 2010).

As the term “sustainable development” encapsulates environmental, developmental and health dimensions, the paper specifically highlight the “Johannesburg Partnerships,” adopted at the 2002 World Summit on Sustainable Development, which were seen as complementary to intergovernmental agreements. As of 2010, 348 partnerships are registered with the UN Commission on Sustainable Development (UNCSD), including partnerships that were launched at the summit[1] In the light of the upcoming Rio + 20 summit in May 2011, this paper takes stock of the performance and legitimacy of

the Johannesburg Partnerships and highlights individual Johannesburg partnerships.

This paper is structured around three questions, which reflect the expanding scholarship on transnational public-private partnerships. First, how and why did the partnerships emerge? Secondly, are they effective at solving environmental problems? Thirdly, are they legitimate (inclusive, accountable) governance mechanisms (Bexell and Mörth 2010; Bäckstrand 2006)? In answering these questions, the plethora of research on public-private partnerships reach different conclusions. Research appraisals of partnerships do not necessarily share the same ontological, epistemological, and normative assumptions on the nature and effects of public-private partnerships. The questions of emergence, effectiveness and legitimacy have been approached from different theoretical and methodological angles. Questions of emergence have primarily been approached from an interpretive perspective, while functionalist and critical perspectives have analyzed the topics of effectiveness and legitimacy. These different approaches are used because their explanatory potential for each of the analytical problems is complementary. For instance, effectiveness in a liberal-functionalist analysis primarily concerns the role of partnerships in fulfilling certain governance gaps; are partnerships more effective than alternative instruments? Do they reach their proclaimed goals? However, the question of effectiveness is less relevant or differently interpreted from a critical perspective (Mert 2009; Mirafteb 2004; Ottaway 2001). For example, “goal attainment” has been criticized for being a too apolitical frame that obscures the question whose interests are served and/or (re)instated by partnerships. In addition, critical approaches have addressed what the source of legitimacy for partnerships is.

Reflecting this theoretical diversity, this paper deals with questions about performance, legitimacy, and emergence of public-private partnerships from multiple perspectives. The first section conceptualizes public-private partnerships as multi-sectoral network governance instruments. It also contrasts the liberal-functionalist, critical and interpretive approach to the study of transnational partnerships. The second section briefly summarizes the context for the Johannesburg partnerships. The third section focuses on how different theoretical approaches have explained (or critically examined) the emergence, effectiveness and legitimacy of partnerships. The concluding section revisits the questions on the effectiveness and legitimacy of transnational public-private partnerships by summarizing cumulated research insights on partnership performance, participation.

[1] The partnerships adopted at the World Summit on Sustainable Development (WSSD) are referred to as the “Johannesburg partnerships”, see website <http://webapps01.un.org/dsd/partnerships/public/welcome.do>

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## System's analysis and knowledge for action – a harmonious marriage?

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Throughout the literature describing the character of sustainability science you will often find properties such as “future orientation”, “complexity”, “system’s orientation”, “human-nature-interface”, “transformation”, “assessment of consequences” etc. (Kates 2000, Kauffman 2009, Komiyama 2006). This conference’s topic vividly displays these characteristics. Furthermore, the Brundtland-report together with the tasks expressed in documents issued by the Rio and Johannesburg Conferences still often serve as references for a general understanding of what sustainable development is about (for an exception cf. Ehrenfeld 2004). I take it to be a common denominator for sustainability science that it strives not only for understanding how the world looks today but also for delivering knowledge for actions towards a more sustainable future for the global human community.

However, there are at least two substantial problems to be considered when the production of scientific knowledge is expected to truly contribute to informed decision making within local, regional or even national constraints.

First, and notwithstanding consensus on its future and action orientation, it is not self-evident what is really meant by “knowledge for action” or “action orientation”. Whereas, for example, many scientists talk in terms of solutions (often natural scientists and assuming that sustainability goals are given by science), other scientists (often social scientists) prefer to address societal deliberation and negotiation regarding sustainability goals. However, if we want to scientifically contribute to the understanding of governance of transition processes towards sustainable development, then our scientific approach towards the setting up of goals - together with their underlying goods and norms - will be one of the most important elements within our analytic undertaking. As we do not have a commonly shared theory of sustainability, which expresses the substantial goals for societal development, it is more than fair to say that the analysis of goals within governance of sustainable development forms part of the trickiest challenges within sustainability science.

Second and additionally, it is again not self-evident what type of scientific analysis regarding the issue in question will debunk adequate options for actions towards a sustainable future. I am not talking about the analysis of institutional settings, actor’s constellations and the like. I am talking about reliably produced information on options for actions for institutional actors given some sustainability issue. This is the place where system’s analysis comes into the picture. It is often argued that the actors first need to understand the complexity of the issue and should then develop possible pathways of the issue via scenarios. I agree that this is the general picture. The problem, however, lies in the fact that there are many ways for system’s analysis and scenario-building to be performed, many of them not taking into account the specific aspect we are interested in: actors and their actions spaces. System’s analysis normally focuses on causal and functional relations. However, social action spaces consist in more than causal and functional relations. Institutional settings (explicitly and implicitly obtaining norms and values defining actions spaces) or the actor’s resources (knowledge, interests, abilities etc.) are very often not displayed within system’s analysis.

The purpose of this paper is twofold. The first consists in addressing the sketched shortcomings that emerge if we focus on system’s analysis alone in our knowledge production for governance of sustainable transition processes. The second consists in contributing to improving the analytic means for analyzing sustainability issues in the context of governance processes. On the one hand, I will present a new way of representing the Swiss Power system, developed within the frame of a project of the Swiss Academy of Science. Its characteristic is that it distinguishes between the causal aspects (matter and energy) and their societal organization by displaying their mutual relationships. On the other hand, I will present a way to include options for actions within a scenario development tool based on two projects carried out in the Basel region. The lesson learnt is that we need to focus on these options for actions from the beginning of system modeling in order to get an output that is able to inform governance of sustainable transition processes.

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## **The UN Global Compact and its Swedish Participants**

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The United Nations Global Compact (UNGC), a transnational norm-building network (Mueckenberger & Jastram, 2010) was launched in 2000 and is considered the world's largest corporate responsibility initiative. A decade later the UNGC had 6,255 corporate signatories whereof 1,415 were labeled as non-communicating and risked being delisted. The member population consists of both large MNEs and SMEs, from developed and developing nations. Our focus is on the Swedish UNGC signatories. Despite the assumed importance of the UNGC, and though Sweden has since inception been one of the largest contributors to the Global Compact Trust Fund (UNGC, 2010), only 103 of the estimated 950.000 Swedish companies were active in the UNGC late 2010. In this paper, we examine the Swedish UNGC population. We explore who they are and what their organizational characteristics look like to develop propositions for a subsequent impact study. Ultimately we are interested in why companies choose membership and what influence and impact membership has had on corporate CSR and sustainability work.

The extant literature on the UNGC has centered around two major areas: the structure and design of the initiative as related to the mission; and the influence from and outcomes of UNGC membership. The voluntary network-based character of the initiative, stressing learning and continuous improvement has been supported by some researchers (Leisinger, 2003; 2007; Rasche, 2009) but questioned by others (Deva, 2006; Bremer, 2008; Mentis, 2010). Though few argue against the need for transnational norm-building networks such as the UNGC, or doubt that the UNGC has contributed to raise awareness, several researchers question the efficacy of its design and structure. Debate centers on insufficient accountability (Aravello & Fallon, 2008; Mentis, 2010), the vague nature of the principles and a lack of guidance related to specific issues or industry sectors (Deva, 2006). Proponents argue the need for critical member mass over the importance of accountability (Bremer, 2008) and that the UNGC should be seen as a supplement to national initiatives, other voluntary frameworks or other existing and emerging regulation surrounding the global business community (Kell, 2005; Rasche, 2009). Compared to research on design and structure, there are fewer studies on impact. The few impact studies conducted focus on businesses' perception of the UNGC, influence on companies' CSR work, and the content of UNGC reporting (McKinsey, 2004; Arevalo & Fallon, 2008; Runhaar & Lafferty, 2008). Evaluative studies indicate limitations of UNGC's effects where only a small majority of the members took human rights into account within their overall corporate code (UNGC, 2007) or embedded into corporate strategies or operations (Oppenheim et al., 2007). Other studies have shown little or no significant impact from participation or indicated that change would have happened with or without UNGC membership (McKinsey, 2004). Studies applying institutional and stakeholder theories posit that companies who respect human rights obtain better stakeholder relations through societal legitimacy and an improved corporate understanding of stakeholder pluralism demands (Mentis, 2010). Yet other studies suggest that despite increasing global CSR norms, country specific factors influence corporate CSR adaptation, focus, activities, and that national institutional environments influence reporting (Chen & Bouvain, 2008).

Thus, the extant literature indicates that companies participate in the UNGC in different ways and for a wide variety of reasons. They may also benefit from participation to differing extents. Though Sweden has been an active proponent and one of the largest contributors to the UNGC, only 103 Swedish companies participate. An overview of the Swedish UNGC population reveals that (as of November 2010) 42 % were defined as SMEs, non-communicating companies do not differ in size, and companies have joined the UNGC at an increasing rate since 2008. The ratio between new member MNEs and SMEs has been balanced. A wide range of sectors are represented in the Swedish population, with the most participants belonging to General industrials, Financial Services and Travel & Leisure. Most companies are in services industries, followed by manufacturing and retail. Signatories are primarily in B2B businesses and a majority of the companies are privately held.

With a basis in institutional (DiMaggio & Powell, 1983), stakeholder (Donaldson & Preston, 1995) and network theories (Rowley, 1997), a review of previous research on the subject of UNGC, and our own overview of the Swedish UNGC population, a number of observations are interesting and will be tested on a subsequent full population survey and in-depth interviews. For example, institutional isomorphic processes would, given the Swedish government support to the UNGC, predict a larger number of Swedish UNGC signatories than the 103 current members out of the potential 950.000 Swedish companies. The balance of SMEs to larger companies is also interesting as some of Sweden's largest MNEs are not members or listed as non-communicating. A proposal that MNEs have in-house competence while SMEs are more in need of the UNGC runs contrary to the fact that the ratio of new members remains balanced between MNEs and SMEs. Moreover it is interesting that though claims of UNGC "blue-washing" through membership have mainly been targeted towards consumer goods oriented companies, the Swedish UNGC membership comprises overwhelmingly service and B2B industries where consumer blue-washing might be less obvious. Stakeholder and network theories would posit that stakeholder groups might be densely connected to each other in their cognitive reference groups. Membership in formal and informal transnational norm-building networks, such as the UNGC, may enhance legitimacy

not only for each company, but also for the network itself and might be interesting to test. Before a more detailed analysis of the UNGC Swedish population, it could be hypothesized that there are strong network ties between the members. This might give rise to the question whether there may be other forces than consumer pressure that may be pushing UNGC memberships. We might need to redefine our existing sector clusters with regards to the UNGC. For instance, perhaps propositionally, we will have to look closer also at public procurement suppliers rather than B2B or B2C, or compare multinational members with domestic ones.

This exploratory study contributes to our understanding of the organizational landscape in relation to membership of transnational norm building networks. Linking institutional, stakeholder and network analysis, our study forms the ground for further exploring the influence and impact of such an initiative on corporate CSR and sustainability work.

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## Promoting Sustainability Across Food Sectors? The Hidden Strengths and Weaknesses of Private Standards Markets

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In recent years, various initiatives have been taken by governments, NGOs, and private corporations to individually and jointly promote sustainability along global food value chains, such as coffee, tea, cocoa and palm oil. Most initiatives thereby address issues of social fairness, economic prosperity and ecological quality. Over time, a large number of standard organizations and certifiers have emerged to promote the implementation of particular sustainability standards, such as Fairtrade, Rainforest Alliance, Utz Certified, Organic etc. Because of the ambiguity of social and environmental sustainability as well as conflicting interests of buyers and producers along food value chains, no single standard seems to emerge as a dominant standard within or across food sectors. Instead, so-called 'standards markets' have formed with multiple, partially competing, partially collaborating standard organizations. In the coffee sector, for example, over 30 different private standard initiatives co-exist until today.

Despite the proliferation of standard offerings, only a small percentage of produced food commodities has been certified. For example, in cocoa farming, only 3% of the volume of cocoa production is certified, and only 10% of farmers have received proper training to qualify them for certification. In face of these numbers, as well as related challenges with implementing fundamental labor rights, such as the abolishment of child slavery in cocoa farming, many scholars have called for intergovernmental regulations to correct the 'failures' of private regulation. However, recent attempts to come to new agreements at the intergovernmental level have also proven to have limitations. One example is the new International Cocoa Agreement which fails to formulate and commit countries to concrete objectives towards greater responsibility and sustainability. This dilemma calls for a better understanding of what the strengths and weaknesses of voluntary standards markets vs. intergovernmental regulation actually are. This study attempts to identify some of these strengths and

weaknesses, based on empirical studies of standards development and implementation in coffee, cocoa and palm oil.

In many food sectors, failed intergovernmental agreements triggered the emergence of voluntary private and multi-stakeholder standards. For example, in the coffee sector, the International Coffee Agreements used to regulate coffee exports from major producing to major consuming countries, by guaranteeing export volumes and by stabilizing prices. However, the agreement was undermined by liberal market policies of certain member countries as well as coffee trade for lower prices between non-members. In 1989, the ICA was finally dismantled, resulting in a longer-term 'coffee crisis'. Another example are ILO conventions protecting human rights, including the abolishment of worst practices of child labor, which have been ratified by many Western African countries to signal their willingness to eradicate child slavery in cocoa farming and related industries. However, recent studies indicate that child slavery and trafficking are far from being eradicated – on the contrary, economic interests and a weak legal system help tolerate these practices. These two examples suggest that intergovernmental agreements are often undermined by conflicting economic and political interests. As a consequence, more recent agreements typically resemble non-binding 'commitments' towards improving social and environmental conditions, rather than regulating them.

Compared to this, what are the (hidden) strengths and weaknesses of voluntary standards markets? Based on empirical data from the coffee, chocolate and palm oil industry, we investigate this question in greater detail, in order to derive implications for both research and policy-making. Data includes a series of semi-structured interviews with standards organizations, MNCs and producers operating in these different food sectors, as well as secondary empirical studies.

First, we identify the proactive role of MNCs in co-developing and implementing voluntary standards to be an underestimated strength of private standards markets as compared to intergovernmental regulation. As powerful buyers in food industries, MNCs help create a demand for certification and also contribute resources to implementation. Thereby, they often help transmit standard certification practices across food value chains as they engage in different food businesses. Kraft Foods, with its chocolate and coffee products, is a good example. Second, and related to this, large certifiers, by addressing MNCs as adopters, often 'sell' their standards across food sectors, thereby generating economies of scale and scope. Whereas international agreements were typically bounded within food sectors, private standard providers typically extend their reach across sectors and thereby help mainstream standard adoption. Third, through continuous market feedback, standard development and adoption have become a learning process that allows for adjustments and differentiation across adopters and regions. As part of this, standards markets have helped create 'baseline certifications' along with 'gold standards' which in combination have raised the common ground.

As a consequence, more than intergovernmental agreements, private standards markets have managed to more deeply embed standard adoption with existing business practices and have allowed for different degrees and levels of adoption, depending on product features, political conditions, market demands etc. Also, in the context of developing countries, Western MNCs have shown to have an equally important 'development role' as for example donor government agencies.

However, as indicated above, private standards markets continue to have major flaws. First, the fact that multiple standards and certifications co-exist, and that even more are being created has resulted in multiple certification practices, involving considerable adoption cost on the producer end. Although standard organizations have started to endorse each other and to promote compatibility, multiplicity remains a practical obstacle for many producers in particular. Second, and related to this, standard adoption remains dependent on market demand for standard labels. Whereas intergovernmental agreements have regulating power independent of consumer awareness, the adoption of voluntary standards is partially driven by market demands. Both consumer and producer education have therefore become subject to costly marketing by standard organizations. Third, because of the possibility of new market entrants to offer alternative standard packages, stringency criteria have shown a tendency to become more relaxed in order to facilitate adoption and to prevent adopters from switching to less stringent providers. Although at the same time the number of adopters – of at least basic standards – has increased, the relaxation of standard criteria may slow down the process towards accomplishing greater responsibility and sustainability along food value chains.

In sum, we argue that private standards markets feature a number of – more or less obvious – strengths and weaknesses compared to intergovernmental regulation. Future research needs to investigate these features further in order to come to a more nuanced understanding of privatized regulation. Policy-makers in turn need to become more aware of the mechanisms facilitating, but also hindering or hampering the adoption of standards vs. the implementation of intergovernmental agreements with similar objectives.

## **Private Regulatory Uncertainty and Firm Choice: Firms' Responses to Stakeholder Pressures to Join Global Governance Codes**

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In this paper, we explore the emerging, yet uncertain, regime of private regulation of corporate social responsibility and sustainability. Specifically, we conceptualize – and empirically test for a sample of 1,326 firms – how external pressure on firms in the form of social responsibility ratings influences their decisions to accede to two leading CSR/sustainability global codes of conduct.

We begin by reviewing the nature and extent of regulatory uncertainty surrounding CSR and sustainability, drawing from the seminal Brundtland Report and other recent contributions regarding how companies increasingly navigate overlapping public and private regulations in multiple jurisdictions and at several levels of governance. Next, we document the emergent phenomena of growing private regulation (voluntary codes, standards, third party ratings, etc.) and the interaction of these private regulatory initiatives with public regulations. We use this review to generate our core research questions, namely, do stakeholder pressures affect firm decisions to join private regulatory regimes to enhance their legitimacy? If so, which stakeholders exert the most pressure upon the corporation?

Historically, the state was viewed as the main vehicle through which regulation of business activity was conducted. For instance, by the 1970s in the United States, such a regulatory type could be clearly seen in the Environmental Protection Agency's enforcement of the Clean Water and Clean Air Acts. Increasingly, however, private regulation is viewed as a supplement or complement to public regulation. Tietenberg suggested that private regulatory regimes involve lower enforcement costs. Such regimes may also encourage and reward the highest performing firms – those that go above and beyond what is expected – with added reputation and legitimacy. Through moral obligation, these voluntary regimes should pressure firms to behave appropriately. In turn, good environmental behavior is indicated in the form of certifications and/or public disclosure, which validates the expected conduct. In addition, public regulation is most often limited by the borders of nation states, a reality underscored by the failure of the Kyoto Treaty. As firms become more global, public regimes cannot oversee their increasingly multinational presence. At the same time, there are concerns that private regimes may supplant or even replace public regimes, undermining the role of the state.

Notwithstanding these conflicting assessments, the proliferation of private regulatory regimes presents a challenge to the business community and its stakeholders. That is, should firms join these regimes? And, what are the potential outcomes derived from this decision? To answer these questions, we develop a typology of sustainability responses that shows alternate paths firms take in making decisions regarding whether to join these emerging movements. We focus especially on the role of stakeholders, as reflected in KLD ratings of firms' CSR and sustainability practices, as a contributor to whether and why they chose to affiliate to the UN Global Compact (UNGC) or the Global Reporting Initiative (GRI), two of the most prominent global voluntary governance regimes.

Drawing on conceptual and practitioner insights and data collected from the KLD social responsibility ratings and from the UNGC and GRI, we suggest firms facing stakeholder pressures have four basic choices when joining private (sustainability) regimes. First, there is the virtuous choice. Under this choice, a firm 'senses and hears' positive messages from its stakeholders. Hence, the decision to join the private regime provides external validation of its inherent goodness. Its choice affirms the stakeholder pressures that it is hearing. Contrasted against this is the devious choice. In this mode, a firm also selects to belong to a private regime, but here, stakeholder sentiment indicates a high degree of concerns. For a firm implementing the devious choice, the affirming private regime enrollment looks more like a way to counter the negative pressures. But, the choice is not congruent with stakeholder perceptions.

The third basic response to stakeholder pressures can be labeled righteous. Like the virtuous choice, the righteous choice also has society's acclaim on sustainability matters, but a firm selecting the righteous choice is so confident in its goodness it opts to ignore private regimes. In other words, the righteous choice implies that a firm does not need the external validation offered by an influential private regime. The fourth and final type of firm choice is termed nefarious. Despite the fact multiple stakeholders frown upon the corporation, a nefarious choice implies neglect for or indifference to the sustainability pressures exerted by stakeholders.

We hypothesized that firms have four basic choices when responding to stakeholder pressures. Evidence for those choices is shown in the summary of our empirical findings. Overall, Community, Customers, and Investors are the most influential stakeholders. Specifically, for the virtuous choice our findings suggest that firms choose to enhance their legitimacy when they 'hear' positive pressures from the community and their customers.

For the devious choice, the implications are a divergence between trying to look good while being rated as performing poorly – utilization of private regulatory regimes appears as a smokescreen to conceal the pressures coming from the

community. For the righteous choice, we suggest legitimacy is internalized to reflect doing good without stakeholder fanfare. This self-righteous attitude is validated through the acclaim of stockholders. Finally, for the nefarious choice, goodness is disparaged not only internally, but also externally. However, there was no statistical evidence that firms made this choice, i.e. disproportionately elected not to register for the UNGC/GRI.

In summary, our statistical findings show that the community and customers are the most important influence upon the firm choice to accede to a sustainability code of conduct. As such, our results support the contention that business executives and regulatory officials can gather important signals from communities and consumers regarding their social performance and that these cues will influence decisions to join global private regulatory codes. These findings also illuminate how stakeholder pressures on the decision to adhere to such codes may reduce regulatory uncertainty outside of the public domain.

## **Developing Community Leaders for Sustainability in a China, Mexico, Nunavut, and US Virgin Islands Network Utilizing a New Assessment Instrument, Community Design, and Collaborative Process**

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New case descriptions of social change agents leading and managing successful communitybased and institutional initiatives for sustainability and sustainable development are being portrayed in a growing number of peer-reviewed scholarly research papers. They are variously defined and described in the literature as world benefit leaders, cultural creatives, positive deviants, social entrepreneurs, adaptive network leaders, knowledge managers, transition managers, and boundary managers. They are active in a variety of settings from small villages to corporate institutions around the world. They are considered key agents for change in public opinion, for example on global climate change (Krosnick, et al., 2006) and key agents for public action, for example by developing local capacity rather than encouraging dependency (Bornstein, 2007). In general terms, these individuals can all be regarded as community leaders for sustainability (CLS) because, in one way or another, they are all engaged in the achievement of various targets and goals for global sustainable development (see Kates & Parris, 2003) which have been detailed, for example with regard to the reduction of poverty, in the UN Millennium Development Goals (Sachs & McArthur, 2005).

Many people may have the potential to become CLS. There may be a latent and underutilized reservoir of CLS potential in communities across global societies (Sternin, & Sternin, 2004) and these individuals may number in the millions (Bornstein, 2007; Ray & Anderson, 2000). CLS often engage in action beyond their local communities and institutions, linking local communities and institutions across cultures (Bradley et al., 2009; Marsh et al., 2004), suggesting that the phenomenon is based in crosscultural global similarities, that is, shared human attributes rather than cultural differences. We report here on the initial progress of a doctoral research project by the first author that seeks to add to the growing body of work on social change agents for sustainability (i.e., CLS) by further investigating the personal characteristics and social dynamics of these individuals. Specifically, by characterizing their psychology across global cultures this study aims to determine if they share personal and social attributes that make them successful and if it is possible to improve these attributes by participation and support in cross-cultural collaborative CLS communities. The term "characterizing their psychology" refers to the American Psychological Association description of "The collection of behaviors, traits, attitudes and so forth that characterize an individual or group..." (APA, 2007, p. 754) We are developing a new quantitative assessment instrument called the Global Sustainability Inventory (GSI) for this purpose. Constructed as a test battery, the GSI is comprised of previously published measures that have been brought together to characterize the individual personality psychology and broader social psychology of effective community leadership for sustainability. The GSI parallels the Global Life Leadership Inventory for business executives developed by former Harvard Professor M. Kets de Vries. Both include a feedback mechanism from the community about leadership efficacy. The GSI differs importantly, however, in that it is being developed as a cross-cultural field tool that can be used to assess and help develop the

personal and social leadership attributes of citizens for a sustainable future across the world.

As described by Beddoe et al. (2009), to effectively transition toward a sustainable global future community-based leaders and institutional leaders need to work together connecting local and global challenges through innovative and evolutionary collaborative initiatives. As described in this paper, our research seeks to bring community-based and institutional leaders together at four field sites, namely, communities in China, Nunavut, Mexico, and the US Virgin Islands in initiatives that address local challenges for sustainability. The CLS communities will also convene at a fifth “virtual field site” on an internet website to compare cross-cultural perspectives, share and disseminate best practices, and to develop global contextualization of the local initiatives.

Implementing change for sustainable development is a complex endeavor requiring careful community design and an optimal collaborative process (Mitchell et al., 2006). In this study the five CLS communities will be constructed utilizing an evolutionary learning community (ELC) design and engage community-based initiatives for sustainability utilizing the collaborative action methodology called synergic inquiry (SI). Quantitative and qualitative research methods will be used to evaluate and characterize the progress of the CLS as they engage in collaborative action across global societies. ELCs are highly collaborative and creative learning communities that have proven successful in building leadership capacity that is particularly adaptable to changing and challenging group dynamics with regard to cross-cultural initiatives for sustainability and sustainable development (Laszlo 2001, 2009). While the research and development of ELCs and SI has occurred independently in initial crosscultural field research this project brings them together for the first time in an effort to help optimize CLS development and success.

The collaborative action methodology of synergic inquiry (SI) (Tang & Joiner, 2006) will be the process by which the local initiatives for sustainability and sustainable development at the field sites will be discussed, action planned, and developed toward resolution. Derived in part from the Asian philosophies of Confucianism and Taoism, SI is a method of community collaboration that includes conflict resolution and transformative learning. It teaches a collaborative process in which differentiation and integration of varied and often conflicting individual and cross-cultural perspectives are utilized to generate new insights and better action.

Based in value judgments of what to sustain and what to develop, sustainability and sustainable development are difficult to define and difficult to put into practice at the local level across cultures (Leiserowitz, Kates, & Parris, 2006). We seek to address these issues and help promote a transition toward a sustainable global future by providing initial data on the development and validation of a replicable social science research protocol that integrates qualitative and quantitative research methodologies to evaluate and develop community leaders for sustainability. The protocol combines a new psychological assessment instrument, an evolutionary community design, and a synergic collaborative process to help develop an individual's capacity to be an effective social change agent for sustainability and sustainable development across global cultures.

## Posters

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### Planning Energy Efficiency Society

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Energy Efficiency has been considered mainly as a technical matter. Therefore, energy efficiency plans have been written by technicians and politicians together. The firstly based their assumptions on the pure rational behaviour of consumers and the secondly on the utopian assumption that they can change lifestyle solely by laws.

That is the failure of all existing European targets on energy efficiency and the current re-writing of the 2020 targets.

To change habits, to refurbish house, to buy a renewable energy plant is not a matter of rational behaviour and cannot be driven by economic advantages only.

According to the BET – Behavioural Economic Theory, people are driven by different factors depending on the technological maturity level of the solutions. Therefore, laws and guidelines have to be written according to the related technological knowledge of society.

To boost an energy efficiency program, we have to focus the attention on mankind and to change some of pre-existing knowledge. There are several elements to achieve a successful program.

First we have to define what energy efficiency is. We can define it as “the optimization of individual man-energy system”. This way, the focus is on the relationship between man and technology and not the performances of a single appliance or machine. And we can consider the whole cycle of energy: from production to consumption, from harvesting to re-use.

Then we have to consider the role of industry and government investment. What are the industrial development plans in the renewable energy sector such as the most recent “5 Years Chinese plan”, the program of the Indian Renewable Energy Minister and the strategy of some American companies including Google and Apple? Geopolitically we will see a stronger competition between eastern and western companies in small scale plants and in related services that we can name “Social-energy services”.

We also have to work on the problem of the identity of 2.0 people and especially on the young generations who have been called “digital native”. We cannot imagine using the same language and the same logic that we have used in the past (and that we mainly still continue with in the present).

Common goods, sharing solutions, sharing couches, downloaded music, hackers and crackers, low cost flights, facebook, twitter are some of the terms that are already part of the identity of younger people. It is not a coincidence that young people want digital cars (the electric ones belong to the nineteenth century) and are prepared for a new form of mobility.

But this digital generation has been educated for ecology too. Schools’ programs already have considered sustainability and renewable energies technologies as part of pupils’ knowledge.

Therefore, we have to connect all the above mentioned aspects with the family home. We can consider that the next generation house is definitely connected with accumulation systems represented often by electric cars (considered as a “battery on wheels” solution).

Transition Towns and Low Carbon Towns have little appeal for young people. Those terms are based on old environmentalist concepts and their starting point is that man is guilty. The truth is that the old generations are guilty but not the younger ones who haven’t decided their future and have still no role in society. Words such as “low” and “carbon” cannot be used effectively as dream-targets. We need to create a new environmentalist vocabulary as in the case of Class A Town, a program focused on families, noting that the main actors in the decision making process among families are women and children.

Tertiary education will play a key role in this revolution (a quick transition) as well as in boosting energy efficiency policy. University only have to remember their trans-cultural essence and be more courageous in promoting energy efficiency culture in all disciplines and all studies - following the example of Sapienza University of Rome. Sapienza organized a mandatory short course for all students of every faculty. These courses were promoted by an agreement between Environmental Councilor of Lazio Region and the Rector of University.

Change speed is so fast - both in eastern industrial system and in social habits – that the real risk is that traditional western systems will lose their role in leading society.

## **Green Marketing or Green Washing: A study of Textile Sector in India**

Himanshi Tewari  
Arun Sahay

India is an emerging market is well established. Some even consider it as emerged market with more than 250 million consumers from the middle class. The marketing world in India has undergone a sea change. Any organization whether it is airlines or railways, automobile or tobacco manufacturer, textile manufacturing or printing, thermal power generator or distributor, hotels or restaurants claim to have gone green. Marketers of all hue and color have resorted to green marketing. Looking around, however, we see that the pollution levels are going up by the day. The communications from the firms, on the contrary, attempt to make us believe that their activities have positive impact on the environment or at least they have reduced the negative impact. One wonders whether firms are really limiting themselves to green marketing or they are green washing the market.

Green washing, in many cases, is a deliberate effort to create a more environmental friendly image of the company than its competitors. No doubt, the firms have a right to differentiate their products or services for getting competitive advantage; they are also responsible to the stakeholders to give them correct information. They may make immediate gains through green washing but in the long run they are likely to lose.

The paper attempts to understand and evaluate this phenomenon in the context of textile industry in India. Secondary data as well as those derived from focused group discussions, the interviews of the concerned executives and responses

from consumers have been used for the study. The analysis of the data leads us to believe that though the firms, to some extent, have taken to green marketing, in majority of the instances green washing is taking place.

### **Capture and Store Carbon Dioxide Technology: Potential to Mitigate GHG in Brazil**

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The need for global actions to combat global warming resulting from anthropogenic emissions of Greenhouse Gases (GHG) has moved both the public and private sector organisations. Capture and Storage of Carbon Dioxide (CO<sub>2</sub>) in Geological Reservoirs (CCS) has been proposed as a major GHG mitigation technology in the short and medium terms. The importance of the use of CCS technology on a large scale to reduce emissions of CO<sub>2</sub> is discussed internationally. According to International Energy Agency (IEA), CCS technology can significantly reduce 20 to 28% of CO<sub>2</sub> emissions from stationary sources by 2050. Due to the importance given to CCS the International Panel on Climate Change (IPCC) published a special report in 2005 that deals exclusively with the different kinds of CCS technologies available. However, the current forms of incentives for the use of CCS are related to the private sector (oil and coal industry) and some public funds. One way to encourage the use of CCS on a large scale is the carbon market such as the initiative of American Carbon Registry (ACR) in the voluntary market. While the regulated market, led by the United Nations Framework Convention on Climate Change (UNFCCC), the discussion about the inclusion of CCS as a Clean Development Mechanism (CDM) should be completed by 2011. The purpose of this paper is to identify the international status and global perspectives of using CCS technology in order to verify its potential to mitigate GHG in Brazil. This paper is part of a PhD research project in progress with preliminary results. The methodology of this study is composed of exploratory, descriptive and analytical research which focuses on qualitative and quantitative strategies and techniques. For the collection and analysis of secondary data traditional content analysis of documents is used. Primary data were collected through, interviews with leaders and key players, and indirect observation of reality by participation in discussion forums with experts on the theme and in official meetings. This study consists of an introduction in which CCS and its potential to mitigate GHG is presented. It then presents the current forms of incentives available worldwide for the use of CCS on a large scale. It also presents Brazilian Climate Change Policy and the strategies and government position regarding CCS. The position of the Brazilian private sector regarding the use of CCS is also presented, specifically the case of Petrobras (a Brazilian oil company) and its potential for using CCS on a large scale. The preliminary stages of CCS in Brazil are analyzed and the possible impacts for Brazilian Climate Change Policy due to the lack of incentive for this technology. Finally the study presents the opportunities in Brazil for using CCS technology on a large scale in the carbon market.

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### **Effective sustainability product labelling: why, how and by whom to gain legitimacy?**

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Recent decades have seen an increased implementation of product labelling schemes by various societal actors to facilitate more sustainable development. These governance schemes differ substantially in their adequacy and the degree to which they trigger behavioural changes, referred to as the “outcome” of a scheme (Underdal 2002:6). So far there are no comparative studies investigating the causalities behind such differences across different sets of product labels. Using the concept of legitimacy as an analytical framework from a normative-prescriptive but mostly descriptive or more pragmatic perspective this paper attempts to fill this gap. It discusses actors and factors that influence different dimensions of legitimacy based on case studies of the Fair Trade, Marine Stewardship Council, EU energy- and EU ecolabel. The case studies draw on an extensive literature review and in depth interviews with advocates of different societal groups.

By aiming to a) be used as a vehicle for societal actors to place a demand for more sustainably produced products and b) assisting the supply of such products, labelling schemes aim for ruling power and an authoritative position within



the supply and demand system. For some labelling schemes authority is (partly) based on legal enforcement and the sovereign position of the state. In line with neoliberal trends away from traditional state regulation towards more privately driven forms of governance most labelling schemes however are more voluntary in their nature. The more voluntary and distant from state regulation, the more labelling schemes need to base their authoritative position on other (non state regulation based) legitimisation processes. This argument can be made on normative-prescriptive as well as pragmatic-descriptive grounds. From a normative-prescriptive perspective voluntary labelling schemes lack the procedures on which democratic states base the legitimacy for their authoritative action and are hence in need for other forms of legitimacy to gain a right to rule. From a descriptive-pragmatic standpoint the less labelling schemes can rely on the enforcement capacity of state rule making the more their effective outcome depends on the voluntary participation and support from the stakeholders the labelling scheme aims to influence or rule. Voluntary support and participation arguably requires stakeholders' consent to the legitimacy of an institution and the power relations that come with it. This argument is based on the assumption that consent to the legitimacy of the institution results in a subjectively binding force and a normative commitment on the part of those engaging but also a publicly symbolic or declaratory force as it constitutes an expressed acknowledgement (Beetham 1991).

Both lines of argument highlight that enhancing legitimacy is a complex process including moral, input, output, pragmatic, and cognitive dimensions.

From a normative-prescriptive perspective moral legitimacy requires the schemes justifiability according to general principles such as conformation to a minimal standard of justice, fairness or neutrality (Koppell 2008). From a descriptive-pragmatic perspective the scheme must be compatible with norms morally accepted by its stakeholders (Bernstein 2005), especially the ones driving societal demand. This includes not only individual consumers but often more importantly societal opinion leaders such as non-governmental and civil-societal organisations, media, academia, or governmental institutions. While the Fair Trade scheme for example has benefitted in many places from a high support among such stakeholders the EU ecolabel has faced a comparatively low support on this account. The Fair Trade example also illustrates the fragility of moral legitimacy with moral criticism rising as Fair Trade has increased its cooperation with multinational corporations such as Nestle or Starbucks. All case studies have shown that moral justification can change over time, differs from place to place, and that different stakeholders may have very different belief systems. Especially the latter can place a major challenge for another important dimension: input legitimacy.

Next to a belief in the moral validity of the norm itself, beliefs in the validity of the procedure by which the rule had been worked out is important (Risse 2004). According to Bernstein "there is an indisputable general normative trend" (Bernstein 2005, p 162) to democratize global governance schemes, implying that "those who have to comply with the rules ought to have an input in rule-making processes" (Risse 2004, p 7). Many authors highlight the importance of deliberation in which autonomous actors "can challenge validity claims, seek a reasoned communicative consensus about their understandings of the situation and justifications for norms guiding their action, and are open to being persuaded" (Bernstein 2005: 147). From a more pragmatic point of view many stakeholders on supply as well as demand side highlight the inclusion of their interests as a major motivation to support a scheme. Next to ensuring their support the inclusion of important stakeholders also enables to utilise their knowledge-, structural- and financial- resources. In addition the institutionalisation of multi stakeholder schemes based on deliberative decision making usually results in a perception of independence, which has shown to be an important factor for moral legitimisation processes. To increase their input legitimacy labelling schemes can for example include multiple stakeholders in their decision making bodies and use deliberative processes for standard setting and certification. However, finding a consensus can be difficult due to conflicting interests especially between supply and demand stakeholders but also interpersonal barriers. Many labelling schemes utilize the inclusion of experts often from academia to overcome such conflicting interests. Nevertheless deriving a non controversial consensus has shown to be difficult in most cases, especially the more diverging interests need to be included and the higher the controversy of the topic. In practice, the key question is usually not to find an uncontested consensus but which interests are crucial to include and to what extent in order to maximize the support across the supply and demand system.

Another important dimension from both perspectives is a schemes ability to fulfil the tasks delegated to it, referred to as output legitimacy (Borras 2007). The degree of this achievement can be either evaluated against normative ideals or against stakeholders' perception of a positive outcome. An effective output results mainly from the behavioural changes a scheme facilitates (outcome), which, as argued in this article, depends on its legitimacy. This can result in a vicious circle where a lack of output decreases a schemes legitimacy which further decreases its outcome and output. A prominent way to avoid such a vicious circle and achieve large scale modifications on the supply side is gaining support and legitimacy from businesses holding the "lead" position (Ponte & Gibbon 2005) within a supply chain. These businesses are often powerful corporations whose involvement can become a threat for deliberative decision making and moral legitimacy.

Closely related to output legitimacy is pragmatic legitimacy, based on stakeholders' judgement as to what extent a labelling scheme serves their own interests. On the supply side such interests include ensuring long term stability of the supply chain, market access or meeting broader societal demand. On the demand side pragmatic judgements are influenced by a schemes moral, input and output legitimacy but also its comprehensibility.

Comprehensibility is an important factor for both demand and supply stakeholders and can be increased through transparent and easy to understand structures (Cashore 2002). It often conflicts with the demands input legitimacy places. Comprehensibility can be seen as part of cognitive legitimacy together with taken-for-grantedness (ibid). Taken for grantedness, the strongest form of legitimacy, has so far not been achieved by any of the studied schemes but tried to be facilitated by connecting to established modes or standards.

The analysis shows that increasing legitimacy is a highly complex, interconnected and often inherently conflicting process. To achieve a more effective outcome, labelling schemes need to strive for maximal support from key stakeholders by finding a balance between different dimensions of legitimacy. The degree of difficulty in finding this balance and who these key stakeholders are depends on various internal, external and dynamic factors and appears to be the main question for any labelling scheme.

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## New Institutional Economics, carbon credits and Kyoto Protocol

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New Institutional Economics (NIE) seeks to explain persistence of inefficient outcomes observed in economy, and concludes that these are the result of property rights bad definitions and the existence of institutional faults, which do not induce the agents to move to efficient points. NIE's main concerns are: property rights, externalities, transaction costs, institutions and organizations.

Negative externalities arise when companies' activities result in impacting negatively others. Externalities emerge as an imprecise definition of private property rights. Air pollution is a typical negative externality example, because it causes harm to others, even if they are not responsible for the damage. The carbon market with a clear definition of property rights seeks to internalize these externalities. The air is a public good, a common society property resource, and it's difficult to measure and trade it, thus the carbon trade is an attempt to define the rights related to air pollution (PINDYCK and RUBINFELD, 1999).

In NIE's view property rights are defined as the set of laws that describe what people and companies can do with their properties, and arise in order to internalize externalities when internalization gains are greater than their costs. If property rights are properly established and determined, they ensure the owners rights over their assets, thus they are allowed to use and replace them. However, in a market exchange, the friction caused by asymmetric information can avoid goods to be traded at zero cost, thus externalities may emerge as so-called transaction costs, such as: drafting contracts, obtaining new information on the product and competitors, bargaining, conducting negotiations, and monitoring the process.

Coase suggests if there are transaction costs, resources will be misallocated, and alternative ways of institutions and organizations will be necessary in order to solve this problem. Still to Coase, the best agreement is one that minimizes the social loss and the transaction costs.

Douglas North defines institutions as <rules of the game> and organizations as <players>. Institutions create incentives and constraints for transactions to happen as well as they cover political, economic and social relationships. Organizations are defined as the number of people with a common interest that give structure in enabling coordination of individual action. The institutions and organizations provide a market mainframe, which is where transactions will take place. The way the relationships between the rules and organization occur determines the structure of economic relations (COASE,

1960; DEMSETZ, 1967; NORTH, 1990; WILLIAMSON, 1985; ZYLBERSZTAJN, 2002).

Kyoto Protocol introduced economic tools to assist emission reduction goals and established that developed countries should reduce its combined greenhouse gases emissions by at least 5.2% compared to 1990, between 2008 and 2012. To facilitate the reduction targets fulfillment, the Kyoto Protocol created trade instruments called flexible mechanisms, by which a country may overcome emissions limit, if at the same time it provides an equivalent reduction in another country, meanwhile there is no global net emissions increase (UNFCCC, 1998).

Flexible mechanisms establish specific rules and organizations. These are: Joint Implementation, Emissions Trading and the Clean Development Mechanism. The three instruments allow the carbon market creation and development. The mechanism that directly affects developing countries is Clean Development Mechanism (CDM), through which industrialized countries can get their reduction commitments by investing in projects that avoid greenhouse gases emissions in developing countries. So, a CDM project results in emission reduction and it is equivalent to carbon credit that could be sold.

International agreements that seek greenhouse gases (GHG) emission reductions such as Kyoto Protocol, through its rules and definitions, define property rights by determining emissions reduction level, as well as which countries should fulfill targets. The emission rights are translated into carbon credits, which primarily belong to the company that reduces its emissions. Through the carbon market, actors may trade rights previously determined, supported by an institutional and organizational apparatus.

International transaction costs arise from emissions reduction agreements. For example, when a country decides to develop a Clean Development Mechanism project, transaction costs are present in every step of the process, such as: preparing the initial contract for the project presentation; project validation; project approval; project monitoring; project certification; and certificates issuance. So, the transaction costs emerge as a consequence of uncertainty, asymmetric information, needs for drafting contracts and bureaucratic excess. These costs added to institutional barriers faced by each country (such as local environmental legislation, country sovereign, high costs in developing a CDM project in a specific local) may influence the number of CDM projects in each region.

It is also important to analyze the changes that go with the institutions, how and why they occur in the economy, considering market specificities. Thus, even before setting rules, it is essential to understand the context experienced, which is reflected in the culture, customs, geographical conditions, religious, and political situation. All of these features take decisive role in the success or failure of the adopted institutional arrangements (ACEMOGLU, 2004; BUCHANAN, 1975; COLEMAN, 1988; ENGERMAN, 2002; RODRICK, 2003).

Drawing a parallel with carbon trade, market failure or success depends not only on the rules definition, but also depends on region particularities in which an emission reduction project will be implemented. The CDM framework is composed by organizations and international standards, applied to all signatory countries, but there are also specific rules and organizations defined internally in each nation. A CDM local characteristic is related to the definition of sustainable development (SD). CDM may be implemented, and hence carbon credits can be issued, just if applicants ensure SD for a host country of the project. The general definition of Sustainable Development is determined by the general rules in the Kyoto Protocol, but it is up to each country to locally define its meaning through their considerations and justifications.

Concluding, different global arrangements established to seek GHG emission reductions have different organizations and standards that serve as the basis to fulfill the goals, and often, a large number of institutional arrangements are required to guarantee that. The Carbon markets are a result of an original apparatus filled with well-established rules and organizations, in order to ensure the proper transactions emission reduction trade.

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## Sustainable Human Development Case Study: Brazil

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The goals of this paper are to analyze the sustainable human development performance of Brazil, and give a comprehensive account of what is faring well, as well as what areas are lacking in performance. Sustainable human development (SHD) is the ability to achieve development standards in the present that can be sustained for future generations. I have used a qualitative case study methodology, as well as a comparative analysis to explore the development context within economic, political, social, and environmental sectors that all contribute to SHD. Although Brazil exhibits economic strength, environmental factors continue to be a concern. However, political instability and inequality further impair development in these other areas.

The components of SHD are centered on people, by empowerment and creation of an environment where they can attain their goals as a society in a sustainable manner. It seeks to develop people's access to opportunities, participation in the development and governance process, and improvement of equitable distribution to ensure sustainability across generations and focus on the common good. This field of study is interdisciplinary, and so encompasses all aspects of economic, political, and social development.[1] This analysis conveys that sustainable human development performance in Brazil is growing steadily in some areas, yet challenges remain in others. Economically, Brazil's GDP has grown, as well as the GNI. In recent years, Brazil has been able to successfully control inflation, as well as increase trade. Total debt service has decreased, while total reserves have increased. However, political factors are not faring as well as economic factors. Political stability and government effectiveness are weak, in addition to the lack of strong, dependable law enforcement. Brazil is highly corrupt, and faces a number of policy constraints. However, both political rights and civil liberties are improving. Social development is hindered by the unequal distribution of income. Education is affected by income as well, because tertiary education receives far more government funding than primary or secondary education. Health measures are improving, although total expenditures are only 7.9 percent of the GDP. Rural to urban migration continues to create problems in unemployment, as 85 percent of Brazil's total population lives in urban areas. Environmental factors display a burden as well due to deforestation and marine habitats, although other areas are showing signs of improvement.

The results imply that policy reform is needed in areas of education and governance, as these sectors are weaker in terms of overall development. Policies to increase government subsidies to primary education, while decreasing expenditures to tertiary education would provide a more equal disbursement to levels of education for the benefit of lower income families. Increasing the number of available primary schools is more important than increasing the quality of tertiary schools to provide more equal opportunities for all, rather than for those with higher incomes. In addition, policies, which increase government transparency, are needed to combat corruption. The independent judicial system is in need of reform as well, to increase efficiency.

I further dissect the governance sector, as most of Brazil's hindrances in development stem from the problems of lack of political stability and corruption. Because strong and reliable leaders are needed for the successful implementation of development measures, much reform is needed within this sector to obtain sustainable human development.

This analysis demonstrates that Brazil has a lot to focus on in the upcoming years of development. Political stability along with combating corruption is key to maintain a strong development framework. Development practices that would benefit all members in a society would distribute a more even pattern of development, as well as curb some of the violence that disturbs the development process.

The sector of governance is important to sustainable human development in both social and economical aspects. As Inter-Development Bank president stated, corruption "is a tax on society as a whole." [2] Without efficient governance, corruption infiltrates society and discriminates against the lower class by placing the power into the hands of the elites. In this effect,

corruption deprives citizens of their rights to achieve common goals because the elites have the power and money to control the system. It not only increases the costs of development, but also impedes its progress as special interests conquer public interests. Political and social tension is therefore heightened, creating additional societal pressures.[3]

As a result, I have dissected the area of governance to display the negative impacts of corruption on SHD. Corruption affects the quality of life of society, and the majority of the poor pays the price because it increases inequality. Economic growth is reduced, while political instability is heightened as illegal investment activity is encouraged. This has created an entangled network of politicians, law enforcement officials, and drug traffickers that continues to cycle through corruption, violence, and money. Corruption has not lessened over the past decade, because punishment is not enforced on corrupt officials.

As a result, chances of society working towards a common goal of development are limited. Corruption undermines the effectiveness of public policies and programs, distracts motivations for the proper allocation of resources, removes fair competition from the market, increases income inequality, and questions the legitimacy of the market and the state. Institutional capacity is dire for the induction of successful strategies for poverty reduction and economic reforms, creating a direct relationship between governance and development. The attainment of effective development measures is highly dependent on the strength of a country's public institution operations and political environment.[4]

Another effect of corruption is the reduction of economic growth by lowering private investment and lowering the private marginal product of capital, leading to inefficient investment choices. Institutional restraints often discourage investment in areas where intellectual property rights have a high value for the firm, resulting in lowered demands for skilled workers. Additional problems can form in the areas of access to credit, as elites gain access to credit at the expense of the poorer impoverished population.[5] It also creates political instability, which increases bureaucratic delays. As a result, less government expenditure is spent on education in corrupt, unstable governments. Low economic growth effects sustainable human development because it leads to higher rates of poverty. [6]

Corruption also has created an undemocratic network that brings politicians, police, civic leaders, and drug-traffickers together in a vicious cycle that contributes to increased violence and encourages illegal activity. They all profit from the drug trade, mainly in the form of bribes.[7] If the police do not take bribes, they arrest traffickers, confiscate contraband, resell the drugs and weapons to other gangs, and then release the arrested criminals after receipt of a ransom payment. [8] The police often enforce these deals by means of violence, torture, and other human rights violations.[9] After the police make money from the criminals, they are able to bribe their corrupt superiors to receive promotions and obtain more powerful positions. As a result, corruption is encouraged.[10]

Because corrupt officials embezzle funds for social aid, drug traffickers are the sole providers of aid for favela residents in need, which empower criminals. Funds derived from the drug trade are additionally used to bribe police and politicians to allow the traffickers to operate freely. In turn, corrupt politicians secure votes in favelas in exchange for political favors.[11] Politicians and police aid criminals by negotiating with judges or simply not enforcing the law.[12]

Accountability reforms are needed to combat corruption. Congress immunity from prosecution must be eliminated, along with a reform of the Federal Accounting Court independent judicial system in order to create secure checks and balances on all branches of the government. Also, transparency in the areas of public service and law enforcement is detrimental for development because corruption leaks through all levels of society. Although institutional mechanisms exist, they are highly ineffective because bribes often supply a form of income stability and security for all who are involved, especially in the area of the illegal drug trade. The reduction of corruption is a vital component for sustainable human development to influence growth in all levels of society.

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# Sustainable development reporting and indices

Robert Chen & Frank Figge

## Oral Presentations

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### **A Value-based Carbon Performance Assessment of Worldwide Pulp & Paper Companies (and a Plea for Sustainability Reporting as if it Mattered)**

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Sustainable development is often defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. Present and future generations will require resources to meet their needs. Measuring and managing reductions of resource use in sectors that have substantial direct, indirect and cumulative long-term consequences for the economy, the environment and society, such as the pulp & paper sector, thus marks an important step towards sustainable development. As this sector is positioned at the heart of one of the world's key ecosystems, natural forests, the future development of its sustainability performance has direct implications for global sustainable development. In particular, the pulp & paper industry's CO<sub>2</sub> performance, affecting global warming both in terms of CO<sub>2</sub> emissions and in terms of impacting forests' capacity to function as carbon sinks, is of crucial importance in this context.

The aim of this paper is twofold: the first part reports on the results of a Sustainable Value assessment of the CO<sub>2</sub> performance of 25 of the largest pulp & paper companies worldwide. The results shed light on the performance spread among the companies under analysis, identify out- and underperformers within the sector, and quantify the CO<sub>2</sub> performance of each company in monetary terms. In the second part, a critical commentary on the current state and quality of corporate sustainability performance information and how this information is processed in the market is provided, contextualized and illustrated through a range of anecdotal examples from the above study of pulp and paper companies. Building on the experience gained from the study, implications for the state of sustainability reporting as well as the treatment of corporate sustainability performance information in the market are developed. The remainder of this extended abstract provides an overview of the general structure and content of the proposed paper.

The Sustainable Value approach takes a value-oriented perspective on the use of environmental and social resources. Sustainable Value is a measure for the absolute excess return that is created by a company using its resources more efficiently than its peers. Based on a strong analogy with financial assessment approaches Sustainable Value values the use of environmental resources based on opportunity cost thinking. The opportunity costs reflect how much return could have been created, if the resources had been used by a different resource user. Only companies that create more return with their environmental resources than the market (opportunity costs) create value. Building on the absolute Sustainable Value, the Return-to-Cost-ratio (RCR) puts the return of a company in relation to the opportunity costs of that company. Consequently, the RCR takes into account company size, and thus allows for direct comparisons between companies.

In this section, the results of the analysis are presented, focusing on (a) the absolute Sustainable Value generated by pulp & paper companies compared to their industry peers, and (b) the Return-to-Cost ratio (RCR) generated by each company. Based on these results, out- and underperformers within the sector are identified, and their performance quantified in monetary terms as well as put in relation to the performance of their peers and the overall sector. In addition, the results are discussed in light of the companies' energy consumption and thus shed light on the crucial role of the energy mix that is available in different countries and regions.

A number of potential pitfalls have to be kept in mind when conducting a carbon efficiency assessment of pulp & paper companies. A key aspect that is of particular importance for the pulp & paper sector is the question whether to

include emissions generated from the combustion of bio-fuels. Closely linked to the latter question is the aspect of how to account for the expansion of companies into areas that have not previously been logged. In this context, regional differences in vegetation may also need to be taken into account, as for instance tropical forests recover more quickly from harvesting and logging than boreal forests in Nordic regions. Other challenges refer to the collection of comparable carbon data as (a) oftentimes the scopes of industrial activities or of the reported data change, (b) the industry classification is not always unambiguous, and (c) data on CDP Scope 3 emissions as well as on transport-related emissions are hard to obtain in practice.

Looking at the data mining process, it became quickly clear that neither the information provided in corporate publications nor the information provided by leading data providers in the field could serve as a sufficiently reliable information source.

Examples in this context include several cases in which the total amount of CO<sub>2</sub> emissions was overstated by a factor of 1,000 in the Carbon Disclosure Project and/or in corporate sustainability reports, and companies using an identical dataset irrespective of whether they are asked to provide data on CO<sub>2</sub> emissions or CO<sub>2</sub> equivalents. Furthermore, a typical pitfall encountered with professional data providers in this context is the occurrence of inconsistencies regarding the scope of analysis: substantial variations regarding the inclusion or omission of indirect (Scope 2) CO<sub>2</sub> emissions and emissions from bio-fuels render a meaningful comparison of companies based on the datasets of some of the leading data provider in the field difficult at best and impossible at worst. This shows that despite all the effort that has been put in the reporting of corporate sustainability data to date there is very little alternative to conducting individual surveys to arrive at a consistent data set of corporate sustainability performance data. Whilst it has become widely accepted that “you cannot manage what you do not measure”, there appears to be much less clarity on what exactly needs to be measured and how it should be measured.

A number of implications can be derived from the Sustainable Value analysis of pulp & paper companies. With regards to the findings generated from the carbon efficiency analysis, out- and underperformers of the pulp & paper industry can be identified and quantified in monetary terms. Underlying value drivers can be detected based on the companies’ data on energy use, CO<sub>2</sub> emissions and financial performance. With regards to the anecdotal information on the process of analysing corporate CO<sub>2</sub> performance data in the pulp & paper sector, there are a number of important lessons to be learnt about the way in which corporate sustainability performance data is generated and processed in the market today. The paper concludes with a set of recommendations regarding necessary improvements to both sustainability reporting as well as the way in which sustainability-related information needs to be used – in order to drive companies towards enhanced sustainability performance.

## **Overcoming Data Gaps and Ranking Progress toward the MDGs in Sub-Saharan Africa**

Gonzalo Alberto Dueñas

The Millennium Development Goals (MDGs) are a series of time bound targets to reduce poverty, disease, and deprivation. While considerable strides have been made globally, not every country will achieve all the MDGs. In particular, progress within Sub-Saharan Africa has lagged behind the world, placing the region at risk of not achieving the 2015 targets. Whatever the level of progress, it is important to better understand the progress made within each Sub-Saharan African country. While a significant amount of funding and effort has been directed towards achieving these goals, development of robust monitoring methods and comprehensive reporting standards at the national level is lacking. The world’s leaders agreed on a set of targets, of which many are related to 1990 data figures. However, this study shows that for many countries the baseline indicators have never been determined, making it difficult to measure progress. Furthermore, there are large data gaps in several databases which track progress in MDGs, including the official United Nations (UN) database for the MDG indicators. These gaps make it difficult to track performance at country level or to make meaningful comparison among countries. While there has been growing interest in improving the quality and amount of data to monitor the MDGs, little effort is put in understanding the results from past years where data gaps exist. While it is impossible to collect data from the past, an estimate of progress is necessary to guide us to a better future. This paper attempts to overcome the challenge of missing data by using statistical, qualitative methods and various databases to offer new insights on national MDG performance from 1990 to 2010. Its aim is two-fold: to emphasize the extent of data missing and its critical impact on proper assessment, and to benchmark 45 Sub-Saharan countries on their progress towards the MDGs. Our research was performed with the hopes that it will enable policy makers, development practitioners, students and other relevant actors to make smart, informed decisions and apply strategic approaches to achieve the MDGs in Sub-Saharan Africa. Along this line, a few indicators were selected to be representative of all MDG goals. Emphasis was placed on indicators with defined, numerical targets (e.g. half of 1990 figures) as these indicators are more measurable than others. Data was obtained from the official UN MDG database

for each indicator. Extensive research was then performed to supplement existing data. Where unavailable, figures were estimated based on the trends seen in the quantitative data compiled and supplemented with qualitative information from credible sources, using a mix of forecasting methods including regression analysis and qualitative reasoning. While a mix of forecasting and/or estimating methods does not guarantee accurate estimates of data that was never collected in the past, the variance in the data and the nature of the indicators led us to the conclusion that this was the best approach. Based on these calculations, this paper assesses the absolute progress made within the 1990-2010 timeframe and the feasibility of obtaining the 2015 targets. It provides a ranking of the progress of the 45 countries per MDG, as well as their overall performance in achieving the MDGs, similar to the HDI ranking. The estimates made in this study are certainly no substitution for real data that is missing, but it is arguably much more useful to have a good estimate than to have an entirely empty data set. Results reveal many country-specific success stories. A handful of countries have already reached their 2015 targets for most indicators and many more have made impressive strides in progress. However, despite progress made by many, there has also been regression even from 1990 levels, and end targets still remain unreached. Additionally, progress amongst the indicators has been uneven. Some countries reside in both the top 10 and the bottom 10 lists for different indicators. While achievement in any MDG is commendable and welcomed, the stark contrast in the achievement amongst the MDGs reflects the need for a more holistic approach to development. In addition, analysis of individual indicators in isolation ignores the inter-linkages between the MDGs. A comprehensive evaluation of overall progress towards the MDGs will not only serve to impact a greater majority of the population, but can also maximize efficient use of resources by tackling the indicators in tandem. Additionally, a comprehensive view re-emphasizes the importance of each indicator. Success in one indicator cannot excuse underachievement in another.

A regional evaluation reveals a grim outlook. For most indicators, Sub-Saharan Africa faces a daunting challenge to meet its 2015 goals.

Missing and poorly reported data was found to severely handicap the ability to assess the progress of individual countries in achieving the MDGs. This paper distills MDG data into numerical ratings to provide concise guidance on country performance. Its overall indicator analysis is based on a simple premise – that a combined view will provide a more comprehensive analysis of the work that has been done and that needs to be accomplished. In order to accelerate progress in the coming years, it is important to understand where the world stands in terms of the MDGs by putting numbers in context. Furthermore, efforts should also be made to improve cooperation between country statistical offices and reporting agencies, such as the United Nations, to improve the quality and increase the quantity of available data. By ranking the progress of each country relative to another, success stories of the top performers can serve as a guide for other countries. Development partners need to prioritize the documentation of the lessons learned of initiatives and policies with proven success in achieving the MDGs, and ensure that this knowledge is readily available to other countries, particularly to those in the bottom 10. Knowledge sharing, particularly through South-South cooperation, is crucial in advancing the overall progress of the region. Better and more consistent data also improves accountability mechanisms by demonstrating to international donors that resources can be effectively managed and applied for maximum impact as well as keeping citizens of developing countries informed on the speed of progress their countries are making towards the MDGs, partly to hold their governments accountable for the use of national budgets to meet MDGs. Only through such collective efforts can the world expect to achieve the MDGs. Moving forward, current methods can be strengthened and mistakes avoided by identifying weaknesses of past approaches. Our research has underlined the necessity of annual reporting on MDG indicators for every country for every year. Evaluation is only as good as the data that supports it, and the world and its member states cannot expect to reach its targets when it does not monitor progress.

## **Sustainable Development and Performance, Financial Position and Market Value of Nigerian Quoted Companies**

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Businesses are faced with the dual sustainable development challenges of internal and external or global sustainability. Internal sustainability could be referred to as the going concern sustainability, which can also be referred to as internal economic sustainable development. It is concerned with ensuring that current activities of the organization are conducted in a manner that will not hinder future activities. Global sustainability can be divergent in scope. It can be communal, national or universally focused. The essence of sustainable development here is that activities of business organizations are conducted in such a manner that both the current and future needs of the society are not compromised. The challenges place many responsibilities on the managements of organizations, who are required to strike a balance between corporate goals and communal interests. The most likely happening is that management, as a service to



their employers, will focus more on internal sustainability against the communal sustainable development needs. 'In contrast to the above, many governments are pinning their hopes of economic growth and technological innovation on strong private sector growth (Fourie, 2009). For good corporate governance that especially takes care of the interests of all stakeholders, the issue of standardization has become significant. Standardization is the mechanism by which procedures of activities are been regulated, so that common interests, rather than self-interests are promoted. The aim of this study therefore, was to investigate the impact of compliance to accounting standards with sustainable development provisions, issued in Nigeria, on the result of activities of Nigerian companies.

According to Middleton (1995:240), there could only be theoretical justification for the removal of resources from environment in the comparative benefit of the removed resources, and in the ability to ensure that the environment is, generally, not worse-off. Corporate governance is the concept that best describes the responsibility of business in sustainable development. On the other hand, Newton-King (2009) stated that 'economic sustainability evaluates whether a company has positioned itself for long-term growth rather than only short-term performance'. According to her, the company 'must be able to adapt to macro-economic trends and act in such a way that the long-term viability of the business is assured'. These are the two sustainable development issues for business. Corporate governance already incorporated these to be 'concerned with holding the balance between economic and social goals and between individual and communal goals, with the aim of aligning as nearly as possible, the interest of individuals, corporations and society (Dixon, 2009). According to Russell (2007), standardization involves inspection, assurance and certification services aimed at regulating businesses, enforcing contracts and assurance for acceptable social and environmental behavior expectations. Standardization that affects business exists as far back as the eighteen century, for weight and measure by French scientists. Several standards exists, today that have impacts on businesses worldwide. The most familiar and well - established set of standards are those on financial reporting.

The Nigerian Accounting Standard Board had issued thirty accounting standards covering various business issues, five of these standards are considered favorable to sustainable development. The five are:

- Statement of Accounting Standard No. 3: Accounting for Property Plant and Equipment. This could be linked to internal sustainability of businesses.
- Statement of Accounting Standard No. 8: Accounting for Employee's Retirement Benefits, about provision for the after service benefits of employees. Could be said to have both internal and external/global sustainable development consequences.
- Statement of Accounting Standard No. 9: Accounting for Depreciation. Like the standard on Property Plant and Equipment, the standard could be linked to internal sustainability of businesses, because of the importance of assets to income generation.
- Statement of Accounting Standard No. 12: Accounting for Investments. Investment decisions of business have both internal and global implications and consequently the standard will have both internal and external sustainable development consequences.
- Statement of Accounting Standard No. 19: Accounting for taxes. Taxation practices have more external sustainable development implications.

This study is an exploratory type that is seeking understanding of a phenomenon. Sample for this study were drawn from The Nigerian Stock Exchange. Forty-four companies that have filled report with The Nigerian Stock Exchange from the commencement of standardization in Nigeria to date are the sample for the study. The study was carried out over five years range using three years data. Consequently, profit, net-asset and market value record of the companies for 2002, 2004 and 2006 were collected from the Nigerian Stock Exchange. The financial statements of the 44 companies for 2002 were collected from Stock Exchange library in Lagos. For compliance statistics, the standards were subjected to content analysis, with the aim of, on a point-by-point basis, determining what the provisions therein are and consequently the requirement of the standards from companies. By this, each point of compliance was identified and scores were assigned to each of the points. The financial statements were then examined for the extent to which they comply with the provisions on points, as set up in the above. Summation of scores per standard divided by number of standards applicable to the companies produced the aggregate compliance score for individual companies. Pearson product moment and Spearman ranked correlation statistical methods were used to investigate if compliance associates with the three variables.

First, both the total and per share values of the relevant data to this study were obtained. The data, which are for the forty-four companies under study are presented in Naira(N), the national and reporting currency for Nigeria. The compliance score earned from each identified compliance item in the considered standards, by the companies were also obtained.

The relevant data where analyzed accordingly and the results were that compliance to standards that promotes sustainable development by Nigerian companies has nothing significantly to do with their profitability. Implying that

whether they comply or not to those standards, their profitability situation is not really affected. Net-Asset and Market value, are however, improved as companies comply with sustainable development related accounting standards.

These results are informative in so many senses. If truly the standards promote sustainable development that fulfills the basics of sustainable development, long-term sustainable profitability will be more an appropriate measure than short-term results.

In line with the same thinking, rather than building immediate profits, economic sustainability should actually target building business assets that shall be positioned to produce long-term sustainable future profits for the concerns. All these relate to internal sustainability, which also aids global sustainability. Sustainable development from the point of view of the society, of course, may involve investment in the society and meeting obligations. These will usually involve resources outflow from the otherwise retainable incomes of businesses. The goodwill of those kinds of activity will in turn bring patronage to the businesses.

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## How sustainability reporting create organizational value

Agnieszka Leszczynska

**Purpose:** The objective of this paper is to examine the extent to which sustainability accounting and reporting can contribute to shareholder value and correspondingly, to consider the challenge that SEA can offer to the traditional views of value.

**Methodology:** This paper compares the most recent sustainability reports of ten global organizations to earlier versions of these organization's sustainability reports. Additionally, it shows market value of organizations in that period.

**Findings:** More recent reports illustrate an increase in efforts to advance the business case for sustainability activities and initiatives. While sustainability reports still convey a organization's efforts to comply with environmental regulations, sustainability reports are showing an increase in communicating the direct economic benefits that sustainability actions can bring to shareholders. It also demonstrates that improving in sustainability reports are connected with value of organization perceived by shareholders.

**Originality:** The paper provides the new look to the study of sustainability reporting. The findings from the research suggest further lines of inquiry including the need to examine the relation between the global reporting and the emphasis on economic value, to explore the intersection of materiality and the shift toward economic value, to consider the influence of economic pursuit on the public perception of sustainability. So, apart from taking debates about shareholder value, the paper confronts data about sustainability actions and results with value of organization.

## An Open Participatory System to Support State of the Environment and Sustainability Reports

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To implement sustainable development principles and practices it is fundamental to monitor, evaluate and report the state of the environment at different levels from global to local levels. The reporting of the environment and its periodical publication

are a practice that has been widespread in most countries, reflecting a form of implement Principle 10 of Rio Declaration on the right to adequate information, transparent and relevant, which states that the publication should be encouraged to facilitate effective access to the public through various means of technology and communication. The Aarhus Convention, from the Economic Commission for Europe of the United Nations, came to reaffirm that principle, committing the parties to publish and disseminate regularly reports on the state of the environment, including information on the quality of the environment and the pressures on it. This Convention also add innovative elements for establishing relationships between environmental rights and human rights, assuming that sustainable development can be achieved only with the involvement of all citizens. The state of environment and sustainability reports should then not only be written in a understandable and accessible way for the public but also developed from the beginning with their involvement and participation. The main aim of this research is to develop a conceptual system to support an open participatory, interactive and adaptive state of the environmental and sustainability reports, where the stakeholders involvement (non-experts and experts) will effectively contribute to the assessment produced in the reports. The stakeholders engagement, includes the general citizens, public and private organizations, non-governmental organizations, universities and research institutions, that can cover the different phases of the reports life cycle, from the planning and conceptualization, the implementation/operation, taking into account the whole process of data collection, processing, analysis and communication, and the follow-up updating and reviewing. However, their role could assume particular importance in the production of its own environmental and sustainability assessments or contributions at various levels: (i) providing new data or information, allowing new assessment conducted by the stakeholders or by the report technical staff; (ii) making own analysis of the formal thematic issues covered by the assessment provided by the report, according to their knowledge background and perceptions. The stakeholders assessment of the state of environment and sustainability can also be used as an indirect way of formal results evaluation allowing a cross-validation process. The proposed approach was put into practice in two case studies: the European Environment – State and Outlook (transnational European report) and the Portuguese State of Environment Report (national country report). A set of steps and procedures was proposed for adoption in the national and transnational case studies and the usefulness of the framework was highlighted. These cases are a practical example of how state of the environment and sustainability reports can be designed and used as an open and dynamic participative instrument.

### **Pilot Research on China Provincial Environmental Performance Index**

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China is confronting significant environmental challenges across the board, from air and water quality to natural resource management, waste management, toxics exposure, biodiversity conservation, and greenhouse gas emissions. All of this is occurring in the context of high population densities, rapid economic growth, and the imperative of lifting large numbers of people out of poverty. Given the challenges China faces, it is important for the government to have policy tools that are adequate for guiding and prioritizing action. Globally, the move toward a more data-driven empirical approach to environmental protection promises to better enable policymakers to spot problems, track trends, highlight policy successes and failures, identify best practices, and optimize the gains from investments in environmental protection. China, like many countries, has employed performance metrics in areas such as economic, educational, and social policy. It is natural to extend this practice to the environmental sphere.

This project explored the feasibility of constructing a provincial level Environmental Performance Index (EPI) in China. The China EPI, designed by a team of researchers at Yale University, Columbia University, City University of Hong Kong and Chinese Academy for Environmental Planning, is a comparative index based on *environmental indicators* that are (1) normalized by proximity to policy targets (with 100 representing at or above the target and 0 representing farthest from the target), (2) grouped into relevant policy categories, and (3) aggregated into an overall index with or without weighting. These indicators provide a gauge at any relevant scale – nation or province – of how close different jurisdictions are to established environmental policy goals. The proximity-to-target methodology facilitates inter-provincial comparisons as well as analysis of how provinces and the country as a whole perform on each policy issue.

Any EPI requires the following core elements:

- A carefully constructed and theoretically grounded framework of indicators that encompasses the range of high-priority environmental issues and situates them with respect to one another in a nested manner.
- Baseline measurements for each indicator.
- Policy targets, whether based on explicit government decisions or alternative sources, against which to measure observed environmental outcomes.
- Methodological transparency with regard to indicator construction and a capacity to verify the underlying data.
- Ongoing measurement programs that provide regular, consistent updates for all data required to calculate indicators.
- A clearly spelled out basis for assigning weights to constituent indicators, to permit aggregation to the index level.

No country or international organization currently possesses all these elements to the full extent desirable. Some jurisdictions approach “best practices,” while others fall far short due to competing policy priorities, insufficient technical and financial capacities, or institutional weaknesses. Interest in producing environmental performance indicators almost always rises before all the elements identified above are in place. Given the high priority put on progress toward pollution control and natural resource management goals in many countries and the increasingly recognized value of a data-driven approach to environmental policymaking, such interest can be observed to be increasing around the world.

Although there is considerable interest in the development of a provincial level EPI within China, we found that not all of the pieces were in place for its development. The absence of clear policy targets for many indicators, the lack of suitable data for some important policy areas (fisheries and water quality), and concerns over data sources and transparency, meant that we stopped short of producing an aggregated EPI. Instead, in this report we present the results of an in-depth study of the main environmental issues and China’s policy responses for 12 environmental policy categories, current international best practices in measurement for those policy areas, and China’s own measurement practices. We also chose selected indicators for these policy categories (32 in total), clearly spelling out the strengths and limitations for each one, and present ranked results by province in the form of tables and maps. But we did not feel that it would be appropriate to normalize or aggregate these indicators until the underpinnings of an EPI can be put in place.

Overall, it is our sense that China has made important inroads in environmental monitoring and policy, but that the country would benefit from greater transparency and freer access to data, especially raw data from monitoring systems and spatial data on environmental conditions. Such transparency could, in turn, stimulate the research and policy communities to develop innovations that will help the country to navigate the difficult paths of sustainability. Even in the very best scenario, however, a country the size of China with economic growth rates of close to 10%, will face significant environmental challenges. The goal of an EPI is to shed light on how the country as a whole is performing across an array of environmental issues, and to point to provinces that are lagging in environmental performance so that resources can be better targeted.

## **A survey and conceptual examination towards Development of New Generation of National Sustainable Development Indicators – Seeking for multi-dimensional indicators that measure interactions between complex phenomena**

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National sustainable development (SD) indicators have been created by individual states for the last decade, especially in Europe, to monitor current states and progress in actions towards SD. However, this necessarily means that appropriate national SD indicators have been being established. From our previous survey (Tasaki et al, 2010), the following five major tasks in the future development of SDIs were identified: (1) creating time-conscious indicators, (2) measuring interactions between elements of a system, (3) dealing with transboundary issues in a national SDI system, (4) measuring SD quality (including subjective elements), and (5) including ordinary citizens by showing the relationships between SDI and everyday life. In order to undertake tasks (2), (3), and (5) especially, we need to step forward to develop a new generation of national SD indicators that focus on multi-dimensional nature of indices and measure interactions between phenomena occurring in our complex world.

This presentation is comprised of three parts. First, we introduce the results of a survey of 1790 national SD indicators adopted by 28 national governments, regions, and international organisations, and examined the drawbacks of current national SD indicators. The aim is to understand the elements of sustainable development (SD). We classified 1790

indicators into 77 subcategories in four categories: environmental, economic, social, and institutional. For instance, in the social category, 'work', 'mortality, life expectancy, and health', 'education', and 'poverty and dependence' were the most common subcategories, being used by more than two-thirds of the countries reviewed. In the environmental category, 'climate change', 'air quality', 'water quality', and 'ecosystem' were the most common subcategories. 'Economic performance', 'capital and investment', 'energy use', 'transportation', and 'waste generation and management' are the most common in the economic category; and 'science and technology' was in the institutional category. The result can serve as a basis to consider a question, "what interactions between two or a few of them would be more influential on sustainable development of a country.

Second, we explain a national SD indicator framework. We created a hexagonal framework that should be useful in performing the five tasks identified. This framework includes the following features: (1) interactions between the three pillars of SD (environment, economy, and society), (2) combined use of both holistic and specific indicators, (3) distinction of specific indicators into national and individual indicators, (4) inclusion of eastern thoughts, and (5) inclusion of subjective elements. In this framework (especially relating to its features of (2) and (3)), we postulated a hierarchy in which national SD fundamentals support individual life and fundamentals of individual life support holistic goal / ultimate SD objectives of individuals and the society. Placing the 77 elements of SD obtained on the framework, we identified areas for which development of specific SD indicators is promoted. The framework is also designed so that we can illustrate interactions of SD elements on it.

Third, we show a result of conceptual examination on how to observe complex mechanisms and interactions and how to select national indicators within complex systems. One of fundamental issues identified is what we call an issue of 'selection of domain', which is that an evaluators' standpoint affects significantly the scope of indicators and conclusions obtained from indicators. For instance, in a field of food and agriculture, there are different standpoints: securing food supply for consumer, profitable and sustainable agriculture, earning money for a family, environmentally sustainable way of agriculture, and sustainable regional development.

We depicted different domains (We call here the scope of a standpoint "domain".) and the issue of selection of domain in a concrete form although the issue of 'selection of domain' has already been pointed out such a person as Herman Daly. We reached at an insight that national SD indicators of the next generation have to measure conflicts between different domains directly or indirectly. This insight implies that even though concrete national SD indicators and concrete operational criteria for SD to judge the figures of SD indicators are established, without resolving this issue of selection of domain, SD indicators could not help to represent issues and challenges in a complex society nor to overcome such issues.

### **The adequacy of indicator projects and processes for local and regional sustainability reporting**

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Susan Byrne

Sustainability in the classic sense, as defined by the Brundtland Report, is 'to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987, p. 43). Although this is the most commonly agreed definition, different worldviews have meant that sustainability is often defined in slightly different ways. This is not unusual as the nature of sustainability is complex. Despite this attempts across the globe are being made to implement strategies for sustainability and to demonstrate that these strategies are making a difference. However, the search for an 'ideal' means to assess sustainability, in the form of a generic set of integrated sustainability indicators for any given application, across all spatial scales, has remained elusive.

Currently, there is a lack of consensus about what indicators are relevant to include in an assessment tool, and there are challenges in obtaining and keeping relevant data for the indicators and ensuring continuity in the way the data is collected. Reporting tools for assessments range from local, community-based, through to regional, state, national and international scales. Initiatives are either developed purely from a short term wellbeing perspective, often under the guise of 'sustainability indicators,' or they depict the 'true' form of sustainability with factors considered for both current and future outcomes across a range of themes. In Victoria, Australia, there has been a call to action from decision and policy makers to develop more consistent, generic regional sustainability reporting tools. Having a generic indicator-based tool for measuring sustainability at a regional scale would be a progressive step toward achieving consistency

and comparability in monitoring and reporting of key themes. Once achieved, this would provide the basis for a shared direction in developing policy to progress regional sustainability across Victoria.

Before embarking on such a challenge the aim of the study reported here was to assist with the development of such a guide by initially gaining a better understanding of sustainable development indicator-based assessment tools/processes developed for use in Victoria, in other parts of Australia and in other countries. Thirty one indicator based assessment initiatives were reviewed using a pre determined set of questions. All the indicators identified in these initiatives were collated into a matrix and analysed based on the method presented by Tanguay et al. (2009). Comparisons between initiatives were then made with respect to the approach taken, scale of assessment and the number, type and frequency of use of indicators. Sustainability indicator-based tools used in Victoria were then contrasted with those at the national and international scales. Finally, a qualitative analysis of projects and processes being undertaken in Victoria was undertaken by interviewing those who are, or have been involved in developing or implementing these assessment tools.

The results revealed a lack of consensus in assessment objectives, frameworks used, indicator selection, methods of application and presentation of outcomes contributing to a fragmented system of sustainability reporting. Irrespective of the large pool of sustainability and wellbeing indicator-based assessments throughout the world, there is no agreed process for measuring and reporting on sustainability and only a few indicators are commonly used. This investigation also highlighted that some commonalities in sustainability assessment across all spatial scales do exist, for example stakeholder participation. Thus, there is a need for the development of a set of guidelines to help regions establish an indicator set capable of assessing sustainability and contributing to policy and decision- making at the local, state and national scales.

## Posters

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### **Sustainability Practices among Multi National Companies: A case of Pakistan**

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The importance of a robust Sustainability agenda and its implementation in a developing country is very crucial nowadays. With the increasing globalization in businesses, multi-national companies are taking charge in proactively battling sustainability issues and corporate social responsibility initiatives in the host countries in which they operate. This paper aims to review the corporate social responsibility policies of selected multi-national consumer goods companies operating in Pakistan, and to what extent do they adhere to the concept of sustainable business practices. The Global Compact is primarily used as a standard to gauge the corporate social responsibility and sustainability performance of the selected companies and the Global Reporting Initiative Sustainability Reporting Guidelines will be used as supporting elements to review the relevant practices of the companies being studied. Pakistan is a developing country rooted in rich history and culture and offers a diverse source of human and natural resources. It's socio-political and socio-economic importance in Asia in particular – and globally in general – merit it an analysis of how its human and natural resources are viewed and catered in the light of corporate social responsibility and Business Sustainability practices, especially by global corporations. The gaps identified in the analysis may present the government and NGOs with opportunities to escalate Pakistan's Corporate Social Responsibility and sustainability requirements to those of international levels and may help the country in achieving better results on its triple bottom-line.

### **Industrial Movement on Corporate Sustainability Performance – An Empirical Overview by the Application of Data Envelopment Analysis**

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This paper reports results of an empirical study of corporate sustainability[1] carried out in an industrial level and depicts the change of corporate sustainability performance over time. A composite index of corporate sustainability performance is measured by applying Data Envelopment Analysis (DEA) approach for sixteen industries over three consecutive

years respectively; The findings indicate that firms' sustainability performance vary across industries and reflect a trend of on going improvement on corporate sustainability performance for most industries. Of the sixteen industries, seven industries who has made improvement in sustainability performance consistently over the three consecutive years whereby firms in natural resources sector tends to have more consistent and stable performance than others on corporate sustainability performance.

- [1] The sustainability score is supplied by SAM Sustainable Asset Management. The views expressed in this paper are those of the authors and do not necessarily represent those of SAM Group. All the corporate sustainability indicators used in the present study have been independently elaborated by the authors of this article from the original data provided by SAM Group. Any possible error in the interpretation of such data remains the sole responsibility of the authors.

## **A Sustainability Label for Public Services: Defining the Criteria and Indicators for Evaluation**

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There is a growing need to integrate environmental and sustainability informed strategies into the core business processes within in the public sector. Public agencies, given their size and influence are expected to lead by example in delivering sustainability goals by informing policy formulation, supporting planning and decision-making from sustainable development based standpoints. The integration of sustainable development principles and practices into government processes, including policy formulation and operations, is crucial for the implementation of sustainable development. It is however a challenging task for public sector organizations. Several countries have commenced to implement government initiatives relating to put sustainable practices into place. These initiatives focus mainly on the environmental dimension of sustainable development and on the measurement and evaluation of government operational performance, namely the assessment of government operations and management practices. Sustainability performance evaluation is increasingly recognized by public sector organizations as a tool that allows them to evaluate the effectiveness of the integration of sustainability considerations into government processes. However, sustainability performance evaluation in public services context is under research as the major focus has been on private sector company environmental and corporate reporting contexts.

The purpose of this study is to develop a conceptual model of a sustainability label as a tool to assess and communicate Portuguese government agencies sustainability performance through an integrated approach of economic, environmental, social-cultural and institutional-governance dimensions. The framework was developed taking into account the European Ecolabel criteria and the guidelines and indicators used by the Sector Supplement for Public Agencies of the Global Reporting Initiative. The European Ecolabel is a relatively well known voluntary instrument in Europe and has a potential for application in public service operations. Currently the European Ecolabel mainly covers products and few services (campsite services and tourist accommodation services). The services criteria were particularly considered for this work. Forty-four (44) criteria and respective indicators were adapted for the proposed sustainability label framework. The criteria cover thematic areas including: biodiversity, water and soil quality, climate change and energy, air quality, natural resources management, economic development, financial performance, labor practices and decent work, social and service responsibility.

To put the proposed conceptual model into practice a Portuguese local public service was used, which took into account the central role of local governments as a major public employer responsible for providing a diversity of services to their populations, the proximity bond with citizens and importantly, that local governments are moving faster than other public sector levels with regard to the integration of environmental and sustainability principles in their operations and strategies. The sustainability label framework was tested in the licensing and support of economic activities service of the Portuguese Municipality of Oeiras. To accomplish this application, a survey was conducted in the municipality department in charge of the service, in order to identify and analyse the environmental and sustainability performance, regarding the fulfilment of the label criteria. The overall results demonstrate that few criteria were verified in this local public service (only about 23 % of the total criteria and respective indicators), stressing that new practices and public policies need to be adopted to invert the current trend. The conceptual model developed has the potential for application in any public service, adapting the criteria for the different organizations scales and typology of respective public services. Furthermore, this case study research can support municipalities in evaluating and communicating their environmental and sustainability performance in order to improve their public service role.

## **System Energy Assessment (SEA), Defining a Standard Measure of EROI for Energy Businesses as Whole Systems**

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A more objective method for estimating the energy needed for businesses to operate System Energy Assessment (SEA), defines a new physical science standard for the measure of economic energy use, the energy cost of producing energy for society (EROIS) and the true scale of environmental impacts embedded in earning and spending. It addresses the problem that we see businesses as operating as whole complex systems with cooperating parts of many kinds, but normally count only the impacts of the recorded energy uses of the technologies they employ. Partly due to having recorded data for technology but not other needs of businesses, the current best practice for measuring business energy use and impacts counts only that, and not the impacts of maintaining employees and other services businesses need to function. Assessing the combined total produces very unusual findings. Because employing technology creates business records of energy purchases for it, but not for employing self-managing business services, using business information to account for environmental impacts leaves technology described as operating without its operators and not counting the impacts of other business operating necessities. The services of employees, management, insurance, and government, etc. are self-managing, and so do not report to the businesses using them the energy requirements or other impacts involved in performing their business service. These unreported energy needs turn out to be the great majority of the energy costs of business. That means recorded energy uses are a highly inaccurate reflection of the real scale of physical energy use, impacts and rates of depleting economic potential in the future, compared to the shares of the observed totals implied by the share of GDP for any given earning or spending. The details of the finding generally confirm those of Hall et. al. in 1981 [9] when asking the same question. The method we develop uses an exhaustive search to identify the energy uses needed for a businesses to operate as self-controlled system, defining a natural physical boundary for what to count and the business as a whole complex environmental system as a physical rather than statistical subject of science with quantitative measures. That expansion of the scientific method for defining complex systems and their measures are part of the subject and discussion.

## **International Environmental Law and Environmental Performance Reporting Practices**

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The dramatically increasing environmental crisis has raised concerns about environmental issues. To ensure growth is within Earth's limits there have been solutions at the local, national and global level. Indeed environmental problems are creating an urgent need to identify and develop new strategies for steering societies towards a more sustainable relationship with the natural world. In this regard, monitoring, assessing and reporting on environmental impacts and performance are some practicable steps to better inform the governments and societies about the environment and move towards a sustainable future.

All the different forms of information and data gathering such as measuring and reporting have been taken into account by many national and international organizations.[1] Environmental Impact Assessment (EIA) is one of the significant techniques for obtaining and assessing environmental information on certain activities. Additionally, the International Standards Organization (ISO) has developed series of standards for environmental management which are well established efforts for environmental monitoring and increasing availability and accessibility of information.

Disclosure of environmental information and moving towards data-driven approaches to protect the environment can make it easier for policymakers to spot the issues, track the trends, determine the effectiveness of current policies and also optimize gains from environmental investments. Therefore, the results of measuring and monitoring environmental progress is valuable both quantitatively (targets, commitments, standards) and qualitatively to improve sustainable utilization of natural resources, both when policies are being formulated and on an ongoing basis.

International environmental instruments often include a requirement for states to provide information relevant to their obligations. In this context the measurement of environmental performance is an important component to meet these international environmental law requirements. Indeed international performance monitoring provides rankings for countries' environmental conditions which assist cross-country comparisons to recognize leaders, laggards, best policy practices and also priorities for action.

Transparent data and reports facilitate proper decision-making and enhance environmental cooperation and governance. Also, evaluating environmental progress assists international institutions utilize legal instruments to take preventative and



mitigation measures. In particular, monitoring and measuring facilitates the exploration and analysis of the adequacy of existing local, regional and global governing structures to implement policies for a sustainable future.

In the context of the role of reporting under international law, monitoring determines whether countries are complying with their environmental legal obligations and commitments and also promotes participation in the decision-making process to move towards environmental sustainability. In this regard environmental performance indicators are the most cost-effective and powerful parameters to gauge progress against sustainability thresholds and objectives.[2]

Internationally, the availability and accessibility of information and providing consistent reports on human interaction with the environment, have a rich history and have received much attention from treaties and international environmental law. In this regard monitoring, systematic observation, inspection or verification are the most common terms used in international law to ensure compliance with the objectives of international treaties.[3]

Under international environmental law, Principle 2 of the 1972 Stockholm Declaration[4] (adopted at the United Nations Conference on the Human Environment) called for 'free flow of up-to-date scientific information and transfer of experience'. Also Chapter 40 of Agenda 21[5], titled 'information for decision-making', promotes the strengthening of national and international capacity to bridge data gaps and collect usable data in decision-making towards sustainable development. Later in the *World Summit on Sustainable Development (WSSD)*, the *Johannesburg Plan of Implementation (JPOI)*[6] encouraged further work on sustainable development indicators and implements national indicators by countries and invited the international community to support efforts of developing countries. In particular, international environmental law calls for the development, harmonization and utilization of sustainable development indicators at the national, regional and global levels.

In this regard, international environmental law treaties require environmental information and reporting. For instance, *Aarhus Convention*[7] provides a framework for best practice procedural law which also requires data collection to support 'access to information'. Therefore, although there is an extensive body of international rules to improve environmental information still collecting information and standardized monitoring systems remain relatively undeveloped.

The main factors that make comparisons and reporting unreliable include: inadequacies in available data; limited basic accessible statistical data, specifically for developing countries; lack of good time series data on the environment; and also lack of consensus on measurement, weighting and indicator selection. To address these challenges at the international level there is continuing interest in the development of aggregated performance indicators.

The Environmental Performance Index (EPI) is a flexible policy tool to track performance of trends by using a set of quantitative indicators.[8] It relies on a proximity-to-target approach by setting explicit environmental objectives with measurable outcomes. Indeed it provides a baseline for states to compare their environmental progress towards policy objectives. In the context of this research, the EPI is considered to be best of sector.

Nonetheless, at the same time, the EPI framework reveals some weaknesses: in particular, limited available and accurate time-series data, which means that performance indicators cannot track changes over time. Data gaps also mean that a number of countries failed to report some key environmental issues.[9] Therefore there is a need to implement mechanisms at the global level to assist states in fulfilling their reporting obligations. In particular, action is needed to bridge the science and policy gaps in disclosure of environmental information, transparent data collection, monitoring, consistent and standardized reporting.

In addition, because of resistance to voluntary disclosure of information in some countries, international legal drivers and enforcement mechanisms play an important part in shifting from voluntary to mandatory reporting. In this regard, further study is required to define appropriate metrics to assess environmental performance and also to legitimate environmental indicators in policy targets.

This research explains the role of monitoring and reporting on the state of the environment in implementing international environmental law. To achieve this purpose, the study focuses on the EPI as an example of best practice in environmental progress monitoring which help states and organizations to implement environmental policies towards a more sustainable future. In particular this research explores how the EPI can facilitate state monitoring and reporting in compliance with international environmental law.

The main result of the analysis provides support for the EPI, and other sustainable development platforms, to evaluate environmental progress and report data comprehensively. In addition, the findings reflect the need for further synergies and cooperation in the development and implementation of environmental performance reporting. Transferring technologies such as global observations of environment to the less developed countries could be recommended to facilitate measurements and quality of data sets.

Finally, this research explores how performance and progress in the field of sustainable development can be translated into political action.

- [1] One early practice, at the national level, involves the OECD- which began to develop environmental indicators in order to publish clear information and reliable data and report major environmental issues in the late 1980s: see OECD, 'OECD Environmental Indicators', 2003; At the international level after *Stockholm Conference in 1972*, UNEP runs a program called *Earthwatch* to provide a continuous assessment of the global environment, see, eg, The United Nations System-wide Earthwatch, *About Earthwatch* (23 April 2010) <<http://earthwatch.unep.ch/about/index.php>>.
- [2] Simon Bell and Stephen Morse, *Sustainability indicators measuring the immeasurable?* (Earthscan, 2<sup>nd</sup> ed, 2008).
- [3] Philippe Sands, *Principles of international environmental law* (Cambridge University Press, 2003).
- [4] *Stockholm Declaration on the Human Environment*, 16 June 1972, Principle 2, UN Doc A/CONF.48/14 (1972).
- [5] *Agenda 21, Report of the UNCED, I*, UN Doc A/CONF.151/26/Rev.1 (1992).
- [6] *Johannesburg Plan of Implementation, Report of the World Summit on Sustainable Development*, 4 September 2002, UN Doc A/CONF.199/20 (2002).
- [7] *Aarhus Convention on Access to Information, Public Participation and Access to Justice in Environmental Matters*, Opened for signature 25 June 1998, 38 ILM 517 (entered into force 30 October 2001).
- [8] The EPI was initiated by *Yale centre for Environmental Law and Policy (YCELP)* and the *Centre for International Earth Science Information Network (CIESIN)* at Columbia University's Earth Institute in collaboration with the *World Economic Forum* and the *Joint Research Centre of the European Commission*. For further details on the EPI reports see, Daniel C. Esty and Mark A. Levy, 'Pilot Environmental Performance Index' (Yale Centre for Environmental Law and Policy, 2002); Daniel C. Esty et al, 'Pilot 2006 Environmental Performance Index' (Yale Center for Environmental Law and Policy, 2006); Daniel C. Esty et al, '2008 Environmental Performance Index' (Yale Centre for Environmental Law and Policy, 2008); Jay Emerson et al, '2010 Environmental Performance Index' (Yale Center for Environmental Law and Policy, 2010).
- [9] *Ibid.*

## Development of a Tool for Monitoring the Environmental Performance of Small-Scale Ecotourism Projects: Example from Brazil

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Ecotourism has been widely recognized as a way to invest in conservation and local communities (Ceballos-Lascurain 2008). However, achievement and failure in ecotourism have varied over time. The creation of economic incentives may or may not lead to conservation outcomes. In some cases, economic benefits are sufficient for gaining at least a modicum of local support for conservation. In other cases, economic benefits from ecotourism were insufficient for building incentives for conservation. In the worst cases, ecotourism generated conflicts and other social problems that ultimately diminished rather than increased chances for collective action for conservation (Stronza and Pêgas 2008). In the last decade, ecotourism becomes one of the fastest-growing segments of travel industry (Ceballos-Lascurain 2008) which annual growth rates varying from 10% to 30% (McKercher 2001). The fast growing of ecotourism causes impacts on the local communities and natural resources. Therefore tourism industry, governments and society have been calling attention to the importance of monitoring ecotourism projects. For instance, the Quebec Declaration on Ecotourism, among other recommendations, suggest that an integral and regular monitoring of ecotourism should be conducted (Vereczki 2007). Monitoring is crucial to the long-term viability of ecotourism projects (Durham 2008). The accommodation sector is a critical component of an ecotourism project since their design and operation influence the natural environment, their employment and purchases practices affect the local community, and the ways they serve their guests have an impact on the education and satisfaction of ecotourists. However, the accommodation performance has rarely been considered in the studies of ecotourism (Osland and Mackoy 2004). Ecolodge are a specialized type of ecotourism accommodation that is usually located in or near a protected area or other ecotourism venue and is managed in an environmentally and socio-culturally sustainable manner (Weaver 2001) which follow the ecotourism principles. According to TIES (2006), anyone who implement and participates in ecotourism, should follow the ecotourism principles: "minimize impact; build environmental and cultural awareness and respect; provide positive experiences for both visitors and hosts; provide direct financial benefits for conservation; provide financial benefits and empowerment for local people; raise sensitivity to host countries' political, environmental, and social climate".

A tool for monitoring the performance of a small ecotourism projects was developed to monitor the compliance of the ecolodge and the eco-tours value chain with the principles of ecotourism. An ecolodge in the Brazil's northeast was chosen as case study. Performance indicators and benchmarks were adapted from the EcoCertification programme (Ecotourism Australia 2003) to monitor the ecotourism project performance. An ecotourism value chain map was defined for the ecotourism project. Three levels of suppliers were identified in the eco-tour value chain map: first supplier is the ecolodge. Second-suppliers are ecotour operators. Finally, third-suppliers are conservation organizations which are responsible for the provision of the tour at the site or the management of the attraction. Third-suppliers are at the end of the chain. Stakeholders' information, direct observation and factual data were used to collect empirical data for

evaluating project performance. Semi-directive interviews were conducted with ecotourism managers (n=6) and ecotourism suppliers (n=6). Informal interviews were also carried out with local stakeholders. Stakeholders included residents, members of the local authority and local non-governmental organizations. Information was content analysed and used in the evaluation of each performance indicator. Each indicator was rated (1- far below the target value, 2-below the target value, 3-the target value and 4- above the target value). Compliance for each indicator was identified. Indexes were used to aggregate indicators performances. Indicators scores were calculated at three levels of aggregation: indicators' categories, objectives and index. The aggregation process proceeded in the following steps: 1. Scores for each category were calculated based on the scores of indicators. Mean was used to calculate the score of categories; 2. Scores of the objectives of ecotourism were calculated based on the scores of the categories. Scores were calculated based on the mean scores of categories; 3. The Ecotourism Supplier Performance Index (ESPI) was calculated based on the mean of the five objective scores for each supplier; 4. The overall Ecotourism Project Performance Index (EPPI) was then calculated which resulted from the mean of the scores of the ESPI for each supplier. Ecotourism project performance and suppliers' performance were classified as Poor (Index <2), Unsatisfactory (Index  $\geq 2 \leq 2.9$ ), Satisfactory (Index  $\geq 3 \leq 3.9$ ), or Good (Index=4) performance.

Result showed that ecotourism project performance (EPPI =2.9) is unsatisfactory. The ecotourism project performs satisfactory in terms of contribution for building environmental and cultural awareness and respect, provision of positive experiences for host, provision of direct benefits for conservation and benefits and empowerment for local people. Contrary, ecotourism project perform unsatisfactory in terms of minimization of the impact on the environment. Results showed that ecotourism performance is unsatisfactory (ESPI=2.9). The principle one (minimization of the impact on the environment) and two (building environmental and cultural awareness and respect) is performing unsatisfactory. Principles three, four and five (provision of positive experiences for host, providing direct benefits for conservation and benefits and empowerment for local people) perform satisfactory. Results showed that the three ecotour operators perform unsatisfactory (ESPIA=2.8; ESPIB=2.2; ESPIc=2.5). Contrary, the three conservation organizations perform satisfactory (ESPI1=3.2; ESPI2=3.4; ESPI3=3.2). In general, ecotour operators and conservation organizations perform unsatisfactory on the principle one (minimization of the impact on the environment), and ecotour operators perform unsatisfactory on the principle four (providing direct benefits for conservation).

As conclusion, the tool is suitable for monitoring ecotourism projects when low technical and/or economic resources are available, which makes the tool very useful for small ecotourism projects. In addition, it provides useful benchmark data for future monitoring in the case study as well as in other similar projects. It can also give a contribution to the project management, giving a contribution for more successful transition towards more sustainable practices.

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## Monitoring Environmental Performance in Rural Tourism Destinations. Results from Ukraine

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Tourism has increased dramatically in the recent years (Mowforth and Munt 2006) which has led always to a substantial economic, social and environmental impact on the tourism destinations (Price 1992). Tourism if not properly managed can have serious negative impact on the often fragile ecosystems (Charters and Saxon 2007), harming societies and destroying the natural resource that ensure its success and sustainability (Vereczki 2007). In contrast, when efficiently managed, tourism can have positive impacts on social and economic development and environmental protection of the tourism destinations (UNWTO 2009). Monitoring environmental performance of the tourism destinations are essential practices for achieve better results in terms of sustainability of destinations. A diversity of tools for monitoring tourism destinations have been developed so far. Regularly destinations may not be able to conveniently offer a comprehensive set of data to allow the use of standardized indicators (Tsaur, Lin et al. 2006) or tools are too complex to be applied in rural destinations due to lack of scientific, technical or economic resources at the destinations. Therefore, site-specific frameworks are usually simpler and

more adequate to evaluate rural destinations. This study describes the application of a site-specific approach for monitoring a rural tourism destination. A rural destination in the Ukraine's southwest was chosen as case study.

For the development of the monitoring approach, subjective measures were used to analyze the relationships between natural resource, local community and tourism industry in a rural destination. Indicators that described the relationships between natural resource, local community and tourism industry have already been used with success by Ross (1999a), Ross (1999b) and Tsaur (2006) to evaluate tourism destinations. According to Tsaur et al. (2006) to understand the relationships between stakeholders is fundamental to achieve the sustainability in tourism. In monitoring environmental dimension of tourism, the economic and social dimensions should be considered as environmental, economic and social issues influence each other in a tourism destination (Briassoulis 2001).

In order to analyze the relationships between natural resource, local community and tourism industry, two rounds of Delphi questionnaires were carried out to identify a suitable system of indicators to evaluate the destination. Stakeholders included residents and members of the local authority, hoteliers, natural resource administration, local NGO and researchers. The first Delphi questionnaire was based on six open-ended questions that explored the following six relationships aspects: the influence of natural resources on the local community; the influence of local community on the natural resources; the influence of natural resources on the tourism industry and the influence of tourism industry on the natural resources; the influence of local community on the tourism industry and the influence of tourism industry on the local community. Twenty-eight questionnaires were returned and 41 indicators were identified after content analysis the information collected in the first round of the survey. A second Delphi questionnaire composed by 41 closed questions based on the results of the first Delphi round was carried out. Stakeholders were asked to rate each indicator in a 5-points Likert scale (completely disagree, disagree, neither agree nor disagree, agree, completely agree) concerning the suitability, comprehensibility and importance of each indicator. Sixteen questionnaires were returned from the second round. The mean was used to calculate the distribution of data. Five indicators were removed based on the weak suitability and one indicator was reformulated based on the weak comprehensibility. A final system of 36 indicators was established based on indicators' importance. An evaluation questionnaire was carried out to evaluate destination performance. The evaluation questionnaire was composed by 36 closed questions based on the system of indicators. Stakeholders were asked to rate each indicator in a 5-points Likert scale (completely disagree, disagree, neither agree nor disagree, agree, completely agree) concerning to the destination performance. Twelve questionnaires were returned from the third round of the survey.

Results showed that for monitoring the influence of local community on the natural resources, at environmental level it is important to monitor the incorrect practices of solid waste and wastewater management, reduction of the forestry area, noise pollution, and the high pressure on agriculture. At social dimension, it is important monitor residents' support of nature conservation and is very important residents' participation on the resource management and planning. To evaluate the influence of natural resource on the local community, it is important monitor the provision of economic benefits for residents, contributions from natural resources administration for conservation and the provision of environmental opportunities for residents. The influence of local community on tourism should be assessed by monitoring the provision of diverse cultural experiences for tourists. In order to monitor the influence of tourism on the local community at society level, it is important monitor the increase of the residents environmental awareness, the traffic congestion in peak periods, promotion of social welfare (e.g. health, education, etc.), improvement of roads and accessibilities, the disturbance of the daily lives of residents, the residents' satisfaction concerning tourism developments and the loss of traditional culture. At the economic level, it is very important monitor the creation of incomes and employment opportunities for residents originated by tourism industry. The influence of tourism on natural resources should be assessed by monitoring the direct economic contribution for conservation. At the environmental level, the increase of constructed area, the destruction of natural resources caused by the overloading capacity of tourism, the pollution of rivers and groundwater, air pollution due to transportation, incorrect disposal of wastewater and solid waste disposal, the visual impact and environmental impact due to winter sports are important to be monitored. To assess the influence natural resources on tourism, it is important monitor the attraction of visitors and the increases of tourists' environmental awareness. Results also showed that stakeholders were most concerned about the environmental issues (50% of the indicators expressed environmental concerns), followed by social issues (36,1% of the indicators expressed social concerns) and economic issues (13,8% of the indicators expressed economic concerns).

Results of the assessment showed that tourism is the sector that causes more negative environmental impacts (i.e. increase of the constructed area; pollution of rivers, groundwater and air; incorrect wastewater and solid wastes management practices) and negative societal impacts (i.e. traffic congestion and loss of traditional culture) than other sector. Tourism industry also promoted more positive impacts than local community or nature resources. At the societal level (i.e. social welfare and improvement of roads and accessibilities) and at the economic level (i.e. increase income and employment opportunities).

This study presents a suitable tool for monitoring and evaluating rural destinations that can be applied even where technical and economic resources are scarce. The methodology applied in this study can be used as pre-set of indicators in similar projects or as a model for developing and evaluation a new set of indicators. Although the study focuses on one destination as basis for empirical research, this methodology can be easily applied to other destinations worldwide of any dimension and any type of tourism destination (e.g. ecotourism, historical tourism, etc). If the tool is used as a pre-set of indicators, this study provides useful benchmark data for future monitoring. In both cases, as long as the indicators scores remain constant over the time, changes in the evaluation scores in the future monitoring years can signal that the situation in the destination is suffering changes whether improving or deteriorating with respect to touristic developments.

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## Frontiers, Footprints and the Firm: A Critical Review of Corporate Social Responsibility in Space Tourism

James Ockenden

Space is a human frontier, and as such promotes frontier behaviour. In this frontier, frameworks for sustainable development may not exist or may be less established than more earthly concepts of sustainability. While space has traditionally been the domain of nations, the rapid rise of commercial space travel tourism and corporate activity in space means that corporate social responsibility (CSR) will be an important issue in developing this frontier sustainably.

This paper provides a critical review of space tourism and the wider commercial space industry, asking what CSR activities we see in space and why. Through a radical critique of the industry, the paper addresses the issues of the adequacy of local, regional and global institutions to implement policies for a sustainable future in space, and aims to address the suitability of current CSR measurement and reporting to assist in the sustainable development of space.

The paper first draws together themes of increasing corporate hegemony over space and the issues surrounding a privatisation of space. A broad literature review introduces some challenging ideas from scientific, engineering, legal, political and even artistic perspectives. The CSR issues, loosely guided by the International Organization for Standardization's ISO 26000 and the United Nations Global Compact, are examined, as are the various power relationships, normative and ethical issues.

The core of the research comprises a detailed benchmarking of CSR activity across 90 US and European upstream space companies, which is followed by a more detailed analysis of six companies.

The decision to use Global Reporting Initiative's (GRI) sustainability reporting G3 Guidelines as a CSR benchmark is discussed, followed by an outline of the sample selection and CSR measurement process. The benchmarking uses 121 G3 indicators to assess CSR activity and uses a specially-developed set of 7 space CSR indicators to measure and analyse corporate behaviour in space.

The research shows inconsistencies between the reporting quality of traditional sustainability reporting metrics and the quality of CSR reporting on space activities. Large, listed aerospace conglomerates, while performing better overall, perform less well in space CSR than "pure" space companies (such as Virgin Galactic or SpaceX, where space is the sole business). Most interestingly, pure space companies, regardless of size, geographic region or public/private status, perform well in their reporting of space CSR issues, while not necessarily being good reporters of other sustainability indicators.

From these findings, the paper concludes that, for pure space companies, the space community is a dominant and important stakeholder, with company leaders and figureheads playing an important role in that community. This has implications for mergers and acquisitions, where "space CSR" may be diluted as companies are purchased and brought into those firms with different – or wider – stakeholder priorities.

The key recommendation emerging from the research is the need for appropriate reporting tools in space CSR. The five areas for reporting that are identified include environmental, political, institutional and legal issues and areas that may arise from government/business coalitions. Recommendations for reporting guidelines include the provision of a GRI «space supplement» such as was devised for this investigation; such a supplement would explore not only environmental, safety and social issues, but also issues of power and ethics in space.

### **Global metrics and network for monitoring agricultural sustainability**

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By 2050, the global population is expected to reach nine billion people, more than doubling the demand for food and creating unprecedented strain on the availability of many ecosystem services. Despite great progress in increasing crop yields over the last 50 years, there currently are no clear solutions for how to feed the coming global population in ways congruent with positive social, health, environmental, and economic outcomes. At the core of the issue are one billion undernourished people, another billion who are overweight or obese, and a global food system that is a major emitter of greenhouse gases and the largest user of water and land resources.

While scientists and farmers develop promising technologies and management strategies, a major constraint to their widespread adoption is the tendency of the food debate to be framed in oversimplified and ideological terms. Examples are debates concerning the use of genetically modified organisms (GMOs), merits of chemically intensive agriculture using fertilizers and pesticides versus knowledge-intensive agro-ecological approaches, and policies that encourage biofuels. Decisions on these issues should be context specific and responsive to the five major goals of agricultural sustainability: food and nutrition security, human health, economic prosperity of farm households, socio-cultural wellbeing of farm communities and environmental sustainability.

To provide scientific guidance to achieve these goals, we must seek answers to a series of critical questions: 1. What are the multiple outcomes of agricultural strategies in different parts of the world? 2. What are the tradeoffs and synergies among the five major objectives of sustainable agriculture? 3. What are the relevant biophysical boundaries or thresholds in agricultural systems and how close are we to approaching them? 4. What are the most important drivers or barriers to achieving the five main goals of sustainable agriculture in different parts of the world?

To answer these key questions The Earth Institute at Columbia University is establishing a global network that connects a diverse and targeted spectrum of scientists, government actors, private sector leaders and other international stakeholders to:

1. develop a set of practical metrics that quantify social, economic and environmental outcomes of agricultural management and policy;
2. monitor these metrics systematically at a landscape scale across major agro-ecological, climatic and anthropogenic gradients; and
3. synthesize, analyze and disseminate these data to inform management, policies and research priorities.

This paper discusses the development of this set of metrics and the design of the network.

First, a review of existing monitoring networks and sites that outlines the most commonly measured metrics and identifies data gaps that limit cross-site comparisons of the multiple aspects of agricultural sustainability simultaneously. A set of candidate metrics will be suggested as a possible minimum dataset, which will be discussed with a diversity of stakeholders. The development of these metrics is a participatory and iterative process to ensure consensus and to build demand for the data. By presenting this preliminary set of metrics at the International Sustainable Development Research Conference, we also hope to trigger discussion and gain feedback on these metrics from conference participants.

Second, monitoring sites of existing networks are mapped and linked to existing multilayer maps describing a range of social and ecological factors, including agro-ecological zone, population density, level of agricultural intensification, soil productivity indices, economic status, and land use. Using principle components analysis the network sites are clustered by these factors to assess the number of divergent types of landscapes could be compared given these current networks and how many replications of these landscapes there are within each type.

Further, connecting these existing networks, we propose a global network, with sentinel landscapes repeated across major agro-ecological, climatic and anthropogenic gradients. We contend that such global network will make it possible to disentangle the effect of major agricultural strategies from the impact of exogenous and endogenous drivers such as climate change, demographic change, political change and invasive species.. Further we argue that such a global network is the most cost-effective way to provide the statistical power required for multivariate and multi-scale analysis to identify major drivers of change and to quantify interactions (synergies and tradeoffs) between competing options and multiple outcomes.

Landscape-level data collected from sentinel sites and linked through a global network, will provide consistent data critical for parameterizing and ground-truthing landscape models that can be linked to regional and global models. The network and generated data will thereby strengthen development and validation of predictive models to identify thresholds and provide an anticipative early warning system.

Key to the success of this network and to ensure proper dissemination, a diversity of scientists and public and private stakeholders will be engaged throughout the monitoring process. The network will not only facilitate a cross-disciplinary approach of agricultural sustainability but also scientifically guided adaptive management and enhanced understanding of decision-making mechanisms.

Making the transition to healthy, equitable and sustainable agriculture is a daunting challenge.

To succeed, we will need to track and understand the diverse and changing impact of farming practices. The global monitoring network that we propose could be in place by mid-2012. And by 2015, the new data would support a much richer understanding of global agriculture and the path to agricultural sustainability.

### **Sustainable collective action in Joint Forest Management, Maharashtra, India**

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The Joint Forest Management (JFM) policy was implemented across India during the 1990s with the vision of combining forest conservation and rural livelihood improvement goals through creating local level partnerships between the Forest Department and the local villagers. The difference between the rhetoric and the reality has been widely documented, as has the great variety in outcomes of JFM seen in forests and villages across India, raising the question about the reasons for such diversity. In this research the departure point of forests as a common pool resource (CPR) is taken, central to which is the concept of collective action through which forest users devise rules to manage the forests. Collective action lies at the heart of the JFM policy. One reason for the variety in outcomes of JFM at a local level could be the differing levels of involvement of external actors- seen here as individuals and organizations other than the local forest users, with the key external actors being the Forest Department and NGOs. This research uses a comparative analysis of four cases in which collective action is functioning and two cases in which collective action is not functioning, with the level of key external actor involvement varying across the cases. The influence of external actors is measured through the independent variable indicators: provision of relevant knowledge, management and social skills, communication channels and financial support. The sustainability of collective action (the dependent variable) is assessed using the indicators: the functioning of collective action, the level of understanding of JFM policy, awareness and involvement of forest users, connections with external actors, confidence in future benefits and the perceived ability to independently manage JFM. The main conclusion is that external actor involvement is not a pre-requisite for functioning collective action, however external actors do occupy a central and powerful position to influence the level of sustainability of collective action. Whilst there are individual positive cases of external actors influencing individual indicators, there is no clear correlation between external actor involvement and the indicators for sustainability of collective action, indicating that their involvement does not necessarily lead to more sustainable collective action. The influence of external actors is determined at an individual, rather than an organizational level and is limited due to a lack of policy knowledge, limited efforts in outreach towards marginalized groups, poor communication between external actors themselves and the low level to which JFM is institutionalized within the Forest Department. The study concludes with policy recommendations for external actors at a local level to strengthen the sustainability of JFM in Maharashtra.

### **Toward to Greener Taiwan: From the Building Strategy and Assessment Tools**

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The concept of sustainable development has become a global trend. Due to the building industry has a large impact to the environment. Building industry should seek for a cleaner way in construction project. The building assessment system

has accepted as an effectiveness way to improve building environmental performance. The tools provide an easier and measurable method for user to benchmark their building and encouraged to improve beyond the minimum regulation.

Many countries had developed numerous assessment tools, tools like Leadership in Energy and Environmental Design (LEED) and Building Research Establishment Environmental Assessment Method (BREEAM) has used in many countries. Both of them have strongly research organization and became a national best practice. However, there are still not yet a universal assessment tool suit for every region and country, because of the diversity in architecture, cultural differences and abundance of natural resources around the world.

In non-OECD countries, the environmental problems of building industry in urban area are more serious. The weak environmental management regimes and social and economic problems caused the building practice more unsustainable, which means the over-density of the urban space, illegal occupation of land and neglected environmental issues caused problems of pollution, congestion, flooding, short of sanitation, power cut, lack of green areas and diseases.

In Taiwan, the building industry produced 20 million tons of construction waste every year. The urban area also suffered in heat island effect, because high population density, short of green space and the transportation emissions. In the case, Taiwan has made some effort to facilitate the building industry into a greener production process. From the environment policy to building energy standards, even the Taiwan-based assessment tool, Ecology, Energy Saving, Waste Reduction and Health (EEWH) has emerged in Taiwan.

In this paper, firstly, it is focus on the transition of institution and sustainable building policy to understand the sustainable strategy in Taiwan. Secondly, it chooses two world famous assessment tools, BREEAM and LEED to compare with EEWH. From a comparison of policy context, implementation process, weightings, incentive policies between the three assessment tools to point out the key factors and issues that long been neglected in Taiwan. Finally, propose some suggestions for policy makers to facilitate the green building.



# Models for decision making on environmental and sustainable development issues

Tommy Jensen & Sabine Marx

## Oral Presentations

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### Policy co-ordination in sustainable development policy: obstacles and opportunities

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The attention dedicated to policy co-ordination has a two-fold origin. On the one hand the subject has always received ample attention in studies investigating the efficiency, effectiveness and quality of public policy, as evidenced by its nomination as the “philosopher’s stone” or “holy grail” of public administration (see for example Leat, Seltzer and Stoker, 2002; Alexander, 1995; Anderson, 1996; Jennings and Krane, 1994; Peters, 1998). In general it can be observed that the need for policy co-ordination, be it intersectoral or intrasectoral, increases as processes of New Public Management are introduced. The intense specialisation and creation of single-purpose organisations which makes up the core of NPM-transformations compartmentalises public policy. This has led to counter-active initiatives (post-NPM) such as “whole-of-government”, “joined-up government”, “horizontalism” or “reviewing the centre” which all emphasize horizontal collaboration and integrated service delivery between public organisations and government levels as essential to “good policy” (see Bouckaert, Peters and Verhoest, 2010; Christensen and Laegreid, 2006). Co-ordination in this perspective ranges from co-ordination between organisations pertaining to the same policy field, co-ordination between these fields, co-ordination between policy levels and public participation in designing public policy.

This already widely studied subject has, on the other hand, merely increased its appeal following the rising importance of sustainable development on the international agenda. Although the concerns regarding “good policy” such as the avoidance of lacunae, overlap, incoherence, etc... have a role to play in the logic of sustainable development (in a minimalistic interpretation: to restrict waste production and to economise government spending), the focal point of concern regards the vertical segregation of Western public policy in isolated “silos”. This impedes sustainable development as it contradicts with the holistic foundations of the concept (Persson, 2004; Robinson and Tinker, 1998, Schnurr, 1998). At the core of sustainable development features the interconnectedness of social life, economic prosperity and environmental integrity, both on a global and a intergenerational scale. Integration across departmental sectors can therefore be regarded as one of the core operational principles of sustainable development (Connor & Dovers, 2004; Jordan, 2008; Lafferty, 2002; Lenschow, 2002). Policy co-ordination as inspired by sustainable development therefore implies a reshuffling of priorities that are at the heart of any public policy measure. As to the degree and extent of this “reprioritisation», academic opinions differ. Some boast *environmental* policy integration, while others emphasise the centrality of *holism*. Some stress the *priority* of sustainability issues over regular economic concerns, while others aim at a principled *equality* of competing interests (see Jordan and Lenschow, 2008; Lafferty, 2002; Nilsson and Eckerberg, 2009; Persson, 2004). Without taking position in this discussion, we will look into the question how such a reprioritisation can come about. Throughout the paper we will apply “intersectoral co-ordination” as the implicit proxy for this reprioritisation.

The paper is divided into two parts. The first part will deal with theoretical and conceptual aspects of co-ordination and integration. The discussion will be approached along two lines of argument, in accordance with the above mentioned two tracks of interest for the subject. We will introduce the subject from a purely public management approach. However, the information on mechanisms and instruments of co-ordination will constantly be evaluated in light of the necessities and requirements that stem from the sustainable development discourse.

In this section we will spell out what we understand by central concepts such as integration or co-ordination, in what respect they differ, how both can come about and which factors can be singled out as potential catalysts or obstacles to

success. In order to make the argument viable for research, many limitations as to the scope of the research had to be established. Scoping and the defining of concepts will constitute another prominent section of the first part of the paper. We will conclude this part with a literature-based model of successful policy co-ordination for sustainable development which we will apply to the case study in the second part of the paper.

In this second part of the paper, a specific case will be reviewed using the previously mentioned co-ordination model. A list of factors conducive or obstructive to intersectoral policy co-ordination geared towards sustainable development will form the basis of the analysis. In it, two overarching, intersectoral Flemish policy programmes (strategies) will be compared: one explicitly aimed at sustainable development (the Flemish Strategy for Sustainable Development), the other (Vlaanderen In Actie) aiming at transforming the Flemish region into a top-5 European region by 2020 by investing in several fields of action. Both strategies will be compared on the basis of the factor list. This comparison will result in several suggestions to improve intersectoral policy co-ordination for sustainable development.

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## A New Episteme and Unifying Intranational Institution for the Management of Sustainable Development

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The management of Sustainable Development is fraught with difficulties at all levels from the local to the global. These difficulties arise not only in the complex practical interactions experienced by scientists and engineers but also in the theoretical attempts to interpret, understand and explain sustainable development to different peoples in different cultures and different nation states at different levels of economic development. The difficulties are as many and various as are their causes. One explanation for the difficulties encountered during the implementation of sustainable development is the lack of a suitable unifying, intranational institution for sustainable development. Such an intranational institution for sustainable development would provide an understating and an integrating practice that would rise both within and above national and economic barriers and contexts.

In addition there is disagreement about the causes of unsustainability. Notable questions are raised about whom or what does sustainable development serve; on what timescale does sustainable development operate; and what level of change is required for sustainable development? Diverse answers to such questions has created a fuzziness around sustainable development which hinders and obscures the difficult choices that have to be made as well as encouraging the pursuit of sub-optimal solutions.

This study takes a unique approach to formulate a unifying intranational institution for sustainable development that addresses the problems identified above. The study considers the possibility of an emerging episteme (Foucault 1970)

which changes the way in which we order knowledge thereby foreshadowing fundamental change. First of all, a summary of Foucault's epistemic analytical approach is provided which emphasises the distinguishing features of the Modern episteme. Care is taken to distinguish between a paradigm and an episteme. A case is then made for an emerging episteme using an empirical approach that draws on evidence taken from life sciences (Capra 1997 and 2003, Leopold 1989, Maturana and Varela 1987, Wilson 1998), social science (Luhmann 1995), thermodynamic theory (Kauffman 1995, Prigogine and Stengers 1985), Chaos mathematics (Gleick 1987), geography (Vallega 2005), philosophy (Ellis 2002) and the science of Complexity (Berkes *et al.* 2003, Carsetti 2010, Mitchell 2009, Norberg and Cumming 2008, Olssen 2008). The emerging episteme is then outlined using an Aristotelian approach (Kineman 2003) adapted to fit the new scientific evidence. This emerging episteme is given the name "Primal" (Birkin and Polesie 2011).

The relationship between the Primal episteme and sustainable development is then considered. A key point in this regard is that an episteme, any episteme, could not and cannot be designed for a particular purpose. Instead we argue that the Primal episteme does indeed meet the needs of sustainable development but by default; mainly because of the properties of the episteme it displaces, the Modern episteme. When surveyed from within the knowledge and understanding of the Primal episteme, the Modern episteme, its institutions and practices, appear to contain within themselves the principal sources of unsustainable development.

Sustainable development's four normative principles of inter-generational equity, intra-generational equity, environment and participation as well as the prevalent anthropocentrism are used to illustrate the usefulness of the Primal episteme for sustainable development over and above the Modern episteme. The consequences of the Primal episteme are also evaluated according to four main categories frequently applied to sustainable development of very weak, weak, strong and very strong.

In order to consolidate the significance, the interpretation and the understanding of the Primal episteme, it is compared and contrasted with the People's Republic of China's (PRC's) 2003 innovation called "Scientific outlook on development" and the Chinese approach of "Harmonious Development" as it was understood both in ancient times and in the PRC's 11th five year plan. In particular the implications of the ancient Chinese concept of *Tian Xia*, "all under heaven", is considered both for the Primal episteme and for sustainable development. *Tian Xia* has recently been proposed as a political philosophy for global unity (Zhao 2009).

The implications of the Primal episteme for major initiatives within the broad sustainable development movement such as ecological modernisation, natural capitalism, environmental economics and ecological economics, and corporate sustainability indices are then considered. In particular, the practical consequences of the Primal episteme are identified with regard to an accounting system for sustainable development first tried out in the three European tourism islands of Harris in Scotland, Ponza in Italy and Samos in Greece. It is an accounting system based on the iterative assessments of stakeholder participation, resource flow, resource flow impact and ecological resilience. A final section of this paper reviews the opportunities and barriers in the Chinese tourism sector for the development and application of a Primal episteme understanding and practice especially in possible collaboration with the new accounting system for sustainable development.

In conclusion, the Primal episteme provides the opportunity for the creation of locally specific but globally united, intrinsically sustainable institutions. This kind of unity in diversity is a feature of the Primal episteme which explains the conundrum in the title of this paper, the "unity in intranational institutions", and which implies a new kind of Intrinsically Sustainable Development (Birkin and Polesie 2011). Recommendations for further studies are made and, finally, attention is drawn to the implications of the Primal episteme for the higher education provision for management where it is likely to have a significant impact.

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## Forum for Sustainable Building Valencian Region (FORO ESCV): A tool to implement policies for a sustainable future

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The building process is a complex cycle which uses large amounts of natural resources and generates large volumes of waste. The Forum for Sustainable Building in Valencian Region (ESCV Forum) was set up in January 2009 by request of the Ministry of Environment, Water, Urbanism and Housing of the Generalitat Valenciana; government of Spain. His aim is to make compatible economic and social development with respect for the environment within the building sector in the Comunitat Valenciana, changing social patterns of behavior of the agents involved in this process, through the optimal participation of all sectors of society[1]. This Forum was set up as a multi stake-holder platform to achieve consensus of local authorities, society, economic and environmental sectors and citizens in general, in the sustainable building field[2].

The ESCV Forum also establishes priorities for action and initiatives to undertake to repair critical situations. The highlights of its activities are: the training and dissemination line through the organization of courses and conferences as «Saving water in the building» or «Housing policies and social cohesion», or editing publications as the «White Paper on sustainable building» or setting of «Guidelines for sustainability in residential building.» The plenary session is held every year in an edition open to the public. In this session the work undertaken is explained and also are scheduled various activities of general interest such as lectures, thematic panels, workshops, exhibitions, contests, workshops, etc.

On March 3, 2010 was published the Strategy of the European Commission Europe 2010: A strategy for smart growth, sustainable and inclusive[3]. The Commission proposed five quantifiable goals for 2020 which will guide the process of policy actions over the next years: employment, research and innovation, climate change and energy, education and fighting poverty. To achieve these ambitious goals, José Manuel Barroso appealed to local institutions, social partners and civil society. In this line of work, the ESCV Forum[4], establish discretionary responds to the purposes having quality information, not only for professionals but also for users that can bring about change in attitudes and sustainable practices at all levels.

ESCV Forum considered essential to promote research, comparative studies and statistics on the field of sustainable building and exchange of good practices and dissemination of knowledge to achieve greater citizen satisfaction[5]. The ESCV Forum strategy is based on the organization of *thematic roundtable discussion forums* around a key issue. Today, with more than 200 members, representing over 70 institutions as local authorities, municipalities, professional associations, universities, user groups and nonprofit entities, make up the ESCV Forum.

The successful implementation of public policies on sustainable development requires good governance based on the principles of openness, participation and accountability, plus an effective allocation of public resources and increasing the direct participation, involving citizens and seek their welfare. Networks as ESCV Forum have a role in the formulation of European policies and are the basis for achieving more inclusive cities.

ESCV FORUM: Focused on integrated urban regeneration

On June 22, 2010 in Toledo, there was the Informal Meeting of Ministers for Urban Development in the member countries of the European Union, whose theme was «integrated urban regeneration»[6]. The meeting discussed the impact of financial crisis is having on the quality of life for its citizens.

The need to develop a model of smart urban management, sustainable and socially inclusive in all the city's urban fabric consolidated were the main target discussed on the annual congress ESCV Forum 2010, titled «The existing city, diagnoses, challenges and opportunities»[7] as also UN-HABITAT recommends with the theme chosen for 2010: Better City for a better life[8]. The ESCV Forum focuses on cities, due to new generations will have to deal with a predominantly urban world[9].

- [1] If you want to belong to ESCV Forum, can join <http://www.five.es/foro/inscripcion.php>.
- [2] The concept of sustainable building has been linked primarily to the environmental impact that building have on the soil and reduction in consumption of natural resources such as water, materials and energy.
- [3] European Commission Communication 2020 A strategy for smart growth, sustainable and inclusive. For more information see: <http://ec.europa.eu/eu2020/pdf/COMPLET%20ES%20BARROSO%20-%20Europe%202020%20-%20ES%20version.pdf>.
- [4] This addresses the challenge of education and consequent poverty reduction from a bottom-up approach. More information <http://www.five.es/foro2010/>.
- [5] Many of the studies conducted by the ESCV Forum with the participation of experts and independent professionals, thereby promoting employment, research and innovation in a family of actions.
- [6] More information [http://ec.europa.eu/regional\\_policy/newsroom/pdf/201006\\_toledo\\_declaration\\_es.pdf](http://ec.europa.eu/regional_policy/newsroom/pdf/201006_toledo_declaration_es.pdf).
- [7] More information [http://www.five.es/foro2010/?page\\_id=516](http://www.five.es/foro2010/?page_id=516).
- [8] More information [http://www.un-ngls.org/spip.php?page=article\\_es\\_s&id\\_article=3015](http://www.un-ngls.org/spip.php?page=article_es_s&id_article=3015).
- [9] According to estimates published on 29 June by the Department of Economic and Social Affairs of the United Nations World Economic and Social Survey 2010 New Instrumentation for Global Development it is expected that by 2050 70% the population will live in urban areas, which will lead to new specific problems More information [http://www.un-ngls.org/spip.php?page=article\\_es\\_s&id\\_article=2708](http://www.un-ngls.org/spip.php?page=article_es_s&id_article=2708).

## **Participative risk communication and risk governance: important models for decision-making on environmental and climate changes**

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Environmental and climate changes are part of a new set of risks produced by scientific and technological advances that are qualitatively different from risks of pre-industrial and industrial societies (Beck, 1995, 1998). These risks are characterized by incomplete understanding of their causes and consequences, by the fact of being incalculable, impossible to compensate, and often invisible, uncontrollable and irreversible. Risk situations associated with environmental and climate changes are usually characterized by considerable uncertainty and controversy.

Some examples of these risk situations have been investigated on an initial empirical research on the Coast of São Paulo, Brazil. The São Paulo Coast summarizes the socio-ecological dilemmas of contemporary economic development. Natural beauty and biological diversity have not done so well with consumerism. The combined pressures of tourism, industry, and oil extraction and transport challenges to quality of life and sustainable development are increasingly difficult to resolve. Environmental and climate changes will intensify these pressures and further limit the margin of maneuver of planners (Hogan et al., 2009).

As we pointed out our study is still in the initial stage, and it is part of a large-scale Brazilian project of the environmental consequences of climate change on the Coast of São Paulo. This project asks specific scientific questions about the spatial and demographic constraints which will condition adaptive response to climate change by coastal communities and local-regional governments; about the context of social conflict concerning the appropriation of the region's natural resources and the potential solutions this conflict may generate for resolving the new tensions introduced by climate change; about local and regional governmental actors' knowledge, concern and actions regarding climate change; and about the ecological changes which may occur as a consequence of climate change.

In our study we argue that dealing with dilemmas and risks associated with environmental and climate changes requires understanding that risk conflicts are not only a question of objective knowledge. Instead a range of issues are involved, such as value conflicts, conflicts regarding power, conflicts regarding the acknowledgement of different rationalities and emotional aspects (Lupton 1999, Taylor-Gooby and Zinn 2006).

If risk is understood as a matter of judgments about acceptability, a whole range of political issues about trust in authorities, experts and officials, about social communication and the mass media come into play. Once the views of the lay public are taken seriously, decision-making can no longer be exclusively a preserve of the authorities, but must include processes of interaction and participation between all those involved (Taylor-Gooby and Zinn, 2006).

We also consider that dealing with these risks requires specialized knowledge to recognize and measure them; meanwhile it demands a collective and participative process to handle them – particularly considering that events associated with environmental and climate changes have highlighted that individual perceptions have an important role in ways in which individual attitudes and actions of mitigation and adaptation are defined and practiced (Hogan and Marandola Jr, 2009).

Brazilian experiences involving different risk situations (contaminated lands, for example), however, have shown that in Brazil the strategies to deal with risk in general gravitate towards a risk management approach that considers only scientific knowledge as legitimate knowledge, and underestimates the potential input from the public. Considering risk

communication, these experiences suggest that, in general, the efforts focus on information transmission and public persuasion, based on the basic model of communication and the knowledge deficit model. This failure to communicate the risks to those affected, as well as technocratic approaches to risk management have led to disaffected communities and a prevalent understanding that environmental and health research and mitigating actions are not being undertaken for the public good (Di Giulio et al., 2010; Di Giulio, Pereira and Figueiredo, 2008a, 2008b, 2008c; Di Giulio, Figueiredo and Ferreira, 2008).

The analysis of these risk situations studied encourages thinking that the risk management and decision-making require actions among different sectors, as well as interdisciplinary approaches which include participative risk communication, articulation, cooperation and integration between the different social groups involved.

These approaches are included in our study which is based on the need to build a dialogue and engage the public in the decision-making to deal with risks associated with environmental and climate changes on the Coast of São Paulo.

In order to reach this objective we seek to investigate local community perceptions of these risks through an innovative public engagement methodology. This methodology is centered on focus group discussions with relevant community groups each of whom have a particular 'stake' in the debate. Using relevant stimulus materials, the research pays particular attention to the social and political contexts in which risks and benefits come to be evaluated by individuals. We consider that the findings from the public engagement exercises can subsequently be deliberated in interactive forums, each involving members of the community, policymakers and researchers – collaborating, then, to engage the public in the decision-making, and to improve risk governance strategies.

We also argue for the need of participative risk communication strategies based on cultural and social elements, trust, an open dialogue and a cooperative collective learning process to implement policies for mitigating these risks and for a sustainable future (Renn, 2008; Boholm, 2008; Lofstedt e Perri 6, 2008; Schlag, 2006; Lundgren e McMakin, 2004).

Then, our research seeks to identify and to analyze risk communication strategies adopted by researchers involved in their studies in the region. We also search to suggest participative risk communication strategies, in order to aim the communication of uncertainties, to introduce environmental and climate information in the decision-making, and particularly to take a dialogue and a partner relationship into account as important elements between those who assess the risks and those who living with the risks.

In our study we endorse for the need to consider participative risk communication and risk governance as important models for decision-making on environmental and sustainable development issues.

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## **Towards Sustainability Scenarios For Chinese Cities: The way China has urbanised since the beginning of the 1990's leads to the question of the long-term practicability and the durability of this development**

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Chinese big cities change their faces in a nearly daily rhythm: new buildings, new city quarters, new cities emerge at a breathtaking pace, and “reading” these new agglomerations becomes a challenge for applied research. They mirror the complexity of the transformation processes that started in China 30 years ago. The metropolises are motors and victims of the economic and social change. At the same time, they express the highly dynamic changes and are a Chinese show case towards the globalised world. While Chinese cities used to be the location for a highly privileged life for the elite of the country, during the past 30 years they have lost this status and developed into a place where all social, ecological and economic problems of the country come together.

Although China is still a country with a vast rural population, the development in the cities has played a growing role in the reform and opening process since the late 1970s. The marketisation of the economy takes place in the cities, the decentralization of the administrative system runs through the cities, and the cities are more open to the impact of globalization. Social change that has been taking place since the reforms of 1979, and is most obvious in the cities where competition for capital and resources is extremely fierce, social disparities very apparent and the coexistence of different lifestyles a major challenge to the urban life. The cities are in need of workers flocking in from the countryside and at the same time strive to preserve the traditional privileges of their dwellers. They expand into the surrounding countryside and thus harm the interests of the farmers in the suburban areas. The built environment changes at a very rapid pace and forces the urban population into constant adjustment processes.

The abstract proposes the hypothesis that state and society have to agree on the terms under which they cooperate in order to make Chinese cities governable despite the rapid speed at which they change and the many challenges people and governments have to cope with.

This is how the project came to select urban architecture as well as land use, health care as well as education, NGOs as well as governmental services as fields where state and society enter into a process of bargaining on their respective shares of the pie. The result of this bargain process can be very different in every location that will be under scrutiny, it can even be divergent in different neighbourhoods of one and the same city. It defines the mode of governance characteristics of the city, and the comparison of the different modes of governance will lead the team of researchers into a discussion with local administrators and urban dwellers on how to bring the bargain process to better results for a better future.

Recent developments in some Chinese cities have shown the vulnerability of these highly complicated and multi-faceted places. Social unrest is no longer limited to the countryside in the People's Republic of China (PRC), and spontaneous demonstrations, often springing from unanticipated social conflicts, can suddenly disturb the patterns of everyday life. Very often, local governments have shown themselves to be unable to cope with the unrest, when citizens start to fight amongst one another with the local state unable to guarantee their safety. The sudden loss of governability is a real threat, and preventing this loss of governability from happening is a task of major importance, which demands a form of cooperation between state and society in which the state hands certain tasks to society while society demands certain tasks to be taken over by the state. The paper describes a process of re-shuffling the responsibilities between state and society in the urban space against the history of Chinese cities, the presence of a rapidly changing urban environment and the future possibilities of a sustainable city.

The paper proposes a methodology for bridging the gap between the city, state and the grassroots level, it will strive to get NGO's more involved in solving local problems and it will thereby come to understand the main drivers of change in the Chinese cities.

## **A methodology for developing roadmap towards local low-carbon society in case of Shiga prefecture, Japan**

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This study proposes a methodology to develop long-term roadmaps towards low-carbon societies (LCSs) for local

governments. The methodology is applied in Shiga prefecture, Japan, and a roadmap which consists of more than 100 policies is estimated considering direct costs paid by public and private sectors.

Currently, local governments around the world have been setting their own greenhouse gas (GHG) emission targets and plans towards low-carbon cities or low-carbon communities. When it comes to developing LCS at a local level, the local authority must see a large number of detailed policies or programs related to various fields. In order to implement those policies effectively, it is necessary to systemize them and formulating a comprehensive plan of implementation. Such a plan is called a “roadmap”. As this is a new challenge for local governments, a methodology and tools to develop roadmaps towards LCS are needed. The objective of this study is to develop a methodology and a quantification tool for that purpose.

“Backcasting” approach was applied in this study. According to classic definition of Robinson (1990), the backcasting method involves “working backwards from a particular desired end-point to the present in order to determine the physical feasibility of that future and what policy measures would be required to reach that point.” From a viewpoint of application and practice, the approach consists of two main phases: describing a desired goal and finding the way to the goal. Developing a roadmap, the focus of this study, is the second phase. It uses a quantification tool called “back-casting model (BCM)” which estimates year-by-year plan of implementation of the policies. The first step is listing all relevant actions (hereafter called “options” ) which are required to implement by the target year. The options included here are not only “policies” implemented by national or local governments (e.g. subsidize solar cell), but also those done by residents or businesses (e.g. installing solar cell on roof of the houses). And then, systemize those options considering anteroposterior or complementary relationship between them. Cost of each option and upper bound of total costs are given to BCM, and it estimates a roadmap in which all options are implemented by the target year. The roadmap is modified and finalized through discussion and feedback from stakeholders.

BCM is a dynamic optimization model formulated as a mixed integer problem. It was originally developed by the authors in previous study (Gomi et al, 2010) and modified in order to consider costs of involved sectors (e.g. public, business and residential sectors). The businesses and residents are likely to have allowable range of payment to low-carbon options, and constraint of governmental budget is more evident. By this modification, the model can estimate a pathway of implementation considering upper bound of costs by the sectors, and if the bound is too low to implement all actions, the model tells it is infeasible.

The methodology and tool were applied in Shiga prefecture, Japan. The prefecture already has set a LCS target in 2030 (-50% compared to 1990 level) and measures which should be implemented by the target year. Through discussion with the prefectural government, a total of 130 options related to LCS were listed. It includes improvement of convenience of public transport, developing compact city structure through land-use planning, deployment of energy-efficient vehicles and equipments, subsidy to solar cell, diffusion of bio-fuel, energy-saving consultation for houses, and environmental education and so on. The 130 options were classified into six groups and systemized based on relationship between them. The groups and their contribution to emission reduction in 2030 are: Transport; 2276ktCO<sub>2</sub>, Town and buildings; 159ktCO<sub>2</sub>, Lifestyle; 944ktCO<sub>2</sub>, Business; 2162ktCO<sub>2</sub>, New and renewable energy; 518ktCO<sub>2</sub>, and Forest conservation; 319ktCO<sub>2</sub>. Direct costs of the options of sectors (here, governments and private sectors) were assumed based on the experience of Shiga prefecture, case studies of other local governments, and market price of relevant goods.

The information above was input to BCM and the first draft of the roadmap from 2010 to 2030 was estimated. Based on the draft, Shiga prefecture organized a series of stakeholder meetings. With the feedback from the meetings, the input information was modified and the roadmap was estimated again.

As a result, the cumulative emission reduction from 2010 to 2030 was 78MtCO<sub>2</sub>, total of direct cost was 7.7 trillion yen (11 billion USD), and governments bear 12% of the total costs. Among the group of options, the largest was that of Transport, 3.1 trillion yen (33 billion USD). Average cost per one ton of carbon dioxide was 1210 USD/tCO<sub>2</sub>. This figure is much higher than other studies and current price of carbon emissions, and likely over-estimated because of following reasons. (i) Total costs of equipments are accounted, not additional cost (difference from price of conventional one). (ii) It is not a “net” cost. The economic benefit from energy saving is not considered. (iii) Costs of policies whose main objectives are not low-carbon, such as public transport or urban development, are also fully accounted. (iv) Costs in future year are not discounted. In addition, those costs are “sales” for the suppliers. If overall economic effect, such as employment, is considered, social cost of the low-carbon options are likely significantly lower than 1210 USD/tCO<sub>2</sub>. However, even though the costs considered here are likely over-estimated, it is still useful to stimulate communication between stakeholders, and for some extent reliable because they were determined based on actual experience or market price. At the time of writing, Shiga prefecture disclosed these results and is asking for public comments. The roadmap is going to be finalized and authorized by the end of 2011.



The findings of this study are: (i) the methodology and tool are useful because they were officially applied by Shiga prefectural government and contributed to formulate the roadmap, (ii) in case of Shiga prefecture, total direct cost is 7.7 trillion yen (94 billion USD) and 12% is that paid by governments, (iii) average direct cost is significantly higher than other studies and market price if whole costs of all relevant policies were accounted. To authors' knowledge, this is the first attempt of developing detailed and quantitative LCS roadmap considering implementation costs at a local government. The model, BCM, is considered useful for decision making of local LCS policies.

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## **Transdisciplinary Sustainability Research – A combination of Buzzwords or a prerequisite for fostering sustainability decision-making?**

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Sustainability science is an emerging field aiming to cope with the fundamental societal challenges of the 21st century. There is broad consensus that approaching these challenges requires new ways of knowledge production and decision-making that challenge established academic and professional institutions. Key aspects of sustainability science are, among others, an explicit problem orientation and the involvement of actors from outside academia into the research process. Research approaches engaging actors from outside academia such as transdisciplinary, community-based, participatory, or transformative research are often suggested as an appropriate way to meet both the requirements posed by real world problems as well as the goals of sustainability science as an emerging scientific field. Despite a growing body of literature on these approaches and a variety of empirical projects applying them, a structured typology of the approaches highlighting their epistemological and methodological core as well as their contributions to decision-making seems to be still missing. As all of these approaches aim at being problem-driven and decision-oriented, such a typology should go beyond an intellectual exercise and help to reveal strength, shortcomings, and potentials for the concrete research and decision-making practice at the interface between science and society.

Based on an extensive literature review and an analysis of exemplary projects we present in the first part of the paper a tentative framework of requirements for structuring approaches in sustainability science engaging actors from outside academia. In the second part we focus on the relation of transdisciplinary research, understood as a mutual and joint learning and decision-making process between scientists with different disciplinary backgrounds and actors from outside academia. We thereby elaborate on the following questions:

- Which theoretical assumptions underlying sustainability science and transdisciplinarity are actually the same, similar, independent, or even contradictory?
- Which questions in sustainability science need to be tackled in a transdisciplinary way?
- Are there specific prerequisites for transdisciplinary research in the field of sustainability science (as opposed to other fields)?
- How can case studies in the field of sustainability science be used to further develop the theoretical, methodological as well as procedural foundations of transdisciplinarity and vice versa?
- What is the contribution of transdisciplinary sustainability research to real-world decision-making?

We close with an outlook how the presented typology as well as the insights with regards to the relation of transdisciplinary research and sustainability science can contribute to substantiate the relevance of transdisciplinary sustainability research and its use to foster decision-making on sustainable development issues.

## **How Determinants of Affective Rationality Impact Individual Perceptions of Alternative Energy Sources: Evidence from Germany**

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Continued global population growth, rapid industrialization and modernization, in particular in the BRIC economies, together with globally increased standards of living will continue to drive the demand for energy-related services and amenities around the world. Sources to satisfy this immense energy hunger are limited mainly to fossil energy sources,

nuclear power, and renewables, with fossil fuels currently dominating the world's energy supply mix (EIA, 2008). However, since the Club of Rome raised considerable public attention with its report "Limit to Growth" (Meadows et al., 1972), modeling the consequences of a rapidly growing world population and finite resource supplies, there is increasing global awareness about the scarcity and finiteness of energy sources. Today, this has broadened to concerns about the social, economic and ecological impacts associated with different energy options (e.g. Dincer, 2000; IAC, 2007). Such concerns have led to numerous fierce and frequently highly emotional debates in both national and international arenas about what should or could be the right answers to the energy challenges of competitiveness, energy supply security and sustainable development.

Such affect-loaded energy debates have two major implications for scholars, societal and energy decision-makers. First, in the controversial field of energy policy and management, there is a need to more thoroughly understand "affective rationality" (Slovic et al., 2007). Scholars in numerous fields (e.g. Damasio, 1994; Finucane et al., 2000; Kahneman, 2003; Loewenstein et al., 2001) are increasingly highlighting the explanatory power of affective rationality, which emphasizes the interplay of affect with rational reasoning in influencing and guiding judgments and decision-behaviors. Second, management and policy decision-makers can neither ignore public opinion nor -consequently- affective decision-making. As a key stakeholder in the energy debate, a failure to understand and address public energy concerns and their acceptance of corresponding energy innovations can have dire consequences, as illustrated by the anti-coal movements in the USA (Sheppard, 2009) and Australia (Williamson, 2009), and more recently by the nuclear protests (Slackman, 2010) in Germany. Therefore, in order to avoid potential misunderstandings and escalations, gaining insight into people's affects toward different energy sources and potential moderators of their affects are essential.

Recognizing that affect-loaded energy debates could pose significant challenges to societal and energy decision-makers, numerous studies in Australia, Europe and USA have investigated citizens' perceptions and attitudes of energy issues (e.g. Ashworth et al., 2009; EU, 2007; Jenkins-Smith & Herron, 2007). However, such studies were either too general, thus providing limited insights into how affect influences people's decision-making, or they have focused mainly on affects toward nuclear power. Furthermore, the influence of potential moderations such as gender and knowledge on perceptions and attitudes toward energy sources were not investigated. To address the aforementioned gaps, we develop and empirically test a model of how affects toward different energy sources influence energy judgments by drawing on studies on affective rationality. The following is a brief description of our research model, design and main findings.

*Conceptual research model:* We propose a model of energy evaluation where affect plays a key role in influencing decision-behaviors in the energy context, with specific factors such as gender and knowledge (gained through field of study, experience and exposure) as moderators of affective responses. Furthermore, the importance of contextual conditions (levels of economic development, institutional/cultural environments) is highlighted in the proposed model. Our hypotheses have been empirically tested in the present study on a full range of energy sources (fossil, renewable and nuclear) in Germany, a prime example for a developed and highly industrialized country.

*Research design:* The underlying continuum, based on our proposed model, is the respondents' types and degrees of affects toward different energy sources. 234 university students from different disciplines participated in a survey on their energy perceptions in 2010, where word association technique (e.g. Slovic et al., 2007) is used to elicit images and affects toward seven energy sources. Additionally, respondents provided demographic information relating to age, gender and knowledge. The research questionnaire was back-translated between English and German to ensure consistency and to allow for the use of the same questionnaire in English speaking countries in the future.

*Main findings:* Findings highlight the importance of the contextual environment in affective evaluation. While positive affects toward renewable and negative affects toward fossil energies were predictable, mixed results toward nuclear energy were not. Additionally, in line with previous studies, gender and knowledge are found to be significant moderators of affects. Specifically, women, business studies students, and those having less experience with energy-related issues tend to exhibit stronger negative affects toward nuclear, indicating that respondents are far from homogeneous in their affective responses toward energy sources. Moreover, it suggests that there are aspects about nuclear energy that distinguish it from other energy sources.

*Discussion:* Both observations from Germany and evidence from international studies provide support for the key role of affect in influencing and guiding energy-related judgment and decision-behaviors as proposed in our research model. Positive affects observed for renewables would explain the strong German public support for renewable energy sources observed in the Eurobarometer study (EU, 2007), and the willingness of energy consumers in the USA to pay a premium for electricity from renewable sources (Borchers et al., 2007). Similarly, negative affects toward fossil energy sources would explain the German public's resistance to fossil related technologies such as CCS technologies (Fröhlingsdorf et al., 2009), in addition to the limited public support for fossil-related energy technologies in both USA and Australia (Ashworth et al., 2009; Jenkins-Smith & Herron, 2007). Surprisingly, though mean affect for nuclear is negative, a rather even distribution

of positive and negative affective ratings is observed for nuclear power, suggesting that affects toward nuclear energy are not consistently negative. Though this appears contra-intuitive in the public opinion sphere, especially in view of the recent anti-nuclear mass protests in Germany, it is consistent with findings from previous studies (e.g. Peters & Slovic, 1996).

*Practical implications:* Our study contributes to insights into affective rationality in the controversial fields of energy policy and management by empirically investigating affective responses to a full range of energy sources and important factors moderating such affects. Furthermore, it highlights the importance of contextual conditions in the proposed energy affective evaluation model. By putting public citizens' affects in the spotlight, the present study could help to facilitate better strategic planning and budgeting efforts, and more efficient channeling of funds in energy R&D. Moreover, it contributes to efforts by societal and energy decision-makers to develop energy policies and investment decisions which will be supported by the majority of their stakeholders, and the development of better targeted communication programs to change stakeholders' opinions.

*Conclusion:* We have started an international comparison study in Germany in 2010. Currently, efforts are underway to collect data in France, Russia and Singapore, and we look forward to further developing and discussing our research with colleagues at the conference.

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## Deciding not to Drive Alone: The Social Context of Reducing Vehicle Tailpipe Emissions

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Approximately a quarter of all greenhouse gases originate from motor vehicle tailpipe emissions. Along with reducing household energy usage, changes in transportation behavior would have the most direct impact on lowering consumer output of greenhouse gases, specifically carbon dioxide. Despite increased levels of awareness surrounding global warming and interest in reducing greenhouse gases in the atmosphere, there is little evidence that people have been willing to make changes in their lives to attain this collective goal. Moreover, it is not clear that consumer-oriented strategies designed to change patterns of consumption – e.g., switching over to more efficient hybrid electric vehicles – will alone be able to reduce emissions to levels necessary to prevent irreversible climate change by the middle part of this century. Researchers in this area have long observed a “rebound effect” or “efficiency paradox” with relation to technological advances in efficiency and emissions reduction which have only resulted in the increased usage of motor vehicles.

The negligible impact technological improvements have had on reducing overall CO<sub>2</sub> emissions, draws our attention to

the motivations people might have, if any, to reduce vehicle emissions as a matter of daily practice. Through the use of a phone survey in three New England states, Maine, New Hampshire and Vermont, this study explores the social context of transportation decision-making. Specifically, we seek to explain the difference between those who drive a motor vehicle alone to work, and those who commute utilizing any other form of transportation (e.g., carpooling, the bus, bicycle, etc.). This is a key point of differentiation since driving alone is easily the most egregious behavior commuters regularly engage in with relation to their carbon footprint. Moreover, with approximately three-quarters of working Americans commuting alone, it appears there would be much opportunity for progressive change in this area. By simply sharing a ride with one other person, solo commuters could greatly improve their energy efficiency and split their vehicle emissions in half, all of this without having to purchase a new vehicle or await dramatic changes in transportation infrastructure.

There are clearly geographic, social structural and even cultural reasons for Americans' resistance to driving alone, however, the fact remains that approximately 25 percent of commuters in the U.S. do not drive alone to work. Earlier findings in this area focusing on the impact greater individual-level awareness of environmental issues has on transportation behavior have been mixed to weak. Instead, a growing body of research suggests that people's decisions about transportation are less based on good information and rational calculation than they are on other sociological factors. Living in an industrial as opposed to a post-industrial region, for example, has been correlated with more negative attitudes toward public transportation, and the role of "travel socialization" has been shown to have significant influence on transportation expectations – specifically, the number of cars in a family household has been positively correlated with the desire of children to want to drive a car.

Symbolically, cars take on particular significance as a means of "conspicuous consumption," a wasteful strategy of keeping up appearances with peers through spending most likely to occur where there exist high levels of social inequality. Moreover, in societies with a high degree of social mobility and thus some degree of status ambiguity, consumer products – automobiles being a quintessential example of this – work to convey status and imply social and cultural meaning far beyond the rational utility of the product itself.

Whether drawing our attention to cars as a key component of social structure or as a primary symbol of status attainment, the above approaches remind us that transportation decisions are embedded in a web of relationships and meaning wherein, before a decision is made, mobility options and marketplace information are screened through a sometimes unacknowledged array of socially-determined assumptions, strictures and expectations. For theorists coming from a social capital perspective, this is on the whole an advantageous process. For the more Veblen-inspired theorists, social interaction and comparison in the context of high inequality and status ambiguity may shift consumer expectations in the direction of more wasteful levels of consumption, a tendency reinforced in the context of media-saturated commercial advertising.

Our dichotomous response variable, driving alone or not, is regressed on factors tied to social capital, including socioeconomic status, interpersonal and community trust, and the strength and diversity of social network connections. This last component is derived from an innovative "position generator" element in the phone survey which provides shorthand access to the diversity, extensity and strength of an individual's social network. We expect that, independent of environmental knowledge and attitudes, and other key demographic and geographic factors, a more extensive and diverse personal network correlates with a greater willingness to use alternative forms of transportation, including carpooling, public transportation and cycling. Moreover, individuals living in an environment marked by high levels of trust and social cohesion would be more likely to take on new behaviors that would tend to reduce vehicle emissions than those in a context with low levels of trust and cohesion.

### **The importance of assessing the group dynamic within transdisciplinarity approaches to sustainability**

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Transdisciplinarity is defined as the integration of diverse forms of research, and includes specific methods for linking scientific knowledge to problem-solving. Transdisciplinarity thereby involves groups of individuals from a range of disciplines and sectors (public, private, NGOs etc.) working together to apply existing knowledge and expertise to address a specific problem. The sustainability of any interventions arising out of such transdisciplinary approaches is clearly a significant concern. Also important are the dynamics which emerge when individuals from such a diverse range of backgrounds work together within such transdisciplinary groups, yet this important topic has received very little attention in the sustainability literature. Developing means for the assessment of group dynamic as a way of appreciating

team work is not new (Whiteoak et al. 2004), One contemporary example in daily use is the Symlog (A SYstem for the Multiple Level Observation of Groups) methodology first set out in 1979 by Robert Bales and colleagues (Bales et al. 1979) as a means of exploring the group dynamic. The Symlog methodology is outlined at [www.symlog.com](http://www.symlog.com) and is founded upon the completion of a questionnaire comprising a total of 26 questions by group members. The questions are designed in such a way as to draw out that individual's view of the group function.

There are also more rapid approaches to assessing group dynamic, although often applied in a more 'outside in' (external) mode by facilitators who are not part of the groups being assessed. An example is an assessment based on a unique method called the BECM matrix. The approach seeks to explore implicit group knowledge and in essence involves facilitators 'scoring' groups depending upon a set of pre-defined criteria of group behaviour in four areas;

- Being (the groups level of internal cohesiveness)
- Engaging (the manner in which the group undertakes tasks)
- Contextualising (the way in which a group applies its knowledge and resources to new tasks)
- Managing (how the group self-organises)

In a full BECM analysis these four are then combined in an overall, systemic assessment (Bell 2008).

The results presented in this paper are based upon BECM and Symlog applied to a total of 16 workshops that took place in 5 countries during 2009 – 2010. Each workshop took 2 days and groups typically comprised 5 individuals (range between 4 and 7). Each workshop comprised a total of 5 distinct stages geared towards the analysis of a defined topic. In the case of these workshops the topic was the use of indicators in framing and implementing sustainable development policy. Stages 1 and 2 took place on day1 for all groups, and for most of them stage 3 also happened on day 1. Stages 4 and 5 typically happened during day 2. BECM assessments were made for each of the stages, so each group in effect had a total of 5 BECM assessments. Symlog assessments took place at the end of each day and respondents were asked to assess their group function for that day.

For comparing the results obtained from BECM and Symlog the 'best subsets' approach to regression analysis was selected. The process is an efficient way of identifying models that contain as few predictors as possible, and in the context of this research it allows for the identification of Symlog components (independent variables) that best correlate with the BECM scores (dependent variable). Results of the best subsets regression did indeed suggest that the BECM scores were significantly related to some of the Symlog characteristics. Symlog characteristics such as the presence of a purposeful and democratic task leader, laughter, good spirits and atmosphere, an analytical, task-orientated and responsible group were all correlated with 'better' group dynamic as assessed via BECM. Also, the Symlog characteristics of unfriendly and negative behaviour and those which had assertive managers which could easily be observed as domineering, were assessed as 'poorer' group function via BECM. Similarly groups which saw themselves as self-punishing, emotional and submissive were also picked up via BECM and associated with 'poorer' group function although in these cases the observable clues may be quite subtle. Perhaps more surprisingly there were other Symlog characteristics that one would regard as being associated with good group function, such as warmth, trust and being friendly and equal, but results suggested that they were equated with poorer groups function as assessed with BECM. Why this should be so is not clear.

A further point worth noting was the absence of some of the Symlog characteristics from the best subset model. For example, groups that perceived the presence of dominant individuals that talked a lot or were domineering should have been observable by outsiders yet these didn't appear in the best subset as being related to BECM. One explanation for this is that individuals were less likely to acknowledge the presence of certain characteristics in their group than others. During interviews after the workshops a number of respondents did mention that they found some of the Symlog questions to be awkward and uncomfortable. In addition it has to be remembered that BECM may be a less precise tool in the sense that dominance or domineering might be interpreted by someone unfamiliar with using BECM and/ or working in a cultural/ linguistic group unfamiliar to the researcher, to be similar to the presence of a purposeful and democratic task leader. The members of a group will know the difference but outside observers may not in the short term.

While BECM and Symlog are both designed to achieve such an assessment they differ in a number of important respects. Firstly BECM inevitably has to be explicitly based on the appraisal of group function by picking up on visual/ tonal clues and what group members say during plenary sessions. In that sense Symlog should, in theory, provide a more representative assessment of group function as all those completing the form will have been immersed in the groups' conversations although the manner of their self-reporting is limited to their agendas and perceptual issues which each member of the group inevitably brings with them into the group context.

Secondly, BECM is a relatively rapid procedure to implement. Many BECM assessments can be made during stages of a workshop, and it is possible for a number of observers to make their own assessment and compare notes thus triangulating their perceptions. There is no interference in group activity. By way of contrast Symlog involves the

completion of a questionnaire, and although this can take place relatively quickly it does mean that the group has to break away from its activity. Inevitably this limits the number of Symlog-based assessments that can be made of group function during a workshop as participants would undoubtedly become frustrated if repeatedly asked to stop what they were doing in order to complete a questionnaire.

Thirdly, Symlog involves far more complexity in terms of interpretation of results compared to BECM. The Symlog questionnaire has 26 questions, and given that a group may comprise a number of individuals putting all this information together is far more challenging. For example, a single group with 5 members each completing a Symlog questionnaire at the end of each day of a two day workshop yields a total of  $5 \times 2 \times 26 = 160$  data points. Multiply this by 16 groups and the number of data points becomes 2560.

In terms of similarities both BECM and Symlog as applied here were opaque to the groups. The results were not given to them and thus were not allowed to interfere with the group dynamic. The results of BECM could have been given to the groups during the workshop almost in 'real time' but this may have changed behaviour or possibly resulted in debates over whether what the facilitators observed was correct. Such near instantaneous feedback with Symlog is far more difficult given the need to enter the results into software for analysis, but is certainly not impossible.

However, it is significant that a best subsets regression can pick up relationships between some of the Symlog answers and BECM. The fact that this is a partial picture is not surprising given the differences between the two approaches. Indeed given that assessment of dynamic is achievable it is important to go further and consider how this may impact upon the nature and quality of an analysis arrived at by a group.

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## **Towards Sustainable Urban Planning: Lessons from the Environmental Planning and Management Process Application in Nigeria**

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Many settlements in the global South face poor quality environmental, social and economic living conditions. Rapid urban growth, depletion of natural resources, poor management of wastes, inadequate shelter and poorly maintained infrastructure are some of the problems resulting in severe threats to the environment and health of the people. Apart from being the least urbanized region of the world, UNCHS (2001) reported that Africa has the least City Development Index (CDI; 42.85) compared with other designated regions of Arab States (CDI; 64.55), Asia Pacific (CDI; 65.55) and the Highly Industrialised Countries (96.59). This poor performance and the continent's marginal stake/role in international trade and foreign direct investment portfolio contribute to the perception of Africa's urbanization as problematic. In the Nigerian scene, urban population (as percent of total population) rose from 15 percent in 1950 to 43.3 per cent in 2000 with the prognosis to reach 60 percent by 2015. The number of urban areas increased from 56 in 1953, 182 in 1963, 359 in 1991 to over 840 in 2006 (Federal Ministry of Housing and Urban Development 2006). This trend raises concerns of unsustainability and threats to systemic stability as it affects the function of cities in the socio-political human eco-system. Sustainable urban development is therefore one of the major challenges facing Nigerian cities as elsewhere in Africa.

Urban planning has a critical role to play in reducing environmental problems and improving people's wellbeing. Many works have traced its path from the erstwhile predominantly drafting responsibilities and spatial phenomena of the early years to the progressively reinvented from the constant struggle to confront the complex challenges of the 21st century (for example Commonwealth Association of Planners 2006; UN-Habitat, 2009; Watson, 2009). Urban planning practice in Nigeria is markedly a disjointed technocratic approach and the planning standards and laws obviously outdated. Much of the planning efforts have therefore proved ineffective in responding to the challenges of complex problems arising from the rapid urban growth. The implication is a disconnect between the existing planning system and the realities of the living conditions it is expected to address.

This paper focuses on the process and practice of urban planning in Nigeria within the sustainability framework. It aims to analyze the challenges facing cities and the traditional urban planning system to explore how an integrated participatory approach could be used for achieving sustainable urban development. Four cities that implemented the Environmental Planning and Management (EPM) process in the Sustainable Cities Programme and the Cities Alliance namely Ibadan, Kano, Enugu and Karu, were targeted for the study.

This study is significant for two reasons. First, the trend in urbanization in Nigeria has to be channeled towards a sustainable direction following the realization that cities are increasingly perceived as resources and engines of development. Second, arguments have been in favour of urban planning systems and innovative approaches that must function as tools for human and environmental improvements to achieve sustainable development. The quest for the adoption of such approaches directed towards broader structural change through learning from international best practices already tested within the Nigerian context is the focus of this work.

Data for the study were collected using the combined method of questionnaire survey, interviews with key actors and review of relevant documents in the implementation of the EPM process in the four cities. It was found, among others, that despite the cities' differences in their general characteristics, they face similar problems, the most crucial being inadequate infrastructure such as water supply, sanitation and solid waste management. Use of working groups and city consultations as broad based participatory mechanisms, preparation of city profile that analysed environment development linkages and the use of demonstration projects to drive commitment and actions were identified as the tangible components for integrating sustainability into the urban planning process. Adaptation and sustenance of the methodology were constrained by socio-political factors and the institutional framework within which the programmes were implemented. The results are directly useful in developing measures for making a major shift in policies, planning practice and education.

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## **An Agent-Based Model for Efficient Life-Cycle Analysis of Rural Water Systems in the Developing World**

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Issues of sustainability are quickly becoming central to most ecologically-based systems, which is especially true for rural water systems in the developing world. An important feature of sustainable systems is the dependence of the system on the socio-economic and physical-chemical-biological context in which it exists, whether this is buy-in of the utilizing population, economic support, or resource availability (Ostrom et. al, 1993). Ignoring the interconnections of these issues and the relative local context will ultimately result in an unsustainable system. We propose an agent-based simulation model that can be used to integrate individuals' socioeconomic decision-making into scenario-based analyses of alternative water delivery systems. While the model we propose is in the preliminary stages of development, the approach represents a different way of addressing these issues and illustrates the many aspects that contribute to sustainable water systems in this particular context.

Understanding how sustainable systems function requires a detailed analysis of the community and the projected impacts after a system has been implemented. Life-Cycle Analysis (LCA) is a standard approach to analyze the projected environmental and economic inputs and outputs at each stage of the life cycle of a system, plus the ultimate impacts of such a system. While LCA has not traditionally handled social impacts, we add to this framework of evaluating inputs and outputs at each life-cycle stage by incorporating Agent-Based Modeling (ABM) techniques to represent decisions made by many heterogeneous individuals. Our approach captures the community context, including spatial relationships, which can be used to model the sustainability of various water delivery options. This approach allows a predictive model that can be tailored to a variety of communities, allowing stakeholders to consider how the sustainable system should be tailored to the specific context before the majority of capital investment has occurred.

ABM is a computer simulation technique that captures the important model features as individual decision-making agents (Epstein, 2007) in software. Agents have a location in the model that changes over time, allowing for time-varying local interactions with the environment and other agents. The combined interactions represent the community at large going about its daily activities, driven by each agent's internal process and the surrounding decisions of others. Decisions are derived from rule-sets that allow a layering of functionality, proving incremental design and exploration of heterogeneous agent types. The simulation aspects of ABM also allow the consequences of specific agent interactions to be easily examined for consistency with modeled system features (Ruebeck et. al., 2011).

Our model captures subsistence farmers in the developing world with limited access to reliable potable water. The model consists primarily of three agent types: households that determine water usage, water boards collecting monetary reserves for maintaining water systems over time, and water assets of differing quality (Weir et. al., 2010). Households are clustered in the model space to represent a living community, with water assets distributed throughout the model to approximate their physical distribution. Households track available water quantity of various qualities, family health, and general household wealth. Water asset characteristics include: reliability, economic cost, quantity, and quality. The model incorporates distance to measure the time cost associated with family members traveling to specific water assets. Movement occurs over a path network to reinforce the physical topology of the modeled community, and provides a computationally efficient mechanism for tracking movement. Time is also considered, using 15-minute increments, with the desired ability to track up to twenty years of simulation time in a reasonable period of computation.

Water assets include springs and surface water (lakes and rivers), groundwater, rainwater, and piped water. These sources can be potable or not, depending on treatment options. In combination with retrieval distance, the sources form a set of possible assets for households. Travel time is determined by field studies of villagers using standard operations research techniques. From water gathering activities, households build up limited water reserves representing water supply over part of a day. This limited reserve is reduced using an estimated diurnal model of water demand, also from field studies. Standard diurnal models for the developed world are driven by easy access to piped water. For the developing world the diurnal model is less predictable, driven by demand and proximity of family members to a water source. The household water retrieval decisions are also field-based, accounting for proximity, price, crowding, quality, and random factors (Nyong et. al., 1999).

The water asset choice by each household has outcomes affecting household health, financial resources, the health of the greater environment, and the sustainability of a possible community-based water system. Household health is based on the mathematical model introduced by Fewtrell et al. (2007), approximating the burden of disease based on a combination of factors including non-potable water, sanitation access, and hygiene practices. The life-cycle cost and greater environmental burden are based on a combination of published LCAs for various water system contexts (Stacey et. al., 2009). Water system sustainability is based on the aggregate community financial reserves available for ongoing operation and maintenance (Brikke et. al., 2003). Previous ABM work (Pape et al., 2010) shows that conjectures can be made about a population's increased welfare as a result of groundwater management. Our work takes into account previous literature (Ahuja et al., 2010), providing evidence for gains from modeling use, take-up based on surveys, and randomized trials, along with potential divergence between actual and stated preferences as well as experience in parameter estimation for structural policy simulations. While there is work studying self-supply of water by the urban poor (Grönwall et al., 2010), we study the rural poor and provide guidance for efforts to improve water quality and access. Additional studies considered, such as Kremer et al. (2009), examine political and social interventions that promote efficient resource use, finding that choice between private and public solutions may depend on income.

In summary, we are establishing both an exploratory-process and modeling-framework that combines field work, published studies, and simulation to determine how capital decisions regarding rural water system infrastructure will affect a hypothetical developing world community represented by the fieldwork. The computer simulation is tuned to efficiently represent a hypothetical 20-year system design life to capture both the amortization and physical change of the infrastructure in the long-term. Our intent is to provide policy makers with tools to explore and develop an effective understanding of multiple possible solutions with substantiated rationale for choosing one solution from the presented alternatives.

This work is supported by NSF grant HSD BCS-079458.

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## Lost meanings of sustainability? How regeneration and sustainability have become fashionable in UK policy making

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In public policy in the UK, notions of sustainable development and regeneration have become increasingly fashionable terms to employ. Sustainability has been used by governments, particularly over the last decade, to convey a range of ideals, such as sustainable communities, sustainable transport measures, and sustainable technologies. These terms have covered a range of policies, including environmental targets associated with sustainable development such as the local Agenda 21 initiative, recycling measures, and notions of 'eco – taxation' measures to cap businesses who fail to meet emissions targets, but have also targeted technologies involved in housing regeneration, communal green space in city centres, and the physical demographic of these areas. While notions of sustainable development in the environment have been understood by scholars to contain notions of environmental, ecological and social responsibility, however, notions of 'sustainable communities' and 'sustainability' are harder to unpack. Under the New Labour governments, the profile of sustainable development in the UK rose greatly. Though the concept of sustainable development under successive Conservative administrations in the 1980s and 1990s was implemented after a fashion following the WCED conference in 1987, this was more of a focus on environmental policy in the UK, which though focused on improving efficiency and environmental measures, did little to emphasise the social aspect of sustainable development. Following the election of the New Labour administration and the subsequent creation of the Department for the Environment, Transport and the Regions (DETR) in 1997, several policies aimed at promoting sustainable development were implemented. This super-department was short lived however, and DEFRA (Department for Environment, Food and Rural Affairs) was created in 1998. In initiatives such as the high profile Thames Gateway regeneration (overseen by the Department for Communities and Local Government), New Labour discussed sustainable development in regard to housing and communities, but the term has rarely (if ever) been defined in such initiatives in a uniform sense. The term sustainable development has evolved from its first widespread usage in the World Commission on Environmental Developments (WCED) 'Our Common Future' (1987), where it was defined as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987). As Mebratu notes, this report constituted a 'major turning point for the concept of sustainable development' (1998: 496). As Rydin has noted, sustainability has been loosely applied to the regeneration process. The question of what constitutes 'sustainable development' in the planning project has been modelled by O'Riordan et al (2001) as composed of The Three Pillars; the economic, social and environmental. O'Riordan has also described the Russian Doll model, in which the three spheres are ranked in order of importance, with the economic at the centre. Both models demonstrate the flexibility of the term sustainable development and the failure to define what constitutes 'sustainability'. This paper draws upon these models as templates for recent policies in the UK, and argues firstly that the lack of clarity and definition of what constitutes sustainable development and sustainability has frustrated progress in renewal projects. Secondly, the paper goes on to suggest that this lack of an accepted definition has engendered a focus away from the social pillar of sustainable development, through focus on technologies and the lack of success in achieving sustainable communities.

## Decisions Matter: Why and How We Make Choices that Impact the Environment

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Many decisions made by individuals, households, and other groups have personal, social, and economic consequences, but also impact the environment. I will review the special challenges in making such decisions, where costs and benefits often vary in their certainty and time of arrival, and where outcomes are typically affected not just by our own choices but also those of others. We will see that there are numerous cognitive and emotional barriers to people's ability to make such decisions wisely. I will then move to a more positive topic, and review the multiple ways in which people have been shown to acquire, represent, and process information about their choice options and arrive at decisions. I will argue that a better understanding of the abundance of goals that motivate people's choices and of the ways in which they arrive at their decisions provides entry points to the design of decision environments that help people, households, and other groups make decisions with which they will be more satisfied in the long run and that have better social and environmental consequences.

## Decision-making Model and Sustainability Pathways: Case Study of Rubber Plantation in Southwest China

Fanxin Xu

In recent years, progress has been made in understanding the importance of sustainable development. However, conflicts and some of the failing of the current governance arrangements for achieving sustainable outcomes are rarely identified. It is still extremely rough to integrate sustainability into the development goals in social and economic system, especially for the developing countries. One of the current challenges for research community lies in finding approaches to address the conflicts and obstacles at the local level, to implement changes which will benefit the poor. Therefore, our research question is what is happening in the decision making process on the development-related issues in those developing countries.

There have been few attempts to bring together the social, technical and environmental dimensions of the poor areas, and chart how the interlock, reinforce change over time. It is thus important to track the realistic development pathways at the local level of the developing countries, and unpack the power and politics of sustainability in those areas.

The paper engages with a case study, the rubber plantation in Xishuangbanna, to address the development pathways and its decision-making model. Xishuangbanna, an autonomous prefecture in southwest China, sitting at upper Mekong River, is famous for the tropical rainforest and ethnic folklore. The region was poor but abundant in natural resources, and was conventionally taken as undeveloped for its inadequate sanitation, poor education and low GDP, but the ethnic residents have developed local strategies (such as self-efficient farming systems) for living harmoniously with the environment. Since 1947, the rubber plantation has been introduced from Brazil for economic benefits and now, it has become the pillar industry for the significant contributions to GDP and employment. As one of the key issues in the farming system transition, it is supposed to contribute to the region's development. Although the large-scale rubber plantation brings wealth and thus improves the livelihoods, it also creates new more challenges, such as threats to biodiversity and regional climate, and has extensive linkages with land use, water contestation, household agriculture, wealth gap, etc.

Taking the rubber plantation in Xishuangbanna as a case, the paper aims to elucidate the existing model of decision-making on the environmental and sustainable development issues in the context of dynamic socio-technological-ecological process.

Base on the investigation, interview, field survey, and literature research, the paper aims to:

1. Explore the dynamics of farming system transition in Xishuangbanna, especially the dynamic interactions of technology, institution and local knowledge, and exposes the transition's environmental and social impacts.
2. Analysis how different institutions and groups understand these relevant issues such as biodiversity, to what extent they perceive the possibilities and risks raised by the new farming system and take response to the challenges respectively.
3. Address which planning priorities come to dominate and why, in the context of the political economy and spatial, local, national and international influences, and what the decisions was made.
4. Discuss an alternative pathway that could mitigate the rubber plantation's environment damage and meet the region's sustainable goals amidst dynamic ecologies and livelihoods system.

We now have the following interesting findings: (1) the sustainable development issues have a historical dimension, such kind of farming system transition have break the old harmonious co-existence between man and nature which has been lasted for hundreds of years, and haven't established a new balance between poverty reduction, environment protection, and maximizing the productivity of natural resources; (2)the development pathway is highly complex and dynamic characterized by evolution of society-technology-ecology, the environment sustainability has profound meanings to the livelihoods and well-beings for the poor and marginalized, and different groups have diverse understanding on the sustainability; (3) with the promotion of the supposed-mainstream "development", institution and politics has been the central topic for achieving sustainability, rather than the technology and model of knowledge.

### **Sustainability: system perspective in development paradigm**

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From Stockholm to Rio to Johannesburg world's summits, development and environment seeks always to find its harmonization. Between development deconstruction and reconstruction, intellectuals debate their visions to conserve the environment, henceforward new concepts are proposed including *sustainability*. Nowadays, sustainable development is one of the most controversial and paradoxical one. The purpose of this article is not to invoke further debate on sustainable development self-contradiction rather it's an attempt to reintroduce its environmental, economical and social dimensions in a way that establishes a new understanding of sustainability in order to meet the environmental concerns and development consequences.

In this work, we adopt a cross-discipline methodology that employs results from other scientific domains in particular, the field of systems theory. This methodology is used to examine the applicability of one of the system configurations in the study of sustainable development. This methodology enables the representation of the interaction between the different system components, e.g., environment, economy and society. We also use results from game theory, specifically Nash equilibrium, to deduct conclusions regarding the optimal strategy followed by the different decision makers in the different model components. In this paper, we argue that shifting the common understanding that 'the world is taken to be developed' to the idea 'that development is the process of intervention into the world' insures more sustainable future. On this base, we consider sustainable project implementations are 'adaptive and purpose-driven' plans whose survival and evolution depends on their ability to interact successfully and on a continual basis, with their surrounding environment.

### **Zoning of physical fragility in Permanent Preservation Areas: a tool for sustainable development**

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Defined by the Brazilian Forest Code, Federal Law No. 4771 (Brasil, 1965), and regulated by resolutions of the National Council of Environment (CONAMA) No. 302 (Brasil, 2002a) and No. 303 (Brasil, 2002b), the Permanent Preservation Areas must preserve their native vegetation and include, among other areas in the landscape: the marginal strips along water courses, around water springs, lakes, ponds and reservoirs, the tops of hills and mountains, ridge lines, and hillsides with steep slopes. The increase of disasters linked to soil erosion, mass movements and floods, visibly occurring in recent years in southeastern Brazil, can be a consequence not only of the higher rainfall observed, but also of the inadequate use of natural resources in areas considered for permanent preservation. The CONAMA Resolution No. 369 (Brasil, 2006), which represents a form of flexibility of the law, regarding the preservation of native vegetation, allowing its suppression and human intervention in the Permanent Preservation Areas in exceptional cases of public utility, social interest or low environmental impact, has generated discussions, especially regarding the subjectivity of the term «low impact», not measurable. Thus, according to Amaral (2010), the purpose of this study was to test a method of zoning the natural erosion susceptibility of Permanent Preservation Areas of the «Pariquera-Acu» quadrangle (1:50,000, SG.23-VA-IV-1), located between the coordinates 24° 30' and 24° 45' S and 47° 45' and 48 ° W, in southeastern Brazil, to present to the environmental authorities a model that can serve as a basis for further legislation, aimed at natural disaster reduction and mitigation of conflict between use and preservation of the Permanent Preservation Areas in the country. Using remote sensing and geographic information systems, a map in the scale of 1:50,000, of the Permanent Preservation Areas was generated, complying to CONAMA resolutions No. 302 and No. 303. To study the natural susceptibility to erosion were used 1:250,000 vector maps of physical factors: geology, soils and precipitation; combined with a raster slope map, with spatial resolution of 20 m. The weights of the different classes of these factors present in the study area were assigned according to Crepani et al. (2001). The weighting of the physical factors of environment and their importance in triggering erosion, was based on conversations with experts, literature searches and analysis of the distribution of different classes of these factors in the study area, with subsequent weighted linear combination of these factors. The resulting maps were reclassified, with classes of susceptibility to erosion, such as: Very Low, Low, Medium, High and Very High. Of the Permanent Preservation Areas (14,001ha), observed and defined in the study area, 68.1% showed High susceptibility to natural erosion, followed by Very high (25.7%) and Medium susceptibility (6.2%). Areas with Low or Very low natural susceptibility to erosion were not observed. The Permanent Preservation Areas along the watercourses showed 26.7% of their area classified as Very high susceptibility, being the category with the highest incidence of this class. The categories of Permanent Preservation Areas on the top of hills, mountains and ridge lines showed more than 99.0% of their areas with

natural susceptibility to erosion classified as High and Very High. Considering that the Permanent Preservation Areas of the study area proved to be naturally propitious to the triggering erosion processes and in order to contribute to the slowing of these processes, as well as to mitigate the negative impacts caused by them to surface water, the fish fauna and local residents in the watersheds of the study area, especially by the riverside, it is proposed that in all Permanent Preservation Areas from the study area, not covered with native vegetation, to conduct the natural regeneration of the vegetation and, where necessary, restoration of the degraded areas and the restoration of native vegetation. In Permanent Preservation Areas with Very high natural susceptibility to erosion natural ecosystems should be restored, with the barring of human activities. Considering the possibility of using the Permanent Preservation Areas by activities of low environmental impact and social interest, as described in CONAMA Resolution No. 369, in Permanent Preservation Areas with High natural susceptibility to erosion, the proposal is to make viable Sustainable Forest Management, through a management plan, allowing the removal of trees and sustainable non-timber forest products (seeds, fruits, oils, honey, among others), bringing more income especially to small farms. As for the Permanent Preservation Areas with Medium natural susceptibility to erosion, we recommend the establishment of Agroforestry Systems, a consortium of fruit tree species and/or timber with agricultural crops or livestock, simultaneously or sequentially. This type of human intervention promotes an ecological and economic interaction in these areas, provided the management practice is of minimum tillage and that extraction, where possible, occurs by manual means and minimum use of chemicals. As exemplified by the case study, it is believed that regional zoning, as well as all other technical and scientific knowledge, should be used by the environmental authorities, to support, among other challenges to the country's sustainable development, the best indication of land uses so as to have the least environmental impact on the Permanent Preservation Areas and its watershed.

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## Community Based Organisation (CBO) Needs Assessment

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In rural area of Togo and West Africa french speaking countries, Community based organisations (CBO) play a main function in nature conservation (sustainable land use, innovative land management ...), community resources mobilisation, poverty alleviation and sustainable development in local level. How to connect local institutions action and stakeholder engagement – often referred to as community-based approaches – to regional and national strategies and policies remains a challenge. The involvement of local people has various advantages over a top-down approach such as the inclusion of local knowledge, and generating greater support and understanding for sustainable natural resource management, rural development, nature conservation and other fields. Local action generally happens as a collective effort. The groups that form are made up of individuals with different interests and backgrounds. Collaborative groups have become vital elements of many governance systems around environmental issues.

However, if their efforts are not based on local realities and coordinated to contribute to a bigger whole there is a risk of duplication or contradiction of activities. Hence, an entity is required which can be termed a CBO. CBO can take various forms and functions. They are rarely government-based but maintain contacts to agency staff, authorities and other stakeholders. CBO 'translate' regional and national policies for local groups and ensure that local action, knowledge and needs are taken into account at higher levels.

The track will discuss the characteristics, functions and context of CBO as an institutional arrangement and whether they are able to institutionalize a new sense of collective responsibility for sustainable development.

- a) How do CBO assess their needs? How do CBO function internally? How do they develop their objectives, strategies and funding? How do they bridge the differences between the (various) local groups they are in contact with?
- b) External effects of CBO: What are the interactive structures and processes they utilize? How do they influence policy and decision making at regional and national levels? How do they impact on local groups?
- c) Evaluation: How do CBO evaluate their own activities? How do local groups perceive them and what is government's reaction to such organizations? Is power devolved as easily as responsibility for delivering outcomes? What are the keys to successful establishment and functioning?

## **Importance of Social Dimension of Sustainable Development - Examples from Africa, Middle East, Asia, and Eastern Europe**

Victoria A. Bakhtina

Sustainable development entails a harmonious balance of the three components – economic, social, and environmental. Global analysis of integrated characteristics of sustainable development and composite indices which incorporate each of the three components, may successfully be utilized by decision-makers on a country level, by means of screening weak links in each of the three domains, and addressing specific areas of vulnerability. Analysis of over one hundred twenty countries from Africa, Middle East, Asia, and Eastern Europe demonstrated that quality of life and resilience to global risks are higher for the countries with better-developed social domain, and therefore, a social component is becoming a defining priority of sustainable development. Comparative analysis of countries from various continents demonstrated how a good standing in social sphere could make a difference for the countries with similar characteristics.

## **Sharing Tools to Fight Climate Change and Biodiversity Loss Across Islands - Island Communication Toolkit**

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Small Island Developing States (SIDS) are especially vulnerable to the impacts of climate change. Their ecosystems and their communities will experience its impacts first and fastest presenting a global challenge to mitigate adverse impacts. To meet this challenge immediate actions are required. SIDS governments need to be proactive in all areas from enacting legislation to climate-proofing infrastructure. To achieve this requires focused efforts to promote the proactive actions and resulting good practices of SIDS as well as to share successful strategies that raise public awareness and stimulate behavior change of SIDS communities. Promoting innovation for climate change mitigation and adaptation is made difficult in SIDS by isolation and limited resources. For this reason, leaders need to inspire each other's actions and communities to share practices and locate the tools that they can use to develop their capacity to prepare themselves for the future.

Under the Convention on Biological Diversity (CBD), the relationship between climate change and biodiversity is a key cross-cutting issue that is of particular relevance for island ecosystems. This is why, with the financial support of the government of the Netherlands, and in partnership with the Global Island Partnership (GLISPA), the Commission on Education and Communication (CEC) of the International Union for Conservation of Nature (IUCN) and others, the Secretariat of the CBD is developing a toolkit to demonstrate the valuable role communications plays in mitigating climate change and biodiversity loss and share best practice examples communication strategies and campaigns from, and relevant to, SIDS.

The Island Communication Toolkit supports the implementation of Convention on Biological Diversity article 13 on communication, education and public awareness and Decisions VIII/6 and IX/32. It also responds to CBD COP decisions related to the Island Program of Work including Decision IX/21.

The toolkit will further aim to facilitate the implementation of the mission of GLISPA of promoting actions for island conservation and sustainable livelihoods. In particular, it will provide organization models, conceptual maps, communications frameworks and awareness tools to inspire leadership, catalyze commitments, and facilitate collaboration among islands. A number of websites exist that are focused on SIDS, climate change, conservation of biodiversity and/or communication strategies. Assessment of these existing platforms reveals that a gap exists to demonstrate how to use communication strategies to inspire and recognize leadership and commitments to action for island conservation and sustainable livelihoods and to create awareness and stimulate behavior change in the public by providing a tool that showcases best practice examples from, and relevant to islands.

## Sustainability policies: Insights from Neuroeconomics

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Recently, models on human decision making have been enriched by an additional perspective, namely the emerging interdisciplinary field of neuroeconomics (Camerer, Loewenstein, & Prelec, 2005). Neuroeconomics combines methods from neuroscience and experimental economics and analyzes subjects' brain activity during various decision making tasks. Pertinent results are already applied to different fields of research, e.g. organizational behavior, entrepreneurship, conflict management (Stanton, Day, & Welpe, 2010) or consumer research (Hubert, 2010). However, no attempt has been made so far to integrate these insights into the study of sustainable development.

Now, what can policy makers, institutions and governing structures learn from neuroeconomics? In our view, the benefit of these new insights is at least twofold: Firstly, decision making processes in institutions and decisions by policy makers can profit from a better understanding of potential biases inherent in human decision makers. Secondly, decisions by households and individuals with regards to sustainability measures can be analyzed more profoundly if the neural basis of their behavior is known. This poster identifies neuroeconomic findings which have the potential to inform the study of (un) sustainable behaviors and discusses how these findings can be helpful for environmental policy.

Neuroeconomic studies for the most part support findings from behavioral economics. People tend to behave like rational and utility-maximizing agents only in very simple, often instinct-driven situations (Camerer, et al., 2005). As the human brain has limited capacity of attention and consciousness, it constantly strives to save resources; e.g. by relying on habits and routines, pursuing a satisfying strategy rather than an optimizing strategy, applying heuristics and imitating the behaviors of others (McKenzie, Zak, & Turner, 2010). Moreover, neuroscientific research confirms that neural circuits underlying affective and cognitive processes extensively interact in all kinds of behavior; decision making presents a dynamic process comprising many feedback-loops before the rational system even becomes engaged. Humans sub-consciously rely on mental shortcuts underwritten by an emotional system when making decisions instead of carefully weighing and evaluating all available options (De Martino, Kumaran, Seymour, & J. Dolan, 2006) and are thus susceptible to various 'behavioral anomalies' such as loss aversion, endowment effects and framing effects. Neuroeconomic results can provide some important implications for policy makers with regards to sustainability measures:

The cognitive system has only limited resources for information processing; it experiences a diminishing return from an increase in information. Hence, although there seems to be a focus on educating consumers about environmental impacts of consumption in policy design, promoting less resource-intensive lifestyles cannot simply rely on increased information supply (see also Gigerenzer & Goldstein, 1996).

Neuroeconomic research has shown that money could be directly rewarding and provide more than a mere indirect utility. On the other hand, loss of money – respectively 'paying' – seems to be directly unpleasant and painful which might explain the effect that payment-neutral pricing schemes have on choices (Camerer, et al., 2005).

The evaluation and choice of risky alternatives involve an interplay of cognitive and emotional processes (Bechara, Damasio, Tranel, & Damasio, 1997; Weber & Johnson, 2009). Risk-taking behavior is not stable across situations but varies with decision context and is governed by inter-individual differences (Polezzi, Sartori, Rumiati, Vidotto, & Daum, 2010). Neuroeconomic findings also suggest that choice situations characterized by either risk or ambiguity lead to different reactions on both the behavioral and neural level (Hsu, Bhatt, Adolphs, Tranel, & Camerer, 2005). The affective component in the evaluation of risk therefore is relevant for understanding the fickleness of public responses to environmental threats such as climate change.

Habits often explain the persistence of unsustainable behaviors. From a neuroscientific point of view, habits fulfill a useful purpose: By drawing on well established neural circuits our brain saves energy for other, possibly more important, deliberative tasks (McKenzie, et al., 2010). Once some kind of activity has become well established in neural circuits, it becomes complicated to rebuild these circuits (Yin & Knowlton, 2006). Thus we have to consider the existence of some kind of 'neural cost barrier': Behaviour change is costly as it requires additional energy compared to just retaining the same habitual behavior.

Social influence has as well to be considered as a driving factor since many decisions are made in a social context. Human brains obviously are not 'designed' for independent decision making; our brain architecture fosters imitation (Keysers & Fadiga, 2008), alignment of preferences (Mason, Dyer, & Norton, 2009), alignment of perceptions (Berns, et al., 2005), as well as norm compliance and reciprocity (Spitzer, Fischbacher, Herrnberger, Grön, & Fehr, 2007). Hence decisions made by others and behaviors of others as well as contextual factors crucially bias individual decisions (Sanfey, 2007).

Despite neuroeconomics being a young field with certain technological and methodical limitations we consider it worthwhile to continue monitoring respective studies. After careful and critical review of the literature we safely can claim that neuroeconomics already is providing some and probably will offer more important pieces for the puzzle of sustainable behaviors. Policy makers ought not to ignore existing insights. First and foremost, results from neuroeconomics provide strong evidence against rational actor models and in further consequence challenge popular assumptions as for instance utility maximizing households. In fact, our neurological heritage sometimes simply prevents us from deciding purely rationally. For this reason policies based on rational actor models are likely to fail when it comes to the prediction of households' reactions to certain sustainability measures. Regarding future studies we especially expect insights for the driving forces of individual behaviors and the complex interplay of behavioral influences in order to assist environmental policy in designing policies and incentives to foster sustainable consumption and production.

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## Participation and Transdisciplinarity: A means to engage diverse communities in resilient decision making?

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Transdisciplinarity is an emerging discipline which has, as a central requirement, the need for multi-disciplinary groups to contribute in sharing and understanding in problem solving teams so as to arrive at sustainable solutions. The need for participatory approaches to analysing complexity and deriving suitable interventions is not a new concept, and the participatory literature is rich with examples of such collaboration. However, as yet, there has been little attempt within the transdisciplinary or sustainability literature to draw out lessons from this wider body of published work or to learn from the key lessons contained within it. Questions such as:

- Or/and, does TP have unique issues over other forms of participation?
- Is participation arising from such mixed groups easier or more difficult than other forms?
- Do specific qualities emerge from the work of such TP groups?

And critically: *Is Transdisciplinarity a unique and purposeful route for resilient participatory decision making of all kinds?*

These questions are addressed by the paper which draws upon an extensive literature review into participation and linked to the participatory experiences gained from working with a series of Transdisciplinary groups in 5 countries as part of the EU Framework 7 funded project – Policy Use of Indicators (POINT).

## Using Life Cycle Assessment (LCA) to Assess the Sustainability of Urban Wastewater Treatment Systems in Bogota

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Engineering solutions has often been described to be vital to solving environmental, sanitation and health quality problems. Conventional centralized wastewater treatment plants (WWTP) have been sort to bring about the much needed solutions related with emerging municipal wastewater management problems and social pressure (sanitation and protection of the aquatic ecosystem) in the cities of developing countries. However, the adaptability of these technologies to both the socio-ecological system and the technologies' flexibility to accommodate changes and uncertainties now defines their sustainability. Sustainability, therefore, "challenges us to reflect on wastewater treatment differently" (Balkema et al., 2002).

This study evaluates the sustainability and adaptive capacity of the El Salitre WWTP in Bogota. The plant, with an average treatment flow capacity of 4m<sup>3</sup>/s, is the first component of the sanitation scheme for the Bogota River treating domestic wastewater from approximately 2.2 million inhabitants corresponding to about 30% of the total population of the capital city. Traditionally, environmental impact assessment (EIA), is the decision making tool which has been used to evaluate the sustainability of development plans in Colombia including the sustainability of wastewater treatment systems, to foresee impacts and to provide strategic decision support (Toro et al., 2009).

Life Cycle Assessment (LCA) methodology based on selected sustainable development indicators (SDIs) was applied in this research to assess the environmental impact of the operational phase of the WWTP as a means of providing opportunities for innovative processes and learning purposes for the much needed adaptability. Although both LCA and EIA have the same basic purpose of supporting decision making on the environmental aspects of a major project (see Palme, 2010 and Singh et al., 2009) their differences gives LCA an edge as it overcomes the weaknesses of EIA to easily address global and regional environmental effects along the life cycle of the product (Manuilova et al., 2009).

Despite this obvious advantage, the identified impacts in a LCA study are tied only to the product function and not specifically to where the impacts occur, making it site-independent (Ness et al., 2007). Another limitation of a complete LCA is that it requires a large quantity of data which results in loss of insight into relevant emissions when data are aggregated into standardized environmental impact categories. Furthermore, additional indicators are needed to measure sustainability as LCA limits itself to a restricted set of technical and environmental aspects (Balkema et al., 2002).

In the light of these obvious needs, this study incorporated the life cycle method on important SDIs with particular emphasis on sustainability, efficiency, overall performance and adaptability of the operational phase of the El Salitre watershed WWTP to provide answers to the research question: what is the sustainability and adaptive capacity of the El Salitre WWTP in Bogota city in the pursuit towards sustainability in the urban ecological system? This study is of particular importance given that many of Colombia's urban wastewater treatment plants have been evaluated to be in poor operating condition (Arias and Brown, 2009; Blackman, 2009) and therefore provides an alternative to their assessment and process improvement.

Sustainability Indicators based on the LCA procedure has been used to evaluate urban wastewater systems in various countries both at small and large scales (see Morrison et al., 2001; Lundin and Morrison, 2002; Muga and Mihelcic, 2008; Pasqualino et al., 2009; Foley et al, 2010) mainly as a procedure for assessing their environmental sustainability and identification of improvement alternatives. The evaluation of the sustainability of wastewater systems based on the concept of sustainable development is proposed as another approach other than the predominant EIA tool commonly used in the country.

Understanding impact to mean the multiple and ripple effects that the function of any technological system has on the environmental, economic and socio-cultural aspects of ecological systems, a set of 4 SDI categories were developed to investigate the overall sustainability of the El Salitre WWTP: functional, environmental, economic and socio-cultural indicators. Results from the selected SDIs were used as basis to evaluate the total environmental impact in both the water and sludge treatment lines and as such enabling the identification of the stages where improvements were needed. Data was collected from the Bogota Water and Sewage Company (*Empresa de Acueducto y Alantarillado de Bogotá*, EAAB) database - the operators of the wastewater treatment plant, literature and public databases based on the indicator categories from the year 2004 to 2010.

The functional indicators applied were effectiveness (the minimal technical requirements and influent-effluent quality), efficiency (pollutants removal capacity), adaptability (possibility to extend the system in capacity or with additional



treatment), flexibility (ability to cope with fluctuations in the influent), maintenance required, and reliability (sensitivity of the system to malfunctioning of equipment and instrumentation). The environmental indicators used included effluent quality, sludge quality, global warming potential (GWP) from gaseous emissions, nuisance and public health risk. Cost effectiveness (total, operational, maintenance and energy costs per volume of wastewater treated) and affordability (capital cost) were used as the economic indicators while aesthetics, public participation with regards to the stimulation of sustainable behavior by increasing the end-user's awareness, community participation evaluated by number of visits to the plant and expertise (level of education) were the socio-cultural indicators.

The inventory results showed that the plants efficiencies of TSS and BOD removal meet the plants objectives (60% and 41%) but low with regards to chemical oxygen demand (COD), total nitrogen (TN), total phosphorus (TP) and total coliform removal respectively (44%, 8%, 39%, 55%). As such the effluent quality would potentially contribute to the eutrophication of the local receiving water. Climate and ecosystem influence affects the adaptability and flexibility of the plant during wet weather flow while nuisance from odor and aesthetics from the plant's operations and biosolid disposal was minimal.

Phosphorus and nitrogen recycling through the reuse of biosolids applied for land recovery provides an opportunity for resource recovery. However, the environmental trade-off of increasing heavy metal discharged to soil, especially given the high value of cadmium (Cd) and copper (Cu) - 156 kg Cd/d and 27 kg/d, calls for further studies to be carried out. The cost effectiveness and affordability of the operation and maintenance cost per volume of wastewater treated and the transportation cost per kilogram of solid generated was high. Favorable results were obtained when considering the socio-cultural impacts of the plant. Target plots showed that the plant has a varying degree of sustainability and adaptation capacity and improvements needs to be made in all the 4 indicators categories. More life cycle impact assessment is also needed to evaluate the use of the biosolid for agricultural application.

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## Minimizing Water Risk for Business: Decision Support Tool in a Climate of Uncertainty

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*Background & Objective:* Global water scarcity is an emerging risk that many companies are now aware of. With freshwater supplies tightening due to population growth, overuse and more variable and weather patterns, businesses globally are coming under intense pressure to measure and cut water use. Traditionally, calculations of how much water a business uses have been based on the quantities used directly in producing that company's products (also called water footprint or WF). In recent years, businesses have been encouraged to look at their water use more comprehensively and investigate not only the direct operational water use but the indirect supply chain water use and impacts as well (see the conceptual diagram on the right in Figure 1). In a recent global survey of large corporations by the UK nonprofit Carbon Disclosure Project (2010), 50% of the 175 respondents viewed water as a "significant" risk affecting business.

Addressed within the context of the local watersheds, upstream business risks are commonly centered on the question of whether or not a company can expect to have sufficient supplies of clean water in the future for continued operation. This can be influenced by growing water scarcity, increasing competition for water resources, drought, climate variability, water pollution, infrastructure failure, poorly managed water allocation systems, ineffective public sector management capacity, insufficient water resource management policy and other factors (TNC, 2010). The downstream business impacts stem from the fact that a company's water use and wastewater treatment practices may impact other water users and stakeholders. When water resources are adversely affected by the cumulative impacts from multiple uses, whether those impacts are a result of a company's use, real or perceived, the resulting pressures can directly threaten a company's production levels, profit margins, and even "license to operate" in water-stressed areas. Often times, the resulting litigation, regulatory or socio-political reactions can trigger increased water acquisition and treatment costs, reduced water supply, more stringent wastewater treatment requirements, riskier infrastructure planning and capital investments and community opposition. In rare cases, the business may be shut down by the local government or may otherwise no longer be viable and voluntarily shut down (TNC, 2010).

Several global tools and indicators are in place to determine the corporation's water risk profile. The weighting factor associated with each indicator can usually be tailored depending on the influence it has on the overall risk. While largely useful, it has been reiterated of late that the method of aggregating the indices into a single water footprint/risk score is of little material value (CDP, 2010). In this study, we demonstrate a prototype decision-making tool for industries to quantify water risk and uncertainty in a probabilistic Bayesian framework. In a probabilistic framework, the "risks" can be defined in terms of "cost" (what is the probability of increased effluent treatment costs to maintain the standards for water quality downstream in case a flooding occurs upstream); "disruption" (what is the probability of increased storage costs due to inter and intra annual variability in rainfall); or "access constraints" (what is the probability of increase in the cost of a product or supply disruption due to impact of severe weather events on agricultural yields). The Bayesian network (BN) induces a causal structure across the various risk indices, which allows the industries to compute the probability of risks instead of a single weighted average. In each case, the goal is to reduce the risk to a level that is acceptable by all the stakeholders in the process.

*Methodological Design & Approach:* Figure 1 provides the methodological framework for risk assessment. The primary objective is focused on the following key questions:

1. *How much would an external change in water availability/use impact the current business use in its operations & supply chains?*
2. *What is the likelihood/probability of change in water quantity, quality, and prices? How does climate variability & change act as a driver/stressor for change?*
3. *What are the problem hotspots and best alternatives for water sourcing?*

A probable BN for assessing the water risks is demonstrated in Figure 2. A complete BN will allow the computation and evaluation of the costs, benefits, and risks associated with the management options. While reduction of water use and minimization of risks is a clear goal, sometimes the most appropriate response actions may not always involve reduction of the water footprint. In many cases, policy and 3 regulatory engagement to manage the shared resource within a watershed may be a more appropriate response. Ultimately decision makers are presented with a probability of success (or failure) of each management option and can make decisions which have a highly probability of success for all stakeholders.

*Implications & Conclusions:* When faced with a supply chain disruption, proactive and reactive supply chain risk management can make or break a company's existence. The loss of a single critical supplier in this supply chain-reliant environment can have a devastating impact on a company. The decision tool demonstrated here illustrates a means for modeling the uncertainty and probability of complex water risks in the industries operations as well as supply chain. The clear choice of management alternatives that results increases the probability that water risks to business, suppliers and infrastructures are minimized based on all the available data and information relevant to the problem at hand. In addition, this will help the corporations in future planning and location of their businesses/operations and for targeting alternative sources for its raw materials and products.

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## Towards a National Integrated Coastal Management Policy for Vietnam

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The world coastal zones are among the most heavily exploited areas because of their rich biological resources. It is estimated that more than half of the world population live within 100km of the shoreline (Chua, 2006). Consequently, there arise conflicts between resources utilization and the need to ensure long-term supply of these resources. In some regions, these conflicts have become so severe with large part of coastal zone polluted, fisheries severely degraded, coral reefs destroyed and natural disasters frequently occurred (COBSEA, 2009). Recognizing these threats, the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro proposed guidelines on Integrated Coastal Management (ICM) to minimize conflicts and promote sustainable resource use.

In the last decade, Vietnam Government has paid increasing attention to ICM and considered it as a main management tool for sustainable development of its coasts and oceans (Nguyen, 2009b). Vietnam is a major marine nation in Southeast Asia. Locating at eastern coast of Indochina Peninsular surrounded by South China Sea, Vietnam has a very long coastline of about 3,260 km with more than 3,000 islands (Nguyen, 2009a). Vietnam's coastal and marine areas are very rich in biodiversity. There are about 11,000 species of marine animals, plants and seabirds recorded so far. Vietnam coastal areas also have many valuable ecosystems such as 110,680 ha of mangrove forest, 108,500 ha of coastal wetland, 7,532 ha of coral reef and 4,600 ha of seagrass (NEA, 2005).

Vietnam's coast is one of the most densely populated regions in South East Asia and as a consequence, the area has been being exploited heavily. Administratively, Vietnam has 28 coastal provinces and over 125 coastal districts. Thirty one percent of total population (25 millions) locate in coastal areas and have their livelihoods depending on coastal and marine resources generating more than 80% of the nation's wealth (Le et al., 2008). The development of industrial activities, tourism, aquaculture, agriculture, port and shipping has generally been concentrated in the coastal areas. The marine and coastal zone of Vietnam currently contributes up to 48% of GDP (VNICZM, 2006).

However, the increasing trend of coastal development poses great threats to coastal ecosystems. Vietnam is facing many obstacles for coastal and marine sustainable development such as overfishing, biodiversity loss, destroyed and degraded habitats and ecosystems, polluted coastal environments, natural hazards, frequent oil spills and severe impacts of climate change. Vietnam has lost more than 80 percent of its mangrove forests due to high demand in shrimp farming development. It was estimated that the annual loss in terms of forgone benefits of mangrove functions (e.g. fishery, forestry, and erosion) could be in the range of US\$ 10-32 million per year (MONRE, 2002). Sea grass areas continue to be degraded and reduced in total area. Sixty three percent (6,774 ha) of sea grass area has been lost since 1997 (VNICZM, 2006). Ninety six percent of Vietnam's reefs are severely threatened by human activities, of which 75 percent is extremely threatened (Vo, 2005).

With all of the above-mentioned problems, it is required to have more appropriate approaches for coastal and marine management, especially for development of policies at national level and policy implementation at local level. Several pilot integrated coastal management (ICM) projects have been conducted in coastal areas of Vietnam in the last decade resulting in significant outcome. In 2008, recognizing the importance of managing marine and coastal area in an integrated manner, Vietnam government established Vietnam Administration of Seas and Islands (VASI) with the function of integrated and unified management for seas, coasts and islands in Vietnam. Vietnam government has also approved and enacted some policies and laws related to ICM. Especially, the Governmental Decree No.25/2009/ND-CP on Integrated Marine Resources Management and Environmental Protection dated 6 March 2009 is the first integrated governance policy for coasts, seas and islands in Vietnam. The Law of Marine Resources and Environment Protection and Law of ICM are in process of preparation (Nguyen, 2009b). National program on "ICM in 14 coastal provinces in central Vietnam toward year 2010 and vision to 2020" has also been implemented since 2008 (Nguyen, 2009a).

With the establishment of VASI and ongoing developing of ICM policies, it opens a promising future for ocean and coastal management in Vietnam. However, learning from all pilot ICM projects in the past, in order to make this arrangement and mechanism work effectively, a number of considerations should be taken into account.

First, the sustainable development of the seas and coastal area should be linked with poverty reduction of coastal local communities. This is believed to be crucial to sustainability of any management mechanisms (Nguyen, 2009a).

Capacity building should be considered as one of the most important factor in the successful implementation of ICM. Education and training activities associated with ICM must be extremely varied to match both the existing capacity of any stakeholders and also the role that it plays within ICM (Hills et al., 2006).

Public awareness plays a very importance role in ICM effort. Creating public awareness should be a continuous process

in ICM implementation to generate support, raise environmental awareness and promote civil advocacy for environmental protection and sustainable development (Chua, 1993).

Sustainable financing mechanism is widely discussed as a major challenge for many ICM programs. The lack of financial resources available for ICM affects the sustainability of the ICM process (Milne et al., 2005; Christie, 2005). In order to ensure the sustainability of ICM effort, it is important to formulate financial schemes, identify, secure and distribute funds to facilitate ICM since planning stage.

Community-based management is quite successful in the context of Vietnam (Ruddle, 2005). According to Chua (2006), the effectiveness and sustainability of community-based management increase if implemented within the framework of ICM. This, in a way, helps ensure the success of ICM effort.

Lastly, an integrated and systematic information system will also affect the success of ICM effort (Chua, 2006). In Vietnam, it is still lack of a unified and systematic information management. This creates obstacles for policy-makers, practitioners, scientists as well as community when discussing and solving the complex problems of coastal and marine management.

In conclusion, Vietnam has experienced rapid growth in coastal area recently. Together with economic developments, it also brings many problems relating to ecosystems and environment. As an effort to balance economic growth and environmental protection, Vietnam government has formulated many policies and conducted institutional rearrangement to meet the need of current coastal management issues. However, in order to sustain the ICM approach, many factors should be carefully considered such as the financing scheme, public awareness raising, capacity building and integrated information system. Although there exist many challenges for Vietnam, scaling up ICM and making ICM a national policy are believed to contribute to sustainable development of Vietnam. The needs for more research of ICM to localize the approach and make it suitable and compatible to present situations of Vietnam are urgent.

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## **Governance through assessment - developing a tool for assessing the sustainability of urban scenarios and plan and promoting a more sustainability-oriented urban planning and governance**

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This abstract presents ongoing development of a qualitative sustainability assessment tool for urban developments. The aims of the paper-to-be are to:

- Present the results from a literature review and synthesis of existing frameworks, goals, and indicators for sustainable urban development.

- Develop a systematically consistent qualitative tool to assess the sustainability of scenarios, long term plans and visions of urban development, with a focus on developments at the scale of city districts.
- Explore how such a tool can be used to promote a more sustainability-oriented urban planning and governance.

A great variety of quantitative assessment methods and indicator systems exist. So why develop another one? Drawing on Holman (2009) and Tanguay et al. (2010), together with preliminary findings from the literature review, there are two main aspects distinguishing the tool we are developing from other approaches:

Firstly, this tool is developed to be systematically consistent. Through a content analysis of the examined literature it was shown that many of the conceptual systems mix concepts and indicators for Drivers, Pressures, States, Impacts and Responses (EEA, 1999) in unclear ways, and seemingly without reflection or argument for doing so. This inconsistency has also been pointed out by others (see e.g. Tanguay et al., 2010). For the purpose of assessing the potential outcome of scenarios the tool needs to stringently distinguish between what is impacted according to the scenario and what can be done to abate, mitigate or compensate these impacts. Also the initial state of the city district needs to be included. Thus, Drivers, Pressures and States are included as part of the analysis to understand the initial (non-sustainable) state of the city district; the Impacts are the Impact on different aspects of sustainability; and the Responses are the measures available to the stakeholders of the scenario to remedy, improve or retain sustainability.

Secondly, the inclusion of a governance perspective in sustainability assessments is a rather new phenomenon, as distinguished from other approaches focusing on either how to optimize the indicators from a scientific/technocratic perspective, or on how sustainability assessments can contribute to 'soft values' such as social capital (Holman, 2009). To take on this dimension of governance the tool includes an approach for identifying the stakeholders needed to abate or mitigate negative impacts, or that could create positive effects. Being aimed at contributing to a more sustainability-oriented planning and governance, the tool is also developed to be suitable for a participatory setting. Using the tool in a participatory setting holds the potential of planners, policy-makers and other stakeholders to gain increased awareness of the complex and contested nature of sustainable development and could also lead to an increased legitimacy of the process and outcome as such (Hajer & Wagenaar, 2003). However, an instrumentally or normatively good process does not necessarily lead to good (sustainable) outcomes (Larsen & Gunnarsson-Östling, 2009). There are many examples of planning processes in which the strive for 'consensus' have made conflicts - between different interpretations of sustainability or between sustainability and other interests - to be disregarded rather than raised. And since both ecological and social sustainability traditionally has a discursively weak position in relation to economic growth these are the ones who typically get neglected (Dovlén, 2005; Lundqvist 2004). The tool presented here is developed from an understanding of sustainability adhering to what is commonly denoted strong sustainability, in difference to the weak sustainability's idea of ecological modernization. Thus the tool also aims at strengthening ecological and social sustainability in relation to economic growth.

With the aim of systematic consistency in view the tool is based on a conceptual model of sustainability comprising four interrelated system levels, further described in the following. When developing this model an assessment tool developed at ETH, Zürich was used as starting-point. This is reported in e.g. Hugentobler & Lütolf (2006).

Ecological sustainability is understood as the sustainability of the Bio-geo-chemical systems comprising the base for all human activities. Social sustainability is divided into two dimensions: *Human individual*, and *Human socio-cultural*. The 'individual' dimension comprise culturally independent aspects such as health, nourishment, reproduction, shelter, sense of belonging, social justice, equity, ability to prosper etc. In this dimension is said nothing about how these needs are met. This issue is instead the focus of the 'socio-cultural' dimension. In this way the tool enables assessing also socio-culturally or politically radical changes in a way that distinguish between whether the consequences concern more basic needs, or rather the way we have learned to fulfill them. Another reason to distinguish between social sustainability at the individual and societal level is to enable including also conflicts between these, such as in the case of (societal) negative social capital or for addressing environmental justice. Economic sustainability is understood as being mainly relevant in terms of its capability of supporting or conflicting with ecological and social sustainability. Together with institutions, technologies and infrastructures, these facilitating systems are allocated to *Societal facilitating systems*.

Thus, the four system levels are:

- Societal facilitating systems
  - o formal institutions, economy, technology, infrastructures
- Human socio-cultural (culturally dependent)
  - o informal institutions, social practices, norms, values, habits
- Human individual (culturally independent)
  - o health & wellbeing
  - o household functions (personal, residence, food, care, common, supply, see Höjer et al., 2011)

- Bio-geo-chemical systems
  - biodiversity, bio-geo-chemical processes, natural habitats, ecological resilience etcetera.

The tool itself is outlined as a matrix, which unfortunately could not be included in this abstract. Instead we refer to the research project's home page ([www.kth.se/abe/forskning/sitcit](http://www.kth.se/abe/forskning/sitcit)) where a version of this abstract including the table can be downloaded. The abovementioned four system levels make up the vertical axis of matrix. To each of these system levels there are number of generic aspects further concretizing the content of that system level. As aforementioned these aspects are delimited to aspects indicating WHAT is influenced and will be identified through examining and synthesizing relevant literature.

The next two columns comprise the scenario (or plan) specific part of the assessment tool. In the column named "What" the question of what is influenced can be made even more specific. In the column named "Who" this is combined with the question of which stakeholders need to be involved in order to prevent, mitigate or compensate degradation. Through this iteration between what and who the sustainability assessment becomes connected to governance in a natural way. This way of doing an issue-driven, bottom-up stakeholder analysis can also be used as an approach to more consciously create the governance network of an urban development project. This way of network design is one of four meta-governing techniques defined by Sehested (2009), the other being network framing (i.e. agenda setting), network management (facilitation), and network participation in which the meta-governor steps in as a participant in the network. Meta-governance has been described as a way of indirect steering, a way for public authorities to keep at least some control of the fragmented governance system (ibid.). The tool presented here enables the use all of these techniques.

Future research comprises putting together lists of generic aspects for each of the system levels. This will be done through further examination of the literature. For further input and for synthesizing findings focus groups will be used. The tool will then be tested and evaluated in an ongoing scenario study of more sustainable Stockholm City Districts and also in a planned urban development project in France.

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# The role of education and universities in sustainable development

Margien Bootsma & Paul Burger

## Oral Presentations

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### **Pedagogical Challenges and Opportunities for the Promotion of Sustainable Environmental Design in Higher Education**

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Education for sustainable development is an emerging imperative, requiring a significant shift in the way in which younger generations are taught within academic institutions. The UN Decade of Education for Sustainable Development calls for Universities to «function as places of research and learning for sustainable development» (UNESCO, 2009). Education can play a fundamental role in both raising awareness amongst students and giving them the knowledge and abilities to put sustainability into practice. To this aim, priority should be given to the development of sustainability literacy as a 'core competence' amongst graduates. Pedagogical methods should move away from 'reductionist' approaches towards fostering critical and holistic thinking, lifelong learning and making multidisciplinary and systemic connections between disparate cognitive domains (HEA, 2005).

Nevertheless, several misconceptions hinder the achievement of such objectives, starting from misleading terminology that is often «attached» to courses in higher education, without being ascribed a precise meaning. The much abused term *sustainability* has indeed to go beyond the natural environment alone, embracing at once several aspects of human activity that include economic, social, cultural, ethical and aesthetic values in addition to the technical issues of energy consumption, resource management and CO<sub>2</sub> emissions, so as to ensure that tomorrow's generations will be able to satisfy their needs at least at the same level of today (WCED, 1987).

In the field of the built environment, awareness of the role that buildings play in the current climate crisis is bringing to the fore new responsibilities for educators and practitioners. Buildings are nowadays responsible for more than half of the energy consumption worldwide, significantly contributing to the causes of climate change. Yet, regardless of the great corpus of knowledge produced by scholarly research in architectural and engineering education, several barriers still hinder the comprehensive incorporation of environmental sustainability in academic curricula. Concurrently, the promotion of principles of sustainable design in practice is not yet consistently supported by professional bodies, whose prescription criteria are frequently characterised by ambiguous requirements, especially in ascertaining an effective integration between creative and technical skills. As a consequence, a substantial advancement in pre- and post-professional education is needed to facilitate knowledge transfer between theoretical sciences and exploratory applications and enhance the implementation of sustainable practices within an imaginative design discourse (Altomonte, 2009).

A global review of pedagogical developments, however, highlights that the promotion of sustainability in higher education is a theme that sits at the core of the activities of many academic institutions. Amongst these efforts, EDUCATE (*Environmental Design in University Curricula and Architectural Training in Europe*, [www.educate-sustainability.eu](http://www.educate-sustainability.eu)) is a project – coordinated by the author – funded by the European Commission (EACI, Intelligent Energy Europe 2008) to promote the integration of sustainable environmental design in the education and practice of architecture.

Building on the analysis of the state of the art of architectural pedagogies and on the exploration of multidisciplinary contributions to curriculum development, EDUCATE aims to foster skills in sustainable design at all stages of higher and professional education and, in partnership with regulatory bodies, to benchmark the level of knowledge, skill and competence of environmental sustainability expected of graduates and practitioners of the built environment.

Currently in its mid-term over a total duration of three years, EDUCATE has recently published a “Framework for Curriculum Development” with the objective to offer an underlying conceptual support to programme design and development that promotes the successful integration of sustainable environmental design in higher and professional education. The document is not intended to define a *prototypical* curriculum, but rather to provide guidelines in curricular

advancement, yet maintaining sufficient flexibility for them to be adapted to a diversity of contexts, pedagogical systems and approaches, environmental targets, and therefore to be applied to different educational structures and organisations (EDUCATE, 2011).

The “Framework for Curriculum Development” is based on a mission agenda, where sustainability is seen as a priority in the education of building practitioners from the beginning of their studies. This requires that academic institutions and professional bodies are all fully committed to this priority, enthusing and inspiring students to the mandates of sustainable development through appropriate pedagogical methods, tools and techniques and the allocation of adequate research, human, financial and temporal resources. Education for sustainable development must encourage critical awareness and reflection on the numerous interdependencies within cognitive domains and support investigative discourse between the various parties and professions involved, continuously contributing to the evolution of knowledge through exemplar research and responsible practice.

A curriculum development for sustainability must build on a critical analysis of the barriers and opportunities required by the professional market, so as to define the *learning outcomes* in terms of knowledge, skills and competence expected of graduates. Clearly, pedagogical objectives aiming at the incorporation of principles of sustainability within imaginative design need to be considered at a rather wide-ranging level, since they also ought to respond to differences between curricular structures and legislative requirements across countries.

To this aim, learning outcomes in the «Framework» are related to a broad *knowledge* base of sustainable environmental design – featured on a publicly-accessible online interactive Portal – which is built on a cognitive construct composed of Issues & Principles, Applications & Case Studies, and Tools. A solid *conceptual* background is indeed an essential requirement to provide students and practitioners with the ability of converting physical laws in creative architectural forms. The translation of building science into meaningful design, however, has to be supported by appropriate empirical understanding and evidence-based learning, so as to reveal how different principles can be applied into practice, and by analytic tools and simulation techniques that can facilitate the testing and evaluation of different hypotheses and make performance predictions from the early stages of design. These three cognitive domains – theoretical, *empirical* and *analytic* – have to be simultaneously delivered in higher education curricula, without marginalising them in the form of technical or specialist studies (AA, 2010).

To educate for sustainable development, pedagogies have therefore to be informed by an overarching ethos that combines the acquisition of cognitive notions with experiential, comparative and synthetic abilities so as to secure people’s comfort and quality of life, whilst safeguarding the environment where designs take place.

Clearly, a plurality of approaches in terms of *programme structure* could be adopted to accommodate such aims, making it impossible to formulate the ‘ideal’ model of a curriculum (Guy and Moore, 2007). This, in fact, has to respond to the specific teaching culture, aims, methodologies and organisation (e.g., staff-to-student ratio) of the higher education institution concerned. However, according to the correlation between pedagogical areas, the “Framework” organises curricular models in five main categories: *parallel*, where each disciplinary domain runs autonomously; *partially integrated*, where different cognitive areas are linked in delivery or, more frequently, in assessment; *fully integrated*, where various disciplines converge around the central core of the design project; *iterative*, where knowledge is progressively deepened through a series of cognitive ‘loops’; and, *elective*, where curricular contents are enriched by optional courses, potentially structured as a sequence of domain-specific teachings.

Each curricular model brings its advantages and constraints, therefore it is necessary that the education is supported by adequate *pedagogical methods* and tools that facilitate knowledge transfer between technical and creative domains. Indeed, process is important for learning, and the way learning occurs is as important as the content of the learning itself (Orr, 1991). In this context, new didactic techniques derived from Information and Communication Technologies (e.g., e-learning) have been proven, amongst other methods, to offer significant opportunities to encourage self-reflection, deep learning and critical understanding and promote multidisciplinary collaboration between specialists in distinct areas, fundamental skills to the achievement of an integrated education (Warburton, 2003).

Endeavours such as EDUCATE testify of the growing appreciation of the need to break out of traditional disciplinary compartments and bridge divides between technical rigour and creative exploration, theoretical sciences and applied arts, education in academic and non-academic environments, reiterating the need for a holistic approach to teaching and learning.

Education for sustainable development must cultivate analytic skills, cross-referencing and imaginative reflection, supporting meaningful dialogue between seemingly distant fields of knowledge and promoting environmental sustainability as the ultimate aim of any pedagogical process.



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## **Sustainability Manager: a business simulation for education and training on sustainability management**

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Corporations have cognitive resources, technologies and skills which can be used to contribute positively to a sustainable transition of our societies. Some corporations engage directly in sustainability related activities, many others will need regulations and incentives (Laudal (2010)). Regardless of its motivation a corporation has to organize, structure and to embed sustainability related actions into its activities, strategies and routines, i.e. into its management systems. Sustainability management has special challenges: integrate externalities, avoid or reduce negative social and environmental impacts and identify opportunities based on a (more) sustainable behavior are central aspects for sustainability management. These aspects have to be regarded in any sustainability oriented business training.

An important aspect of any management initiative is to train and to educate employees. One possible way to do this is to use management games and simulation as they allow the learning and training of new competencies (Hoffmann (2009)). An advantage compared to classical learning approaches is the possibility to repeat the learning content easily and the possibility to learn and test new competences virtually; this virtual learning and testing allows also failing without facing real problems. To fully benefit from the advantages of management games they should be designed as knowledge based games, i.e. real world facts and situations should be implemented in the game in a realistic way. As reality is truly non-linear and non-deterministic, but highly complex a knowledge based management game has to be designed in a similar form. Basis for a knowledge based management game is the simulation of the reality, in case of management games the simulation of business situations. To realize this, real world facts have to be translated into a virtual "simulated" world. These facts contain the relevant information about stakeholder, companies, competitors, markets, authorities, resources, environment or other necessary aspects relevant for the management game.

To enable education and to train on sustainability management a management game called "sustainability manager" ([www.sustainabilitymanager.at](http://www.sustainabilitymanager.at)) was developed in an interdisciplinary team of researcher, consultants and practitioners. The business simulation includes organizational and strategic aspects, market information, and material, energy and cost data. The virtual company produces small light-weight cars and has 150 employees.

An important step in the development of this management game has been the concretization of corporate sustainability management. Starting point were experiences of the development team in numerous consulting projects regarding sustainability and an extensive literature review regarding corporate sustainability management and CSR, especially using the principles for sustainability from the framework for strategic sustainable development (Robèrt et al. (2002)). The team incorporated economic, environmental and social sustainability aspects into the management game; examples for the economic dimensions are innovation and technology management, collaboration with stakeholder and partners, knowledge management, processes, purchase or sustainability reporting. Examples for the environmental aspects are the use of resources (materials, energy) including use of recycled resources, emissions into the air, water or ground, waste and hazardous waste, biodiversity and environmental issues of the product. Social aspects are divided into internal social aspects like corporate governance, motivation and incentives, health and safety, and human capital development; external social aspects are ethical behavior and human rights, avoidance of controversial activities, avoidance of corruption and cartel and corporate citizenship (Baumgartner, R.J.; Ebner, D. (2010); GRI (2006); Labuschagne, C. et al. (2005); Labuschagne, C. et al. (2006)).

The goal for the player is to run the virtual company in the best sustainable way. The player is asked to make all relevant and necessary management decisions (like to decide upon the price of cars, number of cars produced, purchasing of raw materials, hiring of employees, ...) and to chose other management actions (like implementing a management system, training of employees,...). The consequences of these decisions and actions are made visible with indicators; the indicators are grouped according to Sustainable Development in economic, environmental and social indicators. Decisions and actions are structured based on the main elements of Porters value chain framework (Porter (1985)):

infrastructure, human resources, technology, procurement, inbound logistics, production, outbound logistics, marketing & sales and services.

After reviewing the results of one game period the player has to make decisions for the next period. So in fast motion the long term effects of decisions and their impact on sustainability performance are demonstrated. The player can learn period after period to understand the essential aspects of sustainability management and is enabled to develop strategies for his or her practical work in this field.

The sustainability manager has been used in different seminars for practitioners and in university courses. Usually teams with 3 members are playing with the sustainability manager. One advantage of using this web-based training instrument is a high usability as no specific software is required to play the management game and as the game logic is easy and intuitively understandable. In playing this management game, key qualifications like responsibility, team work, communication, creativity and flexibility are trained and improved. The participants' feedback was very positive and confirmed the idea of this management game as well its applicability.

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## Action Field Analysis - a new approach for developing an integrative sustainability strategy at Basel University

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As centres of both the creation and transfer of knowledge, universities have an influential role within society and its development. With their functions as role models and as multipliers, universities are potential "change agents" or catalysts for societal transformation (1). Acknowledging that sustainable development will be the guiding role model for the development of society, an increasing number of universities are becoming active in addressing sustainability issues. The extent of integration of sustainability ranges from „campus greening“ to integral implementation in curriculum, research, outreach and operations. A screening of literature and best-practice examples indicates, however, that the approach to sustainability chosen by universities is often rather pragmatically and not scientifically informed. The implementation of sustainability is mostly based on the Brundtland definition for sustainability, operationalised pragmatically through the 3 pillars of sustainability (ecology, economy and society).

Tools for implementing sustainability within an organisation are available on the market. However, these are mostly business oriented, such as the reporting standards of the Global Reporting Initiative (GRI)[1] or management tools as described in Schaltegger et al (2). Although these are partially scientifically informed, they are not adjusted for the specific use by universities. In early 2010, the University of Basel decided to evaluate its current and future contribution to sustainable development. The questions addressed were: 1) what elements need to be considered when integrating sustainability into a university; 2) what are the current activities of the University regarding sustainable development; 3) what should be the elements of a sustainability strategy that allow it to adequately fit the specific situation at the University of Basel. In lack of availability of a scientifically based tool adjusted to the needs and functionalities of a university, the authors decided to investigate in a new approach for developing an integrative sustainability strategy on the basis of an action field analysis. This structured approach of action field analysis was chosen to ensure that all relevant aspects were accounted for, independent of organisational structures.

Outcome: The purpose of this paper is to present and discuss the chosen approach – the process and structure of the resulting portfolio of action fields - rather than the presentation of detailed results from the outcome at the University of Basel. The expected contribution to the field of *Sustainability in Higher Education* is a working tool that allows the development of a strategy while systematically considering the role of the university within its particular society.

Method: The approach chosen at the University of Basel for the development of an integrative sustainability strategy consists of 3 steps: 1) definition of a portfolio of action fields; 2) action field analysis; 3) development of the integrative strategy. The core of the first step was to define a portfolio that encompasses a spectrum of action fields that are as wide as possible but nevertheless focused to the specific needs and functions of a university. This was achieved by performing an in-depth evaluation of tools available on the market, in the literature and on the Internet. This includes indicator systems developed to measure sustainability or to give guidance on sustainability reporting (GRI), as well as assessment tools that evaluate activities of universities in the fields of sustainability. These data were validated against and complemented accordingly with best-practice examples of universities that show strong commitment to sustainable development. Finally, the data compiled from this analysis were screened for their relevance for universities and their functions. On the basis of this university-adjusted portfolio of action fields, the status quo at the University of Basel was evaluated in each of the fields, and core areas for developing short and long term perspectives were identified. This process of action field analysis and strategy development was carried out in a participative process and was accompanied by a supervising team.

Discussion: We argue that such an action field analysis allows overcoming the shortcomings of pragmatic approaches of strategy building. Bringing the action field analysis together with the University's vision on sustainability allows for the development of an integrative sustainability strategy. The total spectrum of relevant action fields identified for universities may be used as a general guidance to define strategy and actions of an individual university. The use of action field analysis - and the use of the portfolio in particular - ensures that sustainability is considered in all aspects of a university: In its function as shaping the future through its curriculum, research and outreach as well as in its role as a model for society through its operations.

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### **Added value and constraints of real-world learning opportunities in environmental science curricula**

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Sustainable development issues are characterised by their multidisciplinary character, and the fact that they are not merely an academic exercise but pertain to real-world problems. They show large complexity as a result of mutual interactions between social and biophysical systems. Regular or 'normal' scientific approaches tend to focus on different disciplinary aspects of the problem in isolation, using an 'objective' analytical perspective. In contrast, it has been argued that sustainable development issues are in need of a 'Post-Normal Science' approach, in which there are multiple legitimate perspectives, related to values and world views of individuals or groups, while the full complexity including its uncertainty should be part of the scientific analysis. The multiplicity of world views also allows for non-scientific stakeholders to enter into the problem analysis and problem solving arena, enabling the addition of tacit knowledge to the formal scientific knowledge. The resulting networks involving public-private partnerships and the collaboration with community organisations have given rise to new forms of governance. Such participation of multiple stakeholders and scientific specialists involved in sustainability research and problem solving necessitates forms of integration of the multidisciplinary knowledge being produced. Such research is often termed transdisciplinary.

Academic environmental science programs aim to develop students' competencies for working on these complex real-world problems. Therefore, programs should not only focus on developing analytical and research skills and theoretical and professional knowledge of their students, but should also include exercises aimed at developing problem-solving skills and the ability to collaborate successfully with experts and stakeholders. This can be realised by including real-world or transdisciplinary case studies and projects in the curriculum.

In this paper, we present and evaluate three examples of real-world learning opportunities that are part of the undergraduate and graduate curriculum in Environmental Sciences at Utrecht University, with the aim to identify added value and constraints of this approach.

The first example is the Environmental Consultancy Project, in which multidisciplinary student groups of 6-7 undergraduate students act as a consultancy company to advise a stakeholder on an actual sustainability problem. In the second example, the Sustainable Business Case, small multidisciplinary groups of 3-4 undergraduate students apply the knowledge they have acquired through conducting research in companies and providing these companies with advice on the next steps to be taken towards a more sustainable business. In the third example, graduate students enter the transdisciplinary arena and they are confronted with a real-world problem of a real-world client. The students work in multidisciplinary groups to analyse the client's problem. They analyse the multidisciplinary problem from their own specific background, and integrate their scientific knowledge with that of other students, and with the tacit knowledge of stakeholders.

## **Sustainability at the Campus – EMS Development and implementation processes in European Higher Education Institutions – Top-Down versus participatory approaches**

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An increasing number of companies and institutions have become aware of their environmental impact, together with their social and environmental responsibilities. Environmental Management Systems (EMS) have been implemented on a large scale to improve companies' environmental performance, certify their achievements and to express their commitment towards a more sustainable future. Although these tools have primarily been used by industries and private organizations, more recently other organizations like universities are also using this certification process in order to reduce their environmental impact and to start a new dialogue about campus sustainability.

There is a debate about campus sustainability which has grown over the last three decades. Several international conferences and declarations are proof of this growth (e.g. The Stockholm Declaration by UNESCO in 1972; the UNESCO conference in Tbilisi, Georgia, about Environmental Education in 1977; the Earth Summit 1992 in Rio de Janeiro; the Talloires Declaration (1990), the so called "Copernicus Charter" (1993), the Kyoto Declaration of the International Association of Universities (also 1993), the Agenda 21 and its chapters, Chapter 35 and 36 [1], approved at the Earth Summit in 1992). These have all been significant steps in spreading the discussion about the role of universities as multipliers for sustainable development and how the objective of integrating campus sustainability can be approached [2,3,4].

Due to their high societal impact, universities are challenged to take a leadership role in environmental issues. Several authors attribute an ethical or environmental imperative to universities and a duty to systemically integrate sustainability in their institutions [5,6,7,8]. Chambers sees "the impact universities can have in sustainable development (...) vastly greater than the impact of any other single sector of society, (...) because universities educate the next generation of decision-makers and influencers (...)" [4].

Promoting sustainable development is closely linked to the field of public participation and citizens' involvement. The Agenda 21 stresses the importance of public participation as a "fundamental pre-requisite for the achievement of sustainable development" [1]. The governance strategy "Citizens as partners" of the OECD countries and the Aarhus Convention, approved by the United Nations Economic Commission for Europe are aligned with this approach [9,10].

Filho points out that the discussion about sustainability in universities has been brought forward by the climate debate and by the UN Decade of Education for Sustainable Development 2005 – 2014. He distinguishes 3 different stages of sustainability implementation at a university: (1) Stage 1, in which the principles of sustainable development are not integrally understood and no strong efforts have been undertaken yet towards promoting sustainability at the institution; systematic projects or a holistic approach are still lacking; (2) Stage 2, in which significant efforts towards sustainable campus operations have been realized, the principles of sustainable development are broadly understood and there exist projects to promote sustainability as a whole or in the context of specific subjects and/or research; (3) Stage 3, in which the university has fulfilled the requirements of the previous stages and has a long-term commitment towards contributing to sustainable development, e.g. by means of sustainability policies, and/or by means of certification (ISO 14001[A] or EMAS[B] for European institutions), and by means of the existence of senior staff members in charge of the coordination

of sustainability efforts and projects [11]. According to Filho, the implementation of EMS can be seen as a proof of an institution's process in following sustainable principles and as a sign of the institution's orientation towards incorporating sustainability at an advanced level.

Nikolaides affirms that "EMS appear to be growing in leaps and bounds in higher education worldwide and many universities are certified to ISO 14001 or EMAS" [2]. A large volume of literature can be found about how to move campus sustainability forward, and some authors compare different EMS models [12] and discuss their adequacy for higher education institutions [13]. There exist also studies about EMS in universities on national levels (e.g. Australia, Canada, Sweden, United Kingdom, USA), and many universities report about their experience with EMS in case study articles. But there is little yet known about the current state of EMS implementation processes at European campuses and about the approaches universities have followed to implement an EMS. The confrontation of a top-down vs. a bottom-up participatory approach within EMS is an investigation field yet little explored.

This research aims adding further scientific knowledge about EMS development and implementation processes in universities around Europe and investigates in more detail if and how a participatory approach has been carried out. The authors give an overview of the current state of EMS implementations in European universities and provide a deeper understanding of how these processes contribute to sustainability in European campuses and how this issue has been dealt with in different Member-states of the European Union. An on-line questionnaire survey was developed and applied to 47 higher education institutions in Europe, that have implemented or that are going to implement an EMS at the campus. The authors examined in the survey how these universities have carried out the EMS processes (top-down or participatory approach), what motivations led to the decision to implement an EMS at the campus, which levels of participation [14] have been used and how the institutions measure campus sustainability.

From this survey, we might conclude that social and environmental responsibility, together with the importance of awareness raising go in hand with the wish to change to more sustainable consumption patterns and to foster cost savings. A participatory approach and a mix of bottom-up / top-down approach have been the most frequent choice, but the participation and involvement levels tend to vary from institution to institution.

This paper will discuss which aspects of EMS implementation processes can be of value for a university's visibility and its environmental and social performance, and whether they can be key tools to promote sustainable learning and to prepare students for the changing needs of today's job markets and global challenges.

- [A] ISO 14001 means International Standard Organization and is an international standard referring to environmental management system
- [B] EMAS means Eco-Management and Audit Scheme and is an environmental management system developed by the European Union
- [A] ISO 14001 means International Standard Organization and is an international standard referring to environmental management system
- [B] EMAS means Eco-Management and Audit Scheme and is an environmental management system developed by the European Union

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## The Role of Costa Rican Universities in Sustainable Development: Comparative Analysis between Public and Private Institutions and its Implications for the Latin American Region

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Since the creation of the first policy in Costa Rica to achieve sustainable development in 1990, the participation of public universities in the implementation of strategies for sustainability has been significant (Mata, 2002; Mendoza, Quesada, & Solis, 1995). In 1995 Costa Rica became the first country in the Latin American region with a national strategy for sustainable development (López, 1995) and in 2000 Costa Rica became a leader of developing nations implementing sustainable development initiatives (Steinberg, 2001).

The mission of public universities in Latin America has been characterized by an active involvement in national social problems (Twombly, 1997). The trend toward the privatization of higher education in the region since the 1990s is challenging this social role of public higher education in Latin America (Didriksson, 2008). In the early 1990s the government of Costa Rica allowed the creation of seven private universities; by the year 2000 50 private universities offered higher education programs. In 2007 the majority of higher education students in Costa Rica (52%) were enrolled in private universities (Consejo Nacional, 2008).

This trend toward the privatization of higher education in Costa Rica might reflect a change in the participation of academia in sustainable development. The question that emerges from this trend is to what extent existing private universities in Costa Rica are incorporating education for sustainable development in their academic activities compared to traditional public universities. Although all levels of education are crucial to promote sustainable development, higher education is particularly significant because of its intrinsic goal of educating future generations in all areas of human activities: Teachers, doctors, technicians, scientists, and policy makers among others receive training primarily in colleges and universities; therefore, it is vital for universities to educate their students to be responsible citizens and understand the complexities of sustainable development (United Nations, 2005).

The methodology followed for this study was quantitative, qualitative exploratory, and cross-sectional, based on the results of the *Assessment of Education for Sustainable Development in Universities in Costa Rica: Implications for Latin America and the Caribbean* (Garcia, 2010). Garcia's study surveyed 45 of the 54 universities approved by the Ministry of Education of Costa Rica. The data collected included the participation of 100% of the public universities. In the private sector, 49% of the universities responded to the survey.

Results of the study confirmed the traditional role of the Costa Rican public universities in sustainability. All public universities offer courses in sustainability while 60% of private universities offer similar classes. It is important to note that public universities are not including a great deal of sustainability in their traditional curriculum. Some common areas of knowledge in which the two sectors are including sustainability are biology, environmental sciences, tourism, public health, architecture, and ethics. The majority of public universities (75%) require undergraduates to take classes in sustainability. This percentage is lower in private universities (55%).

Seventy-five percent of public universities consider sustainability a factor for faculty and staff hiring and promotion, and 50% consider sustainability a factor for professional development. Half of the private universities consider sustainability a factor for hiring and promotion, and 30% of these universities consider sustainability an area for faculty and staff development.

All public universities have environmental centers where students can participate either as volunteers or as part of their curriculum; half of these universities provide students with sustainable dorms, and 75% provide orientation programs in sustainability. None of the private universities affirmed having these environmental centers, 5% provide sustainable dorms for students, and 25% provide students with orientation programs in sustainability.

Regarding research and scholarship in sustainability, half of the public universities are undertaking these activities. In the private sector 10% affirmed working on these areas. The consistent argument from the private sector for not implementing these programs is that research and scholarship in sustainability are not part of their mission.

All public universities have some kind of formal written commitment to sustainability, while 55% of the private sector confirmed this commitment. Institutional commitment to sustainability can be a decisive factor for the level of participation of universities implementing sustainability initiatives in the community. All public universities have implemented these initiatives, while 55% of the private universities have implemented programs of this type.

The role of Costa Rican universities, public and private, to promote sustainable development in the Latin American region has been substantial (Garcia, 2010). This role includes the development of many prestigious research centers in areas

related to biodiversity, land management and eco-tourism. One example is the creation by the Universidad de Costa Rica of the Institutional Program of Sustainability and Peace (PRINSOPAZ), which united efforts with the Earth Council to create the Costa Rican Group promoters of the Earth Charter. This initiative has been recently adopted by other Latin American countries such as Mexico and Brazil. Other examples of the role of Costa Rican universities in promoting sustainable development in the region are the National Biodiversity Institute of Costa Rica (INBio), an entity that provides training to regional scientists in biodiversity and conservation; the Organization for Tropical Studies (OTS), an entity that groups more than 63 international universities participating in providing education and research, and promoting responsible use of natural resources; and the Costa Rican Institute of Tourism (ICT), an entity that developed the first sustainable tourism certification program in the world, which is classified by the UNEP as one of the most comprehensive eco-label systems (Tepelus & Castro, 2005).

In conclusion, the results of the study indicated that Costa Rican universities, public and private, have contributed substantially promoting sustainable development in the region; however, the public sector has presented a higher commitment to sustainability than the private sector. This commitment is reflected in their mission statements, curriculum, faculty and staff hiring and promotion, student activities, research and scholarship, and participation in sustainability initiatives for the community.

Although public universities in Costa Rica are addressing sustainability issues in a more substantial way, private universities have been doing a fairly good job, especially those whose areas of interest are health, eco-tourism, and agriculture. Furthermore, there is a generalized understanding of the importance of sustainability in academia as well as the importance of university participation in sustainability initiatives for the community; however, the participation of private universities in sustainability requires improvement to take advantage of the opportunities sustainability brings to their institutions and to the community as a whole. Countries in the region can take advantage of the Costa Rican experience and begin to implement initiatives to promote sustainability in public and private institutions as a mechanism to achieve sustainable development.

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## Lifelong Sustainability: The Unique Experience of University Students in Rural Panama

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University students are inundated with many opportunities to volunteer their time and donate their money for different causes, but they are rarely offered a chance to apply their skills and knowledge to hands-on sustainable development projects. Since students are not yet "experts" in their fields, they generally are not granted large roles in sustainable development work. Yet, intimately involving students in international development projects allows them to experience first-hand how the macro theories they study in business, architecture, law, medicine, or environmental studies can apply positively in micro settings such as Panamanian rural communities. Since 2008, over 44 university clubs and over 500 students have participated in sustainable health or development projects with the non-profit organization Global Brigades Panama.

This article examines the ways in which the Panama brigade experience has, both personally and professionally, impacted 150 surveyed students from 25 U.S. universities. It also includes the results of 40 individual interviews in which students discussed their future career plans, the level of positive impact they felt their project had in the Panamanian community where they worked, and whether their experience in Panama had directly inspired them to start a new club, change their major or career plans, or become more involved in the sustainability conversation. The results of these surveys

and interviews also consider whether students were greatly impacted by the brigade experience if they participated in a project that was not directly related to their focus of study.

Of those surveyed, the vast majority reported that they were greatly impacted by their brigade experience. They found that, armed with the basic skills and knowledge they had fostered in the classroom, they could truly support and impact rural and indigenous communities. Those who had not previously been involved in sustainable development work indicated a high level of continued interest and, overtime, increased their participation in other projects related to sustainability. Many others indicated that their brigade experience inspired them to consider new professional paths. Around 50% indicated that they were considering changing their major or pursuing a new minor and 80% indicated that the brigade project helped them form a better idea of what kind of professional career to pursue in the future.

Furthermore, student-led sustainable health and development projects impact and improve the lives of those living in poverty by providing them with small-seed capital, medical attention, and localized training. But development projects need not solely provide rural Panamanian communities with important localized support; they too can also empower students who are deeply impacted by hands-on development. The unique experience university students have with such sustainability projects is directly associated not only to their career choice, but also to their worldview as a global citizen. It is these initial touches and direct connections with development that students are inextricably connected as present and future promoters of sustainability.

### **The path to sustainable university-community partnerships, a case of Mahidol University, Thailand**

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Universities and academic institutions can no longer continue to be centre of knowledge excellence by isolating their entities from the society and community where they belong to. Analysis of the existing literature suggests that there are numerous indicators of successful university-community collaborations. Although success looks different in each partnership, depending upon its specific orientation and goals, these indicators are seen as central elements of all successful collaborative efforts between universities, schools, and communities.

Unfortunately, collaborative relationships are often faced with dilemmas that can limit their success, including the fact that all collaborative relationships between diverse partners and organizations are complex and difficult. The dilemma that most pervades the literature is that partnerships have inequitable distributions of power. Amid claims of equality, colleges often possess financial and intellectual resources that allow them to control most aspects of the collaborations. This also necessitates the need for conceptualizing and envisioning the role of modern universities in the fast changing external environment, and then to analyze how best the role can be defined and performed by integrating the perspectives of the different stakeholders of the higher education system. In addition to the other functions, the university-community interface has also been one of the areas that have experienced the wave of change.

Looking into the complexities of the issue, the paper draws upon the recent research on promoting university-community research partnership, a case study of Mahidol University in Thailand, it has been conceptualized around the broader research question of 'how we can develop sustainable university-community partnerships in the university organization?' In order to address this research issue, the paper reviews the selected developments in the theory and practice of university-community partnerships. While it is based on the secondary literature review and experience based observations into higher education management, the insights drawn from the interaction between the particular university and its community through qualitative approaches have also been used in analysis of the issues. Specifically, this line of qualitative inquiry attempts to center the voices of traditionally marginalized participants in collaborative endeavors. The paper concludes with several suggestions that attempt to assist the continued development of the partnerships of the case study university and its community and also serve as helpful insights for other partnerships that seek similar relationships.



## Sustainable development of Universities: A real chance?

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The purpose of this paper is to show the development of the University of Graz on its path towards becoming a sustainable university, i.e. not merely as a “green university”, but also an economically efficient and socially valuable institution. Putting it in a nutshell, one can say that sustainable values are directed towards enhancing the environment, protecting economic viability, promoting social justice and combating poverty. How can such values be communicated? How can they be used to inspire and guide individuals and decision makers now and in the future? One possible answer may lie in suitable reformulation and implementation of university educational programs.

The University of Graz was the first university in Austria, and one of only a few in the Germanspeaking part of Europe, to publish a sustainability report following the global reporting initiatives (GRI). It was also the first to be subjected to external sustainability evaluation by Pricewaterhouse & Coopers in 2010. Sustainability reporting has become an important instrument of communication. Biennial publication of a sustainability report for the university only serves to raise its significance. A related aspect concerns the foundation of the interdisciplinary task-force *Sustainability4U*, consisting of all four Universities in Graz, and which focuses on bringing new “sustainable” ideas to fruition, promoting sustainable values, and turning Graz into a more attractive, sustainable academic location for various disciplines and international students.

The idea of sustainability at the University of Graz was implemented 20 years ago and is an ongoing process. Concerning the implementation of programs for sustainability the present paper identifies the major barriers, discusses potential paths to success, clarifies the benefits accruing from greater sustainability at university level and outlines possible trends. The establishment of ever more departments and centers with a focus on sustainability provides evidence of the ongoing nature of the development. In addition, the increasing range of student activities, for example, the growth of interdisciplinary internships and relevant international projects, specialized training programs, as well as the availability of various awards, all serve to highlight the growing significance of sustainability at the University of Graz.

Again and again, experts in the field of sustainability emphasize the fact that sustainability programs cannot focus on ecological concerns alone. By their very nature such programs must be non-exclusive and holistic, i.e. focus on existing and potential synergies between the environment, the economy, and society. By way of example, the present paper introduces two prominent sustainability projects: a transdisciplinary real world case study, and a study on mobility.

Universities are sources of instruction for future decision makers and decision users. To what extent does this contribute to a more sustainable future? What ‘sustainability values’ (if any) do such individuals take with them once they have finished their studies? To have any impact in this respect, universities must express their clear commitment to such values and act accordingly. This entails appropriate adaptation of all relevant administrative, teaching and research procedures.

## Engineers for Sustainability? What Education is Required

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After the Brundtland report on sustainable development (SD), a discussion on the importance of engineering in the path to SD emerged. Was technology/engineering to blame, and should solutions be developed that would reduce the role of technology in society, or would new large scale technologies (nuclear fusion, giant sun screens, etc.) be the only way to solve the world from catastrophe?

Gradually, a consensus was growing that engineering was important in developing responses to the sustainability challenges, but that engineering, in order to play an important role in SD, should adapt itself:

- Engineers are problem solvers, but sustainability challenges should not just be framed as problems of scientific-technological efficiency but as problems of providing for the needs of people.
- Sustainability challenges require a future oriented change process. Therefore long-term thinking is important as well as thinking in terms of systems change.
- Technology development and use is influenced by values. Different stakeholders have different values, and so it is crucial for engineers to interact with stakeholders in order to develop and introduce successful technologies.

Therefore the question arises how engineers should be trained in order to perform these tasks successfully. Systematic analysis of what should be Engineering Education in SD has been taking place since the end of the 1990s. The role of

social science driven approaches and active experiential constructive learning is crucial in order to make the engineer a valuable SD problem solver. But how to educate the future engineer for that task, and how to implement the required changes? Engineering has copied many features of science - disciplinarity is one of them. In a previous paper we analysed the main topics that were discussed in the mainly Europe oriented Engineering Education in Sustainable Development conferences (2002-present). The following topics were identified:

1. What should engineers learn on SD?
2. How to trigger institutional change within engineering schools: top-down or bottom-up?
3. How to trigger cultural change, how to win the hearts and souls of the faculty?
3. Curriculum change: starting new programs or changing existing ones?
4. The contribution of active learning and project based learning?
5. The role of external stakeholders, external cooperation?
6. How to measure SD learning effects?
7. Practice what you preach: how to green the campus, diminish resource consumption and sustainabilize procurement?
8. How to teach normative content in an academic context? [1]

In this paper we will broaden our analysis and include discussions on SD and

Engineering Education in North America, Africa, Latin America and parts of Australasia.

Especially for developing countries, additional challenges for educating engineers are of importance:

- How to provide the amounts of good quality engineers that are required to develop?
- How to offer good career opportunities that might prevent a brain drain to industrialized countries?
- How to make engineers aware of equity effects of the infrastructures and technologies that they develop?
- How to prioritise the needs of the poor?
- How to make engineers aware of the social/economic/cultural conditions of technology usage, in order to prevent failures of technology transfer?

Engineers need to develop a more strategic understanding of dealing with sustainability challenges. Education might be effective in this process. European Engineering Education is rather poor in its content of liberal arts. However, having knowledge of arts and social science is often not sufficient for being able to connect technological design with human behaviour and social structures. Creating such knowledge remains a challenge throughout the world.

Finally, it is a main challenge to maintain or develop peaceful relations between various ethnic and religious groups. Although, this is mainly no engineering challenge, engineers play a role in it. Many universities have implemented changes and adapted their curricula in order to train engineers that are equipped for the tasks outlined above. Various successes have been achieved, but also failures have occurred[2]. This paper will identify interesting approaches that have been developed and will sketch the main topics for educational research in order to create engineers that are trained for sustainability. The research methodology consisted in analysing current conferences in Sustainability education in the target regions and networks of SD education in engineering that already exists.

Research on education has not been given a relevant role in technological universities, but in order to train the engineers that are needed it is crucial to reinforce the importance of research on engineering education in sustainable development. Educational topics that arise are: Assessment of sustainability engineering competences, sustainability organizational change at universities, effective/efficient pedagogy, transdisciplinarity learning.

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## **An Exploratory Journey into Changemakers Learning Programs towards Sustainability**

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*The World in a Funnel*; Humanity is facing highly complex challenges at a global scale: climate change, poverty, terrorism and pandemics, to name a few. There are two underlying trends that are shaping the opportunities to meet needs of our present and future generations: the systematic increase in demand that puts additional pressure on natural resources and the systematic decrease on the availability of natural resources and social capital. This sustainability challenge -

commonly summarized by Strategic Sustainable Development practitioners with the metaphor of the Funnel - does not only imply environmental consequences but also constraining human society's future possibilities.

*A functional definition of Sustainability;* In this study we adopt one functional definition of sustainability based on scientific consensus, which is defined by four non-overlapping principles as follows. (Robèrt et al. 1997)

In a sustainable society, nature is not subject to systematically increasing:

- I . . . concentrations of substances extracted from the Earth's crust,
- II . . . concentrations of substances produced by society,
- III . . . degradation by physical means, and, in that society,
- IV . . . people are not subject to conditions that systematically undermine their capacity to meet their needs.

*A new generation of changemakers:* A new sort of conscious sustainability changemakers is needed to face the global sustainability challenge (Drayton 2006). However, the mainstream entrepreneurship education tends to focus on business as usual skills (Olszak 2003), with a significant lack of comprehensive understanding of the whole system and the inner work needed to face the mental barriers to become sustainability changemakers. Even the emerging field of Social Entrepreneurship Education is not founded in a robust whole systems scientific approach towards the challenge of global sustainability. That implies that their valuable contribution towards sustainability more often than not may end at society level. Thus it is likely that sustainability is not addressed in a comprehensive and systemic manner. For those entrepreneurs who only focus on the social dimension, the absence of a systemic understanding of sustainability that considers the complexity of interactions between environmental dimension and social issues, might lead to trade-offs between poverty alleviation and ecological damages.

*Purpose:* The purpose of the research is to explore which of the assumptions that are currently guiding the design of the most innovative learning programs for changemakers towards sustainability in Europe best serve to design further learning experiences in more vulnerable contexts. The research aims to identify the common assumptions that guide the design of leading edge learning programs for sustainability changemakers in Europe. The research question that guided the authors to their exploratory journey was: Which are the assumptions that guide the design of the leading-edge learning programs for changemakers towards sustainability?

*Methods:* The Framework for Strategic Sustainable Development was used as a structured approach to the topic and the research design was based on a dynamic research interactive model. Otto Scharmer's Theory U (2009) on radical innovation guided the data gathering process that included participatory observation, dialogue sessions with organizers and participants through several schools in Europe (four of which are presented in this study), identified *among the most innovative in the world* by Peter Senge. The study utilized the visible practices and tools observed in the fieldwork to decipher the underlying mental models. Building on the findings, the authors designed a prototype of a learning tool in a form of self-reflection card game with the intention of helping and inspiring the next generation of changemakers in their learning journey towards sustainability. The learning tool was co-created through a participatory process of collective design that involved a multicultural focus group, an online survey and a visual crowdsourcing session.

*Findings:* Exploration of the different leading learning programs for sustainability provided us with several primary findings and insights in light of our purpose of fostering a new generation of sustainability changemakers.

In order to foster future sustainability changemakers, the view of the system needs to be comprehensive and systemic. That means individuals within a society within the ecosphere within a metaphoric funnel of dwindling natural resources and deteriorating social fabric due to the prevailing perception of the world as disconnected and mechanistic entity. In short, the fundamental cause of sustainability challenges needs to be incorporated in the mental model of the system.

The learning programs shared a set of assumptions that were used to guide the design of the learning tool. Some of these assumptions are: "Self-motivation and initiative for a purposeful learning"; "Learning should be connected with personal self-development, self-identity and vision"; "Trust in participants: Social systems have the capacity to self-organize them selves"; "Peer learning, Team Learning and Team work helps a fruitful learning"; "Learning happens through an experiential learning cycle: learning by doing connected with real life"; "Fostering and holding a safe fertile space facilitates learning from taking risks and making mistakes".

In addition to the findings presented above, several sources contributed to guiding the design of self-guiding learning tool developed through this study which is a set of self-reflection cards called "Your Journey". Similarly, inputs and feedbacks from multicultural focus group and the external experts we surveyed provided valuable insights into the design and contents of the tool.

*Conclusions:* This study is an exploratory and hypothesis generative study that becomes the basis of further development and research rather than hypothesis testing confirmatory study. Thus our findings need external validation and further investigation into related field. Nonetheless, this research contributes to the emerging field of Strategic Sustainable Development at the system level by suggesting incorporating explicitly a dimension of human perception or mental model of the world in the system. By presenting a learning tool designed for changemakers for sustainability, this study would also contribute to this field of knowledge at the tools level. Finally, this study would contribute to the area of social entrepreneurship training/education by sharing a way to ensure their contribution to development that is not only socially sustainable but also ecologically sustainable

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## **Higher Education Leadership Stages and Strategies that Relate to Campus Environmental Sustainability at U.S. Colleges and Universities**

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The Higher Education Association's Sustainability Consortium (2005), an informal network of institutions with a shared interest in moving environmental sustainability forward on college campuses, acknowledges that higher education has both a challenge and lead role in society. In addition, higher education has been identified as one of the leading entities in society that could have long term cognitive, physical, and philosophical transformative impacts in the area of environmental sustainability (Calhoun & Cortese, 2005; Cortese, 2003; Sharp, 2002). According to Schmidt-Bleek (2008), institutions are expected to incorporate goals that support environmental sustainability, environmental development, policy, and management within a certain time frame among college and university campuses worldwide. The researcher stated that the time frame in the majority of literature, such as the Talloires Declaration of 1990, the 1993 calculation released by the Business Council for Sustainable Development, and the Rio Declaration of 1992 will terminate around year 2040. With such a short time frame to make significant strides, institutional leaders have been seeking guidance through organizations such as the Association for the Advancement of Sustainability in Higher Education (2001), and Society for College and University Planning (SCUP). As part of the second wave of improvements toward environmental sustainability on college campuses, Sharp (2002) mentioned the American College & University President's Climate Commitment (ACUPCC), which encourages a public proclamation by university presidents to commit to environmental efforts in campus policy, procedure, and action. ACUPCC, if signed, signifies a significant step toward sustainability on campuses. ACUPCC requires the creation of a viable plan of action that incorporates strategy by the institution toward environmental sustainability. In the creation of an action plan, strategies of implementation become important to short and long term success in meeting the expectations of ACUPCC. The ACUPCC suggested that institutions examine similar institutions for strategies and emphasized that leaders should utilize strategies that were "institution- specific". This suggestion was most likely made due to the variability among institutions. How would a leader know which strategies to focus upon and which to forgo when examining similar institutions, and more importantly, the operation criteria of identified strategies? Also a challenge to institutional leaders, an expectation of environmental sustainability has been realized through such declarations as the Talloires Declaration of 1990, but how do leaders begin to tackle the challenges of becoming sustainable?

According to Cortese (2007), the well being of the earth, the human population that resides on the earth, and all of earth's resources has approached a critical point. Human beings will be forced to make difficult decisions in response to these changes. Humans can choose to ignore the challenges of the world and witness the destabilization of ecosystems, the climate, and waterways, or humans can choose to organize and develop solutions to counteract the mounting damage to the earth. Contributing factors to the decline of the earth include human population growth, and a higher demand for resources such as water, food, and energy. Unfortunately, technological advances and economic talent has established an artificially increased carrying capacity that has allowed for a situation of overpopulation of human beings worldwide. According to Cortese, events, such as global warming, have the potential to undermine the precarious position of humans in the form of increased health ailments, limited food sources, degradation of soil, and contaminated drinking water. Cortese also noted how the associated consumption rate of resources was approximately

20% in developing countries whereas the consumption rate of resources in developed countries, such as the United States has approached 80%.

Cortese (2007) stated that there was an ethical responsibility for higher education institutions worldwide to become major players in the stabilization of those events that have become risk factors on planet earth. Fiksel (2006) suggested that organizations, such as higher education institutions could become influential forces in the movement toward sustainability through systematic practices. Sharp (2009) stated, unfortunately, that although higher education institutions were interested and supported environmental transformation, and some institutions went as far as sustainable building on campus that supported environmental sustainability, occasionally those same institutions reverted back to previous habits of not being environmentally sustainable.

Two theories, transformational leadership and strategic leadership theory were recognized as the most prominent and relevant theories for this research study and were used to provide a fundamental framework for this research. The two theories mentioned, transformational leadership and strategic leadership theory were identified as the most prominent theories due to the close alignment and association to the study conducted. Both transformational leadership and strategic leadership theories involve the leaders of an organization as decision makers capable of manipulating an outcome. In this case, the organization is the higher education institution. According to Bass (1985), transformational leadership is the ability of a leader to move an organization and the constituents within the organization toward positive change. In this study, university leaders were investigated, strategies were examined, and potential transformations, in the form of environmental sustainability, were evaluated. The theoretical framework also focused on the theme of leaders as decision-makers and sought to prepare leadership professionals with the knowledge and skills to make environmental sustainability a reality. Leaders, as a result, will be forced to reflect on current practices, refine environmental practices, identify current problems and solve implementation issues within an increasingly diverse, complex, and dynamic technological society. According to Skinner (1971), behavior patterns of not only institutional leaders, but followers as well, can be modified. The behavior patterns of all institution stakeholders can be transformed to accommodate the dynamic pace of change in the area of sustainable development.

This study explored and described leadership strategy implementation stages that related to the development of environmental sustainability on college and university campuses within the United States. The goals of the study were to: 1) document prominent leadership strategy implementation stages used on university campuses in the United States, 2) develop a holistic understanding of environmental sustainability as it relates to college and university campuses, 3) recognize the strengths and weaknesses of tools used for sustainable assessment and evaluation on university campuses in the United States, and 4) establish a working bank of leadership strategy execution stages that could be used by university leaders at a regional or global level. The study consisted of a quantitative, non-experimental design. A sample of 284 colleges or universities was selected from a population of 332 institutions that were included in the 2010 Sustainability Report Card. Institutions represented both private and public institutions throughout the United States.

The Auditing Instrument for Sustainability in Higher Education, created by Roorda and associates (2001) was the survey instrument used to collect leadership implementation stage and strategy data from university leaders in the form of ordinal data. The Spearman rho correlation coefficient was used to determine the magnitude and the direction of the relationships between leadership strategy stages and institutional environmental sustainability rankings. Three of nineteen research questions were found to be significant and inversely related. Environmental policy resulted in a significant correlation ( $r(86) = -.209, p < .05$ ), the collection of environmental sustainability comprehension data on professional organizations and area businesses was significant ( $r(86) = -.213, p < .05$ ) and the degree of society data availability was significant at ( $r(86) = -.248, p < .05$ ). The effect sizes for all significant correlations were low. A simple regression was used to predict the environmental sustainability ranking from the degree of leadership strategy implemented. No significant relationships were found.

### Sustainability to Courses In Business Areas

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This article aims at demonstrating the influence of the practical experience of the students of the Business Administration Course – Federal University of Parana (UFPR) at Brazil – in the development of a sustained consciousness. The main question, that drives the research, was: how to teach sustainability for students that daily have to face immorality scandals and corruption in politics and in the business world, besides the constant disrespect to the environment?

The theme, sustained development, is turning to be, each time more usual on our daily activities. Sustainability, in most researches, is composed of three related dimensions: the economical, environmental, and social, normally recognized as triple bottom line, a term introduced by the John Elkington, in 1997. With such definition Elkington understood that in order to attain sustainability one should not only reach the economical performance - bottom-line – but also the environmental and social performance.

It's important consider sustainability in the educational process. In other words, if the importance of the sustainability is to assist the present generation without harming the future generations possibilities to attend their own needs (WCED, 1987), so, teaching the current generations the sustainability concept is primordial to reach the proposed objective.

In the agenda 21, chapter 36 (UN, 1992) – the promotion of teaching, of consciousness raising, and of training – it is exceeded the indispensable role of the University in teaching fomentation, referring to the sustainable development, to the community consciousness and the training of human resources training for specific professions.

The discussion about the sustainability of human actions related to the planet can not omit issues related to education. This aspect is so important that UN (United Nations) constituted the years 2005-2014 as the educational decade for the sustainable development. The main objective of this decade is to build a bridge between the academy and the needs of the community, as well as to decree the higher education sustainability in such a way that affects positively the society in general as well as the biosphere. It is believed that the current situation, of environmental and social alarm, is present just because the teaching methods applied in the last centuries, that have evolved relatively little comparing with other sciences, have not reached the expected objectives in the preparation of society for a sustainable life.

The difficulty is even bigger when dealing with sustainability addressed to courses in business areas. The curricula in such courses are based in values, beliefs, and presuppositions that constitute a vision of the world centred in the organization or in the corporation, which main objective is to perpetuate the constant business searching for larger profits to their shareholders.

To accomplish the proposed objectives exposed in this research, the methodology was developed in two phases. The first phase has been developed with students, in Business Administration graduation level at UFPR, in November 2010, taking the fifth period of the course. Here, the delineation of the research used was the research-action, and the methodological approach was exploratory-qualitative.

The researchers' intervention has been characterized by the group conduction considering the choice and the accomplishment of some actions in a non-governmental organization (NGO), where the premises of the research-action-orientation for the action and scientific rigidity – have been applied.

The research-action activities plan, related to the students, has been sub-divided as follows: (1) students exposition to the reality on the target institution; (2) intervention through the conduction of activities to guide the planned objectives, in this case, to survey the possible ways to act in the labour market, adopting a sustainable posture, and (3) analysis of the intervention under the students perspective.

Just at this point starts the second phase of the research. In order to make the intervention analysis possible it was required that the students answer a questionnaire organized in such a way to make the students position clear considering the theme sustainability. Besides, a semi structured interview was developed in depth, with some students of the group chosen at random, to express their opinions, reasons and motivations that have involved the process from the very beginning of the participation in the project.

The data analysis was verified by a quantitative study of the current data found in the questionnaire, and after, by a qualitative study through the discourse analysis of the material provided by the interviews in depth.

From the qualitative study we realize the visit to the NGO made the students think about the contributions they have given to society, because they began to consider doing some further social action. What most caught the attention of students, on the NGO visit was the clarity of the existence of a strategic plan. But it was also clear that even with a well-made tool of management, the issue of fundraising is something sensible, because the manager said that the funds were guaranteed for just six months.

As the work of discipline required a final strategic planning in NGOs, students emphasized the difficulty of considering the raising of funds, since the whole course is focused on the management of large enterprises. Students also reported that the NGOs chosen for the work of discipline present lack of labor organization on basic administrative processes, which in most companies where students work is something already solved.

Finally, students felt that discipline was very fruitful because it brought a systemic vision of both companies and NGOs, as well as allowed to combine theory and practice, because it was the first visit made during the course.

Some conclusions, resulting from the observations were raised, and it is believed that they can be of a great importance during the debates about the theme: (1) the lack of interest about the argument and the involvement with the subject sustainability. This has been perceived verifying the small number of students that have decided to visit the NGO; (2) the lack of knowledge about the subject: the students cannot differentiate assistance from sustainability and (3) the necessity to exist a behaviour pattern: they inquire "if he does not do why should I" was a recurrent sentence during the interviews.

By this finds, it got clear that there is some changes that should be considered in education process. So although believing in the importance of the promotion and development of specific activities such as water and energy consumption reduction, garbage recycling, harmful gases reduction, and many others, it is necessary to change the nowadays ways of education, in a way that can generate a radical change in people behaviour related to the environment, whatever environmental, social or economical. Thus, one can believe that effective education aiming sustainability should lead the students to reflect on their own learning, and more than that, to undertake the change in values, attitudes and behaviours beyond the University, and towards the organizational environment. Students should not only get acquainted with environmental issues and social responsibilities but also develop analysis and investigation abilities and learn concrete facts to create a process that will permit the unification between theory and practice.

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## **Transnational higher-education partnerships--potential impacts on US faculty, students, and institutions: reflections from a USAID/HED-funded project to build capacity in Ethiopian institutions of higher education in sustainable water resources management**

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*Background:* In this paper we document the formation of a partnership between seven universities in the United States and Ethiopia to build capacity in Ethiopian institutions of higher education in sustainable water resources management.

The partnership was created to respond to a 2008 call for planning proposals issued by United States Agency for International Development (USAID) and Higher Education in Development (HED). This, in turn, was inspired by a 2007 initiative led by the Association of Public and Land-Grant Universities (APLU) to consider how best to strengthen African higher education's capacity to educate and solve problems relevant to national and regional development. APLU's original objective was to facilitate deeper and more effective partnerships between African and US institutions of higher education to contribute more effectively to areas crucial to development, including science and technology, health and education, engineering, and environment and natural resources. The joint USAID/HED initiative speaks to one of the most important trends at the forefront of development practice—the promotion of transnational higher-education partnerships (HEPs) to catalyze the transition towards more sustainable societies.

*Problem Model:* Ethiopia faces many development challenges including food insecurity, recurrent droughts, disastrous floods, poor health conditions, and low energy production. Water is central to these challenges. While the overall quantity of water is adequate, the institutional capacity and workforce expertise to manage water is lacking.

*Project Objectives:* Five key objectives of the project (the Ethiopian-US partnership) to build capacity in sustainable water resources management are as follows. First, the project aims to establish an Ethiopian Institute of Water Resources (EIWR) resulting in an effective coordination of education and research and improved provision of community services in Ethiopia. Second, to develop graduate level academic programs in water resources by developing new curricula, and introducing and delivering new courses designed to build the institutional and human capacity needed to address water resource challenges in Ethiopia. Third, to increase the capacity of the Ethiopian university faculty and workforce through enhanced PhD and Master studies thereby producing over 150 PhDs and 350 MScs in the water sector over the decade beginning in 2011. Fourth, to carry out demand-driven and applied research in areas of critical national needs to properly integrate capacity development initiatives with national, sub-national, and sector priorities. The fourth objective is to provide an effective outreach program consisting of community-based extension services and training programs for practitioners to improve the relevance, dissemination and adoption of new methods resulting from scientific research undertaken on water resources. Finally, the project aims to establish an Ethiopian Institute of Water Resources (EIWR) resulting in more effective coordination of education and research and improved provision of community services in Ethiopia. These objectives were carefully chosen to support the Ethiopian Government's strategy of Accelerated Sustainable Development and Eradication of Poverty. They also align closely with the mandates of many Ethiopian Government ministries including Education, Water and Energy, and Agriculture and Rural Development.

*Capacity Building in Ethiopia:* Given the fact that the project was crafted in response to a call for proposals by USAID and HED, it has been shaped by ideas at the intellectual frontier of development. Initiatives designed to build capacity reflect the important guiding principles of ownership, advocacy and outreach, the creation of knowledge centers, and partnership brokering. For example, a basic but philosophically important component of the strategic plan was an in-depth needs assessment conducted jointly by the partners in the US and Ethiopia. Such assessments have become an integral part of the grassroots-driven philosophy of capacity building. The overarching vision of the project is to build capacity far beyond the universities by, for example, training and empowering community leaders. Advocacy and outreach are expressed in two sets of initiatives, one to engage university students in applied projects in local communities and the other to have universities offer short-term technical training programs to practitioners. Knowledge centers will constitute not only the universities engaged in the project, but also communities in which research will be undertaken. Forging partnerships between stakeholders is an essential ingredient to help promote the sustainability of the endeavor and the likelihood that the model can be exported to other settings.

*Capacity Building in the United States:* Faculty involvement from four schools/colleges at the University of Connecticut as well as at Alabama A&M provides an opportunity to build a community of scholars engaged in applied research on one of the most critical environmental issues facing society—water—in an international setting. The project also offers unique opportunities to US undergraduate and graduate students to broaden their global educational awareness by undertaking field work in Ethiopia. Evaluating the potential outcomes within the context of literature on pedagogy and organizational learning suggests that this project provides an opportunity for students, faculty, and universities to engage what Argyris has defined as “triple-loop learning”. This “learning about learning” is considered to be deep and transformative in that it touches not only the cognitive domain, but reaches a person on a more fundamental level, an existential realm that encompasses higher attitudes, values and habits.

*Conclusions:* We argue that projects such as the one described in this paper provide much wider-ranging potential to build capacity than is evident from considering them within the context of development studies literature. It is well understood that capacity-building takes place at multiple scales, including the individual, organizational, and societal level, all of which are interlinked and interdependent. We also highlight that while capacity building is most often used within the context of developing countries, it is not limited to those settings, and can be applied to any person,



organization, or society. Our main point is that capacity building initiatives have the potential to transform all participants. Projects such as the one described in this paper have potential to provide insights into the sociology of scientific collaboration, active pedagogy and organizational transformation. We suggest that evaluating the impacts of such projects on all participants and organizations engaged in the project—especially universities in developed countries—will provide valuable insights in these various knowledge domains. (997 words)

## **Bridging the gap in education for a sustainable future: The preliminary discussion on the relationships between teachers' environmental knowledge, attitudes and behavioural intentions**

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Environmental education is an important strategy for environmental sustainability (Taylor, Doff, Jenkins, & Kennelly, 2007). It was stated in the Belgrade Charter (1975) that the goal of environmental education is to “develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones”. With regards to the European Commission (1997), knowledge, attitudes and behaviour are 3 important dimensions of environmental education.

*“Environmental education is essential to enhance levels of awareness and understanding of the key issues at the core of the sustainability imperative (the ‘cognitive’ dimension), promote attitude change (the ‘ethical’ dimension), and modify patterns of behaviour (the ‘action’ dimension).” (European Commission, 1997)*

It has, thus, been generally accepted that knowledge, attitude and behaviour are 3 important dimensions of environmental education. In the hope of enhancing the learning and teaching effectiveness of environmental education programmes in schools, it is important to learn the correlations between the 3 dimensions and see whether and in what aspects they could affect teachers' approaches and strategies adopted for teaching environmental issues.

Many research studies have been done to examine the correlations between the levels of environmental knowledge, attitudes and behavioural intentions of teachers. However, few have been done in Hong Kong and most of them are yet to be updated. This paper portrays a study that investigates the 3 above-mentioned dimensions of the primary school teachers (for they are the key environmental education facilitators for our next generation). Based on the findings from a postal questionnaire surveys to 50% of the primary schools in Hong Kong, the study has sought to classify teachers into different groups, according to their levels of environmental knowledge, attitude and behavioural intentions, as explicated in their survey responses. At our first glance of the data collected, teacher respondents in the study who have good mastery of knowledge usually tend to possess more pro-environmental attitude. However, even whilst they have good knowledge and attitude, teachers may not behave environmentally. From the outset, it is seen that amongst the teachers who have expressed higher level of environmental knowledge and more positive orientation towards environmental protection, only a small percentage of them have gained higher marks in the behavioural types of questions that are designed to highlight pro-environmental behaviour. It seems evident from the study reported in this paper that good knowledge and attitude may not lead to good behaviour. All these are interesting findings and indicate some level of consistency with the findings of previous researches done in other parts of the world. It is believed that with the categorization of teachers attempted in this study, more in-depth understanding on the nature and characteristics of each group of teachers could be secured. All these are crucial and invaluable information for the development of effective environmental teaching training programmes for pre-service as well as in-service teachers on environmental education.

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## Environmental education in Hong Kong primary schools: A starting point for moving towards a sustainable society

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Different kinds of environmental problems arise, due to the continued development of a growing world population. Environmental education is viewed to be an important strategy in the development of an environmentally sustainable society. Countries over the world have therefore promoted environmental education in schools. In the hope of promoting in pupils “a lifelong and forward-looking concern for the environment” and enabling them to live as “useful and responsible citizens” (Curriculum Development Council, 1992), the Hong Kong government has as well promoted environmental education in both primary and secondary schools in the 1990s. Experiential learning, balanced viewpoints for all issues, formation of pro-environmental attitudes, and encouragement of pro-environmental behaviour (noted by the Hong Kong Curriculum Development Council, 1992) were all viewed as essential criteria for environmental education that help to move the society towards a sustainable future.

It has long been agreed in the academic and research community that knowledge, attitudes and behaviour are 3 important but interrelated dimensions of environmental education (Belgrade Charter, 1975; European Commission, 1997). Nonetheless, whilst there has been much discussion in the literature, regarding environmental education, there has been varying foci, and depth of literature analysis on these 3 components in the school sector. Whilst schools were viewed as the most important and reliable source of environmental information (Vlaardingerbroek & Taylor, 2007; Taylor, *et al.*, 2007), teachers, who are of far-reaching influences on the knowledge and attitudinal developments of students, have a crucial role to play in training students to be well-informed, environmentally aware and responsible green citizens, for moving our society towards a sustainable one. It was argued that teachers’ knowledge, attitudes and behaviour contribute significantly to the education and quality of students (Tuncer, *et al.*, 2009). Therefore, to ensure a good groundwork for environmental education that contributes to the successful development of our young generation who could move our society to a sustainable one, it is prerequisite for teachers to equip themselves with adequate environmental know-how, proper attitudes and appropriate lifestyle towards the environment (Said, Ahmandun, Masud, & Paim, 2003). For the relationship between environmental knowledge and attitudes, and between environmental knowledge and environmentally responsible behaviour, a number of research results showed that the correlations between the two pairs of variables can be diverse and varied (Kempton, Boster, & Hartley, 1995; Said, *et al.*, 2003; DeChano, 2006; Pe’er, Goldman and Yavetz, 2007; Esa, 2010). There is, however, a much more complicated pattern of interrelationships and intertwining influences on teachers, as explicated in the research related to teachers’ cognition, attitudes and behaviour that may impact on their pro-environmental tendencies. The paper attempts to provide a comprehensive review of the literature, regarding the current situation of environmental education in schools overseas and in Hong Kong. In the process, the history of environmental education and its foci in Hong Kong will also be traced. It is anticipated that the review will provide crucial, specific and baseline information, attributing to the development of relevant and useful teacher education programmes in environmental education and the enhancement of learning and teaching of environmental education programmes in schools, which are valued highly for the promotion of environmental sustainability.

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## **Zoos as models of sustainable development action and education: the case of Cincinnati**

Carla Chifos

The Cincinnati Zoological and Botanical Gardens, a major nationally known institution for its plant and animal programs has also become a demonstration model for sustainable development both within the grounds of the zoo as well as in the surrounding communities in uptown Cincinnati in the past 10 years. The zoo has readjusted its mission to be expanded beyond the protection of and education about animals and their habitats, to include a much broader mission to educate the public about sustainability through becoming a demonstration project on sustainable building and practices, linking educational opportunities with Cincinnati Public Schools, and working with surrounding low income neighborhoods to impact their long term sustainability. This case study will include the details of how this zoo changed its mission, a description of the range of activities it carried out and has planned, a discussion of its educational and community outreach component, and an assessment of the lessons that can be extracted for institutional roles in public education about sustainability. The Cincinnati zoo is an exemplary example of how a public educational institution can be an early adaptor of sustainable building technologies and management practices, partner with local and regional companies to become a sustainability showcase, become a magnet program for local high school education in this area, as well as outreach to surrounding communities in its urban setting. This story and a critical assessment of the path taken and the accomplishments can be a start for a model of moving high profile sustainability education beyond the schools and universities.

## **Towards achieving a Sustainability-Led University for the region: A study on the prospect and challenges faced by University Science Malaysia**

Sharifah Rohayah Dawood

At every level, sustainability and sustainable development have become important agenda for communities and nations. In this respect higher education institutions (HEIs) are becoming important medium to lead towards sustainable development including in developing nations. With the presence of its own community network that has expertise in various disciplines, as well as research and development activities, universities are able to form a small enclave of regional entity by itself. In countries like Malaysia, research universities such as University Science Malaysia (USM) are focusing on their commitment and responsibility towards sustainable development with efforts on developing integrated operational strategies with long-term implication to the locality and region. The concept of sustainability and sustainable development are embedded in three missions of the university: education and learning; research, development and commercialization; and community engagement. The three missions represent the three pillars of sustainable development encapsulating the concept of social equity, economic justice and ecological integrity. In this context, the core agenda for sustainability involves the Regional Center of Expertise on Education for Sustainable Development (EfSD), USM-Community partnership, trans-disciplinary (cluster) approach, the university in a Garden, and the Healthy Campus program. The main aim of the sustainability roadmap is to link the local with the global whereby USM have two approaches which is to integrate global sustainability, and to implement sustainability measures at campus level through education. Thus, this paper addresses the level of success and challenges towards achieving those missions including the level of student awareness, perception and response, the education program, as well as the programs undertaken by researchers towards achieving a sustainable development for the environment and locality. The student communities are seen as viable drivers to promote sustainability since they are active youths, able to produce creative ideas and innovation as well as prospective leaders of the future. Meanwhile the research communities are seen as the pillars to promote the enclave idea and sustainability led strategy for the university in the region. The paper provides significant insights for policy makers not only in Malaysia but also other regions and countries especially in developing new ideas and strategies that are strongly associated with the sensitivity to the locality and the enclave idea and effectiveness to the needs and aspiration of the younger generation and communities as a whole.

## **How to integrate Design for Environmental Sustainability into Existing Engineering Project Courses to teach Sustainability as an Integrated Part of Engineering**

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Universities and, in particular, their engineering departments, have an important role in teaching engineers of the future to integrate sustainability considerations into their engineering designs. Pollution and climate change are two examples of where a broader consideration of the impacts – socio-economic, cultural, and environmental impacts, which are

traditionally treated as externalities – of engineering designs, rather than focusing solely on technical and financial considerations, may have made a significant difference to our sustainability.

This paper contains a discussion of the methodologies and best practices for integrating sustainable development (SD) concepts, design for sustainability (DfS), and design for environment (DfE) into existing engineering design courses, in particular, in Engineering Science, an undergraduate division within the Faculty of Engineering at the University of Toronto in Toronto, Canada. Achieving full integration of SD concepts into the existing curriculum is an ongoing evolutionary process: there are opportunities for continual improvement. This paper contains a description of the evolutionary process to date, what has worked and what hasn't, and lessons learned over the four years – 2006-2010 - in which the integration process began and integration was achieved. It includes a discussion of how Engineering Science has developed ESC101 and ESC102: Praxis I and II, core courses required for all first year undergraduate Engineering Science students, which take both a systems engineering and an interdisciplinary approach to solving complex problems in a local context.

Engineering Science, an elite program, graduates engineers that can meaningfully contribute to sustainable development (SD) through this type of curriculum integration. This integration is key to achieving the mission of Engineering Science, which is to produce “Engineers for the World”. What makes Engineering Science unique is that sustainable design considerations are integrated into the curriculum, as early as in the first year of studies, and in a course required for all students, regardless of whether or not they have any prior interest in sustainability. The result is that all students are required to think about and engage in sustainable design as a regular part of the design process starting from day one of their undergraduate careers. Based on our experience, most students come into engineering not quite sure what it is all about, aside from the application of math and science to practical problems and technologies. Within the first year of engineering, students tend to develop what they understand “engineering” to be, and this curriculum integration of sustainable development concepts is intended to ensure that students are inculcated with the need to address sustainability as a core part of engineering.

Based on presenting our results at international conferences in Europe, most recently in Delft, Netherlands, (at the European Roundtable on Sustainable Consumption and Production (ERSCP) and Environmental Management for Sustainable Universities (EMSU) 2010)), it has become clear that the work done in Engineering Science places the program at the leading edge of sustainability education in engineering.

This paper contains the best practices learned from the gradual improvements made to Praxis II for integrating SD concepts, and how these best practices have been applied to improved integration in Praxis I. The 2010 Praxis II course integrated and the 2011 Praxis II course will integrate SD concepts by explicitly requiring students to consider and develop sustainability requirements, using the «DfX» concepts from the «Design for Sustainability» (DfS) and «Design for Environment»(DfE) literature, and incorporate sustainable design concepts into their final projects.

This paper contains a description and analysis of how students have been guided in these sustainable design activities through introductory lectures, discussion groups, and tutorial activities and how sustainable design has been treated as an explicit part of the assignment requirements.

We identify and assess the goals, process, and successes of the 2010 and 2011 Praxis II course curriculum integration – and the progress on increased integration in Praxis I - of sustainable development concepts. The specific training in problem-solving and sustainability concepts that students received, and the challenges students faced in applying SD concepts to their solutions are presented. We also explore how to improve student engagement in and student acceptance of SD concepts. Finally, we summarize the lessons learned for integrating SD concepts and discuss next steps in the integration process.

### **Multidisciplinary Collaboration to Evaluate Local Water Pathogens, Diarrhea Disease Incidence and the Creation of a Sustainable Water Supply to a Community Health Clinic in Oworobong, Ghana**

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The WHO estimates that 1.8 million people die every year from diarrheal diseases and 90% are children under 5, mostly in developing countries. Eighty-eight per cent of diarrheal disease is attributed to unsafe water supply. Proven simple

interventions, such as improving water supply and sanitation, can reduce diarrhea morbidity by 21%. A multidisciplinary team from the Center for Global Health, the College of Osteopathic Medicine and the School of Engineering and Computing Sciences of New York Institute of Technology (NYIT) has collaborated to address the infant disease burden from preventable waterborne illness in Oworobong, a rural village in Ghana.

Waterborne illnesses, such as diarrheal diseases, continue to be a vast problem in rural Ghana. The research site is a small health facility called Heal the Home Clinic, which like the community of Oworobong, is without electricity or running water. The water used by the community is carried by hand from two borehole wells on each side of the river and the Oworobong River itself. The river is used for drinking water by the residents, a site for bathing and clothes washing and a watering site for domesticated and wild animals. Since the river flow can run from full to nearly dry depending on the season, low flow during the dry season can drastically influence water quality and availability. Therefore, the ultimate goal of the project is to reduce the burden of diarrhea through the creation of a safe and sustainable water infrastructure in the presence of seasonal variation.

Our initial health and sanitation needs assessment has involved collecting water samples since June 2010 from the three water sources in the village (two wells and the river) and correlating findings with the monthly cases of acute gastroenteritis by chart review. Qualitative and quantitative bacteriology, virology and parasitology analysis was conducted by the University of Accra Medical School. The chart review portion of this study was conducted at the local clinic run by The Rohde Foundation, a 501-c-3 non-governmental organization (NGO) by research staff between June and July 2010. It will be reviewed again in July 2011 for a 14-month record. To date, there were a total of 1,489 patient encounters recorded. Data collected from a prior survey which investigated water usage in the area around Oworobong was also analyzed. With this combined data, a water safety intervention for the community women who are already conducting maternal health outreach will be designed.

A sanitary survey was also conducted for the two wells, the river and the health clinic. The two traditional borehole wells are located next to houses where domesticated animals are kept and allowed to roam freely around the well heads. The first well (well #1) is in close proximity to the Oworobong River. Both the well and the river were found to be contaminated with various pathogens. This well was drilled to a depth of 80 feet yet it is contaminated and not a suitable source of safe water in the community. Runoff from storms brings rainwater directly toward the second well (well #2). This well is several hundred feet down-gradient from the public latrine. It is also contaminated with bacteria. The clinic itself is located between homes that keep domesticated animals, mainly goats and chickens. There is a small latrine to the back of the clinic which is often used by clinic staff.

The clinic serves patients with many possible types of diseases. Therefore when considering the development of a safe water supply for the clinic, the collection of wastewater must also be considered. Once the clean water is used, the waste water must be safely collected and disposed of to avoid further health risk to patients, local residents and clinic staff. Thus, the water investigation also examined likely locations for the development of a wastewater disposal system for the clinic.

To provide the clinic with a dependable and safe source of water, the proposed solution for the site is to drill a new well at the clinic equipped with an electric pump and capable of supplying both the clinic itself as well as one or more outbuildings that will be developed for staff and visitor housing. The clinic itself was surveyed by NYIT engineering students for layout and dimensions so that using scale drawings, various water delivery and removal systems could be evaluated. Among the options considered were collection of rainwater with treatment, use of well water with treatment, the use of the river for in-stream energy generation, solar panel installations for energy generation, and water treatment technologies such as ozone disinfection. Each system was evaluated for applicability to the site, ease of use, ease of installation, degree of maintenance required and technical difficulty of maintenance, need and use of electricity, reliability and potential for replication at other facilities. The wastewater collection system and disposal system will be designed to protect well water and river water quality.

While the initial goal of the project is to assess waterborne illness and provide a safe and reliable water supply for the clinic, it is expected that the clinic itself may stimulate community-wide economic development, creating further demand for similar infrastructure for the visiting public and for the residents themselves. Therefore water safety and health education will also be taught by community health workers as well as the clinic staff. Through this project we propose to model how educational institutions can bring their multidisciplinary expertise to underserved areas of the world and improve the quality of life in a sustainable manner.

## Sustainability Science in Mexico's Southern Border: Achievements and Challenges

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Despite some progress in fighting poverty, Mexico's southern border continues to have medium to low human development indexes, migration continues to be the best option for many of its youth, and deforestation and pollution are still important environmental problems. Given this context and in order to have greater public support and funding, impact evaluations for local research centers on sustainable development have been contingent upon their effect on these conditions. Since gross economic indicators of well being, tell us little on sustainability, and given that the scale of local research and graduate teaching efforts is rather small, we cannot expect to see their impact on general contributions to macroeconomic indicators. In this poster we use the experience of a local research center, El Colegio de la Frontera Sur (ECOSUR) to evaluate the contributions of in site research to sustainable development. We observed that most evaluations are project specific and we argue that objective indicators are needed to evaluate and compare impact on sustainability between research projects with different objectives and disciplinary methodologies.

In the 1970's, before the sustainability paradigm, two public research centers, the "Centro de Investigaciones Ecológicas del Sureste" (CIES), and "Centro de Investigación Científica de Quintana Roo" (CIQRO), were created in Southern Mexico to study environmental, economic and social interactions that could lead to alternative development strategies in this tropical region. In the 1990's these two centers were merged into one, El Colegio de la Frontera Sur (ECOSUR), with 125 researchers and its mission was redefined. This time, the center was to explicitly contribute to the sustainable development of Mexico's southern border through research and post-graduate teaching. At ECOSUR, sustainability was perceived as the result of a system that includes the understanding of local or imported human adaptive strategies, their impacts on both participants and their environment, and an active participation in the development and application of alternative technologies, formulation of public policy and the promotion of household and community empowerment through changes in grass root level organizations using participatory methodologies. To achieve this, ECOSUR was divided into three thematic areas that roughly correspond to the three pillars of sustainable development: 1) Society, culture and health, 2) Alternative production systems, and 3) Biodiversity conservation. Interaction among these 3 areas was encouraged through the formulation of research projects and student thesis and dissertations.

After 35 years we have generated positive changes at the household, farm, community and sometimes regional level. Examples of these include the most complete inventory of biological richness in tropical Mexico, basic knowledge for the sustainable use of forests and fisheries, the first community benefits of the voluntary carbon market through agro forestry systems, the growth of organic agriculture through the development of biological control methods for pest management and other environmental friendly technologies, understanding of survival strategies used by the local people and how social development programs impact their well-being, public policy assessment on health and gender relationships focusing on the most vulnerable groups.

In addition, in the past 16 years our program has graduated 464 MSc and 76 PhD students. About 95% of our PhD graduates work at universities or research centers, the other 5% have joined local governments and NGO's, and 71% are located in our Southeast region.

In conclusion, many of our projects and graduate school, have contributed to local and regional empowerment and capacity building for sustainable development and our presence in the area makes ECOSUR part of the process and not just a facilitator. Nevertheless, we still lack independent impact measures on sustainable development and while we understand that these measures should be target specific, there must be objective indicators that can be applied across disciplines and research projects to allow us to make comparisons and help us take strategic decisions. So far we have not advanced in this area and so while we may be proud of our individual achievements, until more research on the impact of in site research can guide us we must keep on wondering if, as an institution, we are on the right track.

## Towards Sustainable Technical Universities: Two Cases of Resources Consumption Savings in Campus Buildings

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It is widely agreed that universities have a particular responsibility in a transition towards sustainability. Their principal role in sustainability is associated with two of its more tangible mission goals, the knowledge it produces and the students it

educates. These have the potential for transforming our unsustainable society. However, as it has been widely stated, the sustainability mission does not end here. Universities are organisations with campuses, buildings and communities, with their associated resources consumption and waste generation. Taking in account all these dimensions together sets the framework for sustainability strategies in universities when considering them as organisations that are inserted inside the society they want to change.

Since 1996, the Technical University of Catalonia (UPC) has implemented an institutional sustainability strategy, not only related with research and education of engineers and architects but also with the organisation system as a whole (Ferrer-Balas et al., 2008). This encompassing strategy has proven to have some advantages. First, universities as a knowledge institution must be coherent with their sustainable theoretical discourse. If the organisation pretends a social change, university has to prove capable of changing itself. Second, the future actors in sustainability (students) are part of the university organisation. Their everyday life in campus can be part of their education. Third, campus is a handy study case for researchers to explore and evaluate new methodologies, tools and strategies in sustainability. Therefore, living laboratories approach is a suitable methodology for research and innovation in these fields.

On the other hand, this strategy orientation (UPC as a sustainable organisation) needs and allows sociological approaches. From a disciplinary perspective, these are not traditionally associated with technical universities, like sustainable organizations (Lozano, 2009) or organisational learning (Senge, 1999) and transdisciplinarity (Max-Neef, 2005). These approaches, not only centred in technological innovations, could try to overcome the reductionist, positivist and disciplinary perspective which generates a 'blind knowledge' to solve complex current problems (Funtowich and Ravetz, 1993, Max-Neef, 2005) like sustainability issues. Thus, introducing those perspective in a technical university is an organisational challenge in itself.

Under the umbrella of the institutional strategic program for sustainability, various projects have been applied in UPC campus, progressively developing what it is called today the 'UPC lab', aiming at practicing transdisciplinary research and looking for a wide participation of the community (researchers, students and UPC staff).

In the field of energy efficiency in buildings, strong efforts have been done to have sound access to information. Since 2007, UPC has a public on-line energy information system called SIRENA which provides information on buildings energy and water consumption and allows monitoring the data every 15 minutes. This system has been a key for developing UPC's case as a living lab.

In this work, the results of the resources savings in two UPC buildings are presented: Architectural School (ETSAV) and Ferraté Library (BRGF).

Traditionally, the engineering and architectural approach to reduction of resources consumption in buildings has been focused on improving their envelope quality and systems efficiency. Nevertheless, another factor has a strong influence in the final building consumption: human behaviour. It has to be kept in mind that at the origin of their resources consumption is people demand, which is not a rigid parameter but, in the contrary, has some flexibility. In fact, this is not only related with individual behaviour but also as an organisation. In this case a technical approach might be insufficient, and the first mind shift is that from this integral perspective, a building can be considered a community inside a structure. From this approach, we have developed the work in energy consumption reduction as a particular case of UPC organisation transformation towards sustainability.

In the ETSAV case, a transdisciplinary team of architecture students, researchers and staff stimulated the ETSAV community participation and obtained significant results using a diagnostic methodology based on users' participation. The more tangible are about 100 tons of CO<sub>2</sub> and 2.500 m<sup>3</sup> water annual reduction (about 50.000 €/year savings).

In the BRGF case, students from ETSAV and staff-researcher, with community participation, helped to introduce changes and the result was a reduction of about 75 tons CO<sub>2</sub> (16.000 €/year savings).

This work analyses the results obtained in these two cases from two angles. First, exploring the pre-conditions that have made their implementation and development possible, which seems to be very much linked to the integral nature of the sustainability strategy. Secondly, understanding the importance of the method applied for reducing the energy consumption of buildings, which is innovative with regard to the current predominant approach to building energy saving taught at the university. In the light of organisational learning, this might be a promising step.

In conclusion, the path taken in 1996 seems to have allowed to approach old problems like building resource consumption from a new perspective, not only centred in technical innovation but also in sociological approach: understand buildings as an integral conception, with people inside, with an organisation that has learning capacity.

Eventually, a work with university as a living laboratory towards Sustainable technical universities is a useful strategy to enhance in the sustainability of their product: actors and knowledge with capacity for the necessary transformation of our society.

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## **Sustainable Development through Self-reliant Women Groups in East Africa: Challenges Overcome by Community based Ethical Education**

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Worldwide panic due to climate change increases year by year as the global effect of addition of green house gases accounts for locally affecting natural calamities. Erratic rainfall patterns in Africa and Asia, drought and flooding in most of the African countries, food shortage and diseases spreading in alarming rate are the concerns for developing countries. Since the time of industrialization in 1850, the production of all life easing machines and products are hugely dumped in many of the developing countries by the developed nations. The phase of globalization in 1990s has multiplied the world wide fancy on pleasure seeking instruments and products, which has increased the input of green house gases into the atmosphere affecting the regional and local climate patterns even in the poorest countries. The United Nations' instruments such as Clean Development Mechanism (CDM) and Joint Implementation (JI) have very meager effect in reducing the carbon level in the atmosphere. What the world requires is to adapt a nature loving approach to stop the negative effects of changing climate patterns.

The global warming during the last two decades has devastated the climatic pattern in Ethiopia causing erratic rainfall causing severe drought and flooding leading to the food insecurity and shortage of drinking water in most of the areas. In this context, a locally based work on sustainable development, named as Integrated Sustainable Development Project (ISDP), has been launched as an individually sponsored project based on community focused ethical education for sustainable livelihood development and capacity building in rural communities in Adigrat City in Tigray Regional State in northern Ethiopia. The ISDP initially has been applied for a group of twenty five families represented by women farmers in Adigrat City. The livelihood mechanism launched as a test drive was, home based poultry units for economic development. Other livelihood mechanisms such as dairy farming, goat farming, cotton weaving, etc. are in consideration for other groups in the proceeding stage of the project work. ISDP successfully integrates the development of sustainable livelihood mechanism and capacity development for local farmers. The livelihood mechanism is a climate adaptation program that supports the farmers to earn little by little and secure the savings through the microfinance system. The ethical education for the basic environmental practices for the pre-school children and for the adults is designed as the foundation for this developmental initiative to strengthen the community based learning. The microfinance system has been designed for the savings from the selling of eggs, chicks, etc. and the money will be utilized for capacity building for individual house holders to bring other developmental elements like clean water and scientifically developed sanitation facilities, health facilities and employment for the educated youth. The major challenges identified from the initial stages were population, illiteracy, social vulnerabilities like addiction to drinking, smoking, sexuality, family disintegration, slow and lazy approach towards learning new ideas, the perception about the livelihood mechanisms and its capacity to ensure income generation for economic development. Ethical education programs have been delivering for pre-school children for preparing them for the school education and adult community education classes delivered to strengthen the social integrity and environmental awareness for cleanliness, health and economic development through livelihoods development. The challenges are overcome by regular community education, training classes and field trips to the already successful farmers and sharing of their experience and guidance for others. The ISDP therefore has been designed to bring total sustainability in every walk of life in rural Ethiopia and thereby adequate enough to build Ethiopia as a developed nation, which will be a self-reliant country that can never expect any donations from international agencies.



## Education and communication for transition towards a sustainable future

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This paper focuses on the importance of education and communication in the context of transition processes towards sustainable development in industrialized countries. Scenario studies have shown that a sustainable resource-efficient and low-carbon society is achievable but requires a radical and rapid reduction of our resource and energy consumption. In order to implement the necessary changes, a perspective of sustainable transition must be developed; covering science, governance, companies and institutions, as well as other relevant stakeholders, in an innovative and integrative manner. Here, education and communication strategies play a crucial role for transition towards a sustainable society.

A key research question is how to bend the trend from unsustainable production and consumption patterns towards more sustainable behavioural patterns. Transition of present political structures, culture and regimes towards sustainability imposes huge challenges on all levels of socio-economic systems. Specific educational and communicational infrastructures, institutional as well as knowledge-related, are an important precondition for the acceleration and diffusion of transition processes. High levels of education are necessary for understanding complex problems and a set of certain skills (or competencies) is needed by citizens to actively participate in society and societal transformation processes (de Haan, 2008; Bliesner and Rohn, 2009). They also require a well functioning communication network allowing for a quick exchange of information and experience. Frontrunners in transition processes need to be convinced to become active change agents, being well educated in their discipline (knowledge) and the management of transition processes (competencies) (Kristof, 2010).

The Dutch transition research approach developed by the Dutch Knowledge Network on System Innovations and Transitions - KSI (Loorbach, 2007; Loorbach, 2010; Loorbach and Rotmans, 2006; Kemp *et al.*, 2007) will be used in this paper to describe transition in the field of education and communication for sustainable development as it helps to fundamentally structure this research field in the context of sustainable transition (Schneidewind, 2010). Transition research analyzes the non-linear fundamental systemic “change[s] in structure, culture and practices” (Rotmans and Loorbach, 2010; 109) in society or in a specific part of society. Transitions towards sustainability are framed as joint searching and learning processes with a focus on long-term sustainable solutions for persistent problems. The circular nature of this learning process is therefore a crucial element of the transition research approach (Rotmans and Loorbach, 2010; Schneidewind, 2010).

The Transition Cycle consists of four phases (problem assessment, vision development, experiments, learning and up-scaling), not necessarily taking place successively, but influencing each other. Based on these four phases, the Transition Cycle will be described along the following questions: what is the *status of analysis*, what are relevant *visions*, what kinds of *experiments* have already been carried out, which concrete *learning processes* (e.g. in the form of concrete policy programs or actions) have taken place and have been implemented. These descriptions will finally deliver input for the analysis of the role of education in transition management towards sustainability.

On the one hand, existing education and communication systems have not focused on the challenges of education and communication for sustainability and transmission of necessary competencies; on the other hand, education of sustainable development is not yet tied appropriately to relevant discourses in the field of education research. Nowadays, people are highly educated concerning their discipline but they only get very limited support (if any) in developing their social learning competency (learning by doing – doing by learning). A crucial educational task would be to foster an interdisciplinary, anticipatory and connected way of thinking (Vester, 1985) as well as a global and responsible way of acting that is embracing current and future generations (Jonas, 1979).

The basic vision is to move towards a communication and research society that aims at implementing sustainability and resource efficiency at all levels and in peoples' daily life. A systemic way of thinking can only be learned if supported by structures and frameworks in society – existing thinking structures influence the development of infrastructures and social structures, and vice versa. In terms of sustainable production and consumption patterns, people need to be integrated in development processes of product service systems in order to allow a systemic view on value chains. This leads to product development systems fostering

interaction between producers/designers and consumers. A vision of education for sustainable transition is an integrative, interdisciplinary and holistic concept of education for all groups in society (UNESCO, 2006; UNU-IAS, 2005).

The German Wuppertal Institute for Climate, Environment and Energy has developed several educational projects to support the transition to sustainable consumption and production patterns in industrialized countries, e.g.:

- Living Lab: Design study for the Living Lab research infrastructure to research human interaction with, and stimulate the adoption of, sustainable, smart and healthy innovations around the home ([www.livinglabproject.org](http://www.livinglabproject.org)).
- Encouraging Sustainability: Developing and implementing a scientifically based communication strategy for sustainable consumption and production ([www.mut-zur-nachhaltigkeit.de](http://www.mut-zur-nachhaltigkeit.de)).
- Course 21 «Schools manage future»: Bringing schools and companies together in learning partnerships for sustainable development ([www.kurs21.net](http://www.kurs21.net)).

Collaboration with institutions and networks in the field of education for sustainable development (ESD), such as the UN-Decade for ESD, and with communication-institutions have great potential for developing shared visions of a sustainable civilisation among researchers as well as societal stakeholders. Access to current educational research, e.g. to transfer research in education science, is needed for successfully implementing ESD approaches in the educational system in industrialized countries (Gräsel, 2010).

In consequence of these findings we need to modify education and education for sustainable development. Lozano (2006) claims that people need a multi-, inter- and trans-disciplinary education for transition towards sustainability:

- multidisciplinary education: “cooperation between various disciplines, keeping intact every separate set of theoretical concepts and methodology”
- interdisciplinary education: “cooperation between various disciplines with a common methodological approach and theoretical fundament as a synthesis of the participating disciplines”
- transdisciplinary education: “not only cooperation between specialists of various disciplines but also direct involvement of others: users, problem owners, clients, stakeholders etc. (trans-disciplinary = beyond the disciplines)”

An educational system based on this vision can enable people to develop necessary competencies for transition towards sustainability enabling individuals to overcome the barrier between ignorance and knowledge (Kuckartz and Rheingans-Heintze, 2006) and between knowledge and action (De Haan and Kuckartz, 1996).

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## Sustainable Development Education

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Implementing policies for a sustainable future requires that people are knowledgeable and ready to approach challenges from a long term perspective. Universities play a critical role in developing educational programs in sustainable development, both to raise general awareness about different approaches to problem solving, as well as to train decision-makers.

One of the first degree programs of its kind in the United States, Columbia's PhD in Sustainable Development combines a traditional graduate education in the social sciences, particularly economics, with study in the natural sciences and engineering, to prepare scholars who are uniquely situated to undertake serious research and policy assessments in furthering the goal of sustainable development. The program includes a set of core requirements in the social and natural sciences designed to provide a deep understanding of the interaction between natural and social systems, and provides students with the flexibility to pursue in-depth research in a broad variety of critical policy areas.

Columbia's master's programs address the critical issue of short-term training of decision-makers and include a M.S. in Sustainability Management (MSSM), M.A. Climate and Society, M.P.A. in Environmental Science and Policy (MPA ESP), and M.P.A. in Development Practice (MPA DP).

The M.S. in Sustainability Management is co-sponsored by the Earth Institute and the School of Continuing Education. The MSSM program is a specialized professional program developed in response to the increasing demand for sustainability expertise in a broad range of fields. It provides practical training for a new generation of professionals who will address critical interdisciplinary issues from limiting carbon emissions and financing alternative energy to managing water resources and developing green buildings. The program is offered on both a part-time and full-time basis in order to meet the needs of working professionals in the tri-state area. Sophisticated environmental measurement tools, cutting edge environmental science and world class management and policy studies help students understand the systematic and organizational role of sustainability in any organization.

The M.A. in Climate and Society, co-sponsored by the Earth Institute and the Graduate School of Arts and Sciences, is a one-year program that trains professionals and academics to understand and cope with the impacts of climate variability and climate change on society and the environment. The M.A. Program in Climate and Society combines elements of established programs in earth sciences, earth engineering, international relations, political science, sociology, and economics with unique classes in interdisciplinary applications specially designed for the program's students. This rigorous program emphasizes the problems of developing societies and the program recruits outstanding applicants from the developing world who will return to advance development in their own societies. Graduates are prepared to address environmental issues from positions in government, business, and nongovernmental organizations.

Co-sponsored by the Earth Institute and the School for International and Public Affairs, the MPA Environmental Science and Policy program is a one year program that trains public managers and policymakers to apply innovative, systems-based thinking to environmental issues. The MPA ESP integrates management and policy analysis with practical skills and ecological and planetary science, requiring more environmental science core courses than any other existing public policy master's degree in the world. Almost 40 percent of those graduates working in environmental fields are based in the public sector, working for government agencies such as the City of New York, the Metropolitan Transportation Authority, the Environmental Protection Agency, the California Public Utilities Commission, and the United Nations Environment Programme, among many other domestic and international agencies.

The MPA in Development Practice, co-sponsored by the Earth Institute and the School for International and Public Affairs, is a two-year program designed to train and educate experienced development practitioners in understanding, developing, and implementing integrated approaches to sustainable development in order to become more effective development professionals. The two-year degree program includes a hands-on field experience through a mid-program field internship. The program equips students with the skills and knowledge required to better identify and address the global challenges of sustainability development, such as poverty, population, health, conservation, climate change, and agricultural productivity. MPA DP emphasizes practical knowledge and skills in food systems, public health, education, infrastructure, environmental sustainability, business enterprise, economics and management. The creation of the MPA-DP degree was one of the core recommendations of the International Commission on Education for Sustainable Development Practice, supported by the John D. and Catherine T. MacArthur Foundation. Students are trained to apply cross-disciplinary and cross-sectoral knowledge to address complex sustainable development,

integrate science and technology into sustainable development policy and implementation, and develop and analyze a broad range of sustainable development interventions and policies. Students are trained to work for NGOs, the United Nations and related UN development programs, aid-relief agencies, foundations, as well as consultants for private corporations and companies.

Columbia University's new undergraduate major in sustainable development is founded on the principle that students must be trained in a variety of disciplines in order to be effective leaders in the field of sustainable development. The program is designed to ensure that graduates, upon completion of the degree, will understand the basics of the natural and social sciences and will be equipped to address complex problems across a wide range of challenges facing humanity.

These programs are highlighted from the 24 academic programs affiliated with the Earth Institute, Columbia University. Ranging from undergraduate to graduate options of study and student programs, this represents one of the largest collections of environmental education programs in the world.

### **Strengthening Sustainable Development Practice in Sub-Saharan Africa: Role of the Centre for Sustainable Development, University of Ibadan, Nigeria**

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Sustainable development is generally explained as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs". It has three intertwined goals of meeting basic human needs, reducing hunger and poverty, and maintaining the life support systems of our planet. These goals have global acceptance in the forms of the targets of the millennium declaration (UN General Assembly, 2000) which include the goals of reducing hunger and poverty by 50 percent in the world by 2015. Unfortunately, many African countries may not attain the Millennium Development Goals (MDGs) as a result of limited capacity to put in place and implement workable policies on sustainable development at the country level. Even where this exists, the issue of stewardship and good governance leaves much to be desired. Incidentally, the optimal development performance of any country rests on these, and development practitioners are critical to this process. Studies in many developing countries have shown that there is unmet demand for knowledge support for development practitioners at all levels. Enhancing development actors' capacity and leadership may directly result in improving sustainable development in such countries.

The University of Ibadan has over the years demonstrated its commitment to sustainable development and has taken up the challenge to support development actors in developing countries to achieve this. This paper details the capacity building efforts of the University of Ibadan, Nigeria towards sustainable development in the midst of the myriads of developmental challenges besetting developing countries. It examines the innovative nature of the capacity building process leading to the establishment of a Centre for Sustainable Development (CESDEV). The Centre is a scheme aimed at moving society toward a sustainable future through the provision of capacity building programmes to development practitioners.

The commencement of the MacArthur Foundation-funded Master's in Development Practice (MDP) Programme now provides an avenue for advanced training in sustainable development practice for Sub-Saharan Africa through an integrated and multidisciplinary approach that incorporates local knowledge. In addition, the Centre has instituted the following programmes that impact directly on sustainable development: Tourism Development Programme (TODEP), Environmental Protection and Natural Resources Programme (EPNARP), Society and Climate Programme (SCP) Leadership and Governance Programme (LGP) and the Ibadan Sustainable Development Summit (ISDS). By design, these programmes will build and strengthen the capacities of practitioners mainly through short courses. An annual Sustainable Development Summit has also commenced since November, 2010. The programmes have generated interest and hold promise to galvanize the developmental needs of Sub-Saharan Africa.

Several cross-cutting issues that are relevant to sustainable development also have major impacts upon the efficacy of interventions to bring local empowerment to the sub-Saharan Africa region. These cross-cutting issues also tend to impact upon each other, making development planning more complex. Among these issues are: gender inequality, pervasive poverty, social exclusion and vulnerability, past and potential social conflict situations, low level of infrastructural development, climate change and environmental degradation, type of development approach, inadequate and inaccurate databases, and policy inconsistency (Olawoye, 2010a&b). This paper, therefore, presents the new approach by the University of Ibadan to address issues germane to sustainable development in Sub-Saharan Africa in general and Nigeria in particular.

The University of Ibadan Centre for Sustainable Development provides the intellectual platform for identification of issues germane to sustainable development, critically analyze them, and provide leadership in finding enduring solutions that will enhance sustainable development. The Centre for Sustainable Development aims to integrate economic, social, cultural and environmental objectives in development. It is based on a consideration of the relationship between economic factors and other developmental elements such as housing, education, the natural environment and health. The establishment of the Centre has thus emerged as a compelling alternative to conventional approaches to development: a participatory, holistic and inclusive process that leads to positive, concrete changes in communities by creating employment, reducing poverty, restoring the health of the natural environment, stabilizing local economies, enhancing governance and increasing civil societies' control of their own affairs. The vision statement of the Centre is "to be Africa's Centre of excellence for Sustainable Development" and the mission statement is "to build and strengthen human capacity to unleash Sustainable Development in Africa".

The mechanism and opportunities that CESDEV adopts to achieve its aims include: offering professional Master degree in Development Practice (MDP) and professional and academic Master's degrees in Tourism Development (TODEP); organize short courses in all the broad programmes. The short courses are aimed at developing and sharpening the skills of employees in the public sector organizations, private sector organizations and non-governmental organizations, who may otherwise not have the luxury of returning to the university for long period of studentship.

The Ibadan Sustainable Development Summit (ISDS) is another initiative of CESDEV aimed at providing a platform to discuss topical developmental issues of national, regional and global importance. The maiden edition was held on November 25, 2010. The first ISDS brought together experts from across the globe, especially sub-Saharan Africa. Over 120 scholars, technocrats, researchers and politicians participated in the summit. The theme of the summit was: "50 years of Nigeria's Nationhood: Experiences in, and Prospects for Sustainable Development". The summit identified and recommended the following: need to effectively harness the nation's abundant resources for the benefits of all; need for the establishment and strengthening appropriate institutions involved in, and for sustainable development; need for national re-orientation on national values & ethics for sustainable development; need to sustain and improved democratic governance in Africa; need for public and private sectors investments in research and development for sustainable development; need for political will in the implementation of national development policies for sustainable development; need to mainstream gender in sustainable development as well as the need for strengthening international cooperation. The proceedings of the summit are being processed for publication.

Further, beginning from the second quarter of 2011, the following short courses will be delivered: Mentoring and Succession in Public Sector, Corporate Social Responsibility in Sustainable Development, Tourism Administration and the Media as a veritable medium in climate change information dissemination. The short courses have been carefully designed to address specific niches and gaps in developing economies. The short courses for the third and fourth quarters of 2011 are already in process. Preparations for the second Ibadan Sustainable Development Summit which will hold in August, 2011 have commenced with the announcements and call for papers and contributions (visit [www.cesdev.ui.edu.ng](http://www.cesdev.ui.edu.ng) or [www.cesdevui.com](http://www.cesdevui.com)). The theme is: "Global Change: Challenges and Opportunities for South-South Cooperation".

The University of Ibadan administration has invested heavily on a state-of-the-art infrastructure to host the Centre's activities. These include lecture suits, syndicate rooms, Information and Communication Technology (ICT) facilities and a cafeteria. Similarly, to ensure the effective realization of the objectives of the establishment of the Centre a strict mechanism for the monitoring and evaluation of the activities has been put in place. This is to ensure accountability, performance and quality standards that enhance decision-making for strategic planning, resource mobilization and sustainability. The overall aim is to achieve organizational effectiveness that enables the Centre to deliver first grade services and impact society in line with its vision and mission statements.

Africa's declining development remains unacceptable and requires urgent concerted measures to re-direct efforts and resources at unleashing sustainable development. Capacity building and strengthening in strategic areas is therefore germane. This calls for the support of stakeholders for such initiatives as the emerging Centre for Sustainable Development at the University of Ibadan.

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## UCSAL Green Room: Sensibility to the Environmental Question

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The establishment of a green room within the structure of the Universidade Católica de Salvador (UCSAL) in the Brazilian Atlantic Coast represents an interesting factor of sensibility to the environmental cause, notably among members of the community (instructors, students and administrative personnel) who have in their conceptual spaces - reference space, articulation space and dissemination space - the necessary tools for the development of actions and practical measures of environmental preservation.

By reinforcing its role towards sustainable development the University stimulates the adoption of postures of zeal for and protection of the environment. Therefore, the green room - on account of its total assets and the cataloging of its experiments - operates as an irradiating pole of purely scientific and empirical knowledge, i.e., immediately useful for individual researchers and also as a stimulus for team work in either private or government management. It can thus be characterized as a reflection point concerning the role Brazil can play for environmental management in the world as a whole, as for example, with a view to its preparation for the event Rio+20 to occur in 2012.

The fact of its being a multi-campus institution has allowed the Universidade Católica de Salvador to appear in foremost position, actually as a pioneering institution in this part of the country whenever sustainability stands out as a topic of academic or pragmatic discussion, and mainly so when the fact is considered that one of its most important *campi* is situated within a large public ecological park in the very heart of the city of Salvador, in the state of Bahia, Brazil. In actuality, our privileged position permits the simultaneous use of various conceptual spaces, for it provides immediate practical benefits to different communities, thereby enlarging the field of actions. In such park - the Parque Metropolitano de Pituáçu (Pituáçu Metropolitan Park).

One can verify permanent attempts of aggression of the urban space by means of arbitrary construction of inadequate dwellings in direct confrontation with the necessity of environmental preservation. Such social-environmental issue tends to stimulate the debate among researchers, thus raising constant challenging of new themes to be periodically incorporated in the agenda of the UCSAL green room.

This paper describes the experience of the establishment of the green room, which is not the first effort of the Institution, since for some time it has already counted with the support of PREAM (Programa de Educação Ambiental), a program of environmental education linked to the Institute of Biology of UCSAL. The outstanding present fact is that the University has sought for synergy with other institutions of teaching and research in the areas of engineering, administration, social services, etc and has also promptly adjusted to characteristics of the major program of the Federal Secretary of Environmental Questions of the Brazilian Government.

The simplicity of the conception of the Green Room model has made it operate as an inductive element of postures of sustainable development, preliminarily within its own academic community -with an extension to other audiences that may be sensitive to the environmental cause, such as NGOs, churches, associations, and so on.

With an ever increasing number of audiences from the diverse social groups that inhabit the geographical area of UCSAL, the Green Room has been enlarging its importance as an adequate alternative to define the role of universities in relation to environmental issues and has also propitiated the application of its learning to other teaching and research organizations in different parts of our country, or another countries. .

## Sustainable Education: Where does the intellectual capital go?

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The purpose of this paper is to investigate the significance of sustainability and sustainable development in both university teaching and education in general, and to examine the role of sustainable development in the life of the individual. An attempt is made to identify the specific competencies needed for promoting sustainable action, and also to determine the paths followed by the related intellectual capital once developed. The paper should be seen as a general statement in light of the scope of the conference. The aim is to show that education for sustainability should not entail a focus on any single discipline, but rather that it should be designed to match the prospective multi-dimensional paths of future decision makers. The main research question is thus: What form of university education is required to deal adequately with the problems of sustainability for present and future generations?

A sustainability questionnaire was developed in a joined effort of scientists, practitioners, teachers and students (students particularly of an interdisciplinary training course as part of the degree program Environmental Systems Science (USW) at the University of Graz). The questionnaire was pretested in various study programs and consequently provided to 500 students across the six faculties of the University of Graz. In addition, guided interviews with lecturers, deans and vice-rectors were also undertaken.

There is a clear need for 'sustainability values' such as concern for the environment, economic fairness, social responsibility, ethics and cultural diversity, to become part of the "DNA" of present and future generations. This is a basic precondition for any further development in this area. The research findings provide a basis for ongoing research on a broader national and international field.

Sustainable development aims to satisfy the needs of the present generation without diminishing the opportunities available for future generations. Today, the field of sustainability normally concerns itself with the synergies and interactions arising between the environment, the economy and society. In other words, it aims to highlight the tradeoffs and solutions involved in dealing with questions of resource conservation, economic viability and social justice. Today's recipients of university education should be instructed in such a way that they become competent decision makers for themselves and for coming generations

### **Popular entertainment films can constitute a motive for citizen's participation in the environmental decision making process: The impact of the films *The Day After Tomorrow* and *Erin Brockovich* on people's perception of environmental problems**

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Climate change plays an obvious role in tourist destination choice. The "amenity of climate" is recognised as one of the major determinants of tourism flows (Maddison 2001, Lise and Tol 2002, Bigano et al., 2007, Bigano et al. 2008, Wall 1992, de Freitas 2003, Gomez-Martin 2005). The Mediterranean in particular benefits from this determinant, being close to the main holidaymakers of Europe's wealthy, but cool and rainy, Northwest. Tropical islands are another example, where in the recipe of a dream holiday their "perfect" climate is a fundamental ingredient (Bigano et al., 2008). Climate change would alter that, as the currently popular holiday destinations may become too hot, and destinations that are currently too cool would see a surge in their popularity (Hamilton et al. 2005a,b, Hamilton and Tol 2007, Amelung et al. 2007). Low ski resorts and winter tourism may be particularly vulnerable. The theory of sustainable tourism emphasizes the critical importance of environmental stewardship (Brander et al, 1995).

Environmental Education (EE) can constitute a dynamic means of stimulating environmental behavior and encourages participation in the decision-making process in order to sustain the development of tourism. The main objective of EE is that citizens develop a responsible environmental behaviour (Hungerford and Volk, 1990). Critical evaluation and citizen participation in the environmental decision making process constitute basic values of EE (Skanavis et al., 2005). EE has mainly been established in the formal education; however, its importance has been recognized in the forms of non-formal and informal education.

Environmental Communication is closely related to Informal Environmental Education. Environmental Communication is the planned and strategic use of communication processes and media products to support effective policy making, public participation and project implementation geared towards environmental sustainability (Harrison, 1993, OECD, 1999, Cox, 2010). Environmental Communication should play a more active role in order to encourage visitors and local population to alter their inappropriate behavior and to assist the management of environmentally sound tourism development. Media usage has a serious influence on awareness of environmental problems and on related behavioural intentions.

Films do influence social groups because cinema disseminates information, messages and represents stereotypes without, however, implementing a specific communication strategy (Grant, 1986, Dimnik and Felton, 2006). In other words, cinema is responsible for shaping the environmental attitude of the public. At the same time, films reflect the audience's environmental profile in order to be agreeable to it, confirming the theory of interaction between public and media. The dissemination of environmental information through films can change society's environmental sensitivity, awareness, attitude and participation skills.

The film *The Day After Tomorrow* depicts the abrupt and catastrophic transformation of the Earth's climate into a new ice age, playing upon the uncertainty surrounding a possible North Atlantic thermohaline circulation (Gulf Stream) shutdown.

Much has been said with regard to the statements of the film and the assessment of their scientific realisms, and most critics pointed towards exaggerations and even false facts (Reusswingetal., 2004). In this framework, studies were designed (Lowe et al. 2006, Reusswingetal. 2004, Balmfordetal. 2004, Lowe, 2006) in order to assess the impacts of the film to the lay public. Evidence suggests that, the film did increase awareness and concern of the variety of potential effects of climate change, but there was uncertainty about the likelihood of such events actually occurring. Viewers recognized the film as fiction and not as science. Despite the scientific uncertainties, the film had positive effects on willingness to act.

The film *Erin Brockovich*, is a US made film about underground water toxic contamination in Hinckley, California. The film tells a real-life story about a toxic tort lawsuit filed by residents of a small American town. The plaintiffs claim that a local industry has polluted the community's water supply, causing sickness and death. A similar case is found in Greece, at Inofita Industrial Area and the near-by Oropos town, a popular Greek domestic tourism destination. A survey was designed, concerning the impact of the environmental film *Erin Brockovich* to the potential visitors of Inofita and Oropos touristic area, where underground water are heavily contaminated. The audience of *Erin Brockovich* watches the Greek documentary *Erevna*, which correlates the toxic pollution cases of the two regions, Hinckley and Inofita. Evidence suggests that the film *Erin Brockovich* has stimulated learning effects among its viewers and had a net positive effect with regard to the self addressed goal of stimulating awareness and willingness to act.

This paper investigates the impact of two big Hollywood films, *The Day After Tomorrow* and *Erin Brockovich* on people's perception of environmental problems. Results suggest that the instructive role of cinema and the revelation of an environmental problem through a film, can constitute a motive for the environmental sensitization of the audience and promote citizen participation in the environmental decision-making process. Future recommendations include the use of popular environmental films in the formal education system, in order to change the content of curriculum in direct and relative to the needs and perceptions of students. The nature of popular films, as a device for storytelling and for the communication of information can be used to raise environmental awareness of local communities, in order to promote their participation in the environmental decision-making process. Finally, the combination of documentaries of local interest with fiction environmental films, both introducing the same environmental problem, can attract the interest of the audience, foster environmental sensitivity and promote citizen participation in the environmental decision making process.

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## The Benefits of Education on Marine Sustainability

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Today the United States is in the process of a “green movement” in attempts to create more sustainable lives for both humans and animals, yet many people still have not been educated in the social constructions and meanings of sustainability. Many people do not pragmatically understand what is required to live a sustainable life. This paper focuses on how public school education efforts intersect with conservation efforts of sea turtles in the East Coast of the United States. It explores how educational curriculum, teacher training, and teacher attitude impacts what students perceive as important regarding sustainability. In the United States, the East Coast is home to some high quality nesting habitats for several species of sea turtles including (but not limited to) *Caretta caretta*. In the communities surrounding these nesting beaches there is a unique opportunity for schools to educate their students on sea turtle and marine conservation. This study explores to what extent marine sustainability awareness is part of a designed curriculum much the same as any other environmental phenomenon might be. This study hypothesizes that schools that provide a general education about sustainability will encourage students to be more concerned and aware of sustainability in their marine environment. The sample for this study will consist of 12 schools along the east coast from North Carolina to southern Florida which have endangered sea turtle nesting beaches. The methodology used for this project consists of a triangulated model that includes: 1) a review of the literature on sea turtle education; 2) a teacher survey to determine to what extent sea turtle and marine education is part of the overall biology curriculum, 3) details about that curriculum; and 4) an analysis of the importance of sea turtle sustainability to the communities. Both qualitative and quantitative data will be provided about public school education, and recommendations for incorporating sustainability education into school programs will be provided in the forms of sample curriculum and educational forum discussions on the topic of marine sustainability.

## Challenges, Opportunities, and Roles of Japanese Universities in Fostering Environmental Leadership in Asia and Africa

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Resource users' activities such as over-use, unplanned-use, and non-use of environmental and natural resources can result in potentially unwanted consequences, including soil erosion, floods, and food insecurity as well as dysfunctional relationships between humans and nature. These activities threaten the sustainability of natural and environmental resources. Japanese universities are playing increasingly active roles in developing environmental leadership skills in graduate students so that they can become future environmental leaders and take the initiative to address these issues in Asia and Africa. This study examines the challenges and opportunities that Japanese universities face in promoting environmental leadership programs for graduate students both at home and abroad.

The Japanese government has funded 17 environmental leadership programs at Japanese universities for graduate students who are enrolled at both Japanese and partnership universities in Asia and Africa. This study focuses on two environmental leadership programs – Leadership Program in Sustainable Living with Environmental Leadership (SLER) at Yokohama National University (YNU), and Special Coordinated Training Program for Sustainability Leaders and Sustainability “Meisters” (StraSS) at Hokkaido University. The study demonstrates that both programs have comparable objectives and that the way in which they address their sustainability challenges are both similar and different. These programs have added new facets to the traditional education system and play an active role in creating new opportunities for developing environmental leadership skills in graduate students who are already enrolled in varying graduate programs in partnership universities of Asia and Africa. This goal is accomplished through the use of lectures, seminars, conferences, and field training and surveys.

The main purpose of the programs is to achieve sustainability in natural and environmental resources as well as a harmonious relationship between humans and nature. In this regard, the programs have developed partnerships with overseas universities in developing countries, including Indonesia, Malaysia, the Philippines, Thailand, Kenya, Madagascar, Burkina Faso, and China. The programs are also utilizing video conferencing systems at the partnership universities to deliver credit courses and to organize conferences in a real-time setting for larger classes at these universities.

The programs invite highly talented students and faculty members to Japan for intensive trainings. SLER argues that environmental leaders cannot entirely eliminate environmental risks, but they can minimize those risks to an acceptable level so that humans can coexist sustainably with nature. Similarly, but from a different viewpoint, StraSS attempts to achieve social, organizational, cultural, and resource sustainability by resolving interrelated problems that threaten human survival, as well as by ensuring environmental durability in a holistic way while involving various stakeholders. StraSS also aims to establish virtual curriculum by combining resources from its partnership/alliance universities. Both of the programs are committed to providing an exciting career path for those students who wish to take on leadership roles in the field of sustainability.

# Redefining economic systems for sustainable development

Karl Johan Bonnedahl & Fernando Diaz

## Oral Presentations

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### A Time-Spatial Approach towards Integrated Sustainable Development of Post-Monetarism

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Associate Professor Elin Wihlborg Linköping University

The post-industrial information society leads to new patterns of societal change. Despite the changes, the conventional monetary market oriented economic view of development is still dominant. However, essential values are often concealed or even excluded in conventional monetary analyses, which are fundamental for integrated sustainable livelihoods.

Rural areas in the western world have a possibility to be in the forefront of new alternative routes to achieve sustainable integrated ecological, social and economic development processes that reaches beyond the conventional monetary market oriented development strategy.

Thus, this article aims to elaborate and discuss a conceptual model that can contribute to alternative development approaches – towards post-monetarism. The article will thereby enhance new alternative political-economic analytical tools and strategies to achieve a sustainable sound integrated socio-, economic-, and ecological development process. Using a time-spatial perspective, building on Hägerstrand's time-geography, the exploration of an alternative post-monetary norm takes off from an in-depth case study in Ydre municipality, Sweden. Hägerstrand's models open for an alternative constructive approach to analyze and physically anchoring socio-economic and ecological processes extended over time. Such a view contrasts the conventional monetary development growth perspective.

The empirical work is conducted through a combination of quantitative data collection methods primarily consisting of in-depth field studies/interviews with households. The analysis reveals the interplay between actors and structures in the interaction between people's daily life, and aggregated data of population, economic activities and political structures.

The political implications of these potential conceptual tools could be to analyze and value people's everyday norms and activity patterns in different ways, and thereby avoid inadequate stereotyped standard policies towards development.

### Voluntary standards on the climate common: To set the wolf to guard the sheep?

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Among many reasons for the lack of a substantial business sector response to the climate challenge are insufficient consumer demand and an unfavourable institutional setting. An inherent dilemma is that climate change presents a collective problem which resembles the tragedy of the commons (Hardin 1968), while our social organisation, to meet goals and challenges, largely rely on individual initiatives and market coordination. According to conventional economic discourse, actors are expected to seek growth, maximize profits and focus economic interests near in space and time. Ecosystems are mainly viewed as resources and sinks, underpinning the linear cradle-to-grave system that became the engine in economic growth but also in environmental degradation. In other words, although climate change is “the greatest example of market failure we have ever seen” (Stern 2006), society largely relies on individual initiatives, market solutions and voluntary agreements to create low-carbon routes of action. Is this a matter of asking the wolves to organise the common and guard the sheep?

This paper is an attempt to investigate the scope for market actors to, through voluntary standard setting, unlock the system that so far has compelled us to increase activities that drive not only climate change but also pollution and ecosystem degradation more in general. This “system” is not only constituted by institutional rules and structures concerning individual property, international trade, etcetera, which encourages individual maximization rather than prudent management of the common. Corresponding assumptions and values, such as the firm belief in individuals, technology and market solutions, also uphold and reproduce the current unsustainable use of the common.

Nevertheless, research has presented guardedly optimistic views on institutional diversity and the possibility to learn from earlier experiences of successful governance systems as stewards of environmental resources (Dietz et al 2003; Ostrom et al 1999). In such a context, the paper discusses a delimited endeavour to manage the climate common, through voluntary regulation in a particular sector and market. Investigating the development of a climate standard and related label on the Swedish food market, the purpose is to assess the potential and limitations of this form of initiative in terms of change of food sector practices and, hence, management of the climate common.

Although the outcome is ambiguous as an attempt for prudent management of the common, there are arguments for why an initiative such as the one studied could be successful. It relies on well known instruments and builds on a reduction of some of the complexity associated with governance of the common. Largely based on the shared understanding of the problem, grounded in scientific explanations, standards were indeed produced. These became market leading and called for change beyond legislative requirements, even though large mainstream actors dominated the process. However, the partial success of the project became dependent on balancing problem solution with conflict avoidance. As clear examples of the latter, neither the integrity and assumed responsibility of consumers, nor the economic interests of producers, were challenged in the standard-setting process. Environmental criteria were incorporated into market activities through the standard, but in steps that did not disturb or harm prevailing economic and social interests. Here, one can refer to a central theme in Hardin's article, the common assumption that environmental problems have technical solutions, in contrast to posing new demands on human values or ideas of morality. The wolves are indeed reforming their eating habits, but sheep continue to disappear from the common.

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### **Ability of the state to build a green economy and the impact on labor**

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The global financial crisis of the late 2000s came at a critical time for the development of responses to the climate change imperative. However, the potential creation of green jobs offers an apparent 'win-win': investment in environmental technologies could simultaneously boost the economy and protect the environment. This argument (made by politicians in the UK, the US and elsewhere) follows Michael Porter's 1991 assertion that economic benefits can accrue from environmental policy implementation. It is argued that environmental policy can be used to direct the process of innovation, fundamental to firms in a capitalist economy, in the interest of the environment. However, whilst the environmental benefits of policies may be widely shared, the financial benefits are likely to be far more restricted in distribution. This theoretical paper seeks to address the lack of attention to labor in standard discourses on economic-environment issues by analysing fundamental contradictions of capitalism. One of these is the capitalists' need for a market whilst keeping wages low. The second is the tendency, without regulatory restraint, to exploit resources to exhaustion in disregard of potential future needs. This paper argues that the state should not expect to ameliorate one contradiction by drawing on the effects of regulating the other. Innovation inspired by environmental policy is not immune from the broader logic of technological innovation in capitalism, a major aim of which is reducing the cost of labor.

Discourses around the environment-economy interrelationship are commonly framed in terms of what has been called the second contradiction of capitalism (O'Connor, 1994). Regulations are needed to protect the environment from businesses' short term profit taking at the expense of their long term interests in resource supply and ecosystem health. A good example of the second contradiction is the marketing of homes on the outskirts of Tucson, Arizona, for their desert location, when that very environment is encroached upon by development (Prytherch, 2002). Few would argue today that environmental regulation is unnecessary in principle, although of course it is contested in practice. The protection of the environment has become a major task of governance at all scales. However, the complexities of environmental governance and the re-organisation of the state required to bring about something resembling sustainable development are not well understood (While et al., 2010).

The necessity for state intervention to place constraints on capital arises from the constant drive for growth within capitalism. Given the need to compete in the market place, profit needs to be substantially re-invested in business development (Harvey, 1982). Environmental-economic work has focussed on the potential for innovation to bring about operational efficiency savings and environmental product development. Thus, policy instruments incentivising reductions in CO<sub>2</sub> emissions may bring about improvements to the fuel efficiency of standard internal combustion engines and/or investment in renewable energy technologies, as well as encouraging firms to look for ways to consume less energy in

their production processes. These developments may indeed bring with them the hoped for returns on investment and green jobs.

However, the emphasis on innovation as a solution to environmental issues arising from the second contradiction of capitalism overlooks the pressures arising from a more fundamental contradiction. What O'Connor (1994) has termed the first contradiction of capitalism arises from the overlap between workforce and market, manifested by the need to keep wages low whilst having a populace with sufficient spending power to provide a market for the goods they have helped to produce. Investment is also made in the production of goods for sale to other companies, either as part of a supply chain or equipment for use in the production of other goods. Ultimately, however, there is an end market comprising consumers (Cox, 2002). Thus there is a fundamental conflict of interest between labor and capital as the former seeks to maximise the value of its labor power and the latter to diminish it. This contradictory relationship is disguised by the fact that labor is reliant on capital to provide employment, which is an argument that employers and the state do not hesitate to make. However, capital, and individual firms, out-ride changes and crises of capital accumulation in part by shedding workers. Given that labor is often the most expensive factor of production, the reduction of the wage bill is financially an attractive means of reducing production costs. For the worker, the firm's survival and even improving prospects for the nation's economy may be scant consolation for the loss of their job. A major means to reduce labour costs is to increase productivity (production per unit time per worker) by increasing process efficiency, possibly by automation (Harvey, 1982). Technological and operational innovations, therefore, do not resolve the first contradiction, but rather are the process by which it operates.

This paper makes a theoretical contribution. The above arguments will be developed and illustrated with a range of examples from secondary sources. It is intended to provoke a serious debate on the potential for sustainable development that has a critical awareness of the constraints of the economic system within which the world exists. The multiplicity of institutions that govern exchange within capitalism hides the fact that capitalism is itself an evolved institution, and not necessarily one capable of implementing sustainable development.

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## **Eco-innovation and structural change for a low carbon economy: results from a European survey and implications for policy**

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Recently the topic of eco-innovation has come to the forefront of policymaking discussions and forums. Evidence of this fact is found in the agendas of recent meetings held at the highest political level (e.g., OECD, World Economic Forum, UNEP, UNFCCC, etc.). In these forums policy makers have already considered eco-innovations as very real economic multipliers. The environmental driver of eco-innovation has been reinforced by issues like the financial crisis and the resulting economic meltdown. In Europe, the EU 2020 strategy highlights that smart, sustainable and inclusive growth are mutually reinforcing priorities. In these ambitions, eco-innovations are envisaged as key enablers for securing a knowledge-based, resource efficient, greener, and competitive European economy. As a result, manifold expectations have been raised around the young field of eco-innovation. Not only it is expected that this form of innovation could bring solutions to environmental challenges such as climate change, but also to represent a key source of economic growth, job creation and associated prosperity.

The novel field of eco-innovation, building on innovation, economics and business literatures, is an area of research that is called to provide a better understanding on how and where innovations occur and under what conditions they generate conditions for a greener economy. It is an imperative to understand how eco-innovators are different from regular innovators. What is driving eco-innovative firms, how entrepreneurs face constraining or enabling factors, how eco-innovations may contribute to structural change and economic growth, and other unsolved issues that ought to be addressed.

This paper presents and analyses the results of the TNO survey of strategic eco-innovators. The TNO Eco-innovation Futures Survey enquired strategic eco-innovators about the applicability and structural change potential of their eco-

innovations. Respondents were managers and CEOs of firms developing and commercialising radical eco-innovations in the early market stage. This survey included 88% of SMEs as respondents in 23 European countries. This survey primarily focused on eco-innovations in the ready-to-market, early market and prime unfolding stages of the innovation life cycle.

Structural change strictly refers to changes of the economic aggregates over time. Changes in the structure of the aggregates arise primarily from innovation, changes in the structure of demand and displacements on international patterns trade. There is yet not sufficient longitudinal data on eco-innovation to make an appraisal of eco-innovation effects in the structure of the economy. Despite this is possible to obtain a picture of the emerging patterns of technology diffusion and where this is leaning to. Eco-innovation by definition must contribute to give solutions to environmental issues while generating economic rents. In this paper we gauge where eco-innovation is contributing the most in environmental terms and what sectors of the European economy are having the highest churning, as an early symptom of structural change. For doing it so this paper presents the results of an eco-innovation survey on four aspects on the potential for Eco-innovation and structural change in twelve sectors of the European economy. In particular, we look at: (1) what eco-innovation opportunities are currently deployed in a wider number of sectors; (2) what type of eco-innovations are being developed by strategic eco-innovators (process, service, organisational, marketing); (3) the multiplier effect or structural change factors induced by early market eco-innovations (activity, firm, industry and market levels); and, (4) the contribution of eco-innovations to seven eco-innovation priority areas (greenhouse gas reduction, energy efficiency, material efficiency, waste minimisation, eco-design, new advanced eco-materials and recycling and reuse). Finally implications for policy are provided

### **Beware of negative social impacts on small scale enterprise**

Annemarije L. Kooijman-van Dijk

This paper explores the social dimension of climate change mitigation instruments as they impact small scale enterprises in developing countries. The current focus on the environmental dimension of sustainable development leads to a focus on large scale enterprises and on transfer of innovative technologies. Small scale enterprises, however, play an important role in developing economies not only with regard to emissions, but also as a resource for income generation that is crucial in the livelihoods of the poor. Existing institutions and policies designed from a top-down environmental perspective either neglect and thereby passively disadvantage small scale enterprises, or actively oppose small scale enterprise operation in favour of cleaner production by larger scale enterprises. This is true both for international and national and local policies and policy implementation. At international level, the first of the UNFCCC objectives of sustainable development to avoid dangerous anthropogenic interference with the earth's climate system is receiving due attention, whether or not triggered by national energy security and economic development motives; with many different policy mechanisms being developed and implemented. The second UNFCCC objective: the need for developing countries to achieve sustained economic growth and eradication of poverty, is reduced to a potential, but not essential, positive secondary effect of the first. This paper shows how the discourse of sustainable development in this international forum have an inherent bias towards large scale rather than small scale enterprises. It also shows that the policies at national level has targeted or impacted small scale enterprises in different ways than it has medium- and large scale enterprise, sometimes intentionally, and often unintentionally. Both at international and national level, innovation theories and discourse on innovations for sustainable development have a technological fix approach, which may lead to an increase in poverty rather than sustainable development.

An analysis of specific policy instruments and sector cases of energy efficiency in small scale enterprises in developing countries show how the economic discourse has been translated into an institutional structure and policy instruments that are inappropriate to target environmental and social sustainability improvements for this large section of the economy. The impacts of regulations, often claimed to be beneficial for economic development through the effect of stimulating innovations, is studied based on the Chinese Regulations on Promoting the Adjustment of Industrial Structure. The impacts of market based mechanisms such as Energy Service Companies (ESCOs) is based on experience in China and India. The impacts of policy instruments based on training and awareness programmes for energy efficiency in China, India and on the African continent. Empirical evidence from India indicates that the pronounced efforts for the stimulation of small scale enterprise on the one hand, and improving energy efficiency on the other, are not yet aligned.

The subsequent discussion shows that such a mismatch between policy sectors is not unique, but rather inherent to the system in which environmental benefits are defined in terms of economic utility, neglecting the social sustainability dimension. Recommendations are made to redefine the system for sustainable development to include small scale enterprises in such a way that a transition to a more environmentally sustainable society is less harmful to social sustainability.

## How Payments for Environmental Services Can Deliver Co-Benefits for Business and Sustainable Development: A Conservation Finance Strategy to Protect Armenia's Natural Heritage

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The Republic of Armenia and the Caucasus region have been identified by international conservation organizations as global hotspots for biodiversity. The Critical Ecosystem Partnership Fund (CEPF) has included it as one of the planet's 25 most diverse and endangered hotspots and named it "globally important for conserving representative areas of the Earth's biodiversity, making it worthy of international attention."

Armenia's wide range of mountainous landscapes and climate zones make it a site for dozens of rare and endemic species including the Caucasian Leopard (*Panthera pardus tulliana*), which is listed as endangered on the IUCN Red List of Threatened Species. Its environment has faced widespread degradation driven by factors including unsustainable management, market failures, poverty, and lack of alternative energy supplies.

Official data reported by the United Nations Development Programme and the Stockholm Environment Institute reveals that Armenia's environment will become further degraded as a result of climate change over the next century. Such effects are likely to have widespread socio-economic impacts unless measures are taken to mitigate and adapt to changes. This is a challenge in Armenia because of a shortage of sustainable financing for conservation.

In order to address similar challenges, some countries have implemented Payment for Environmental Services (PES) programs to compensate upstream landowners or land managers for environmental conservation that benefits downstream users. Sven Wunder defined PES as "a voluntary transaction where a well defined environmental service--or a land use likely to secure that service--is being 'bought' by a (minimum one) service buyer from a (minimum one) service provider."

This research presented three examples of PES programs: one that was the most widely known, a second that demonstrated very strong sustainability benefits, and a third in Eastern Europe that demonstrated the novelty of the concept in the region.

The examples in Costa Rica and the Catskill Mountains demonstrated that a PES program can generate significant levels of financing and that a program can achieve favorable sustainable development results. The ongoing example in the Danube Basin also shows that PES can be implemented as a pilot program to demonstrate the applicability of the concept and transfer lessons learned to neighboring regions.

The examples are supported by research from the Millennium Ecosystem Assessment and UNEP's program on The Economics of Ecosystems and Biodiversity (TEEB), which conclude that investing in conservation is a more cost-effective strategy than depleting a resource that may be irreplaceable or more costly to produce by artificial methods.

Based on these results, this paper argues that PES may be an effective strategy to apply in the Republic of Armenia. This is especially relevant since there are several industries that have been identified as strategically important for the country's economic development and rely heavily on environmental services as a core part of their business. These include hydropower, the beverage industry, and the tourism industry.

This paper has shown that these industries have a direct interest in environmental conservation and that investing in natural capital would ensure their long-term viability and profitability. In addition to addressing risk in these strategic industries in a proactive manner that lowers business costs, a PES program can deliver additional co-benefits by enhancing a Corporate Social Responsibility (CSR) program.

In short, a PES program delivers co-benefits to businesses and for sustainable development by addressing natural capital, financial capital, and social capital. All three aspects are important, especially for impoverished rural stakeholders that rely on environmental services and are often stewards of these resources. Their interests are vital to the public and to the private sector, since "companies cannot succeed in societies that fail."

The paper concludes with areas for further study and a series of recommendations outlined as a plan of action to implement a PES program in Armenia. These include using the World Resources Institute Corporate Ecosystem Services Review to identify business risks and opportunities arising from a company's dependence on environmental services, initiating a pilot scientific and economic study of a specific ecosystem that provides services or inputs to businesses in one of the key sectors in Armenia, and then taking the steps to develop an actual PES project using a guidebook developed by the Katoomba Group's Ecosystem Marketplace.

## The Visible Hand: Designing Effective Market Based Solutions to Environmental Problems

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It is widely acknowledged in the literature that market-based approaches<sup>[1]</sup> to environmental policy are more socially and economically acceptable than traditional command-and-control regulatory policies. From a political viewpoint, it is generally believed that such policies succeed because they “harness economic forces”<sup>[2]</sup> and allow participants to determine how to meet societal goals, either through adapting their operations or through trading of permits or allowances. In the classical economic view, the initial allocation of permits or allowances isn't as important as the structure of the market, since participants will eventually trade their way to the most efficient allocation.

In reality, however, market-based environmental instruments generate relatively little actual trading. Even in successful market-based approaches, the benefits appear to result from changes in individual behavior (reduction in consumption or emissions) rather than reallocation from permits via trading. In terms of policy design, this suggests that the overall cap or quota and initial allocation are particularly important. When caps and quotas are miscalculated or skewed by non-scientific influences, the desired environmental improvements will not be realized. Similarly, the allocation of permits and allowances can have distributional effects that undermine the efficacy of a given policy.

Many studies have examined why specific market based policies have failed or succeeded. These types of analysis are valuable in an academic sense, but by failing to connect results to diverse current and future real world scenarios, such analyses also help perpetuate a cycle of trial-and-error policy making. Thus, we feel that a study that is prescriptive and general in nature is a necessary first-step towards creating and normalizing effective market-based approaches for environmental improvements and protection.

While other studies have tried to articulate reasons for the relatively low level of trading under various market-based schemes, we will focus on the implications of this fact for effective policy design. In particular, given that relatively little trading is likely to occur under most market based policies, how can initial limits and allocations be determined so as to lead to effective outcomes?

This study will entail a review and comparative, qualitative analysis of existing literature on four case studies, all of which have been at least reasonably successful in meeting their objectives: the European Union's Emissions Trading Scheme (EU ETS), the Sulfur Dioxide (SO<sub>2</sub>) cap-and-trade system in the United States, the lobster fisheries of Australia, and Alaskan Salmon fisheries. We chose to focus on these particular examples due to the range of ecological, political, and economic specifics they present, which will allow us to establish a broad base for studying caps and allocation decisions and identifying successful practices.

In addition to a literature review, our research will also include interviews with scientists, activists, and policy-makers in order to glean unique insight into the processes of setting caps and allocating permits or allowances and how these processes differ across industries, time, space and for different environmental problems. We have identified key employees of the Australian Department of Agriculture, Forestry and Fisheries; EPA officials of the mid-to-late 90's; and members of the European Commission for the Environment. We will also engage with representatives of environmental groups that had roles in creating the policies we will examine in this study.

Research will focus on two areas: First, we will analyze the level of trading that occurs under each of these schemes, how this amount has changed over time, and what, if any, relationship this trading level has to efficacy of the schemes. The analysis will then shift to focus on how initial limits and allocation amounts were designed under each policy and what the implications of these decisions have been. The goal will be to isolate common factors relating to limits and allocation amounts that have influenced the overall success of the policies.

As noted above, we predict that pre-implementation factors will prove more important in achieving policy goals than the magnitude of participation in the resultant markets. Depending on situational specifics, some factors which we expect to find important, to varying degrees, include:

1. The amount of social capital that exists amongst individuals or firms that will be affected by a policy and the degree to which policy design augments or maintains this social capital.
2. The degree to which incentives are individualized.
3. The degree to which initial permit or allowance allocations maintain the preexisting relative competitive and economic status quos.
4. The appropriateness of the cap or quota limit to achieve the desired environmental outcome.

We predict that, in general, the more a given scenario meets the conditions listed above, the more successful the ultimate market based policy will be.



The principal aim of the study is to identify common factors at play in developing market-based environmental policies across a range of political, economic, ecological, and socio-cultural situations. We also hope to capture how such factors have different influences at various scales. More specifically, however, we aim to demonstrate the importance of initial limit levels and permit allocations for a policy's success. These two areas have proven to be two of the most contentious steps in the creation and implementation of market-based environmental policies to date. This study aims to shed light on the impact of these factors on policy outcomes and thereby begin laying a foundation for better-designed market-based environmental instruments in the future.

- [1] Here we use Stavins' (1998) definition: "Market-based instruments are regulations that encourage behavior through market signals rather than through explicit directives regarding pollution control levels or methods."
- [2] Organization for Economic Cooperation and Development (1989, 1991) and Stavins (1988, 1991).

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## **Towards developing a Theoretical Paradigm for Sustainability oriented Innovation Systems: a literary analysis**

Pieter Jan van Heyningen

The problem focus of this paper relates to the lack of a sound theoretical or epistemic foundation congruent with sustainability principles emerging within Innovation Systems (IS) and economic transitions literature. Advancing the concepts of Sustainability oriented Innovation and IS requires a coherent epistemic foundation that is distinct from theories that promote unsustainable economic and technological lock-in and social exclusion via IS (Elzen et al 2005).

These fundamental incongruencies of various epistemic proponents of innovation pose a problem to achieving sustainability. For example, interpretations of innovation traditionally associated with economic growth and competitiveness (Kemp et al 2001; Hoogma 2000). Their epistemic functioning are traditionally embedded in reductionist thinking – which does not bode well for sustainable innovation and for developing a sound platform for Sustainability oriented Innovation Systems (SoIS) theory (Stamm 2009; Montalvo 2009; Charter 2007).

For this reason a new knowledge paradigm is necessary to form the theoretical foundations of SoIS and thus sustainable innovations. The basic principles of sustainable innovations should be measured as outcomes that enhance ecological, social and economic value positively either directly or indirectly (see Birkeland 2009, for "Positive Development"). The appropriate epistemic and scientific rationale must be employed to form theory for valued sustainable innovation. In turn promoting policies and practices for sustainable innovation outcomes at various levels, namely at national, regional and firm levels.

Currently mainstream innovation theories stress sustainability in innovation without a solid theoretical understanding of sustainability. For example reductionist thinking within Technological Innovation Systems often encourage incremental innovations rather than systemic. Consensus suggests that reaching sustainability in innovation requires increased system innovations (Geels 2002; Tucker 2005; Elzen 2005). Technological and Sectoral IS and Socio-Technical IS have an overwhelming focus on the emergence of innovations (rather than promotion) and place greater emphasis on technological innovation as opposed to social or organizational innovation (Geels 2002; Stamm 2009; Elzen 2004). Narrower perspectives about the form and function of innovation are being challenged by newer and broader concepts and definitions such as social innovation, inclusive innovation and sustainable innovation (Charter 2007, Lundvall, Joseph, Chaminade & Vang 2009).

A paradigm shift in the epistemic base necessary to promote the theory of SoIS which is distinct from Technological, Sectoral, National, Regional and other Innovation systems in the sense that it is congruent with sustainability principles and theory is proposed.

In the literature, there are several attempts to merge overlapping elements of various theoretical schools of innovation thinking. These reviews manage to highlight the differences and similarities of various epistemic and theoretical origins (Peneder 2010; Nill & Kemp 2009; Coenen & Lopez 2010; Stamm et al. 2009). General consensus is that there is an urgent need for more sustainable approaches to innovation and their applications. Currently attempts to assemble definitions of sustainable innovation utilize the same array of epistemic fundamentals that now and in the past have

promoted innovation for economic growth. These tend to be exclusionary of wider factors and end up contributing to unsustainability producing negative or unforeseen externalities. Reductionist thinking generally produces linear system innovations for example, whereas the shift to complexity thinking needs to be explored in an innovation context. This paper explores this shift within the context of a new paradigm for the design of systems, products and processes to provide the basis for sustainable innovations.

The intention of this paper is to propose the need for an alternative epistemic paradigm as the foundation for building theoretical approaches to SoIS. The research question can then be presented as “How can a new epistemic paradigm for SoIS be created utilizing and moulding existing knowledge of innovation, systems and sustainability?”

The study was executed mainly from a theoretical understanding and merging of overlapping principles of various innovation and IS literatures from various epistemic communities and the knowledge paradigms of systems understandings and sustainability science. A literature analysis from a critical standpoint was conducted with the aim of highlighting theoretical incongruencies and suggesting a way forward for the theory of SoIS. Literature stemming from several streams of thought and various epistemic communities were reviewed including: the national and regional innovation systems literature (derived from Lundvall, Freeman and Nelson and more recently Rip, Kemp, Nil, Chaminade, Lundvall, Vang and others); the socio-technical innovation literature and transition theories; ecological modernization; evolutionary and ecological economics (mainly Geels, Elzen, Green, Hajer and Soderbaum); sectoral and technological innovation perspectives; triple-helix innovation perspectives (including Etzkowitz & Leydesdorff); new knowledge management, learning perspectives and regions (as discussed by McElroy and Bokoema and Rutten) and finally SoIS perspectives (by Charter, Stamm, Nil and Kemp, Lundvall, Vang, Chaminade, Montalvo and others).

The findings remain theoretical, yet provide the foundations for greater empirical understanding and future research. The analysis and assimilation of various theories - notably the merging of sustainability principles and innovation literatures provides the foundations for a new epistemic. This provides the potential for the development of coherent and logical SoIS theory. This direction of innovation provides enhanced impetus to transitions and transformation for theory and practice toward sustainable economic trajectories. A theoretical model of these possible innovation and economic growth trajectories is presented in the paper.

The major contribution that this paper brings to the innovation community is the start of establishing SoIS as a distinct theoretical paradigm. The purpose of which is to provide the necessary patterns of thinking within innovation communities necessary for transition and transformation of economic systems at the micro (niche), meso (regime) and macro (landscape) levels toward sustainability.

The implications of this research has potential to provide a solid theoretical framework from which to i) Merge alternative theoretical understandings and models of innovation into a coherent understanding of sustainable innovation principles, and ii) Establish sustainable innovation and IS as an alternative [sustainable] economic development model. These implications will be translated into and will be useful for government policies, regional development and firm-level innovation inputs.

## Posters

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### **Underneath the carpet: The contradictions of sustainable development implementation in developing countries, A Thai case study of Phuket Island**

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Sustainable development is easier said than done. Despite the widespread adoption of sustainable development principles in the global community since the release of ‘Our Common Future’ in 1987, unsustainable practices persist in developed and developing countries. Failed governance, social and economic inequality, and corruption are common causes, and biodiversity loss and pollution are common symptoms in many areas where economic growth remains the priority and chief indicator of success.

The political, social, economic, environmental, and cultural contexts in developing countries are different from the

developed countries. Nevertheless, globalisation and technological advancement has facilitated the spread of universal assumptions about economic growth pattern which are often prescribed by developmental theories constructed in 'developed' societies. While such models may result in modernisation of the economy and technology in the less developed countries, sustainability of these changes are not guaranteed especially when problems in governance, human development and social issues remain unsolved.

Consequently, the usefulness of the 'classical' sustainable development concept for developing countries is questionable if it does not take into account the implications of the cultural differences, the indigenous knowledge, and traditional values. Models that lack deep understanding of local contexts and the social fabric which underline the developmental outcomes are unlikely to be able to capture the real causes of the problems and lead to appropriate solutions and can result in the perverse outcomes.

In Thailand, many scholars, governmental agencies, non-governmental organisations (NGOs), donors and community groups have widely adopted and participated in the 'classical sustainable development' rhetoric. However, monitoring and evaluation on the effectiveness of the numerous projects with this popular label are rare and often are limited to econometric indicators. Implementation without evaluation is meaningless whereas measuring success without incorporating both the tangible and intangible aspects of development can hardly represent a holistic picture of the reality. Policy documents and project reports may display the level of awareness and commitment by the government, NGOs and scholars but they do not necessarily inform as to if the operations have been appropriate, effective and sustained beyond the availability of the external funding. The barriers that prevent the long-term success of these initiatives are discussed in this paper.

This paper presents challenges in the implementation of 'classical sustainable development' in a context of a developing country using Phuket Island, Thailand as a case study. It examines the cultural implications of developmental practice and interpretations of sustainability. The multi-cyclic study starts with preliminary mapping of Phuket systems from publicly available documents on major developmental problems and their causes. This is then refined through further literature search and observation. In-depth interviews and focus groups were conducted using the snowballing technique starting from professional networks with people actively involved in Phuket's developmental planning. Data saturation was reached when there was no more issue being raised. Notes from attendance at public seminars on Phuket's developmental issues were also used to verify the data saturation point. A grounded theory approach was used to analyse the primary and secondary data acquired by these processes. Contextual coding of the interview transcripts, field notes and documents was conducted electronically using NVivo 8. The results from the analysis were used to validate and adjust the original mapping of Phuket's developmental context and issues.

The data reveals that the top-down approach of policy delivery by the state has been perceived to be inadequate and has begun to lose public trust. Meanwhile, the bottom-up approach in mobilising policy change from the civil society has not been effectively facilitated and its potential is extremely underutilised. In addition, the findings identify 6 major contradictions that undermine the island's progress towards sustainability. These are i) governance without leadership, ii) politics without political wills, iii) freedom without discipline, iv) education without ethics v) wealth without wisdom, and vi) talk without action. These contradictions are perceived by the residents in Phuket to be the major hindrance for the implementation of appropriate sustainable development. The interrelationships among these issues are discussed and causal links are explained. The paper provides insights into how the systematic analysis of the complex problems associated with the development of Phuket can be used to analyse other regions in Thailand or similar developing countries.

## **Sustainable work. Conceptual considerations about an emerging discourse**

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The current multiple crisis – high unemployment rates, unsecure rates of economic growth, high national debts and climate change – has provoked critique about unrestricted economic growth as the (classical) overall solution for the crisis by some critical economists (e.g. by Tim Jackson). Concepts of sustainable growth enter slowly the political agenda, pleading almost casually for general working hour reductions and an improvement of the quality of life, hardly considering the complexity of these issues.

But the discourse about the significance of work in a sustainable society has only just begun, and the effects of the postulate of sustainability upon the organisation of work are everything but clear.

In the German-speaking countries this discourse has already been stimulated about 10 years ago by the German interdisciplinary research project «Work and Environment» (German: «Arbeit und Ökologie», 1999-2001). In this project "mixed work" was introduced as a new, ideal type of full-time employment, which is taken to be essential for social

sustainability; it was expected to open up new opportunities and provide additional ways to ensure social welfare. Besides part-time gainful employment, “mixed work” should also include unpaid work, care work, and community work, and it should replace the existing – and already rather «eroded» – standard employment relationships (see Hans Boeckler Stiftung (ed.) (2001): *Pathways to a Sustainable Future. Results from the Work and Environment Interdisciplinary Project*, Düsseldorf). Even today, “mixed work” is already carried out by a large and continuously growing number of people – men and women –, although the quality of life it entails is subject to variation and depends on how this type of work is treated at a political level. “Mixed work”, as it was proposed by the aforesaid project, results in mixed incomes (from different fields of work) and requires mixed skills (which are necessary to meet the requirements of different working areas). The authors argue for the enlargement of the dominating narrow understanding of work as paid work in favour of an understanding that takes all necessary societal work into account. Meanwhile the idea of “mixed work” has been taken up and modified by several political players such as social movements like Attac, Solidarity Economy or the Transition Town Initiative, parts of the trade unions and the churches.

Concepts of sustainable work start from the notion that modern societies are working societies, whose exchange with nature, i.e. the measurable material flows, are many times more and/or higher than they were in earlier forms of society. However, work in modern working societies is not just a means to use nature and to ensure people’s livelihood and the satisfaction of their needs, but rather – especially in the case of gainful employment – the primary means to stratify and structure society and organize individual lives. Working society is a product of the modern era, and it stands out for the fact that paid work is ranked higher than reproductive work and other unpaid activities of people’s lives. The gender-based division of labour, with the resulting gender arrangement in families as well as the forms of welfare provided by governments, is one of the main characteristics of modern working societies and their position and interactions at a global level.

What follows from these considerations for the conception of sustainable work is preliminary that one important starting point is the re-distribution and re-organisation of work and, connected to that, of all forms of social welfare. The strong emphasis on work in the existing working societies still needs to be taken into account; not just with regard to securing people’s incomes, but also with regard to the psycho-social functions of gainful employment (time structure, identity, etc.), citizens’ integration (due to the high social status of paid work), and the significance of paid labour for social cohesion. It is furthermore absolutely necessary to pay special attention to the situation of women, not least because gender mainstreaming – with its clear and extensive demand for the equal treatment of both genders in social, economic and legal matters – is listed as one of the key goals in official sustainability documents (Chapter 24 of Agenda 21, cf. United Nations, 1992). But gender issues are often marginalised in the contributions to sustainable work.

If feminist analyses of the gender-based division of labour are to be taken seriously, securing (part-time) employment and creating new (environmentally compatible) jobs, especially in the caring segment, will surely be conducive to the further integration of women into the labour market. The “greening” of existing employment should be given top priority in the re-structuring process. In addition to that “green jobs” i.e. decent jobs with a high qualification profile in the environmental sector, should be promoted. Considering both the demand for socio-ecological sustainability as well as the feminist demand for a gender-sensible (re-)organisation of labour, a sustainable working society will basically require:

- The greening of existing employment and the creation of new, environmentally sound jobs, so as to ensure the environmentally, socially, and health-friendly provision of goods and services.
- The gender-sensible re-distribution of all the work that needs to be carried out in society, so that everyone can have a sufficient income from useful and publicly accepted work (e.g. by means of shorter working hours, childcare facilities, work-life balance for men and women, economizing care work, etc.).
- The freedom to choose at any stage in life between different forms of work (work arrangements, field of work) or lifestyles, while being at all times entitled to individual social security.

The presentation will outline the different concepts of sustainable work and resume the main lines of argumentation within the emerging discourse of sustainable work. It will critically highlight the shortcomings of the debate from a feminist perspective and propose basic requirements of a gender-sensitive concept of sustainable work.

## **Ecological Limits to Growth and Path Towards a Just Safe World**

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Classical economists had their vision of a ‘stationary state’-the ontological destination of economic growth and development constrained by population exploration vis-à-vis finiteness of arable land and the exhaustibility of non-renewable resources. But the early modern period witnessed the colossal enterprise of scientific inventions and their technological potential where economic growth appeared unlimited and the stationary state mutated from an ontological

reality to an analytical fiction. The twentieth century has spanned through two world wars, post-war recovery-boom-burst and emergence of neo-liberal globalization. The treadmill of production, founded on law of capitalist circulation -supply creates its own demand, have all along driven the expansion of production and consumption synergistically. The industrialized North has emitted massive greenhouse gases, with increasing energy- and chemical-intensive production since the days of industrial revolution and has polluted the environment to a catastrophic extent. The neoliberal insight to overcome the burst phase of exploitation cycle looks towards intensive exploration of fragile and sensitive regions around the world like Arctic. The economy subsystem expands relative to the fixed dimensions of the containing and sustaining ecosystem and becomes disembedded from the planetary socio-ecological threshold. Thus fossil-fuelled industrialization and growth has created increasing resource constraints like peak oil and sink constraints like disastrous climate change.

Frederick Soddy, a 1921 Nobel laureate in chemistry, offered an alternative perspective on economics rooted in the laws of thermodynamics and observed that like any machine the economy must draw energy from outside itself. Soddy criticized the prevailing belief of the economy as a perpetual motion machine, capable of generating infinite wealth. By the metaphor 'creative destruction', Joseph Schumpeter in his magnum opus 'Capitalism, Socialism and Democracy' (1942) described the evolutionary character of the capitalist process as a consequence of the changing social and natural environment. Thus capitalism would destroy its own foundation, not by failure but by its 'success'. The most daunting task emerges to confront the autistic macroeconomics according to which structural stability is achieved through continued consumption growth. Nicholas Georgescu-Roegen and other ecological economists challenge the notion of growth-as-progress given that ecological and resource factors are constrained. Thus the incongruity between paper assets and real debts has engendered the contemporary financial crisis rooted in critical socioecological sphere. The concept of sustainable degrowth is becoming social movement in the various parts of industrialized world.

The sustainable degrowth movement of the North and climate justice movement of the South complementarily reflect on the global ecological crises in terms of overconsumptive western lifestyles, ecological unsustainability of capitalism and developed world's climate debt. The regions and populations with the least carbon footprint in the world are the most vulnerable to environmental calamities. North has been the main source as well as main beneficiary of climatic deterioration from the days of industrial revolution to contemporary neoliberal world order. Apart from historic entropy transfer, the globalization has facilitated the developed countries to off-shore hazardous manufacturing in the underdeveloped South. The climate debt thus encompasses the historical as well as contemporary exploitation of third world natural resources and the excessive use of 'environmental space' for dumping waste and thus expropriating global atmospheric resources. Climate Justice Movement views climate debt as a development debt and argue that climate debt should be paid back by rich nations in the method of funding green projects to ensure that all countries are at the same level of development and industrialization. The aim is to have access to basic services to people, thus ensuring economic, political and social independence. The industrialized countries have already surpassed sustainable limits of earth's carrying capacity. Depletion of stock resources like fossil fuels, the degradation of the global atmosphere and the shrinking space on Earth available to receive our waste may seriously condition future human activity and its economic returns. Such bio-physical constraints can become binding in a fast and irreversible manner, not allowing an effective correction once the thresholds have been surpassed. The lack of political will by developed countries to fulfill their commitments and obligations under the UN Framework Convention on Climate Change and the Kyoto Protocol is further compounding the plunder of the planet.

The grand South-North ideological alliance has philosophical resemblance with the tradition of Karl Polanyi that has sought to deconstruct the naturalness of the economy. Polanyi had the visualization to 'reembed' the economy in society in order to free ourselves from the illusion of modern times disembedded from socio-ethical domains pursuing one single economic form of exchange and profit as a universal model. Foucauldian wisdom reminds us that the dominant configuration of knowledge and power is not inevitable and further reflections can change it. Thus if the values and political implications underlying the debates on 'growth business as usual' do not ensure how to protect the society, we can refuse to accept their imperatives and develop alternative epistemology and strategy. The emerging social preferences for ecological rationality, based on the preanalytic vision of reembedding the economy as the subsystem sustained by a larger ecosystem with limits and capacities, justifies creative destruction of the disembedded economy. The ideological alliance can further enrich itself by Latin American indigenous 'Pachakuti' discourse towards the protection of 'Mother Earth', and all forms of life on it with 'Sumak Kawsay' or 'live well but not better at the expense of others' principle. The World People's Conference on Climate Change and the Rights of Mother Earth, Cochabamba, Bolivia, April, 2010, has been such an bold effort to usher in an era of 'just safe world'.

## Urban Sustainability, Microfinance Technologies and Public Services: The Case of Nairobi, Kenya

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As Kenya grows into the future, one issue remains a contagious challenge; the rapid growth of the country. In search of better living standards, Kenya's populations are highly concentrated in urban centers increasing social, economic and environmental challenges. At 4% per annum, Kenya's urban growth is the one of the fastest in the world. According to UN-Habitat, around 34% of Kenya's population today lives in urban centers and by 2030, this percentage will surpass 50% mark. Of this population, a higher percentage lives in sprawling slums under uninhabitable conditions with a severe lack of social amenities.

Although mainstream debates on sustainability especially in urban centers is full of literature on the importance of creating sustainable cities through a clear balance between different stakeholders in urban societies (UN-HABITAT, 2007), there is little practical orientation for the fast increasing gap between the rich and poor in academic literature. In addition, Current literature is enormously concerned with resource use and environmental challenges (Beatley 2000) and has very little mention about the nexus between urban sustainability and empowerment of urban poor.

The core hypothesis in this article is that public-private collaboration through the use of microfinance technologies as an urban tool for poverty alleviation (Mutisya, 2010) can support public services' delivery systems and stimulate urban sustainability. The case study of Nairobi shows that there is clear evidence on the impacts of technologies supported by microfinance in informal settlements.

This article further deplores and develops workable policies that may be utilized by cities for innovative sustainability and also for further related research activities and projects on related domains. It shows how providing services to the poor could be a way towards attaining the much desired innovative urban sustainability in Kenya.

## A governance framework for the promotion of lead markets for environmental innovations

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A greening of the world economy can only be achieved by extensive innovation in environmental technology and its rapid international diffusion. Experience has shown the crucial importance of lead markets in this process. Lead markets are national or regional markets where a specific technology is first introduced before subsequently being adopted as the standard for a global market (Beise 2006). They provide a platform for technological learning and the development of productive capacity before a global market takes shape. A better understanding of what drives the development of lead markets in environmental innovations and what factors contribute to their internationalization can deliver key insights for accelerating the spread of environmentally-friendly technologies.

Previous research has identified a number of factors that contribute to the development and international diffusion of lead markets in environmental innovations (Beise and Rennings 2005; Jacob et al. 2005). These include a number of economic factors, such as relative factor costs or market size, that are common to lead markets for any type of innovation. In the field of *environmental* innovations, an additional key factor is the presence and type of environmental regulation. Empirical studies have shown that the introduction and subsequent diffusion of relevant environmental regulations are important elements for the development of lead markets (Jacob et al. 2005).

These findings build and expand on the Porter Hypothesis. Twenty years ago he stated, "Strict environmental regulations do not inevitably hinder competitive advantage against foreign rivals; indeed, they often enhance it." (Porter 1991). This statement turned the conventional wisdom on its head that strict environmental regulations would incur additional costs on a firm and thus weaken its competitive position versus foreign rivals. Instead it views regulations as a potential catalyst for innovation and technological upgrading that will improve the competitive position of firms and the respective national industries in the medium- to long-term.

However, this link between environmental regulation and innovation is not automatic. It depends in no large part on the specific design and an effective implementation of environmental regulations (Zaelke et al. 2005). It requires what Porter and van der Linde (1995) refer to as "innovation-friendly" regulation. Taking this a step further, the catalytic role of environmental policy will be further enhanced when it is integrated with innovation and industrial policy, i.e. measures to enhance innovation and industrial competitiveness (see Jänicke 2008; Jacob 2009 among others).

The lead market concept provides a useful framework for further optimizing such a smart policy mix. The lead market factors mentioned above provide additional entry-points for promoting global markets for environmental innovations.

While certain factors, such as home market size or consumer preferences, may not be sensitive to government intervention, a number of lead market factors provide additional levers for stimulating the development and diffusion of markets for innovative environmental technologies.

This paper outlines a governance framework for promoting environmental innovations that integrates approaches to environmental, innovation and industrial policy with a number of relevant lead market factors. It first outlines a set of desirable governance mechanisms, institutional arrangements and policy approaches for developing an enabling environment for environmental innovations. This includes not only the respective contribution of each discrete policy field but the challenge of promoting integration among the three policy areas (Lafferty et al. 2005; Jordan and Lenschow 2009). In a next step the paper identifies entry-points for incorporating relevant lead market factors, i.e. those that lend themselves to government intervention, into such a governance framework. In particular, the paper addresses the challenge of facilitating international policy diffusion (Tews und Jänicke 2005), frequently a prerequisite for global market penetration of environmental technologies.

The suggested governance framework builds on the work on national innovation systems (Lundvall 1992, Nelson 1993, OECD 2005), the literature pioneered by Michael Porter (1998) on developing and sustaining competitive national industries and the related work on innovation-friendly environmental policy (Ambec et al. 2010; Porter and van der Linde 1995; Zaelke et al. 2005). Within this framework, the paper only briefly outlines a number of cross-cutting governance functions in the three policy areas, like the provision of high quality tertiary education in science, engineering and other relevant disciplines, the provision of basic data on environmental quality or market regulations to ensure competition. The main focus lies on the identification of more specialized governance functions where policies require fine tuning and hence more complex governance arrangements to meet the needs of individual sectors. It is here where additional entry points exist for incorporating policy measures derived from the lead market factors. This might include issues like targeting R&D subsidies to sectors with a high lead market potential, the promotion of standards at the international level or the setting of environmental policy targets that anticipate expected international trends.

The paper develops a generic governance framework to help assess the framework conditions for any type of environmental innovation. However, it recognizes that different types of environmental innovations at various stages of their development also require different governance approaches. These differentiated and changing needs are what constitute the challenge for developing and adapting policy mixes to different stages of technological development. An important emphasis is, therefore, also placed on mechanisms for policy learning and leveraging the knowledge of stakeholders in the policy cycle.

In conclusion, the governance framework to be outlined in the paper defines elements for promoting environmental innovations that are potentially subject to government intervention. Clearly, the development of lead markets for environmental innovations depends on a host of other economic, political and structural factors that cannot be directly influenced by government. These are not addressed in the context of this paper. The goal of the paper is rather to provide a framework for assessing governance capacity to promote environmental innovations. As such, it can serve as an input to a broader conceptual framework for explaining the development of lead markets for environmental innovations or assessing the lead market potential for a particular country and sector.

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## Transitions and Transformations toward Sustainability – the Sustainability Oriented Innovation Systems Approach

Pieter Jan van Heyningen

This paper follows on from a previous paper: *“Towards Developing a Theoretical Paradigm for Sustainability oriented Innovation Systems: a literary analysis”*. The analysis brings together various strands of thought with a focus on innovation and economic change including, amongst others: evolutionary economics, transition theories, techno-economic paradigms (TEP) and trajectories, the triple-helix system, innovation systems theory, ecological economics, and sustainability. The previous paper concluded that a post-normal paradigm is necessary to provide the foundations for Sustainability Oriented Innovation Systems (SolS). The mainstream innovation paradigm is seen as serving unsustainable economic growth trajectories, which is perpetuated via a socio-cognitive paradigm and socio-technoeconomic path dependency (see Geels & Schot 2007; Geels & Kemp 2007; Frame & Brown 2008; Raven & Geels 2010). While the sustainability paradigm may co-exist and is emerging alongside the economic growth paradigm, there is an urgent need to catalyze this shift via adopting SolS into mainstream policy. The purpose of which is to shift socio-cognitive patterns and innovation practices and incentives toward more sustainable trajectories. This paper argues for transitions as radical shifts of trajectories or techno-economic paradigms (TEPs) and transformations as incremental shifts or improvements of existing trajectories toward sustainability. Reproduction refers to no shift in the trajectory of innovations toward sustainability. This is adapted from the views of Geels & Kemp (2007).

The SolS approach is an inclusive framework and provides a platform for existing innovation and transition theories and policy initiatives to adopt sustainability principles. This may be achieved through adapting existing theories and policy initiatives to focus on sustainability as the main emphasis. Examples of existing theories include the multi-level perspective (MLP), strategic niche management (SNM), triple-helix innovation systems and collaboration, development platforms and innovation systems.

The SolS approach seeks to build on the strengths of these theories; for example, the distinction between macro (landscape), meso (regime) and micro (niche) levels in the MLP (see Elzen et al. 2004). However, this paper also highlights the advantages of including perspectives of change such as learning, social innovation, and networking for sustainability, that can take place on all levels (Boekema & Rutten 2007; Lundvall et al. 2009). The concept of innovation environments or innovation eco-systems can be linked to the micro level niche in the MLP as ‘protected environments’ for stimulating innovation. Finally, this paper proposes the notion of transforming the mandate of existing technology parks, science parks or innovation hubs into niche environments for sustainability as a starting point for adopting SolS’s at the micro level.

This paper seeks to build upon the theoretical framework of SolS presented in a previous paper by assessing various theoretical and policy approaches to innovation, transitions and transformations. It is also aimed at merging the understanding of SolS into existing theories as a new post-normal inclusive theoretical paradigm for sustainability. Finally, the purpose of this paper is to open up the proposition of real world application and policy considerations for SolS.

As already mentioned this paper builds upon a literature analysis of different streams of thought about innovation and economic trajectories and transitions. This paper also serves as the basis for a theoretical lens for research purposes in the real world. The paper introduces a research project that seeks to assess the potentials for transformation at the micro-level using an innovation network approach. The latter approach and results are intended to be assessed against the theoretical lens of SolS.

The theoretical hypothesis proposes that a post-normal epistemic paradigm would best suite the concept of a SolS. This allows for an inclusive alignment or arrangement of several theoretical approaches to innovation and transitions simultaneously - which is needed to solve complex sustainability challenges. Furthermore, a pluralistic dialogue will broaden and deepen the traditional or mainstream conception of innovation systems which will be a necessary factor if sustainable economic trajectories are to be achieved.

Although there has been mention about the need for Sustainability oriented Innovation Systems, no adequate attempts in formulating a theoretical framework have been made. This paper subsequently presents a post-normal framework for Sustainability oriented Innovation Systems. Furthermore, it brings together various theories that have until now been separate streams of thought from different epistemic communities. It allows for plurality and co-generation of knowledge for sustainability that is a fundamental requirement for solving complex sustainability issues. To date no such theoretical framework exists that seriously considers such a pluralist epistemic paradigm for sustainable innovation and economic development. This paper then presents a hypothesis that has potential for radical changes of innovation policy internationally, nationally and locally.



This paper is appropriate and relevant to all the major conference themes, because it allows for a new way of thinking about economic trajectories, human progress and for finding solutions to sustainability challenges at various levels. It promotes the concept of collaboration and co-existence of theoretical and practical efforts which is more realistic a function for a complex world in need of rapid transition and transformation toward sustainability.

5A

## How can pilot programs and lessons learned from them inform Rio+20?

Combined with 5B, please see below.

5B

## Assessment of global initiatives

Scott Barrett & Benjamin Cashore

### Oral Presentations

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#### Official Development Finance for Energy – trends and optimisations

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The objective of the paper is to assess the characteristics of international Official Development Finance (ODF) for the Energy Sector of Developing Countries and in particular their relationship with the relative levels of energy poverty.

Although energy has been addressed by the international development assistance to a certain degree, it is only in recent years that it has focused on the specific problem of energy poverty. Specifically, the relationship between access to modern energy services and poverty reduction has been officially recognised in the UN system only since the 9th Session of the United Nations Conference on Sustainable Development (2000-2001). It then gathered momentum at the subsequent World Summit on Sustainable Development in Johannesburg (WSSD, 2002) (UNCSD, 2001), as well as in various initiatives and studies that stressed the importance of access to modern energy services to achieve the Millennium Development Goals (Modi, McDade, Lallement & Saghir, 2005) (UN-Energy, 2005).

More recently, the UN Secretary-General's Advisory Group on Energy and Climate Change suggested that the international community should make energy an international development priority and suggested to set two new targets to be reached by 2030: 1) universal access to modern energy services and 2) a reduction of global energy intensity by 40% (UN-AGECC, 2010) while the UN General Assembly just proclaimed 2012 as the «International Year for Sustainable Energy for All» (Resolution 65/151 - 10 Dec. 2010).

Reaching universal access to modern energy services will require a significant additional effort for the international community, both in terms of funding and of strategies; early estimations of the costs have been made by the International Energy Agency (IEA, UNDP & UNIDO, 2010) and by other authors (Bazilian et al., 2010). These studies highlighted two points: 1) that with the current business as usual scenario the share of the people without access to modern energy services will not drop considerably and 2) that the amount of efforts needed to reach universal access is considerable (albeit achievable).

Although it remains uncertain if the UN will set an objective on universal energy access, energy is without any doubt becoming more and more central in the international development agenda and thus it's crucial to understand how is the reality of the official financing flows.

The sources of data are the AidData.org database (Findley et al., 2010) for the ODF and the IEA and UNDP for the data on access to modern energy services (UNDP, 2009) (IEA, 2010). AidData contains a significant amount of additional information with respect to the Creditor Reporting System (CRS) Data of the OECD normally used in these kind of analysis (Tirpak & Adams, 2008), covering a larger share of multilateral donors and non-OECD countries. The data extracted refers to the Gross Official Development Finance for the Energy Sector for the period 2000-2008 and includes commitments for 1) bilateral Official Development Assistance (ODA) 2) grants and concessional and non-concessional development lending by multilateral financial institutions, and 3) Other Official Flows (OOF) for development purposes (including refinancing loans) which have too low a grant element to qualify as ODA.

The distribution of the ODF for the electricity sector has been put in relation with the electrification levels to understand if the distribution of ODF is coherent with the relative needs of the developing countries. Aid Distribution Curves and the relatives

Suits Indexes have been built for relevant donors and for the whole international community, using a methodology indicated by World Bank and recognized in literature (Baulch, 2006), (O'Donnell, van Doorslaer, Wagstaff & Lindelow, 2008).

The data analysis shows that the distribution of Official Development Finance for the Energy Sector of developing countries is distributed in a very regressive way with respect to the needs: few countries with high electrifications levels are able to attract a great part of the aid. We ordered the countries by reverse level of electrification (starting from the lowest) and we compared the cumulative share of aid and the cumulative share of unconnected people. The first 40 countries (including India) represented 94.67% of the 1.3 billions of people without access to electricity but received only 50.96% of the ODF Commitments for Electricity generation and distribution. If we also include in the analysis the large share of ODF for the purpose of "Energy Policy" (37.5% of the total) the distribution becomes even more regressive: the same 40 countries manage to attract only 35.08% of the ODF.

A graphical analysis is made to assess the inequality of the aid distribution. The horizontal axis represents the cumulative share of population without electricity access, starting from the country with lower access levels, while the vertical axis represent the cumulative share of ODF for the sector. A diagonal 45° line represents the equal distribution of cumulative ODF and population without access: the line behind is the actual distribution. The area between the curve and the line represent a measure of the inequality that we measure with the Suits index for various donors in order to evaluate, together with other descriptive indicators, the characteristics of their respective aid distributions.

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## All for naught? The plastic bag debate as a window into the abandonment of zero waste policy in New Zealand

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In 2002, New Zealand became one of the first countries in the world to adopt zero waste as a national policy. In doing so, it acquired a global reputation as a pioneer country in applying innovative approaches to the problem of waste. However, while other countries have since followed their lead, New Zealand itself has reversed course, culminating in 2010 with a formal abandonment of zero waste targets in favour of less ambitious goals.

*Zero waste* is a worldwide philosophical movement, based upon a rethinking of the very notion of waste, and addressing it at its sources – in contrast to the prevailing *waste management* paradigm which focuses primarily on 'end-of-pipe' disposal. The zero waste movement has emerged around the world over the past several decades, mainly from among grassroots environmental activists responding to and protesting perceived failures by governments to address growing waste problems. Subsequently and in increasing numbers, governments worldwide have responded by adopting their own zero waste goals – some as ambitious as calling for zero waste to landfill or incinerator, and with target dates as early as 2010, and many thereafter.

New Zealand was an early exemplar in this regard. Grassroots activists took the lead in 1997, securing private funding to set up a charitable trust dedicated to the pursuit of zero waste. Funding was offered by the trust to local councils which adopted their own zero waste initiatives – and by 2001, more than half of the nation's local councils had signed on.

The central government of the day responded by initiating a process of official consultation and waste strategy development that led to the release, in 2002, of *The New Zealand Waste Strategy - Towards zero waste and a sustainable New Zealand*.

In 2008, the New Zealand parliament passed the *Waste Minimisation Act* (WMA). Although it made no explicit reference to 'zero waste', the Act did contain unprecedented measures to address waste, including the introduction of a mandatory disposal levy, and provisions for designating 'Priority Products' – which would grant the government new powers to regulate and/or eliminate items deemed to pose environmental threats.

Later in 2008, a federal election brought change to New Zealand: the incumbent and largely socialist Labour Party was replaced by the more conservative-leaning National Party. Two years later, in 2010, the new Minister for the Environment released a revised national waste strategy document, in which the zero waste goal was explicitly dropped, and replaced with the less specific goals of "reducing harm and improving efficiency".

The set of events which led to the abandonment of zero waste in New Zealand is complex, and identifying all of the contributing factors and their sources is a highly challenging task. Rather than attempt to pick apart each component of the overall waste stream, this study focuses on one particular subset of it – plastic shopping bags – and employs it as a 'window' into the wider issue of the demise of the zero waste movement.

The ubiquitous plastic bag has become a universal symbol of the modern throwaway society. Viewed widely as low-hanging fruit on the waste tree, it has become a popular target for reduction or elimination - and in many cases around the world, a chosen starting point for larger zero waste efforts. The resulting debate on plastic bags has become one of the most high-profile topics of environmental discourse today, and a useful indicator of attitudes toward, and performance on, wider sustainability issues.

In New Zealand, pressure to ban or charge for plastic bags emerged from the grassroots shortly after the 2002 declaration of the national zero waste policy. At the time, there were already a small number of retail stores across the country which chose on their own to charge for giving out these bags at the checkout.

The packaging industry responded pre-emptively to the increased prospect of government legislation, with the passing in 2004 of a voluntary accord that emphasized recycling in favour of reduction or reuse. This gesture from industry appears to have succeeded in averting any legislation to regulate plastic bag use, until the passage in 2008 of the WMA. Of particular interest to zero waste advocates – and concern to industry – was the 'Priority Products' clause, which gave the government the power to regulate, or ban outright, items such as plastic bags which were deemed to be harmful to the environment.

The change in government which shortly followed, however, appears to have given the plastic bag another reprieve. Continued grassroots pressure on the issue led the new Minister for the Environment to announce publicly, in 2009, plans to introduce a plastic bag tax. This proposal, however, was opposed by the Prime Minister, who indicated that voluntary, industry-led measures were preferred to mandatory ones. No further action on plastic bags has emerged from the New Zealand government since then.

Later that same year an initiative to charge a fee for plastic bags was launched, by one of the country's two main supermarket chains. The move resulted in immediate and significant reductions in bag consumption; however, industry opposition, a negative response from some shoppers, and fears that business would be lost to the rival chain – which did not follow suit – contributed to the fee being abandoned within a month of its introduction.

Analysis of the plastic bag debate in New Zealand provides a valuable window into the evolution of its national zero waste policy, from adoption to abandonment. The results reveal the following key factors which can be attributed to the policy's failure in New Zealand:

- (1) *An absence of clear articulation between specific elements of the waste stream, and how addressing them will achieve the zero waste goals.* In the case of plastic bags, there is no clear indication, in the waste strategy, of how reducing or eliminating them would address any of the targets. It is therefore not clear, to either the public or government, what are the consequences of failing to address plastic bags – or any other component of the waste stream.
- (2) *A change of government from one which enacted the zero waste legislation, to one which largely rejected its key tenets.* The 2002 waste strategy has simply failed to survive the shift to a new government with sharply different priorities than its predecessor. The WMA can not be as easily rejected, because it is enacted legislation – but it can be 'ignored', as demonstrated by the fact that the 'Priority Products' clause has yet to be invoked. The formal abandonment of zero waste in the 2010 revised waste strategy makes the new government's opposition to this philosophy quite clear.

- (3) *The absence of a 'champion' within the higher ranks of government, to advance the cause of zero waste in the face of intense industry resistance, public apathy, and conflicting political agendas.* During the Labour government of 1999-2008, zero waste was championed in parliament mainly Green Party members outside of Cabinet. It appears likely that more progress towards zero waste goals would have resulted, if these minority-party proponents had instead been within the governing party. The new National government, with a significantly different overall philosophy which favours unfettered markets to legislated government intervention, offers an even lesser likelihood for the emergence of a zero waste champion(s) among the inner ranks of government. This was demonstrated when the new Minister for the Environment failed to advance the idea of a plastic bag tax – and further evidence is the lack of any other zero waste-related initiatives on the government agenda since then.
- (4) *A lack of widespread and well-organized grassroots support for implementing the zero waste policy.* While grassroots groups have led the push for zero waste in New Zealand, they have never amounted to more than isolated pockets of advocacy in a larger sea of public apathy. The zero waste movement has been vocal at times – such as in 2009 when pressure on the government to act elicited a signal from the Minister for the Environment to consider a bag tax. However, there has been a general lack of follow-through, with public pressure virtually non-existent since the tax idea was vetoed, and since the fee in supermarkets was launched and then abandoned shortly thereafter. Meanwhile, wider public apathy has endured and even grown at times to antipathy, notably in the case of consumers who resisted against the short-lived supermarket plastic bag fee. It appears that a resurrection of zero waste in New Zealand may require a seismic shift in public attitudes, regardless of what is done at the government level.

### **Private Regime of Global Environmental Governance (GAG): experience of the Carbon Disclosure Project (CDP) in Brazil**

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Climate change is considered by scientists an undeniable global environmental problem, causing a rise in Earth's temperature and influencing the economy, the environment and human health. Solution for climate changes has required collective actions and global reactions from public and private sectors and civil society, emanating a new structure of Global Environmental Governance (GEG). It also aims at mobilizing and negotiating related actors' different interests, regarding the constitution of global regimes of climate issues.

GEG is thought as a series of conduct rules, which defines practices, assigns roles and guides interaction among social actors in order to address global environmental problems. It is the sum of various formal and informal institutions which private and public actors rely on to regulate global environment problems.

In that context, GEG encompasses a group of organizations, instruments, funding mechanisms and norms in order to regulate and protect the environment in a worldwide scope, via strengthening and mobilizing strategic actors, and above all, a network of state and independent actors for addressing environmental issues in a global scale.

The Carbon Disclosure Project (CDP) is one of the most important GEG regimes, developed by the private sector to confront the climate change problem, using the disclosure information strategy. That information is related to four major areas: a) the risks and opportunities that climate change represent to the company's businesses; b) the inventory of Greenhouse Gases (GHG) ; c) corporate strategy towards emission reduction and risk minimization; d) Corporate Governance regarding climate changes. The empiric object of this research is Brazilian companies, members of CDP since 2005. Created in 2000, CDP is a nonprofit entity, patronized by the British Government's *Carbon Trust*, which create a global database about the corporate sector carbon emissions, improving the relations between shareholders and companies in order to respond to the climate change problem.

Thus, the research problem is: which are the main responses of the Brazilian companies (signatories in CDP between 2005 and 2010) to address the climate change problem? This paper analyzes corporate responses in three levels of institutional performance: macro-environment, micro-environment and internal environment. In relation to the methodological strategy, this study is classified as exploratory, bibliographic and a documentary research. The exploratory character aimed at becoming more familiar with the theme, whereas the bibliographic and documentary characters were respectively supported by a secondary data collection – in academic literature on environmental/ climate changes and analysis of the questionnaires filled by Brazilian companies in CDP editions from 2005 to 2010. For analytic purposes, the companies were grouped in ten most representative Brazilian productive sectors: Siderurgy

and Metallurgy; Paper and Cellulose; Telephony (Mobile and Fixed); Public Utility Services; Retail Businesses and Consumerism; Petrochemical; Civil Construction and Transportation; Iron Ore Trade and Extraction; Industrial goods and machines; Financial.

Results showed that initiatives to address climate changes in a global scale, related to macro-environment, are concentrated on the marketing strategy of most companies. Adoption of this strategy was perceived analyzing the changes on the macro-environment caused by the global warming phenomenon, which can directly or indirectly affect the organization in different ways, such as economic, technological, environmental, social, demographic, physical and legal factors. This has demanded a greater capability of adaptation strategies and sustainability practices development from the companies, applied to businesses, aiming to comply with the climate GEG instrument requirements demanded by the macro-environment, such as Kyoto Protocol, carbon market, etc.

As for micro-environment, a concern to attend to the *stakeholders'* needs is emphasized, since they represent interest groups with a certain legitimacy and influence over the organizations. A demonstration of this relation could be perceived through the formation of political-institutional strategies such as alliances, deals and social-environmental programs among governments, companies and NGOs. Finally, as to the internal environment, initiatives associated to environmental performance indicators prevailed – such as research and development investments aiming at lower carbon innovations; social-environmental responsibilities and carbon neutralization; adoption of integrated management systems; carbon credits generation and negotiation, both on the carbon market regulated by the Kyoto Protocol and volunteer initiatives such as Chicago Climate Exchange (CCX); and an inventory of GHG emissions; search for alternative energy sources, such as biomass and wind energy.

Results show that CDP as a climate GEG private regime contributed to the evolution of its Brazilian companies' responses, in three acting levels: macro-environment, micro-environment and internal environment of the organizations. However, responses are concentrated on attending to the organizational internal environment and associated to the environmental performance and GHG emission indicators. Corporate strategies adopted for addressing the climate changes vary wildly among the Brazilian economic sectors, aiming to assure competitive advantages at a global scale.

Generally, this research found that most of the initiatives from Brazilian companies are associated with mitigating problems related to climate change, and few are associated with adaptation to its effects. The climate change issue is being treated as a market problem and it is a recent issue for the corporate world, surrounded by many uncertainties. The Brazilian companies respond very preliminary to the governance and political-institutional strategy aspects related to the climate change. This shows that external variables, such as international market and *stakeholders'* demands are the most influential factors on these companies' decisions when adopting more concrete responses to address the climate change phenomenon.

Finally, the challenges of Brazilian companies, posed by climate changes, demand quick and concrete Brazilian corporate responses in all economic sectors in order to contribute to a low carbon economy and mitigate the risks and increase the opportunities for business.

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## **Carbon Emissions and Mitigation Potentials from Land-use Change in Southeast Asian countries**

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Land-use change contributes for 18% of total anthropogenic greenhouse gas (GHG) emissions in 2004 (IPCC, 2007) and it is the second largest emission source following the power sector. Especially, in Southeast Asia, land use changes contribute a large part of the carbon sink and emission source. The United Nations Framework Convention on Climate Change does not require commitments from developing countries, but recent decreases in the rates of deforestation in Asian countries (FAO, 1997) may have contributed to reduce emissions there. Evaluating the future sources and sinks of carbon from land-use change quantitatively may help countries make decisions for countermeasures of land-use change and choose how to comply with commitments for reduced emissions.

The focus of this study is to estimate the quantity of carbon reduction potentials that could be generated by implementing mitigation countermeasures for land-use change in Southeast Asian countries, Indonesia, Philippines, Thailand and Vietnam. To do so, we estimated the change in land-use and forest biomass harvested from 2005 to 2020 based on the Representative Concentration Pathways (RCP) 2.6 into country levels. We developed the scenario of land-use change and amounts of biomass harvested by country. We used ratios of land-use change and biomass harvested per grid cell to calculate changes in the amount of land use and carbon held in terrestrial ecosystems and wood products. Based on the changes, we estimated quantitatively future carbon emissions and reduction potentials from forestry and land use change by using a bottom-up model, Enduse model. We also developed Marginal Abatement Cost curves (MACs) accumulating reduction potentials by countermeasures. The reduction potential was calculated by comparing expected emissions in the “without” countermeasure scenario (baseline scenario) with those in the “with” countermeasures scenario. The difference in emissions between the two scenarios represents the total technical potential.

We used Enduse model to calculate annual emissions of carbon from changes in land-use. Carbon emission and sequestration are estimated by using Tier 1 or 2 of IPCC inventory guideline (IPCC, 2006). In this model, the amounts of applied countermeasures are calculated under several constraints as an optimal problem to minimize total mitigation costs in each year, and a change of the amount of applied countermeasures is described quantitatively. GHG emissions were calculated from area of land use changed, emission per area and information of countermeasures. Information of countermeasures such as mitigation cost(US\$/tCO<sub>2</sub>), reduction ratio(tCO<sub>2</sub>/ha), life time period(year) and implementation degree (% of total target area), was given to the model exogenously. The costs are converted into annual cost equivalents by using discount ratios, subsidy ratios and life time periods of the countermeasures. The types of countermeasures were chosen in order to minimize total mitigation costs in the country and each year. The amount of applied countermeasures in each year was calculated from that of previous year and the amount of introduced countermeasures in the year. We collected action plans/countermeasures for land-use change and forestry sector from not only international reports(IPCC, 2007) and literatures(Rodel and Pulhin, 2000, Yusuf et al, 2010) but also national reports published by governments (Socialist republic of Vietnam, 2010, Office of the President of the Philippines, 2010, Republic of Indonesia, 2009, 2010). Countermeasures can be classified into reforestation, reducing deforestation and forest management.

In the baseline scenarios, in the four Southeast Asian countries, Vietnam, Philippine, Malaysia and Indonesia, C sequestration capacity of LULUCF is expected to 70 TgC in 2006 to 65 TgC in 2020. In 2006, for example, in Vietnam, total GHG emission from LULUCF was 1.8 TgC including 7.6 TgC emissions from forestlands, 6.3 TgC from croplands, 1.1 TgC from grasslands, and 13 TgC removals by harvested wood products. In Indonesia and Philippine, C sequestration capacity in forestland is expected to change from 85 TgC/yr and 18 TgC/yr in 2006 to 83 TgC/yr and 18 TgC/yr in 2020.

As for emission mitigation, in 2020, improvement and management of forest, land rehabilitation, avoiding deforestation and plantation can reduce 4600, 1100 and 800 TgC under 5.1US/tC in Indonesia, Thailand and Vietnam, respectively. Most of this will come from preservation of existing protection forests and protection and sustainable management of existing production forest areas. The preservation of existing protection forests is 1700, 420 and 310 TgC, at abatement cost of US\$2.8/tC. The potential for this countermeasure is 1300, 330 and 240 TgC, at abatement cost of US\$5.0/tC.

Activities in tropical forest lands provide both reducing emissions and reducing atmospheric concentrations of GHGs. We conclude that the large part of emission can be addressed to reduce by existing techniques and technology in forest lands. Carbon sinks provide a practical available method of achieving meaningful reductions in atmospheric concentrations of CO<sub>2</sub> and at the same time contribute to national sustainable development goals.

Acknowledgement: This study was supported by the Global Environmental Research Fund BC-088 and Research Fellowships of the Japan Society for the Promotion of Science for Young Scientists, 7066.

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## Local social entrepreneurial leadership for sustainable development

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Realizing Sustainable Development (SD) is a wicked problem (Latesteijn et al, 2011). Any attempt involves many stakeholders, has to be sensitive to local context and, in particular, appreciate yet also contend with deeply rooted ecological and socio-economic conventions (Latesteijn *et al.*, 2011, p.10). It is a particularly difficult task in developing countries where lack of resources compound the challenge of improving the welfare of current and future generations.

A critical case is Bangladesh: 156 million people with a population density of 1100 people per square km, poor land-man ratio, slow economic growth, and massive unemployment (Mabud, 2008). About 80 percent of the population lives in rural areas, where poverty has a higher prevalence than in urban environments (USAID, 2011). Seventy-seven percent of rural households' livelihoods depend heavily on natural resources, causing pressure on natural capital and biodiversity and potentially endangering the household's source of income. Yet, fundamentally, in Bangladesh, sustainable management of the bio-diverse natural capital is a key to poverty reduction (USAID, 2011).

However, in many countries public efforts to generate sustainable livelihoods and to alleviate poverty often fail poor people because the services offered are inaccessible, low-quality or unaffordable (World Bank 2003, p.19). The high variability of local contexts often is a cause of the failure to reach the poor in large-scale poverty alleviation programs. One consequence is that the UN General assembly concluded in 2005 that national strategies will not succeed without the engagement of civic actors (UN GA, 2005, p.4). A tacit argument of this position is that individual entrepreneurs can be better than governments and large organizations in scanning for opportunities and building up grassroots efforts from very limited capital, on the grounds that they have in-depth knowledge of the local context (Seelos *et al.*, 2005).

We evaluate the Social Entrepreneurial Leadership (SEL) programme in local communities in Bangladesh. The SEL-approach is a form of the new Sustainable Livelihood Approaches (SLAs). SLAs historically focus on finding local solutions for complex problems from an interdisciplinary perspective, and from the poor end-users' point of view (comp. Scoones, 1998). This model has five key dimensions.

1. A focus on people's access to the resources they use to improve their livelihoods, often divided into human capital (e.g. skills and capabilities), natural capital (e.g. forests, biodiversity and arable land), economic capital (e.g. cash and income), physical capital (e.g. available infrastructure and access to information), and social capital (e.g. networks and friendships).
2. It places people in relation to multiple factors that influence these resources, like climate, politics, and demography.
3. It pays attention to the livelihood strategies of people.
4. It analyses the (presence and absence of) institutional and organizational influences on access to resources and the development of new strategies.



5. It analyses the effect of the livelihood strategies and the institutional influences on livelihood outcomes. Outcomes include more income, increased well-being, reduced vulnerability, improved food security and a more sustainable use of the natural resource base. (Scoones, 2009)

A critical aspect of the SLA approach is that it takes into account the distribution of knowledge and power, and the challenge of changing social values and political balance (Scoones, 2009).

In the highly hierarchical and patriarchal Bangladeshi society, where patrons play a pivotal role (e.g. Mair *et al.*, 2008), addressing existing power relations and politics is essential in order to enhance the livelihoods of the poor. SEL uses 1) local entrepreneurial leadership in villages, 2) local knowledge of different stakeholders, 3) cooperation between local and external institutions and 4) trust relations, as core pillars of its change strategy.

The SEL-approach, a form of Action Research, involves selecting local people with entrepreneurial skills. It is implemented by a local intermediary organization (*Pride Bangladesh*) that works on sustainable development and protection the natural resource base. SEL is typically organized in a three-tiered design, which leverages its reach and effectiveness. *Pride* (tier 1) organizes co-learning processes between all stakeholders for the development of Income Generating Activities (IGAs). The selected local entrepreneurs (tier 2) are trained in these IGAs, in monitoring and in conducting group meetings. These entrepreneurs on their turn stimulate community members (tier 3) to start IGAs and develop supporting social structures. They provide knowledge, the required inputs (for a fee) and assist in selling the produce. Next to that, they have regular meetings where they discuss progress, the production and use of compost and green manure, and topics like rights and family planning.

For the evaluation more than 100 semi-structured interviews and 20 focus groups were conducted in more than 30 villages; the findings were analyzed using the sustainable livelihood model.

The results show positive effects on all defined livelihood outcomes.

*More income and increased well-being:* there is a strong increase in IGAs, leading to a higher household income. Participants consume their own produce and some even have a little surplus that they sell or exchange for other products. They experience a reduced stress on their home and family structures and indicate to feel happier and more self-confident. Parents reported that children pay more attention in school and have exercise books to work in.

*Reduced vulnerability and improved food security:* participants reported increased household production of vegetables and fruit. They have more and more nutritious meals at more regular times. The entrepreneurs effectively facilitated in setting up small cooperatives (4 to 6 people) of poor community members, while their own personal network was expanded and strengthened. Some were even asked for their opinion by village councils, which for ultra-poor is an unprecedented sign of local influence. Entrepreneurs and community members get more sources of income.

*More sustainable use of the natural resource base:* increased production was achieved without any external input like pesticides or fertilizer. Moreover, the local entrepreneurs produced their own green manure, increasing soil fertility. The entrepreneurs and the community members started using compost pits. The cooperatives leased arable land from urban rich or they pooled resources to set up and exploit a fishing pond, where the fish were (partly) fed with waste.

Lastly, the local entrepreneurs could sustain themselves without financial donor support.

For these marginalized people, small increases in household income have a great effect on their livelihood. The social entrepreneurs are contributing in a number of direct and indirect ways to sustainable development. Their self-sustained livelihoods and diversification of income sources make these people more resilient against small shocks, decreasing the need for crisis interventions. By increasing their own produce and by improving the quality of their soil, they uplift their own livelihoods and simultaneously protect the natural resource base. Moreover, the entrepreneurs' enhanced income allows them to stimulate communal investment in e.g. arsenic-free water supply and health care.

Local social entrepreneurs thus use the specifics of the local context productively and prove that even in a poor, resource scarce environment, it is possible to produce sustainably by using only local inputs. What is more, they prove that the local values and patron-client relationships can be adjusted, and that people can be organised in new, empowering structures. While local differences usually hamper development models, in the SEL-approach they are used to advantage, providing at least part of an answer for the wicked problem of Sustainable Development.

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## **An Analysis of Greenhouse Gas Reduction Targets in Japan Using a CGE Model**

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In recent years, global warming has been one of the most critical problems in the world. The Intergovernmental Panel on Climate Change (IPCC) declared that warming of the climate system was unequivocal, and most of the observed increase in global average temperatures since the mid-20th century was very likely due to the observed increase in anthropogenic Greenhouse Gas (GHG) concentrations (2007). In the same year, the Group of Eight summit was held in Heiligendamm, Germany, where the G8 countries agreed to consider some decisions, which included at least a halving of global emissions by 2050. Japan's former prime minister, Yukio Hatoyama declared that Japan's GHG reduction target was a 25% reduction from 1990 levels by the year 2020 in his statement at the United Nations Summit on Climate Change. When the GHG reduction targets are applied, there is no doubt that the global society would be affected significantly. Analyzing the affects of GHG emission constraints is the very first step to take appropriate countermeasures to minimize impacts, and achieve targets.

This study targets Japan and simulates the future vision under the GHG emission constraints using a Computable General Equilibrium (CGE) model. Based on the simulation results, the impacts to Japan's economy and their supply and demand of energy from the emission constraints are analyzed. The CGE model is a recursive dynamic model and the target period is from 2005 as a base year to 2050. Carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) are considered as GHG. The GHG reduction targets are determined based on Japanese government's target and the global target. As countermeasures of the GHG emission constrains, carbon capture and storage technology (CCS technology), renewable energy and energy efficiency improvements are taken into account. In addition, after 2020, Japan starts GHG emissions trading with other countries. For future simulations, the future scenarios of major indicators, for example, gross domestic product (GDP) and population are determined based on scenarios from Japanese domestic publications and reports.

The CGE model used in this study is a recursive dynamic model with 36 sectors. This model requires energy balance tables as the input data, which allows it to treat detailed energy distributions and simulate future GHG emissions in great detail. This model also deals with GHG emissions trading and CCS technology. The input data includes the base year's social accounting matrix (SAM), energy balance table, and future scenarios. With this input data, the simulation is carried out on the CGE model annually. A case with GHG emission constraints and a case without the constraints are compared, and the impacts from the GHG emission constraints are analyzed. The SAM and the energy balance tables are compiled from several sources, for example, national accounts, industry statistics, and energy statistics. There are often inconsistencies among this data, which then need to be adjusted to avoid errors. For these adjustments, this study uses a mathematical method (Fujimori, 2011), which uses functions that minimize the summation of discrepancies between estimation and observation with some constraints. The future scenarios that exclude the emission constraints are determined by referring to scenarios from Japanese domestic agencies. The CGE model requires annual scenarios; however, since the scenarios produced by Japanese domestic agencies are not annual, interpolations of the data are needed. For these interpolations and adjustments, a scenario complement tool is used, which interpolates using other appropriate data and adjusts to statistical data already present. The GHG emission constraints are determined based on the Japanese government's target, a 25% reduction from 1990 levels by 2020, and the global target, a 50% reduction from 1990 levels by 2050. The amount of emissions in 2020 from Japan, and the amount in 2050 from the world are calculated based on the two targets. Following a burden sharing method, the amount of emission from Japan in 2050 is calculated based on the population, assuming the amount of emission per capita is equal for everyone all over world. After interpolating the data, the emission constraints for Japan are determined, and results in an 86% reduction from 1990 levels by 2050.

A case without GHG emission constraints (Business as Usual case, BaU case) results in a decreasing trend in GHG emissions of about 4.6%, 8.9%, and 18% in 2020, 2030 and 2050 respectively from 2005 levels. The total primary energy supply (TPES) and the final energy consumption (TFC) also decrease, and the TPES decreases 21% and the TFC decreases 14% from 2005 levels. These reduction trends result from the autonomous energy efficiency improvement.

Compared with the BaU case, a case with GHG emission constraints is named the Burden Sharing (BS) case. In the BS case, the emissions from Japan follow the constraints until 2020. After emissions trading starts in 2020, the GHG emissions become constant until 2025, and starts decrease again. On the other hand, the amount of GHG emissions credits, which Japan purchases through GHG emissions trading increases rapidly from 2020 to 2025, and after that, it decreases and increase moderately. In 2050, the half of Japan's emissions is covered by GHG emissions credits. The GHG reduction cost, which is defined as the cost to reduce a ton of GHG in CO<sub>2</sub> equivalent, shows a monotonic increase up to 136 US dollars in 2005 prices in 2019. After emissions trading starts in 2020, the cost decreases to 94 US dollars in 2005 prices, in 2025. After 2025, the cost increases again, and in 2045, the cost becomes the highest, 648 US dollars in 2005 prices. Finally in 2050, the GHG reduction cost becomes 596 US dollars in 2005 prices. GDP of BS case is lower than that of BaU case in almost all periods. In 2050, the gap of GDP between BaU case and BS case is 1.5 % of BaU case GDP. The energy supply and consumption decrease considerably, the TPES decreases 41% and the TFC decreases 44% by 2050 from 2005 levels. The supply of fossil fuel in the TPES decreases heavily, and the share of fossil fuel in the TPES becomes 59% in 2050 from 82% in 2005. While the TPES decreases, the TPES of renewable energy sources such as wind energy shows an increase. The decomposition analysis of GHG emissions reduction shows a reduction of the TFC per TPES in BS case. Also in BS case, CO<sub>2</sub> from fossil fuel combustion per the TFC decreases and increases depended on the periods. From the analysis, Japan not only improves energy efficiency but also introduces CCS technology and purchases GHG emissions credits depended on emissions trading price in order to satisfy GHG emission constraints.

In conclusion, the findings of this study are; (i) When the GHG emission constraints based on the Japanese government's target and the global target are applied to Japan, the reduction requires an enormous cost, maximum 648 US dollars in 2005 prices in 2045. (ii) Economy of Japan is affected from GHG emission constraint, and GDP decreases 1.5% at a maximum. (iii) For the energy supply and demand, the emission constraints result in a reduction in energy supply and consumption with a substitution from fossil fuels, to lower GHG emission energies, for example, wind energy. (vi) In order to satisfy GHG emission constraints, Japan applies counter measures like GHG emissions trading and CCS technologies depended on its situation.

Acknowledgement; this research was supported by "Global Environment Research Fund" by Ministry of the Environment, Japan", A-0808.

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## **Sustainable Development in Iran: An Exploratory Study of University Students' Attitudes and Knowledge about Sustainable Development**

Luis Antonio Perez-Batres

In this paper, we explore the perceptions of Iranian undergraduate college students about the concept of sustainable development (SD). In so doing, we measure students' attitudes and knowledge on the various aspects of the SD paradigm. The results indicate that while most Iranian students surveyed have a positive perception toward SD, their attitudes and knowledge about it is linked to certain demographic characteristics. Implications of these findings are further explored.

Sustainable Development has received more attention in recent years due to the growing evidence that current development strategies embraced by many nations are not sustainable into the future (Meadows, Meadows, & Randers, 1992; Earth Charter, 2002). The United Nations Conference on Environment and Development in 1992 made several recommendations to accelerate the move toward SD. Agenda 21 of the Earth Summit (UNCED, 1992: p. 1) states: "education is critical for promoting sustainable development and improving the capacity of the people to address sustainable development issues." Ten years later, at Johannesburg, South Africa, the World Summit on SD (WSSD, 2002: p. 5) proposed "adopting a decade of education for sustainable development starting in 2005."

Among several directives, the WSSD (2002) report urges member nations to redirect some educational outcomes in order to promote a better understanding of sustainable development. Specifically, it urges nations to provide environmental and developmental education through formal and non-formal channels to all age groups. The hope is that SD education would lead to behavioral changes conducive to its goals. We do not dispute this reasonable assumption (i.e., that SD education would further congruent SD behaviors). However, we first need to understand if SD education indeed affects (student) perception and attitudes towards the very concept.

To this end, researchers have begun to gauge the level of undergraduate students' knowledge and attitudes about sustainability. The results of such research have provided important insights into students' views on the issue of

sustainability and their understanding about this concept. However, most of these studies have limited their attention to the developed world (Carew & Mitchell, 2002; Darnton, 2004; Kagawa, 2007; Stir, 2006; Summers, Corney, Ghil, 2004). Notwithstanding, several researchers have called much attention to the developing countries (e.g., “BRIC” countries), where about 80% of the human population of the world lives. As social progress permeates through these world regions, their perception about sustainability can result in a grimmer or more hopeful outlook.

Understanding that knowledge about developing world regions is also of paramount importance to the World's well-being, the present paper serves as a first attempt to explore the perception (i.e., attitudes and knowledge) of Iranian undergraduate students toward sustainable development concepts and, consequently, the progress that Iran has made in meeting the educational needs of sustainability.

In order to develop policies and coordinate development strategies consistent with Rio's Earth Summit declarations, the Iranian government, as a signatory to the declarations, established the National Committee for Sustainable Development (NCSD) in 1992. The Committee's objectives, among others, included the development of a unified framework to meet the requirements of Article 21 of the summit. Among this Article's directives was the emphasis placed on the role of education in promoting the understanding and the capacity to work toward sustainable development goals (Maknoon, 2006). These directives are indeed encouraging given the various economic, social and environmental challenges that the country is facing. For a detail discussion of these problems (which are beyond the scope of this paper) readers can refer to Human Development Report (2009), Iran pollution Report (2002), and Ghazinoory (2005). It is also important to note that the Iranian government exerts substantial control over the economy both directly and through semi-private entities such as foundations (*bonyads*), mutual funds, pension funds and companies linked to military organizations.

To determine the level of SD knowledge by Iranian undergraduate students, we used a survey instrument consisting of 51 questions. We then conducted a factor analysis and found four common loading factors. The following step was to test the relationship of each one of the factors four factors with a set of demographic characteristics (exploratory variables) encompassed by: gender, area of academic study, years of university study, foreign language ability, household income, and the important environmental education in high school.

The purpose of this research was to investigate the knowledge and attitudes of Iranian students toward the multi-faceted SD concept. About SD knowledge, our results show that gender (Iranian women) and SD education in high school, were variables with a positive relationship to the concept of SD. Specifically about undergraduate Iranian women, our analysis revealed that they are more knowledgeable, than Iranian men, about non-technical environmental issues, social fairness, and the public welfare dimensions (factors) of the SD concept; yet there is no difference between Iranian men and women about the technical environmental factor. Our research also showed that respondents with SD education in high school were more knowledgeable about some aspects of sustainability concepts (Fairness, Technical Knowledge and Social Welfare) than their peers, those with no SD high education.

About overall attitude, students with more years of undergraduate education (not specific SD education) placed more value on the multi-facet SD concept (SD value, need to change behavior to avoid environmental crisis, business development) than their peers with lesser years of undergraduate education. Also, Iranian undergraduate women place more importance on the need to change our human behavior to avoid an environmental crisis, than men did.

Indeed, these results underscore the important role of education in enhancing the understanding of younger generation toward sustainable development. Not only that, but it might be the only ethical and effective way to sustain our human development, and with it, our very existence!

## **Assessment of whether the inclusion of aviation within the European Union's Emissions Trading Scheme can drive the aviation industry towards a sustainable future**

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Aviation traffic has seen a significant increase over the last two decades with total scheduled traffic growing at an annual rate of 4.4% (ICAO, 2010) and passenger traffic expected to grow at an average rate of 4.8% per year beyond 2030 (ICAO, 2010). The emissions produced by aviation contribute to the forcing of the climate; most importantly the emissions of carbon dioxide (CO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), water vapour, aerosols, and the effects of contrails and contrail cirrus (IPCC, 1999; Lee et al, 2009). Despite improvements in technology, traffic growth rates result in increased emissions, which is potentially unsustainable within the context of stabilizing the Earth's climate – the ultimate objective of the United Nations Framework Convention on Climate Change (United Nations, 1992). In this paper, a

sustainable future is considered to be one which ensures that global temperature increases are limited to ensure that average surface temperatures do not rise beyond 2°C above pre-industrial levels. This target has been adopted by some national governments and the European Union (EU) (as well as being a recognised objective in the Copenhagen Accord) (European Commission, 2009a; UNFCCC, 2010), and it is within this context which the aviation sector must become sustainable and not exceed emissions levels which may potentially prevent the stabilization objective being achieved. Aircraft emissions were not included within the binding targets of the Kyoto Protocol, and the industry has received attention in recent years with commentators demanding it be subject to emission reduction policies. With the Kyoto Protocol's commitment period coming to an end in 2012, and a potential successor still in development, policies to mitigate the climatic impacts of the aviation industry are starting to be employed. One such policy is the inclusion of aviation within the EU's Emissions Trading Scheme.

This study investigates whether the inclusion of aviation within this market-based mechanism has the potential to significantly reduce aviation emissions and contribute to a sustainable future under the premise of climate stabilization. From 2012, all flights arriving to and departing from EU Community airports (with some exemptions such as those operators with an emissions threshold of less than 10,000 tonnes of CO<sub>2</sub> per year) will be included within the Emissions Trading Scheme (European Commission, 2009b). Whilst the inclusion of the aviation sector within the Scheme is a step in the right direction, it is uncertain as to whether the inclusion will actually bring about meaningful reductions in total emissions, for a number of reasons. This study investigates a number of these reasons.

Firstly, the emissions that would be covered under the Emissions Trading Scheme only make up approximately 20% of global aviation emissions. This paper updates a study on the allocation of international aviation emissions for the year 2000 to specific countries, undertaken for the UK Government's Department for Environment, Food and Rural Affairs (Lee et al, 2005); updating it for the year 2006. The updated study showed that for 2006, the total global emissions from international aviation for scheduled flights, was approximately 561,000 Gg of CO<sub>2</sub>. Approximately one fifth of these emissions were attributable to flights to and departing from the EU-27 countries. Therefore, a considerable proportion of global emissions are unaddressed.

Secondly, only the emissions of CO<sub>2</sub> are covered under the Emissions Trading Scheme, meaning that the climatic impacts of the non-CO<sub>2</sub> emissions and their effects resulting from aircrafts, will not be addressed. If the aviation industry is to move towards a completely sustainable future then the climatic impacts of these additional gases will need to be taken into consideration.

Thirdly, the gradual decrease of the emissions cap under the Emissions Trading Scheme may not provide significantly meaningful emissions reductions in a fast enough time frame. This study suggests that the annual reduction in the emissions cap (from 2013 the cap will be reduced annually by 1.74% until 2025) (European Commission, 2010) is insufficient at driving down emissions, particularly considering that emissions from the global aviation sector alone are increasing by 3-4% per annum (WRI, 2005).

Finally, there is the risk that the financial cost of trading in carbon credits will be passed onto the passengers within the ticket price, meaning that there will be a limited impetus upon the aviation industry to focus more attention upon reducing its carbon emissions, developing technologies, and changing practices. Additionally, only the routes under the EU Emissions Trading Scheme will be affected, meaning that if there is any impact upon passenger numbers due to an increase in air fares, its impact on a global scale will be minimal.

This study concluded that whilst there are a number of issues regarding the inclusion of aviation within the Emissions Trading Scheme as highlighted, it is one of a number of valuable tools in mitigating aviation's emissions. However, for its potential to be increased, implementation on a global scale could prove even more effective. Therefore, the linking of emissions trading schemes might be an option. There are currently a number of emissions trading schemes in operation (or in development) which could be linked with the EU's Emissions Trading Scheme. These include the Regional Greenhouse Gas Initiative, the Midwestern Greenhouse Gas Accord (which both have participants from some US states), and the Western Climate Initiative (which has some states from the US and Canada as participants), the Carbon Pollution Reduction Scheme in Australia, and the New Zealand Emissions Trading Scheme.

This study calculated that the proportion of global aviation emissions for 2006 (from flights to and departing from these countries/states included within the respective trading schemes) was just over 40%; double that of the EU Emissions Trading Scheme alone – considerable potential in mitigating against the aviation emissions. Finally, whilst it has been argued that the non-CO<sub>2</sub> effects of aviation on the climate should also be accounted for, the means by which this could be done, however, is uncertain. This study concludes that whilst the inclusion of the aviation sector within the Emissions Trading Scheme is a positive climate mitigation policy, there are a number of issues that could hamper its success in contributing to a sustainable future.

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## Posters

### Is Houston Moving Towards a Sustainable Future? A Case Study of Houston's Progress Regarding LEED Certification for New Development

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Energy usage, raw material exhaustion, potable water consumption, pollution, and green house gas emissions have been salient topics for scholars, environmentalists, economists, developers, and politicians. Many efforts designed for sustainable technology to reduce the burden of pollution and the depletion of natural resources have occurred over the last three decades. U.S. buildings have a significant impact on the use of general resources as follows; 40% of primary energy use, 72% of electricity consumption, 39% of CO<sub>2</sub> emission, 13.6% of potable water consumption, and 70% of solid waste (U.S. Green Building Council (USGBC), 2010). Consequently, the concept of sustainable technology aims to have buildings with lower environmental impact, which eventually improve the following:

- The quality of the natural environment by reducing pollution and natural resource depletion.
- The community life by providing a healthier environment and improving resident's well-being (Jabareen, 2006).

Despite the growing interest in sustainability, there are still tremendous challenges due to the high initial construction cost vis-à-vis conventional technology, shortage of green building materials, and finally, a scarcity in the labor pool that is knowledgeable about green construction. Accordingly, cost burdens make it more difficult to develop green buildings as an institutionalized planning tool (Down, 2005; Mayerson, 2007).

This study is designed to investigate the following questions:

1. a- What is the distribution of Leadership in Energy & Environmental Design (LEED) certified buildings in Houston, Texas?
1. b- Do these buildings have an agglomeration pattern or are they geographically random?
1. c- Do they coincide with major transportation routes?
1. d- Does the distribution of these building's reaffirm Houston's sustainable urban form?
2. a- What is the building's primary function (educational, civic, commercial, medical, or industrial)?
2. b- Are these buildings mixed used complexes or a single purpose function?
2. c- What is the primary land use in U.S. Census tracts where these buildings are located?

2. d- What types of employers / industries are located in LEED certified buildings in Houston?
2. e- Is there an equity issue related to the distribution of these buildings?
2. f- Is there a spatial pattern connected to a specific industry?
3. a- What are the strategies that will lead Houston toward sustainability at the local, regional, and global scale?
3. b- Does Houston's size ( population and land area) create opportunities or challenges toward a sustainable future based on limited public transportation, lack of zoning, and geographical position at the crossroads of global trade routes (Panama Canal expansion)?
- 3.c- How does low density, fragmented development, and sprawl impact future sustainability of City of Houston?

This research will use both descriptive and inferential statistics, along with spatial analysis to explicate the sustainable future for the City of Houston, which includes City of Houston Full Purpose City Limit, Limited Purpose City Limit, and its Extra-territorial Jurisdiction; a combination, which occupying a majority of Harris County's 1777 square mile area. This caste of research reviews data from a diverse index of resources that include:

1. LEED certified building in the City of Houston as published by USGBC under LEED Projects & Case Studies Directory. This list provides data about certification type (New Construction, Existing Building, Core and Shell, and Commercial Interior) and level (Platinum, Gold, Silver, and Certified) for the buildings, while additional information such as, building function, employment type, and land use can be accessed through the U.S. Census and City of Houston Planning Department.
2. The City of Houston map (parcels shape file) that was documented by Harris County Appraisal District (HCAD) property records will be the base map for the spatial analysis.
3. Detailed Tables and Geographic Comparison Tables from the U.S. Census Bureau, American Fact Finder, Decennial Census (2000), Summary File 1 (SF 1 – 100 Percent Data) and Summary File 3 (SF 3 – Sample Data) provide specific socio-demographic data.

Generally, data will be accessed in Microsoft Excel and CSV format that can be connected to a Geographic Information System (GIS) platform, such as (ArcMap) for spatial analysis, and SPSS for descriptive and inferential analysis.

GIS will be used to identify and update the physical location of LEED certified buildings in Houston. This can be achieved by inserting the physical address of projects on a base map for the City of Houston (a spatial map will be created), which should provide a reconfirmation of Houston's urban form, and that, the location of LEED certified buildings are not confined to the Central Business District (CBD). The results of the statistical and spatial analysis for building function, employer, and land use are anticipated to suggest the agglomeration effect of LEED certified buildings at major transportation intersections and business sub-centers. Finally, the distribution of buildings should create a pattern, which will lead us to discuss the present issues of equity related to what industry groups have access to healthy/Green buildings, and how Houston can expand in the future within a sustainable frame work.

The anticipated outcomes of this research are expected to set strategies and standards for sustainable development at the local, regional, or global scale. These strategies should provide guidance towards sustainability through different stages of Houston's future development. Ultimately, the intent is for policy makers to advocate for enforcement of community development that aims to harmonize growth, along with sensitivity to a nature rich coastal environment. Consequently, this research is intended to be a toolkit for all stakeholders to make a move towards sustainability.

Finally, the contribution of this study to the literature on sustainability is an analysis of LEED certified buildings in Houston, which expands upon the research connected to employment sub-centers as presented by Giuliano and Small (1998), Craig and Ng (2001), Craig and Kohlhase (2008). While, Craig and Kohlhase (2008) identify the ship channel corridor, our study is intended to highlight the emergence of an energy corridor in another sector of the metropolitan area, which is characterized with an amalgamation of LEED certified buildings. This will help to explore and contrast the idea of industry specific «district corridors» with LEED certified buildings as a possible path towards the City of Houston achieving a more sustainable future.

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Acknowledgement: Amal Abed and Margaret Kidd thank Dr. Qisheng Pan, Chairman, Dr. Lalita Sen, Doctoral Coordinator, and Professor Peter Brown, Adjunct Faculty, Department of Urban Planning & Environmental Policy; and Dean Theophilus Herrington, Barbara Jordan-Mickey Leland School of Public Affairs, Texas Southern University, Houston, Texas.

## **Paradoxical Urban Policies and Programs in India: A Major Hindrance for Urban Sustainability**

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In the twenty first century the urban problems have become increasingly complex and challenging. Clear policies and programs are required to guide the process of urban change towards the desired outcome. India is enjoying a rapid economic growth coupled with fast urbanization involving major shifts in human settlements. In spite of continuous efforts and trials, India has not been able to make a real breakthrough in controlling the range of urban problems. The area of urban development in India remains one of the most unplanned, unregulated planning systems in the world.

The vision of India is to fulfill the Millennium Development Goals and creation of sustainable cities with improved quality of life. The understanding of sustainable development in developing countries poses more complexity. In first place, there are the eternal issues related with the core concerns of sustainability. Then, there are the additional quandaries appear in the form of puzzled planning process. Moreover, lack of development and struggle to overcome poverty originate many environmental and ecologic problems. In India, the term sustainable development first appeared in 1997, during the ninth plan period.

Indian urban scenario: The urbanization trend is unique in India. The degree of urbanization is about 27.8% which is not very high in the world. But in terms of absolute number it is one of the highest in the world. India has 35 cities which have population of more than 1 million. Among them 3 cities have population well above 10 million and 4 cities have population between 4 to 10 million (Census 2001). 590 million Indians will be living in cities by the year 2030, nearly twice the current population of the United States (McKinsey). This phenomenon is demonstrated by the growth of number of cities and urban agglomeration from 3768 in 1991 to 5161 in 2001. 26.53 million housing shortages has been registered in urban areas. 99% of this shortage belongs to economically weaker sections (Planning Commission). Moreover, an estimated 61.82 million people live in slums and squatters (Census 2001). This dichotomist situation leads to immense pressure on civic infrastructure, transportation and overall quality of life in the cities.

Urban policies in India: In India, policies on urban areas have two components; urbanization policy and urban policy. Urbanization policy deals with the role of small and large urban areas in the overall context of human settlement. Urban policies concentrate on issues of regions, urban areas and concerned planning fields like land use, transportation, housing, urban governance etc. India has a legacy of constituting the national policy through 'Five year plan'. The Planning Commission under the watchful eye of National development Council creates the 'Five year plan'. India is presently served by the eleventh 'Five year plan' (2007 – 2012).

The very first plans concentrated on to tackle the problem of housing demand and refugee settlement. In the second and third plan there was an effort to prepare master plans for the major cities. But from the fourth plan onwards the policy shifted from the master plan approach towards sector development e.g. housing, transportation, environment etc. Subsequent plan experienced the launch of Integrated Urban Development Program (IUDP) for large cities and Integrated Development of Small and Medium Towns (IDSMT). After the launch of Jawaharlal Nehru National Urban Renewal Mission (JNNURM) in tenth plan, all the development programs (e.g. IUDP, IDSMT) has been integrated under JNNURM.

Housing and slum eradication policies exist from the very first plan. Institutions like Housing and Urban Development Corporation (HUDCO), Housing Development Finance Corporation (HDFC), National Housing Bank (NHB) had been established to finance the housing sector. In the few initial plans, the government role in housing was of a provider. But with rising demand, growing land price and increasing construction cost, the Government role shifted towards enabler rather than provider. Land is a key component in urban development. The major land policies in India had been the land acquisition Act 1894 and Urban Land Ceiling and Regulation Act (ULCRA) 1976.

Policies to stimulate urban governance through strengthening Urban Local Bodies (ULBs) are widely practiced after the 74th amendment of the Constitution Act, 1992. Creation of Pooled Finance Development Fund (PFDF) and introduction



of e-governance were another step forward to that direction. Recently the Government policy focused more on to create provisions for private sector and Foreign Direct Investment (FDI) to invest in urban development.

Conclusion: Indian cities are already among the most populous cities in the world and are expanding at a scorching pace. But under investment and lack of planning have resulted in a handicapped urban situation that may threaten the growth momentum of India. Historically, urban planning in India is paradoxical with lots of predicament in it. It is largely due to the resource constraints and lack of spatial perspective in planning which have suppressed the overall planning system. India is yet to materialize its long time ardent desire of National Urbanization Policy. The problems have become manifold due to the lack of co-ordination between central and state governments; and absence of hierarchical administrative/municipal governance for spatial planning and project execution. Overlapping of administrative functions creates lots of confusions. The absence of regional plan, master plan and urban management further attribute to the chaos in urban development. Decentralization, integrated development, poverty alleviation and people's participation are the recurring themes of successive plans in India. After the ninth plan sustainable development, inclusive growth and capacity building of ULBs are added as the additional visions of Indian planning acumen. There are lots of mismatch between India's desires of economically vibrant, inclusive, efficient and sustainable cities to the present situation. In spite of all the effort, the programs and policies up till now happen to be a mere paper work rather than a reality. Now, with the rapid economic growth, the spatial imbalance is widening more than ever towards a disastrous situation. It is the high time to take corrective measure for a better scenario not only for India but for a sustainable world as a whole.

### **Synergic Approach Enhances Marine Conservation and Human Wellbeing: Lessons from a Philippine Population-Environment Pilot to Inform Rio+20**

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The Integrated Population and Coastal Resource Management (IPOPORM) approach was designed to redress food security concerns in coastal Philippines by building local institutional capacity to implement coastal resource management (CRM) strategies in tandem with family planning and reproductive health (RH) activities. The pilot was tested in coastal areas of the Palawan Biosphere Reserve, which spans the entire Province of Palawan. The province is renowned for its unique marine, forest and mineral resources which, until recent decades, have remained relatively unexploited. Although still deemed "the last ecological frontier" (Sandalo & Baltazar, 1997) and "most biodiverse island environment remaining in the Philippines" (McNally *et al.* 2004), Palawan faces serious development challenges due to its population growth trajectory and the affects of growth on patterns of land use, settlement and natural resource extraction.

Palawan's population has increased dramatically from about 40,000 persons in 1905 (McNally et al, 2004) to an estimated 840,000 in 2010 due to both natural increase and immigration. The high proportion of young people in the population is another driver of the province's continued high rate of expansion (3.64% per annum) which far surpasses the Philippine national average figure of 2.01% (NSO Philippines 2002). These demographic factors together with poverty and lack of income opportunities underlie much of the environmental degradation that prompted the government to establish the Reserve in 1991 (Sandalo & Baltazar, 1997). The preservation of Palawan's biodiversity not only requires local capacity building for resource management and adaptive technology but also for management of the reproductive health needs of local people. It was with this need in mind that the private, nonprofit PATH Foundation Philippines Inc. (PFPI) set out to test a holistic approach to marine conservation that at the same time offered promise of addressing population pressure, a root cause of environmental degradation and human poverty in coastal Philippine. Widespread adoption of this approach, which recognizes the important interplay between people, population pressures, and the environment, could serve as an important step towards a sustainable world in the future.

With permission from the Palawan Council for Sustainable Development, PFPI conducted baseline (2001) resource and ecological assessments (REA) of selected island ecosystems and coastal habitats in Palawan. A random sample of 1200 respondents was interviewed in the same study areas to gather information on the socio-demographic characteristics of coastal households and residents. Results of these surveys revealed high rates of poverty, malnutrition and fertility that surpassed national and regional average figures with the most acute conditions found in coastal areas where REA surveys exposed evidence of over-fishing and degradation of coral reefs and mangroves (Castro & D'Agnes 2008). Multiple regression analysis showed that children in fisher households were twice as likely to be under-weight as children in other households. Those whose mothers were not currently practicing family planning also were more likely to suffer from malnutrition (Amarillo & D'Agnes unpublished data 2005).

Using information from the baseline surveys, PFPI designed the IPOPCORM approach and transferred know-how to local institutions for the delivery of a package of coastal resource management (CRM), reproductive health (RH) and alternative livelihood interventions to targeted communities. Capacity building inputs paved the way for participatory decision-making on resource use and planning and active involvement of communities in the establishment and management of fish sanctuaries and mangrove reserves in the study areas. Small entrepreneurs from the same villages participated in social marketing activities that expanded access to family planning information and affordable contraceptive products. Public education campaigns implemented by collaborating Peoples Organizations encouraged residents to plan their families and protect their coastal resources to assure food security from the sea. Simultaneous advocacy by partner NGOs impelled local governments to strengthen enforcement of laws prohibiting use of dynamite and cyanide in fishing. The same NGO partners facilitated micro-credit and alternative livelihood opportunities for fisher folk, women and youth that provided a safety net for maintaining incomes while ecosystems regenerated (Castro & D'Agnes, 2008) and helped to rectify gender disparities in access to credit and skills training in rural coastal communities (D'Agnes et al. 2005).

Follow-up REA and socio-demographic surveys were conducted in 2007 (post-project) in the same Palawan study areas using the same methods applied in the baseline (2001) surveys. Regressions analyses were performed on the 2001 and 2007 datasets to examine the statistical significance of the differences in RH and CRM indicators over time while controlling for other related factors. Results indicate a significant decline in the average number of children borne to women in the IPOPCORM study areas, and improvement in safer sex practices among youth. Food security also improved, with fewer families in 2007 reliant on subsistence fishing compared to 2001 and fewer fishers resorting to use of cyanide, dynamite and other destructive fishing methods. The same data also indicate appreciable declines in the level of income-poverty among youth in the project sites. REA findings reveal positive and significant changes in coral condition and mangrove indices. Within the fish sanctuary, average biomass of reef fish species more than doubled. (D'Agnes et al. 2011).

A quasi-experimental analysis of IPOPCORM's impacts in comparison with independent CRM and independent RH interventions established evidence of the superior performance of the synergistic approach and its potential for promoting human-ecosystem interactions that contribute to environmentally-sustainable development (D'Agnes et al. 2010). Integrating responses to population, health, and environment (PHE) issues provides an opportunity to address multiple stresses on communities and their environments and, as this study demonstrates, adds value in such a way that significantly improves community resilience and other outcomes. The study's rigorous time-series data and regression analysis provide "the first concrete evidence of the impact of integration across family planning/reproductive health and environment" (USAID 2011).

The IPOPCORM approach has since been replicated in 12 other Philippine bioregions (PFPI 2007) and its best practices - rated as "the gold standard model for PHE planning and execution" (Pielemeier et al. 2007), have been transferred to organizations in Asia (Nepal) and East Africa (Ethiopia, Tanzania, Ghana and Zambia) where the model is being adapted for use in forest, wetland and watershed ecosystems in addition to marine environments. PFPI is also working with global initiatives such as Building Actors and Leaders for the Advancement of Excellence in Community Development (BALANCED) Project to build local capacity for PHE implementation in other areas of high biodiversity where population pressure is a central issue for conservation and sustainable development (CRC 2009).

IPOPCORM speaks to Rio+20's aim of defining a sustainable development pathway that secures a reasonable standard of living for the global population while preserving life-sustaining ecosystems and resources. The results of this pilot demonstrate that cross-sectoral approaches that address population growth, high fertility, and environmental degradation in a holistic way increase the likelihood of success that extends beyond simply meeting people's needs for family planning or improving management of natural resources to larger development issues such as food security and poverty. Scaling these lessons to reach more people and resources will put the world on a pathway to a sustainable future.

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## Assessment Of Existing Pilot Programs Aimed At Moving Society Towards A Sustainable Future

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Homestead or kitchen garden (Akarima k'igikoni) and One cow per family programs (Girinka) in Rwanda, tools to attain MDG1 and Rwandan 2020 vision.

This paper seeks to explore the current changes and trends of Rwandan governing systems through different initiatives towards the attainment of Rwanda 2020 vision starting by 2012 EDPRS (Economic Development and Poverty Reduction Strategy).

Rwandan population was approximately 10,746,311 on a total land of 26,338 square kilometers, January 19th 2010, meaning a physical density of 408 people per sq km and a physiological density of 896 people per sq km. The total arable land is 45.56% of the total area (2010, CIA).

It is in this regard that Rwandan President, His Excellence Paul Kagame, in late 2006 inspired by Rwandan culture has created awareness and building capacities (socio-economic and financial) amongst people in order to improve their livelihoods. It is in this way that Rwanda started a one cow per family program (Girinka munyarwanda) and homestead garden (Akarima k'igikoni) to enhance food and nutritional security, small scale agribusiness (selling milk after home consumption) and efficient land resource use.

The Government of Rwanda instituted in 2006 the "One Cow per Poor family Program". The main objective was to improve the livelihood of the poorest families in Rwanda, by helping them to access milk for the household consumption, gaining income generated through the sales of extra milk and accessing manure for increasing their agricultural production. Cows were and are given by the Government itself and donors, volunteers including military agents and local & national administrative agents.

This program is implemented in two ways : (i) Girinka y'ingabirano (donation): a poor family receives a cow free of charge. When the cow calves, the calf is given to the neighbor who keeps it and gives the next calf to the next neighbor and so on. This procedure is called "kuziturirana" (credit revolving scheme). The second way is (ii) loan (Girinka y'inguzanyo): an average family gets a bank loan to buy a cow. It is the responsibility of the average family, to be able to comply with the criteria necessary to receive the cow. For example: being able to construct a cow shed (Kraal), the field planted with different pasture species for nutrition purpose, etc... Girinka program was a success and other related initiatives have followed. For instance, in Southern Province, Kamonyi District initiated "inka y'akaguru: process of producing many cows in the community whereby the first owner remains with the calf and the next beneficiary takes the mother and so on. This is much faster than kuziturirana mentioned earlier because there is a possibility of getting a new calf every year to the benefit of different households. Another initiative is "Kuragiza": a cattle owner gives a cow to his neighbor who keeps it for him and when it calves twice the owner gives one calf to the neighbour as recognition for his work to care for his cow. Elsewhere, well-off cattle keepers give cows to poor neighbors to enable them to own cows for milk, but also to benefit from manure. This is called "koroza".

The main activity under this program is the distribution of heifers that have been inseminated to farmers. These are intensively managed (by zero grazing) and as soon as they deliver the farmer has ready source of income through the milk that is produced by the cow. Furthermore, the first female calf is passed onto another beneficiary when it is about 12 months, so that way the farmer gets to "pay" for the cow that was given to him/her. In addition the program places an emphasis on vulnerable groups, especially child-headed households and female-headed households (Minagri, 2011).

After the Ministry of Agriculture sensitized at least every household disposes a homestead garden, now the design and the structure of the garden has attained the form to produce home fruits and vegetables. The design gives possibilities for erosion control means like radical terraces. The system can retain water in all ways which allows it to last for so long. The production time is one year.

In August 2010, more than 90,000 families over 257,000 targeted have had already benefited from the program. In early beginning of March 2011, its fifth anniversary, March 2011, 106,000 families have received cows. 75,000 of those have been donated by government and development partners, the rest were calves that were passed on or from traditional Rwandan custom of donating cows as gifts. This is convincing about the rest of target families in less than two years (end of EDPRS-2012).

Milk production has been increased from 15.4 to 33.2 million liters since 2006 to 2010. This is a convincing fact that food and nutritional security can be enhanced through the Girinka munyarwanda program.

The One Cow per Poor Family program (Girinka), has boosted the welfare of families four years after it began, according to the Director General of Rwanda Animal Resources Development Authority (RARDA), New Times-August 31st 2010.

That Girinka program has also uplifted the socio-economic welfare of the citizens where they have been able to access credit facilities from banks to expand their farming businesses.

The Director General of RARDA added that they have some beneficiaries testifying that their farm production has doubled because manure has increased from two to five tones, which is a very positive impact.

The program has also boosted farming by generating fertilizers, which is sign because some naturally infertile zones, with resident families which were not able to afford a cow have been thankful to the program and the reduction in malnutrition has been confirmed (RARDA, 2010).

Akarima k'igikoni is a joint program with one cow per poor family program, that is population food and nutritional security, crops yields and soil fertility would be enhanced through efficient utilization of organic manure provided by cows.

One Cow per poor family and Akarima k'igikoni programs are the key strategies for reduction of poverty in a country like Rwanda which experiences high population pressure, implying scarcity of resources. They are main reliable shortcut ways towards attainment of Millennium development Goal number one of poverty and hunger halving.

One Cow per poor family and Akarima k'igikoni are programs that are contributing efficiently to poverty reduction in Rwanda as the data have showed that since 2006 the results have been positive.

They are very successful because there is a participation of beneficiaries even if the number of beneficiaries is still too low comparing to the 57% of Rwanda who live still poverty line.

The way is still long to get on expectations but the level on which the country stands is encouraging and convincing. The remaining part is to spread it widely so as to save millions of lives in extreme hunger and the ever damaged environmental resources that might sustain Rwanda and sub-Saharan Africa.

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## **The Changing Nature Of Business – State – Society For Sustainable Development : A Study of “Surabaya Green & Clean” Program in Indonesia**

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Just like “two sides of one coin”, the ongoing globalization in our contemporary world today, has not only resulted in positive economic impacts, but also there have been environmental consequences with implications to negative impacts on the well-being of human kind, living in developing and poor countries in particular. To a larger extent, business community, represented by MNCs in particular, have been responsible to the global environmental degradations that has occurred and presumably continued to take place in the developing world because under the pressure of global competitive markets, the resources they consume, the process they apply and the products they manufacture have significantly reduced both the quantity and quality of the environment.

Despite of the strategic role of MNCs in both problem creation and solution, it is recognized that business does need to work cooperatively and effectively with a whole range of institutions and individuals to move towards a sustainable future (Welford & Starkley, 1996). In fact, the 2002 World Summit in Johannesburg has endorsed the idea of “multi stakeholders partnership”, promoted by the 1992 UN Earth Summit in Rio de Janeiro, which brings together governments, business community and civil society to implement sustainable development --with the Agenda 21 as a platform of action-- into the practice at any levels (global, national, regional and local). Nevertheless, partnership is not the first word that comes

to mind when one thinks about business – state relations or business – society relations, particularly in dealing with environmental issues. Over the past three decades, most relationship between these three sectors have been founded upon conflict. With this regard, the most challenges in the partnership projects established around the world is how to maintain it in a long term. Thus, further empirical research is still very important to see whether the changing nature of business – state – society triangular relationship has taken place so as to contribute positively in the pursuit of sustainable development agenda.

This study basically attempts to evaluate the existing program in Surabaya, the second largest city in Indonesia, aimed at changing the paradigm of people in facing with solid waste management problems by applying 3-R principles (reduce, reuse and recycle) that have shown the dynamic relations between business – state – society. Just like many cities in Indonesia and other Asian countries, Surabaya face common problems of increasing waste generation resulted from the growing complexities of population growth, economic and industrial development as well as shortage of final disposal sites. In 2001, Surabaya even experienced such problematic problems of municipal solid waste management when the only final disposal area called “Keputih” had been closed by force by the local community living around resulted in the piling of garbage at 155 temporary disposal sites and almost at every street corner in the city. The unbearable odor and pollution disturbed the neighboring communities. However, ten years after the establishment of multi stakeholders partnership engaging many actors across sectors, business-state-society, Surabaya has come up as the benchmark of municipal solid waste management in Indonesia. The city is also awarded by UN Habitat as the top one-hundred best practices of developing cities in the world in environmental management.

The study has attempted to answer such following questions as: How far is the effectiveness and sustainability of such Surabaya environmental initiatives; How should we assess the Surabaya’s achievement in such a long process of partnership program; What significant changes have been made so far; What kind of approach or strategy Surabaya have actually applied in its partnership program called “Surabaya Green and Clean” program. What is the determinant factors have contributed to the achievement of Surabaya? What are the critical points to be discussed further in the context of sustainable society in the long run?

The argumentation developed in this study is that multi stakeholders partnership has proven herself as the strategic instrument to promote sustainable development in such an effective and sustainable manner; however the local context with its own traits as well as the intervening conditions have significantly contributed to some significant changes for a better achievements. Above all, the role of MNC, the engagement of local media, the existence of “environmental cadres” and the full support of local government, are among others, that have become some major features in such multi stakeholders partnership.

This study applies qualitative research approach. Data collection and analysis is conducted based on explorative depth-interviews method to a number of relevant stakeholders. This study also applies direct observation to some relevant sites and activities to collect image data. In addition, document study, including examination to the relevant archives, newspaper, and other official publications, especially sustainability reports, is also used to some extent. As an ongoing research, so far, a set of 33 open ended, semi-structured interviews were already conducted which include at least two representatives of three sectors or ‘participant groups’, that is business (Unilever), state (Surabaya local government), society (Surabaya local communities, NGO and academicians). The interviews carried out have met key figures from three representative sectors which have been intensively engaged in the partnership program since the beginning of process. The interviews were taped and transcribed in full to permit detailed analysis of content and context.

This study offers an empirical case study that brings an important lesson learnt about the best practices in urban environmental management in Indonesia that not only offer a strategic solutions to the problem created by continued development of population growth but also able to transform society towards a sustainable future. As well, it is very much hope that the case study will bring about a rich and insightful discussion of local political and policy dynamics of the kind and relevant to replicate in other public issues.

## Sustainable Development and Cultural Heritage Resources Management: Opportunities towards sustainable communities

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This paper aims to raise awareness about the potential value of cultural heritage resources in sustainable development initiatives in sub-Saharan Africa, and lobby for a meaningful incorporation of cultural heritage resources into a sustainable development policy framework. The paper will illustrate how this merge can be achieved and catapulted on to inform Rio+20 as well as extend agenda 21 chapter 26 beyond a narrow definition of “communities” to a much broader and holistic definition that encompasses all people/communities that have a relationship with their cultural landscapes. The approach aims to bring more people on board that can spearhead sustainable development initiatives since cultural heritage parameters are contained in most immediate surroundings of developing countries such as Botswana. The omission of cultural heritage resources in sustainable development initiatives has only served to compromise the process of achieving sustainable use of the environment as a whole has become apparent that cultural heritage resources are important in reducing stresses on socio-economic and systems, in devising coherent land use planning, as well in redefining economic systems. In addition, omitting cultural heritage resources in sustainable development planning initiatives has curtailed initiatives that could have contributed to the building of sustainable communities in rural areas of developing countries such as Botswana. In these areas, potential to juxtapose cultural heritage resources with wilderness and wildlife tourism activities is high, and it can enhance community participation in development through eco-tourism approaches. Communities local to wilderness and wildlife landscapes are custodians of tangible and intangible cultural heritage resources (cf. UNESCO 1972; 2003), and as such they provide a potential to establish practical implementation of the link between sustainable development and cultural heritage resources management as a strategy towards poverty alleviation. Communities are key in this regard.

In a European context of cultural heritage management, a more prevalent focus on cultural heritage and sustainable development link has been placed on urban spaces or cities. In sub-Saharan Africa cultural heritage management is suited more towards cultural landscapes in rural areas. However, African countries are still lacking behind in identifying, documenting and conceptualising cultural heritage within a sustainable development framework that is key to addressing rural poverty.

The main question is: how can practical implementation of the link between the two be achieved? This paper builds onto an existing work and an already published article (Keitumetse 2011)[1] and present opportunities and challenges that lie in exploring cultural heritage for community development in sub-Saharan Africa, using Botswana as a case study, with reference to other countries in sub-Saharan Africa.

In addition, the presentation will use a suggested model/process/programme coined by the author and named Community Based Cultural Heritage Resources Management [COBACHREM] (Keitumetse 2009) and illustrate opportunities for implementing the model in a practical set up that first establishes production and consumption indicators in cultural heritage resources management within a community context. Various fields of cultural heritage management provide the platform to develop the link between sustainable development and the field of cultural heritage management in a meaningful manner. These include public archaeology; historical archaeology, intangible heritage inventory, museums, among others.

The author uses research outcomes and experiences accumulated over a decade to develop a Community Based Cultural Heritage Resources Management (COBACHREM) model/process/programme framework (Keitumetse 2009a) as a guide towards practical implementation of cultural heritage resources conservation within a sustainable development framework at community level. The research and experiences were accumulated from continuing work in Botswana’s two regions of Okavango Delta and Kgalagadi. Other experiences emanate from consultancy work for institutions such as UNESCO in various sub-Saharan countries. Production and consumption factors within a cultural heritage management framework have also been considered in earlier publications dealing with this subject (Keitumetse 2005; 2009b). Case studies from Botswana and elsewhere will be presented to illustrate a coordinated approach that in future will enhance links with SD and cultural heritage resources management at community development level.

The model is meant to guide sustainable use of cultural resources by applying the equivalent of the *precautionary principle* of sustainable development. Rather than wait for communities to over utilize the cultural resources, a COBACHREM model/process/programme will provide a proactive approach to conservation of cultural resources in the context of cultural heritage tourism.

In addition to bringing in a new perspective to sustainable development approaches, the relevance of this work lies in its potential to offer comparisons on the application of SD in natural resources and SD in cultural resources, thus providing

opportunities to approach conservation of the environment in an all-rounded manner. Below is a brief list of existing opportunities:

- Developing countries vs. developed countries
- Will allow extended debates on renewability of cultural resources using on-ground examples.
- Expand efforts at deducing production and consumption indicators in cultural heritage resources.
- Develop a community-based model for sustainable use of cultural resources in sub-Saharan Africa.

[1] Published online 11 June 2009 in Wiley Online library, DOI: 10.1002/sd.419

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## National strategies for sustainable development – translating international discourse to local realities

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Sustainable development is a widely accepted paradigm and in theory, the reconciliation of environmental, social and economic concerns seems common sense. Yet, the reality often does not reflect this objective.

Not least the Rio Declaration on Environment and Development and its follow-ups document the general commitment to foster sustainable development. However, this commitment cannot be regarded as sufficiently translated to action since actual results of the three “columns” are unsatisfactory. The global norm does not reach the local level.

The discrepancy between global decisions and local implementation in the field of sustainable development is illustrated in this paper. For this purpose, the South African 'National Framework for Sustainable Development' is analysed in order to determine why implementation is not successful. Two possible explanations – veto player theory and the lack of capacity – are applied. Veto player theory examines the possibility of policy reform as a result of the structure of partisan, institutional and other veto players (Tsebelis 2000, 2002). Also, a lack of capacity (financial and human resources, information, cooperation capacities) can hinder implementation even if responsible actors are supportive of the norm. In the emerging market South Africa sustainable development policy-making might face both obstacles, while the latter is likely to be more severe in economically less stable countries.

In addition to the analysis of the obstacles, it is asked which impact the business sector has since it is in a crucial position concerning economic, social and environmental developments and companies have been integrating more and more “corporate sustainability” programmes into their own strategies over the course of the past years.

The paper is structured as follows: First the term of sustainable development as a global norm is summarized; then we propose an approach to analyse the translation of this global norm into national policy-making. Possible action of the business sector is outlined and a brief case study of the South African sustainable development strategy follows.

The brief case study of South African sustainable development politics shows how the implementation of policies that are in accordance with an internationally recognized norm is hindered by national veto players and the lack of capacities to enforce decisions and regulations. Competing governmental actors prevail over the institutional agenda of the government portfolio in charge for implementing the national sustainability framework. One reason for this is that policies pursued by other players are insufficiently congruent with the sustainability agenda and that there is little effort with regard to improving the alignment of different, however relevant and also related portfolios. Other reasons are the insufficient resources allocated to the responsible government department (environmental affairs) and corresponding departments at lower administrative levels. Thus, the number of veto players, but also their relatively greater weight, are obstacles for a successful implementation. It is therefore a combination of competing players and a lack of capacities that impede change.

Also business does not fill this implementation gap. Even though corporate sustainability and corporate social responsibility programmes are en vogue, business is still doing more harm than benefiting social and environmental

development. Hence, in the case of South Africa business is not able to replace governmental implementation of a public policy framework in the field of sustainable development (yet).

Market incentives are not enough to trigger extensive sustainability efforts and incoherent policy making of different government departments as well as the actual resource allocation impede the creation of a framework which effectively determines the development trajectory. Still, due to their potential, companies could positively contribute to sustainable development in a stronger national framework and although budget choices might underlie certain constraints policy coherence and coordination could be improved.

### **Assessment of Water Environmental Policies in China: An Exploration of Water-saving Society Construction Program in Zhangye City, Northwest China**

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Water scarcity is one of the key issues for China. Especially, in the arid northwest, increasing demand from growing population, expanding irrigation agriculture, and various factors related to rapid economic growth have posed serious constraints on the sustainability of water resources. To address the water scarcity issue, since 2002, the Chinese government has initiated a comprehensive program called «water-saving society construction» which incorporates plans for agriculture, industry and cities. The Zhangye City, northwest China, was among the first group of cities for piloting the building of water-saving society. The program in the city was acclaimed successful and a good example for other cities.

Up to date, although the government has spent considerable policy efforts to promote the program nation-wide, the policy scheme has not received much attention from the academic side. A number of recent studies emphasized the consequences of specific reform policies including the introduction of water use right system, water saving technology and water pricing. However, they have not taken water-saving society construction program as the subject. In the case of Zhangye City, the official ex-post facto policy assessment of the program is not available although the plan promulgated by the city government includes an evaluation framework. It is not clear whether the policies contribute to water-saving, and how they contribute to water-saving. In addition, the social impacts of the policy implementation are not clear too.

This paper aims to fill up the blank by evaluating the consequences of water-saving society construction program in Zhangye City, northwest China. To evaluate the consequences of water-saving policies in the city, we conduct both quantitative and qualitative analyses. We especially focus on the validity and attainment degree of the city government's assessment criteria. To evaluate the natural environmental impacts of the policy scheme, we first examine the land use and land cover changes after the implementation of water-saving society construction program using remotely sensed data. Second, we examine the changes in basin-wide water balance using hydro-meteorological data as well as estimated evapotranspiration from irrigated farmland. To evaluate the social impacts of the policy scheme, we conduct semi-structured questionnaire survey targeting local farmers. We investigate their awareness of new policies and reasons for their behavior changes if there is any.

Our study indicates that the reality might hardly conform to the government's expectations. On one hand, the newly reclaimed land consumes (through evapotranspiration,  $2.6 \times 10^8 \text{ m}^3 \text{ a}^{-1}$ ) more water than the amount saved ( $2.0 \times 10^8 \text{ m}^3 \text{ a}^{-1}$ ) through cropping structure changes in the former farmland. On the other hand, local farmers, i.e., largest stakeholder of water use, have low awareness of the new water management system and barely incentives to save irrigation water. Our results bear importance for the sustainability of both water resources and farming sector in China.

### **Reducing GHG emissions through development policies: an interventions-based approach to analyze the dynamics**

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After more than four decades of international efforts for global environmental policy-making the call for innovative policy instruments is increasingly heightened. This paper addresses whether policies that do not primarily target the environment could be better equipped to spur action than is the traditional mitigation pathway of the environmental treaties? As negotiations within the United Nations Framework Convention on Climate Change (UNFCCC) have struggled to deliver



sufficiently strong commitments analysts and policymakers have devised instruments to produce quantifiable co-benefits meeting both mitigation and development goals. This idea was first labeled Sustainable Development Policies and Measures (SD-PAM), but has since largely been incorporated into the concept of Nationally Appropriate Mitigation Actions (NAMA) – a notable outcome of the 2010 Cancun negotiations. The core idea is that the UNFCCC shall recognize developing countries' greenhouse gas (GHG) reductions resulting from policies and measures primarily focused on development. A procedure would be developed to allow countries to define in advance the activities they would consider sustainable development actions, which as a side effect limit GHG emissions (Winkler, Spalding-Fecher et al. 2002). Any future climate agreement will likely include detailed instruments to promote synergies between development goals and climate action. The analytical challenge is to pursue an ex-ante evaluation of an evolving and 'not-yet-defined' policy instrument.

This paper analyzes whether intervention theory can be used to assess what is required so that such instruments can achieve the intended goals. The research is based on analyses of proposals to international negotiations complemented by a set of national case studies in Brazil, China and Mozambique, covering a diverse set of sectors –bioenergy, agriculture, and transportation.

The word “theory” in “intervention theory” easily causes confusion, since it may be taken to refer to scientific theory. Theory is used here to indicate the opposite of practice, i.e., referring to how an intervention should work, not how it actually works when implemented (Vedung 1997). An intervention theory thus describes how policies or measures are supposed to be implemented and function; an intervention theory does not describe how a measure actually works, but rather provides tools for evaluating the actual implementation and effects of an intervention in practice.

When we examine policies, we need to distinguish between how they are intended to change a situation and what actions and institutions the policy-makers presuppose to accomplish this change. Huey-Tsyh Chen's (2005) framework consists of two interlinked models: a change and an action model. The change model includes the goals and outcomes, their leverage mechanisms, and the intervention. Any intervention's impacts depend on the extent to which the assumptions about how change can be achieved are true, but also on the actual implementation of the intervention (i.e., the action model). The action model consists of assumptions about institutions, resources, the legal framework, and support mechanisms through which the intervention is implemented so that it reaches a target population. The third essential element of the framework is the context, since outcomes of a mechanism (the change model) are not fixed, but largely depend on the context (Falleti and Lynch 2009).

Our analysis provides a test of intervention theory as an analytical tool for assessing not yet adopted international policy proposals. There are various ways to provide a leverage mechanism to alter socio-technological systems. Most critically, an SD-PAM style mechanism constitutes a means to provide recognition for national activities that are otherwise not viewed as climate policies. This could in turn generate: 1) new commitments; 2) additional direct funding; 3) indirect financing in the form of tradable permits; and 4) different forms of technology transfer.

Since the change model is based on recognition it is essential that the institutional framework and the implementing institutions provide the ingredients for recognition. The level of recognition is ultimately contingent on the degree of transparency in and legitimacy of the policy process. This emphasizes the importance of credible systems for measurement, reporting and verification. Particular challenges are to establish: 1) baseline criteria for GHG reductions; 2) the appropriate time scales for mitigation; 3) a definition of what constitutes additionality; and 4) criteria for assessing sustainability. The situation is poignantly illustrated in the Chinese electric car case (Wang 2011), where a reduction of GHG emission in the transport sector may in fact produce a global net increase if the electricity is generated from coal, as well as the Brazilian biodiesel program (PNBD) that failed to generate the social sustainability impacts it was originally justified by (Maroun and Schaeffer 2011).

The SDPAM proposal is quite elaborate with respect to its function as an international mechanism. However, it gives few details on how any national implementation is to be effectuated. The way that the proposal is presented, it is simply assumed that each national SD-PAM activity would have its own action model. This implies that each activity will have its own particular set of implementing organizations, acting within a specific institutional framework and context to implement the policy or measure.

The case studies establish the need to engage and connect actors at various levels of the system. The Brazilian Ethanol Program (Proalcool), for example, only worked because it built upon a strong network of public institutions that produced the detailed proposals and later implemented and enforced them (Maroun and Schaeffer 2011). Another observation, most clearly illustrated in the Mozambican case study, is the importance of a minimum level of human and institutional capacity for policies to take effect (Román and Hoffmaister 2011). In Mozambique, the lack thereof constitutes probably the greatest impediment to any major advancement in the rice sector.

Each national SD-PAM is unique insofar that it operates in a particular contexts that influence the implementation of and impacts of policies. Such contextual factors are, for obvious reasons, difficult to control. Instead, the SD-PAM

mechanism must have the flexibility to adjust to changing conditions. The notion of contexts applies at different levels. In a global perspective it is, for example, increasingly difficult to talk about isolated national socio-technical systems as they are gradually more linked to, and influenced by, global trade and international commodity prices. For example, the Proalcoal program was largely created in response to the first oil crisis and was later in significant trouble when the oil price declined in 1986 (Maroun and Schaeffer 2011).

The influence of the context is very apparent in least developed countries, where a general lack of basic infrastructure, human capacity and funding, combined with inefficient institutions and markets, create serious impediments to progress. In the Mozambican rice case (Román and Hoffmaister 2011), the principal obstacles towards progress are not necessarily identifying the leverage mechanisms, or even the absence of efficient implementing organizations and institutional frameworks. Instead, the main problems are the lack of roads for transportation, capacitated people, access to energy and, most fundamentally financial resources.

Many of the proposals for developing country commitment focus on pledging baskets of policies with mitigation effects. We conclude that by combining analysis of evaluation theories and a socio-technological systems perspective, it is possible to analyze key assumptions in how the instruments are intended to work and where some of the loose ends are.

The SD-PAM types of proposals are most frequently based on the assumption that international recognition would increase financing for implementation of these policies. The proposals are based on the assumption that sufficiently efficient and transparent organizations and institutional frameworks are created at all levels in order to generate either recognition or credits with a market value. At the international level it is clear that both a register of pledges and a reporting mechanism would be required. It is also clear that recognition would be stronger the better the measurement, reporting and verification of the effects are. The proposals made largely leave the national implementation as a black box.

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## Feasibility of Low-carbon Society in Vietnam based on on-going National Policy

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This paper aims to show possibility to create a low-carbon society (LCS) in Vietnam in 2030 based on current National “green development” policies. While the former paper focused on description a picture of LCS in Vietnam towards 2030, this time we mainstreamed on-going Nation policies to create more detailed and reliable portfolio of low-carbon countermeasures. We used a numerical tool to show the facts and figures as to how much emission can be reduce with the countermeasures.

Back-casting approach was chosen as a methodology to create a national LCS scenario in Vietnam in 2030. This approach idea includes two phases; the first step is to set a desired target, and the second step is to find the way to achieve that target from the current situation such as investment path or policy schedule. Estimation tool was used in this study, namely Extended Snap Shot Tool (ExSS) (Gomi, K. et al., 2009), which can estimates quantitative and consistent future snapshot consists of socio-economic (SE) indicators, energy demand, CO<sub>2</sub> emissions, and a portfolio of low-carbon countermeasures to meet the environmental target. This tool is a static model formulated as a set of simultaneous equations, and input-output analysis is the central part in the computation system. SE indicators include population, number of household, industry, passenger and freight transport demand et cetera. ExSS is a designing tool of a future society and highly flexible so that we can design a wide range of future societies. Future SE assumption in 2030 was determined based on Vietnam SE development strategies from 2011-2020, and others relevant document. Low-carbon countermeasures was collected from previous study (Japan, China, India, etc), which was proper chosen for Vietnam case. Moreover, this portfolio of low-carbon countermeasures was chosen based on on-going National policies.

We estimated two scenarios: (1) Scenario without low-carbon countermeasures, namely 2030 business-as-usual (BaU), which was according to Vietnam SE development plans/strategies towards 2030; and (2) Scenario with introduction of low-carbon countermeasures, namely 2030CM, which were adopted potential low-carbon countermeasures to reduce CO<sub>2</sub> emission in 2030 (Hoa, T. N. et al., 2009).

Estimation of energy demand and corresponding carbon dioxide emission in 2030 is based on bottom-up type energy demand and supply model. The model result shows that the total energy demand of Vietnam is projected to increase about 3.3 times from 44.4 million tone oil equivalent (toe) in 2005 to 144.7 million toe in 2030 BaU scenario. Energy demand of passenger transport and freight transport has rapidly increased of 5.7 times and 6.9 times, respectively. However, energy demand of industry is estimated to increase 5.2 times and still will maintain the largest share of 36% (52 million toe), followed by transport (42 million toe, 29%), residential (39 million toe, 27%), and commercial (11 million toe, 8%) in 2030 BaU.

By 2030 BaU, the energy system of the country would rely more on oil than biomass (fuel wood) this corresponds to the increasing of oil products of supply from the domestic refinery. By 2030 BaU, the share of oil in the TPES (total primary energy supply) would rise to about 34% (as compared to 24% in 2005), followed by natural gas (24%), coal (19%), renewable (15%), hydropower (8%).

The finding of this study shows that: (1) CO<sub>2</sub> emission from energy consumption will increase from 81 million t-CO<sub>2</sub> (Mt-CO<sub>2</sub>) in 2005 to 446 Mt-CO<sub>2</sub> in 2030 BaU case, in which, CO<sub>2</sub> emission from residential sector was 53.9 Mt-CO<sub>2</sub>, occupied 12.1% of total national emission, commercial sector: 47.8 Mt-CO<sub>2</sub>, occupied 10.7%, industrial sector: 210.3 Mt-CO<sub>2</sub>, occupied 47.1%, passenger and freight transportation sector: 59.7 Mt-CO<sub>2</sub> and 74.7 Mt-CO<sub>2</sub>, occupied 13.4% and 16.7%, respectively; (2) with annual GDP growth of 7% and population of 99.3 million persons in 2030, per capita emission will increase from 0.97 t-CO<sub>2</sub> to 4.5t-CO<sub>2</sub> in 2030BaU or 4.6 times higher than base year 2005; (3) Low-carbon countermeasures were classified into four categories; behavior change, energy efficiency (EE) improvement, fuel shifting (energy demand side) and improvement of carbon dioxide intensity in power supply sector. Each countermeasure accounts for 8%, 40%, 33% and 19% of total CO<sub>2</sub> emission reduction, respectively. Among the countermeasures, energy efficiency improvement was found to have the largest potential (40% of total reductions). Portfolio of energy efficiency improvement includes (i) industry sector: improvement of low-efficiency coal-fired boilers to higher efficiency one, improvement of low-efficiency oil-fired boilers to higher efficiency one, and more efficiency industrial equipments and motors; (ii) residential and commercial sectors: replace existing coal-cooking stoves and existing LPG (Liquefied petroleum gases) -cooking stoves to BAT (Best available technology)-cooking stoves, replace incandescent light bulbs by compact fluorescent lamps.

Behavior change can reduce 16 Mt-CO<sub>2</sub>, which includes a modal shift from vehicle to walking, bicycle, and public transportation; or energy saving behavior. EE improvement can reduce 78 Mt-CO<sub>2</sub>, which used to turn the existing or low-efficiency devices, equipments, motors or vehicles into “best available technology” models in all sectors. This countermeasure is based on the “National Target Program on Energy Efficiency” approved through Decision 79/2006/QD-TTg dated 14th April 2006 (PM, 2006). Moreover, “Law on Energy Efficiency and Conservation” (PM, 2010), which was a legal framework approved by Vietnam government recently, will support this countermeasure can be implemented effectively. Fuel shifting countermeasure can reduce 65 Mt-CO<sub>2</sub>, which includes improving renewable energy such as solar water heating in residential sector; shift from coal, oil to gas in industrial sector; shift from oil to bio-fuel in transport sector. This countermeasure was defined based on Decision 177/2007/QD-TTg 20th Nov, 2007, approving the scheme on development of bio-fuel up to 2015, with a vision to 2025 and Decision 1885/2007/QD-TTg 27th Dec 2007, Strategy for Renewable Energy development up to 2020, outlook to 2050. Improvement of carbon dioxide intensity in power supply sector can reduce 37 Mt-CO<sub>2</sub>, which includes power generation efficiency improvement, reduction of transmission and distribution losses, promoting using of renewable energy and development of nuclear power plant. Decision 957/QD-TTg dated 24th Jun 2010, “Master plan on development and utilization of nuclear energy for peaceful purposes by 2020” was used to define this countermeasure; (4) based on on-going National policies, the potential of CO<sub>2</sub> emission reduction in 2030 is 45% reduction from 446 Mt-CO<sub>2</sub> in 2030BaU to 245 Mt-CO<sub>2</sub> in 2030CM.

This portfolio will be proposed to policy makers and stimulate discussion among stakeholders and then it will enable us to draw up a guideline to formulate policies towards LCS. Following this, we hope that Vietnam government implements these low-carbon policies.

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## **Common Ground: Frameworks for Effective Global Governance**

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Business entities are increasingly being called upon as actors in addressing sustainability issues through participation in governance forums. Over the past two decades emergence of international governance instruments and tools such as the United Nations Global Compact (UNGC) and the Millennium Development Goals (MDGs) have sought a proactive role from business. The UNGC, for example, sets out a ten point agenda on labor and human rights, ethics and environment to construct a basic compliance program, universally accepted and fundamental.

This paper examines the movement--from adoption to application--given the challenges of geographic, cultural and regulatory diversity that businesses voluntarily adopting such global instruments may have to transcend as they act locally. Towards this end, the paper lists specific company examples in examining factors such as size, location, life-cycle maturity, nature of industry, width of supply chains, among others, that may influence the implementation potential of global governance principles in specific firm context.

Secondly, the paper submits learning on the need for operational frameworks and toolkits that may accompany such governance mechanisms. In this regard, the use of the Social Accountability 8000 standard, an auditable, voluntary, framework on labor and human rights as a tool in achieving the UNGC principles is reviewed in the companies studied. Finally, some recommendations are offered towards improving the understanding of intent and, thereby, the implementation and subsequent return to society at large from governance frameworks. Such improvements, among others, would involve on-going and iterative dialogue between the 'designers' and 'users' for better fitment and scaling up of initiatives being undertaken in the course of meeting the criteria or the standards set forth in the particular governance mechanism.

# Corporate Sustainability Programs

Pontus Cerin, Peter Dobers & Richard Welford

## Oral Presentations

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### Organizational culture and corporate sustainability management: framework, strategies and change processes

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The philosophy of Sustainable Development is intensively discussed in politics and industries but rarely transferred to the reality of business activities. One reason is that the relationship between corporate sustainability and organizational culture seems to be underestimated within the discussion about Sustainable Development. Organizational culture is an important factor in business organizations as it frames behaviors of individual members of the organization through shared norms, values and beliefs. Although the concept of organizational culture has become popular also in sustainability related literature there is little theoretical underpinning and understanding of the relationship between organizational culture, sustainability management and sustainability performance (Linnenluecke et al. 2009).

The starting point for this research is that ambitious corporate sustainability activities and strategies have to be embedded in the organizational culture in order to be successful. If aspects of Sustainable Development are not part of the mindset of leaders and members of the organization, corporate sustainability activities will not affect efficiently the core business and are more likely to fail. The goal is to gain a better understanding of the link between sustainability strategies and organizational culture on a detailed level.

Based on previous research (Baumgartner 2009, Baumgartner et al. 2007) the role of different types of organizational cultures and their fit with sustainable corporate strategies is discussed. On this basis a generic framework to analyze the relationship between different types of organizational cultures and different types of sustainability strategies is developed. This framework can be used by organizations to identify possible gaps between their culture and strategies. It is supported by the discussion of culture change processes organizations can use to reach the fit between desired strategies and their cultural conditions.

Korhonen (Korhonen 2004, p. 66) distinguishes two levels of sustainability theory based on the model of strategic sustainable development (Robert et al. 2002): the conceptual level of a favorable or successful outcome of planning and management toward the goal of Sustainable Development, and the level of concrete and practical actions and measures. This research refers to the conceptual level; organizational culture and corporate sustainability strategies are analyzed to identify interrelations between them as a basis for corporate decisions. The framework can then be used at the practical level and help organizations to analyze their specific situation regarding sustainability orientation and organizational culture.

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### Institutional Convergent Alternatives to Instrumental and Ethical Corporate Social Responsibility Perspectives

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The notion of Corporate Social Responsibility (CSR) is often described as a concept from which business can assume a role in addressing the challenges of sustainable development (SD) (e.g., Blindheim and Langhelle, 2010; Langhelle, Blindheim and Øygarden, 2008), and thus contribute to moving society towards a sustainable future. The research on CSR is currently dominated by two broad strands of literatures (Gond, Palazzo, and Basu, 2009), *instrumental* approaches

to CSR (e.g., Husted and Allen, 2000; McWilliams and Siegel, 2001; Porter and Kramer, 2002), and ethical approaches to CSR (e.g., Donaldson and Dunfee, 2000; Shrivastava, 1995; Swanson, 1995). However, the shortcoming of the instrumental and ethical CSR approaches is that they often fail to recognise the political and institutional mechanisms needed to support responsible business behaviour. On this background, this paper suggest a convergent institutional CSR perspectives from which the institutional contingent nature of business CSR activities can be evaluated and questioned, and from which discussions about the appropriate role for business in addressing SD challenges can take place, begging a critical inquiry into questions like: What is – from the perspective of sustainable development – the appropriate role of business in society? How can CSR come to constitute an improved mechanism “through which global society can move away from a non-sustainable path towards a sustainable future” (<http://www.isdrc17.ei.columbia.edu/?id=home>)?

The inquiry of this paper is informed by two concurrent observations. The first observation is that, within the Business and Society literature, the notion of corporate responsibility is often interpreted within the assumptions and aspirations of methodological individualism (e.g., Weber, 1968), a social and political philosophy putting individual rather than collectives in the centre of its ideas about the ideal institutional order, and of theories on how to understand and explain societal phenomena. The basis of the instrumental and ethical approaches to CSR within the assumptions and aspirations of methodological individualism has important implications for how the notion of CSR is understood, that is, what the notion contains, what responsible – or irresponsible – corporate action is, and of the variables that might promote responsible behaviour. In its positivist and descriptive outlook *instrumental* approaches to CSR seeks to explain responsible – or irresponsible – corporate behaviour with reference to rational self-seeking individuals’ pursuit of profit maximisation. In its normative outlook, instrumental approaches justify CSR solely on economic grounds. In slightly other words: business and companies may legitimately engage in CSR only when their underlying motivation is the attainment of financial performance. In its positivist and descriptive outlook, ethical approaches to CSR seek to explain corporate responsible – or irresponsible – behaviour with references to the values premises of individual preference-based action. In its normative outlook, ethical approaches justify CSR solely on ethical grounds. In slightly other words, business and companies should engage in CSR because this is the right thing to do according to some ethical treaty, which, in turn, should inform moral reasoning and better individual decision-making. The second observation informing the inquiry of this paper is that – within the Business and Society literature – the notion of CSR is often interpreted in apolitical terms: Interpretations of CSR tend to ignore the specific political and institutional roots of CSR (Hanlon, 2008), it tends to ignore the political nature of the social institution of business, the corporate entity, and the activities companies perform under the rubric of CSR (Crane, Matten, and Moon, 2008; Scherer and Palazzo, 2007), and it tends to ignore the potential institutional and political implications of CSR (Barley, 2007; Vogel, 2005).

In contrast to instrumental and ethical CSR perspectives, the institutional convergent perspective of CSR suggested in this paper, in its descriptive outlook, assumes that social reality contains “chunks of irreducible social matter” (van Oosterhout, 2002, p. 125). That means that rather than seeing challenges of corporate responsibility as residing primarily in the value premises of individual preference-based action – as assumed within instrumental and ethical perspectives – an institutional perspective assumes that challenges of corporate responsibility constitute an inherent aspect of the structures of political rules, institutions, and identities (e.g., March and Olsen, 1996). In its normative outlook, the institutional convergent perspective on CSR suggested in this paper assumes that political democracy and the pursuit of the common good not only depends on economic and social conditions, but also on the appropriate design and functioning of political institutions (e.g., March and Olsen, 1984). The perspective thus builds on a normative vision of a political order based upon institutions (Wolin, 1960, 2004) as its point of departure for descriptive analysis of the impact of diverse institutional variables on manifestations of CSR, and reasoning about the how to judge and evaluate the institutional and political implications of CSR and manifestations of the notion within institutional fields. The paper argues that institutional theory not only constitute a strong descriptive social and organisational theory that can be used to understand and explain different manifestations of CSR, but that institutional theory in addition holds some promises for justificatory purposes, and hence can be used to outline criteria for probing into the question of why the social institution of business and companies has a responsibility towards society, and what constitutes the elements of this responsibility. In sum then, this paper argues in favour of a convergent perspective (e.g., Jones and Wicks, 1999; Kochan, Guillen, and O’Mahony, 2009; Margolis and Walsh, 2003; Van Oosterhout and Heugens, 2008) of CSR in which descriptive analysis is combined with normative assumptions about the preferred institutional order and prerequisites for organisational and corporate responsibility.

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## The Value of Green Buildings: New Evidence from the United Kingdom

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Attention to green building practices has substantially increased over the last decade, but evidence on financial performance of such investments is very limited outside of the United States. To fill this gap in the literature, this study investigates the financial implications of green building practices in the United Kingdom: one of the world's largest property markets and the first to introduce a formal green building rating scheme – BREEAM – in 1990. This rating scheme laid the foundation for the development of rating schemes such as LEED in the U.S. and Green Star in Australia.

We match proprietary information on BREEAM-rated office buildings to the characteristics of geographically nearby control buildings, their selling prices, and rental rates. This results in a sales transaction dataset of over 1,200 observations, and a rental transaction dataset of over 26,000 subject and controls. We then model the characteristics of green buildings that impact financial performance, controlling for differences in quality between subject and control buildings using a hand-collected set of hedonic characteristics. Results from this analysis suggest a positive impact of a building's green characteristics on sales and rental transaction prices in the order of 8 percent and 16 to 20 percent, respectively, depending on the model specification.

Financial support for this research has been provided by the European Center for Corporate Engagement (ECCE). We are grateful to Thomas Saunders of BRE Global for assistance in collecting and interpreting BREEAM data used in this analysis. Valentin Voigt and Ignas Gostautas provided excellent research assistance.

## What makes collaborations resilient at the Base-of-the-Pyramid?

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The increasing occurrence of natural catastrophes, political instabilities, and economic crises depict the challenges that world faces today. The earthquake and tsunami in Japan in March 2011 has caused not only immediate losses and direct damages to the people, infrastructure and economy of the country but is causing indirect danger to other parts of the world and future generations with the yet unknown consequences and long-term effects of the radioactive leakages from the damaged nuclear reactors. This shows how fragile and interrelated the world we live in is, and no matter how we try to compartmentalize

societies and analyze them independently, for instance viewing nation-states, markets, institutions and economies as autonomous systems of their own, there are always linkages between the environment, society and the economy. Building on this assumption of the interconnectedness between nature and society in general, and viewing markets as part of larger systems in particular, this paper aims to investigate what makes collaborations resilient from existing literature.

Collaboration between different sectors has been the mantra of international development institutions, public officials, global leaders and social organizations, and is slowly being embraced by the business sector. Global partnership for development is the 8th goal of the United Nations Millennium Development Goals (MDG); public-private partnership (PPP) initiatives have been at the heart of government agendas; and partnerships between non-government organizations (NGOs) and companies have been scaled-up such as in the case of microfinance. This is not surprising since in the academic literature, collaborations has been the solution in managing risks and conflicts, achieving goals, sharing knowledge, alleviating poverty and fostering resiliency. In the management literature, even the top-down base-of-the-pyramid (BoP) discourse, which originally posits that there is a fortune for companies to be made by targeting the 4 billion people who are living on less than 2 USD per day while alleviating poverty (Prahalad and Hart, 2002), has shifted its focus on creating fortune «with» and not «at» the BoP (London and Hart, 2011), implying a more collaborative, bottom-up approach. Shifting approaches, however, requires a re-examination of the assumptions behind the BoP concept.

Using a resiliency perspective, this paper views the 4 billion people comprising this income group, not only as a market or economic entity, but as part of the socio-ecological system, embedded in larger and smaller systems, within which collaborations among different sectors are a part of. In viewing collaborations this way, long-term relationships constantly go through the different opportunistic, collaborative, adversarial and tactical phases (Nkhata, Breen and Freimund, 2008). Identifying the factors that make the collaborations persist in these different phases is what this paper aims to investigate from the existing literature. In particular, it makes use of the evidences from game theory and randomized experiments in behavioral economics, which point to altruism, commitment or reciprocity as factors that make collaborations persist. This paper is a work-in-progress.

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## **Promoting sustainability in Europe through the Eco-Management and Audit Scheme (EMAS): final results of a survey on Italian organizations**

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Sustainable development has long been a key objective of the environmental policy of European Union (EU) Member States. In fact, ever since the Fifth European Community (EC) Environmental Action Programme (1993), European environmental policy has been founded on the notion of sustainable development. Moreover, a significant methodological shift has taken place, progressing from legislative tools to more flexible instruments such as environmental taxes, tradable permits, and voluntary agreements.

The Eco-Management and Audit Scheme (EMAS) can therefore be considered a key voluntary tool amongst those proposed by the EU, since it offers a framework for organizations to manage their environmental impacts through the implementation and periodic revision of a comprehensive Environmental Management System (EMS).

The first version of the scheme (Council Regulation (EEC) No 1836/93) dates back to 1993, and at the end of 2009 EU institutions revised the second version of EMAS (Regulation (EC) No 761/2001) to make it more attractive for organizations and ultimately more effective.

Thus, the purpose of this paper is to analyze the experiences of all Italian EMAS-registered organizations to identify the criticalities of the second version of the scheme, and provide useful suggestions for the improvement of its effectiveness while simultaneously comparing these suggestions with the changes made to the third version of EMAS (Regulation (EC) No 1221/2009).

In order to achieve our goals, a questionnaire of 32 multiple-choice questions was designed for submission to all 1,119 Italian organizations in the Italian Institute for Environmental Protection and Research (ISPRA) database of EMAS registrations at the end of 2009. For most of the questions we chose categorical scaling with 6 possible answers.

The questionnaire was tested on a small sample of the population and thereafter corrected accordingly.

We particularly focused on the drivers to register, the difficulties encountered, and the benefits achieved, while also



assessing the time needed to obtain the registration, the economic assessment, the use of the EMAS logo as well as the intent to renew the registration.

The comprehensiveness of the analysis with respect to the population, as well as the aspects surveyed, makes our survey unique as far as Italian EMAS-registered organizations are concerned.

Our analysis shows that for all 616 responding organizations, regardless of their size, the main drivers for registration are the improvement of corporate image and legislative compliance, which are also in fact the key benefits for registered organizations. Significant size-related differences emerge with reference to the difficulties that organizations encountered during the registration process. Indeed, big and medium organizations have greater problems with the documentation required, conceivably due to their complexity, while smaller organizations mainly suffer from high costs and the uncertain repayment of their investment to implement EMAS.

The article concludes that the revision of the second version of the EMAS Regulation should particularly address the standardization of the environmental statement, the creation of industry-specific environmental performance indicators, and the simplification of bureaucratic procedures. The third version of the EMAS Regulation has substantially acknowledged these suggestions and we propose that a similar survey be conducted starting at the end of 2011.

### **Sustainability Orientation and the Sustainable Organization**

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The importance of sustainability orientated organizational culture is crucial to attain business sustainability. A sustainability orientation is valuable because it focuses the firm on (i) stakeholder intelligence and competitor's capabilities and (ii) use this knowledge to create continuously superior sustainable value. There is need to explore sustainability orientation in the context of sustainability management and strategy.

However for a firm to maximize its ability to learn about stakeholders, creating a sustainability orientation is only a good beginning. A sustainability oriented organization culture can achieve maximum effectiveness only if it is complemented by an enlightened leadership and appropriate organizational capabilities. Thus, the critical challenge for an organization is to create the combination of capabilities and climate that maximizes organizational learning on how to create superior sustainable value in marketplace, because the ability to learn faster may not only help harness opportunities but also to take care of future challenges.

The paper put forward that a sustainability orientation provides strong norms for learning from stakeholders and competitors; however, it must also be complemented by leadership and appropriate organizational capabilities for higher-order learning to take place. In short, the culture values of sustainability orientation are necessary, but not sufficient, for the creation of sustainable organization. Although authors have discussed the sustainability organizations, there is perhaps no widely accepted theory of what comprises the culture and climate of a sustainable organization. The objective of this paper is to propose a theory of sustainable organization that extends our understanding of the benefits of sustainability orientation and stimulate research on sustainable organization. To accomplish this, the paper aims to:

1. Describe the capabilities through which organizations develop new knowledge and adapt themselves to reflect the better understanding of stakeholder intelligence.
2. Explain how organizational capabilities creates and sustain competitive advantage during periods of high uncertainty
3. Propose a set of organizational capabilities that comprise sustainable organization.
4. Suggest topics of further research.

### **A VRIO model proposal to sustainable tourism planning**

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Due to environmental and social pressures, a lot has been claimed for sustainable tourism development (s.t.d.). Both scientific literature and tourism organisations are unanimous as to the need for it. Nevertheless, it is not always easy to step forward towards implementation because, it must be acknowledged, it is less difficult to debate sustainability in theoretical terms than putting it into practice. Not that it is easy to debate sustainable tourism, but the fact is that it is even harder to put into practice or, as mentioned in the editorial of the first issue of the *Journal of Sustainable Tourism*,

“(…) to walk the talk”. In the tourism sector, the practice of sustainable development (s.d.) gains higher relevance and complexity due (i) to the mix of products and services that integrate the industry; (ii) the variety of resources consumed; (iii) the wide spectrum of environmental and social-economical impacts it involves; and (iv) the large number of those on whom the impacts fall, the stakeholders.

The amalgam of tourism products reveals a remarkable set of resources used to attract and satisfy the demand. Environmental and socio-economic resources are the main contributors to tourist attraction. Some of these resources are common to the entire community, easily degradable and depreciable and, upon depletion, are not reproducible. Tourism destinations have some heterogeneous and asymmetrical resources, of difficult, when not entirely impossible, transfer, a characteristic which, depending on the resource, can perpetuate in time. Tourism destinations, while ‘*bundle of resources*’, are, therefore, very concrete and vivid examples of spaces where the RBV (Resource-based View) assumptions fully occur. Nevertheless, some of the tourism destinations resources also have two other features that distinguish them from the generality of those that are available to companies – non-exclusion and subtractivity –, making their analysis even more complex.

The various international bodies (including the World Tourism Organization) and the academic literature are unanimous about the inclusion of stakeholders in planning and decision making. This means that local people must be heard regarding the type of tourism development to the tourism destination. With the development of the activity it is common for residents to lose quality and quantity of environmental and socio-cultural resources, in exchange for greater economic returns. But these options are rarely discussed with stakeholders. In the lack of a clear trade-off, people feel that the benefits are not fairly distributed. Several studies point to a perceived loss of some stakeholders, particularly the host community.

Therefore, it is easy to understand that the management of tourism resources and respect for stakeholders are the main challenges ahead of the Destination Management Organizations (DMOs). Only a careful management of the tourism resources will allow a certain destination to promote sustainable development within the framework of strategic competitiveness. Geographical locations compete with one another for a certain type of tourism and tourists, and this competitiveness must be approached and considered in the public planning model. Moreover, the discussion of the type of tourism development with stakeholders makes the process more democratic, increases the level of satisfaction of residents and facilitates the implementation of decisions.

Recent studies indicate that stakeholders (especially the residents and environmental organizations) are not heard in the processes of tourism planning, and resources are not managed with a view to achieving sustainable competitive advantages. The destination management involves the appropriate use of different types of resources for the satisfaction of various stakeholders. The universality of the challenge regarding the management of resources suggests the application to tourism destinations of theories initially developed for corporate strategic management, and specifically the RBV and the stakeholder theory.

The aim of this paper is to explain, in a context of promoting sustainable tourism development, the importance of (i) the management of tourism resources, (ii) the satisfaction of stakeholders, (iii) a VRIO (*Value, Rarity, Imitability, Organization*) model that incorporates the environmental and social issues. Based on the analysis of the role of stakeholders (section 2) and use of resources (section 3) in the tourism sector, we proceed to apply the VRIO model to DMO:s (section 4). Finally, in section 5, it is proposed to adapt the original model to the challenges of sustainability in tourism destinations, what we call VRIO(S).

The RBV and the stakeholder theory are essential tools for the management of tourist destinations, contributing to better decisions. The mainline contribution of this work is to relate the issues of stakeholder theory and RBV, in the management of tourist destinations when sustainable tourism development is required.

### **Promoting Organizational Sustainability by Measuring its Performance through Stakeholder Approach: A Strategic conceptual framework**

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In the organizations across sectors, performance measurement plays an important role for translating strategy into desired behaviors and results, communicating these expectations, monitoring progress, providing feedback, and motivating employees through performance-based rewards and sanctions (Chow and Stede, 2006). How to manage and improve the performance of an organization with sustainable growth is always the moot question which every business organization tries to answer to survive in competitive environments (Baron 2000).

Corporate performance measurement systems in literature and actual business practices focused largely on financial performance for shareholders. Socio-culture and ecological environment imbalance created by flaming globalization has placed business organizations under a closer scrutiny of civil society organizations and various groups of stakeholders. The pressure of balanced sustainable growth has forced business organizations to shift their focus from profit/revenue maximization to social objectives and socially responsible behavior. Triple bottom line approach (TBL) and corporate social performance expectations expects a corporation to adopt an integrated approach to sustainability.

Hence, the meaning of word 'performance of a business organizations' cannot be limited to business's profit standing but it should be determined by their business objectives, strategies, operations, ability to cope with market and non-market factors (like state of economy, competition etc.), acceptance by customers, support of employees, suppliers, community, government and other relevant stakeholders. Precisely, it could be termed as stakeholder management for sustainable growth i.e. understanding the needs of the relevant stakeholders and fulfillment of the same is the criteria for better performance and sustainable growth (Freeman, 1984; Woods, 1991; cooper, 2004).

The concept of stakeholder management was popularized by Freeman (1984) almost 25 years ago, by expanding the ways in which we think about corporate strategy formulation and implementation. Since then the emphasis placed on stakeholders, initially conceptualized as any group or an individual who can affect or is affected by an organization's activities, has increasingly permeated the business literature. Over the years, theorists have developed, refined and expanded the concept, differentiating between primary and secondary stakeholders (Buono & Nichols, 1985; Clarkson, 1995; Wheeler & Sillanpaa, 1997) and assessing corporate performance through the lens of different stakeholders (Clarkson, 1995; Donaldson & Preston, 1995) and their role in contributing to organizational wealth (Post, Preston, & Sachs, 2002). Several studies in the past used the stakeholder concept partially to develop comprehensive model for measuring the organizational performance. In Early 1990's, Kaplan and Norton (1992) devised a comprehensive model labeled as «Balanced Scorecard»- by supplementing financial measures with operational measures such as customer satisfaction, internal processes, and the organization's innovation and improvement activities. On the other hand researchers like Sethi, 1975; Steckmest, 1982; Waddock & Graves, 1997; Post et al., 2002 considered stakeholders like community, environment to develop a model for measuring social aspect of corporate performance and term it as "Corporate Social Performance" (CSP).

But, performance measurement cannot simply a function of an enterprise's contribution to the benefit of the shareholder (i.e. financial + operational performance = economic performance) (CSR Europe, 2003). Rather it depends upon an enterprise's contribution for maximizing customer delight (Anantharaman, 2007), contribution for sustainable development (triple bottom line) (Elkington, 1994), welfare of employees and their families, local community, society at large (WBSD, 2002; O'Rourke 2003) and maximizing stakeholders' wealth (including shareholders) amounting to economic + social performance (Eells and Walton in Carroll 1999).

The main objective of this study was to evolve a comprehensive framework within which economic and social performance of an organization can be determined by using Stakeholder approach. For developing this framework, survey based in-depth case research design alike Kaplan and Norton (1992) and a sequential mixed research design for instrument and tool development (Milton et al., 2003) has been used. Indian Oil Corporation Ltd., a state owned best Indian company featured in Fortune 500 list has been selected for the purpose of this study (<http://money.cnn.com/magazines/fortune/global500/2010/countries/India.html>).

Firstly, to explore stakeholders' economic and social expectations from a company (foundation of the performance of the company) focus group discussions with experts on the four relevant groups of stakeholders have been conducted. Then on the basis of above identified indicators, a detail sample survey has been administered on the shareholders (both institutional and retail), customers (both institutional and retail), employees (at each level) and community of the Indian oil corporation. Finally, an overall performance measurement model has been articulated as per requirement of a company after a discussion with management of the company by merging expectation with actual financial performance. Model developed above is helping the industry in not only improving their economic performance and its related decisions to improve (by gap analysis) but also addressing the issues of sustainable development for long term. The developed model can be replicated and customized to other organizations due to inbuilt flexibility in its design.

## Moving the aviation sector to a more sustainable future: the importance of stakeholder participation in the UK airport master plan process

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Airport growth is a highly controversial process (Kaszewski and Sheate, 2004; van Eeten, 2001) with communities becoming increasingly aware of the negative impacts airport operations have on the local and global environment. The primary environmental impacts resulting from aviation include noise, emissions, waste and climate change (Hooper et al, 2003), all of which have the potential to constrain growth and cause airport-community conflict. Consequently, environmental constraints pose operational challenges; such as scheduling problems caused by night restrictions or curfews (AEF, 2007; EUROCONTROL, 2007). If the air transport industry is to grow sustainably it must meet the needs of society and contribute to the economy whilst preventing damage to the environment. In response to this challenge, in 2003 the UK Government Department for Transport published the White Paper: *The Future of Air Transport*, which stated that airports forecast to have a minimum of 20,000 air transport movements by 2030 were expected to produce and maintain a master plan document detailing development proposals and their impact on the community and environment (DfT, 2003). In 2004 guidance was published stating that airports should engage with stakeholders during this master plan process, thereby facilitating a range of stakeholder groups' involvement in development processes with the aim of balancing local concerns with national interests (DfT, 2004). This emphasis on public participation is intended to enhance the quality and sustainability of planning documents through increased transparency and the subsequent establishment of public trust, thus reducing the likelihood of stakeholder opposition and any potential future community conflict (Thomas and Lever, 2003; Upham et al, 2003; Hanchey, 1981). As such, it is an activity which should be included within both airport planning procedures and master plans. However, public participation is open to wide interpretation and has historically often been absent from planning procedures or included as an add-on process.

This research critically assesses the quality of stakeholder participation within the master plan processes employed by the airports owned and operated by BAA plc (Heathrow, Gatwick, Stansted, Edinburgh, Glasgow, Aberdeen, Southampton) and Manchester Airport Group (Manchester, East Midlands, Humberside, Bournemouth) the two largest airport groups in the UK, in order to identify areas for improvement and determine the potential contribution to sustainable development. The effectiveness of the participatory techniques employed within the master plan processes were evaluated by reference to the best practice that has evolved from the application of environmental planning procedures such as Environmental and Social Impact Assessments and Strategic Environmental Assessments. This paper presents an analysis of documentary evidence supplemented by data drawn from interviews with key actors at BAA plc and Manchester Airports Group, which has enabled a number of key findings to be identified. First, the stakeholder engagement methods employed during the UK airport master plan process were both tokenistic, participants were informed of development plans but not able to influence them (Arnstein, 1969), and only partially completed. Airports' reported undertaking 3 to 4 months of consultation; however this resulted in wildly varying response rates (29-800) and little detail on the actual nature of the individual submissions. Indeed, the reporting by airports on the feedback received from stakeholders was found to be so piecemeal that no firm conclusions can be drawn as to how this informed the final master plans subsequently produced. In some cases the only opportunity for feedback was in response to specific questions on draft plans, which appeared to be designed to restrict stakeholder input by channelling responses to a narrow range of issues. Secondly, the guidance provided by the UK Department for Transport was incomplete and left scope for interpretation, which could explain the varying levels of airport public engagement in the master plan process. Thirdly, there appears to have been little utilisation of the public engagement good practice developed in other environment assessment regimes in the master plan stakeholder engagement processes examined. Therefore, whilst corporate programmes such as master plans can help drive the sector towards a more sustainable future, there is significant room for improvement, which could be addressed in the forthcoming round of master plans expected to take place after 2012. In particular, this study and accepted good practice points to the need for a move away from the linear approach to strategic planning underpinning the derivation of the current master plans to one incorporating feedback that encourages public participation at each stage of the assessment. Encouraging stakeholder inputs at the early stages of master planning would help shape the procedures that follow and the overall outcome of the process and in theory this would help produce documents that build consensus as to the most acceptable and sustainable form of airport development. It is clear from this research that UK airport master plan documents should be both strategic planning tools for the UK Government, and tools for communication, providing stakeholders with both an outline of future airport development and an opportunity to affect change in an industry that has significant local and global consequences. Unfortunately, the rather tokenistic public engagement to date has limited the potential of airport master planning to provide a mechanism for wider public participation in this key planning process. The next round of master plans offers an opportunity to address previous limitations by adopting good practice that enables more interactive stakeholder engagement; but this will require airports

to relinquish some control over the planning agenda, provide more opportunities for stakeholder input and demonstrate greater receptivity to the modification of their plans. If this change in airport behaviour is widely adopted it could enhance the process of stakeholder participation, facilitate more proactive and inclusive engagement, and thereby enable more sustainable planning outcomes.

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## Posters

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### Relationship Management Approaches and Strategies for Sustainability Co-creation

Marlen Arnold

Modern industrialized production and consumption systems cause considerable social and environmental impacts. One of the critical questions for managers and other stakeholders is the importance of innovation and organizational learning in order to strengthen sustainability. Co-creation and customer relationship management can be key elements for implementing sustainability effectively within companies.

Relationship management emphasizes the on-going relationship between stakeholders or market actors, e.g. customers, and the company to enduring entrepreneurial success. Co-creation or user integration means including well selected customers and users in the innovation process on a targeted basis. Co-creation is a possible way to develop new sustainability product and service innovations and introduce them to the market successfully. Possible advantages of customer integration into innovation processes are: higher customer acceptance, risk reduction of product flops, decrease of information asymmetries between consumers and producers, higher efficiency in product usage, knowledge transfer, etc.

Nevertheless, we still have less empirical knowledge about the process of relationship development, especially about the different purposes and forms of relationships and their interrelations. This study focuses on integrating concepts of relationship management and co-creation. Moreover, it discusses the possibilities how a sustainable development can be strengthened, and what should be changes in companies. The article intends to contribute theoretically and empirically to this area of research addressing the following research question: How do companies integrate the idea and concept of sustainable co-creation with respect to relationship management approaches? This article addresses how companies see their economical and political influence on sustainable production and consumption from a co-creation and relationship management perspective. Strategies and instruments used to operate and control co-creation processes promoting sustainable consumption will be discussed. The theoretical reflection of sustainability-oriented co-creation and relationship management is supported by an empirical analysis of eight companies practicing co-creation. The theoretical and empirical analysis suggests to integrate co-creation processes into relationship management concepts, e.g., to strengthen present customer relationships and to broaden the consumer network. The findings also highlight that with respect to sustainability the use of open innovation tools to integrate consumers or stakeholders in co-creation processes at an early stage can provide information to the companies for developing sustainable products and services or can even co-produce sustainable consumption options. Companies can engage in programs for their current and future customers or they integrate them into production processes. However, integrating co-creation processes into relationship management concepts seems to need new organizational anchors and structures. Furthermore, we discuss these findings for theory and research on relationship management approaches.

## Stakeholder perception of corporate social responsibility

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The topic of corporate social responsibility (CSR) globally is getting more and more attention not only by many different company stakeholders. Researchers are also increasingly exploring corporate social responsibility, its motivation as well as its implications. However, so far, not much is known about the perception of corporate social responsibility. This empirical study explores the link between stakeholder perception of CSR and, in particular, its relationship with underlying factors. Using the results of multivariate regression, we find that companies that publish a corporate social responsibility or sustainability report experience a higher level of stakeholder perception regarding corporate social responsibility. The findings also suggest that organizational age of the corporation, community involvement, and cultural diversity have a significant influence on CSR perception of stakeholders. However, no significant results were found for the sustainable use of natural resources and Dow Jones Sustainability Index inclusion. Recommendations on how to enhance stakeholder CSR perception are provided.

## Are we there yet? A critical reflection of the state of Corporate Social Responsibility in the light of the recession

Claire Bastin  
Ralf Barkemeyer  
Louise Ellis  
Frank Figge

This paper examines the relationship between Corporate Social Responsibility (CSR) and recession and periods of austerity, in order to investigate whether the current mode of predominantly voluntary, beyond compliance corporate responsibility is crisis-proof, or whether the discourse of CSR has changed since the onset of the recession. Examining this relationship allows for a critical evaluation of the current state of CSR; focusing on the extent to which CSR has been truly integrated into business models.

Within this paper recession can be seen as a crisis event, and therefore it is interesting and useful to consider the impact it has had on CSR directly and also as a means of understanding the potential effects other crises may have on the discourse and application of CSR, and more broadly corporate sustainability. Gaining such an understanding has never been so important with the discussions relating to other crisis events, such as those related to climate and change and resource issues such as peak oil, ever increasing.

This paper has been developed within the context of CSR being firmly associated with incremental change and the growing argument for the need for more fundamental step change. The rise of CSR has coincided with the emergence of more conciliatory modes of governance (Gouldson & Bebbington, 2007). A common underlying rationale of CSR-related concepts, tools and initiatives is the voluntary character of these approaches, focusing on private governance and corporate self-regulation rather than regulatory pressures. Hence, it has been characterized as a tacit social contract between the company and wider society (Moir, 2001; see also Donaldson & Dunfee, 1999). CSR can generally be characterized as a series of incremental steps towards more responsible – and more sustainable – corporate conduct, relying on organizational learning and the so-called business case.

A range of scholars have conceptualized corporate responsibility as an incremental progression from reactive towards more innovative and proactive strategic approaches (e.g. Steger, 1988; Hunt & Auster, 1990; Roome, 1992; Winn & Angell, 2000; Mirvis & Googins, 2006). This corresponds to the widespread rationale of corporate learning or self-enlightenment in order to reach a tipping point (Gladwell, 2000) or critical mass of responsible companies (Waddock, 2003; Whitehouse, 2003) in advancing corporate sustainability. However, taking the often-used allegory of CSR as a journey, it should be noted that we embarked on this journey several decades ago and it remains unclear in this context whether we have actually made any real progress in terms of corporate sustainability. A key question in this context is whether CSR by now has actually entered the “corporate DNA” and whether the tools and initiatives linked to CSR have matured to an extent that they have not only survived the economic recession but actually have a role to play in terms of addressing it. The current recession may serve as litmus test for the relevance and maturity of current approaches to CSR.

This paper will examine the question of whether and how the recession has altered the discourse of CSR in the United States, Australia and the United Kingdom. It will begin by developing propositions that describe the nature of the relationship between the economic recession and the discourse of CSR, providing a reflection on this impact as a starting point to discuss the evidence of, or the potential for a shift away from incremental change as a result of the recession. Through this discussion the different facets of CSR will be considered, for example, CSR as a tool for risk management, the operational cost of CSR, CSR as a remedy for corporate irresponsibility, and the overall business case for CSR. The

examination of multiple ways of talking about and enacting CSR allows this paper to provide a more complete and robust examination of the current relationship encompassing the contested nature and understanding of CSR that exists within both practice and theory.

In order to shed light on how the discourse has changed since the onset of the economic recession, samples of (a) broadsheet newspapers, (b) specialist business publications and (c) CEO statements extracted from corporate sustainability reports are analysed using the software package WordStat/ODA Miner, focusing on changes in the levels of coverage on CSR and related issues as well as the way in which CSR is specifically referred to in light of the economic recession. In addition, this data has been supplemented with the examination of business-related blogs and interviews with practitioners; from which discursive themes have been identified.

This paper will conclude by discussing the role and relevance of the current wave of CSR in the light of an external shock such as the economic recession. Additionally, it will provide a narrative of the current state of CSR in an economically challenging environment. Initial findings have shown there is a changing discourse around CSR, moving back to a safe corporate-centric language grounded in efficiency and business sustainability (rather than sustainable business). In more practical terms it has been seen that the recession is having little real impact on CSR in action, mainly as a result of the lack of real integration of and investment in CSR by business. Therefore, there is no real financial need to make any substantial cuts in the CSR activity. These findings suggest that CSR has not widely become integrated into the DNA of business, but this has indeed protected CSR from the recession and perhaps more importantly highlights the real need for a step change if corporate approaches to sustainability are to have any real impact.

### **Understanding and Modelling Sustainable Behaviour in Office Environments: A Case Study on Corporate Express, Australia**

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The consumption decisions people make and the actions they take – to consume certain products or services – have direct and indirect impacts on the environment. Thorpe (2010) states user consumption has been a concern for sustainability for a long time as people have been consuming more than the global resource capacity permits. This paper focuses on consumer (in this case author focuses on employees) habits in office environments and look at the possible ways to switch to sustainable consumption patterns; such as reducing energy consumption, encouraging material recycling, offsetting the environmental impact of emissions from their air travel etc. The energy consumption in office-based companies per employee is around 6-6,500 kWh per with a personal computer accounts for about 9% of the overall ecological footprint of 'world- average' citizen (Thorpe, 2007, p. 29). Moreover, according to UNEP (2008) lighting an empty office overnight can waste the energy required to heat water for 1,000 cups of coffee. In short, changing consuming habits and implementing more sustainable consumption patterns in the workplace will help reducing carbon emissions significantly.

This paper presents some existing methods to change consumption habits in office environments and the framework is discussed in the context of a case study on an international retail company, Corporate Express which demonstrates some applications of consumer behaviour change in Australia, such as launching staff sustainability program called GreenXpress and encouraging employees to reduce energy consumption and recycle waste, launching an awareness program on water conservation in kitchens and bathrooms, introducing an at-desk recycling program for staff to ensure maximum recovery of paper and cardboard, and implementing a "Say No to Bottled Water" campaign in vending machines to reduce the amount of waste coming from bottled water consumption.

### **Corporate Social Responsibility with a Developing Country Focus: Saudi Arabia**

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Sustainability remains to cultivate as both a challenge and an opportunity for businesses and their investors. Corporate Social Responsibility (CSR) is about good corporate citizenship and corporate responsibility. Businesses are committed to address not only their economic and financial concerns but also the environmental, social and ethical concerns of the society in which they cooperate (Aggarwal, 2010). Significant areas of concern are about achieving a "triple bottom line" which are focuses on three dimensions of sustainability: economic, environmental, and social. The concept of CSR is underpinned by the idea that corporations can no longer act as isolated economic entities operating in detachment from broader society. Traditional views about competitiveness, survival and profitability are being swept away.

The Saudi Arabia context, the established values of generosity and goodwill and the position of local business leaders on social engagement; all provide for countless opportunities to advance CSR so that it plays an effective role in the development of local society, and economy. Moreover, environmental sustainability is a critical issue, many Saudi Business leaders and corporations understand that being socially and environmentally responsible serves as a source of sustainable development, and they use CSR projects as way to create a better world, as they initiate programs that are not at all related with the core businesses.

Friend of Jeddah Parks (FJP) is one of the leading distinguished sustainable CSR programs in Saudi Arabia. The beginning of FJP started 9 years ago when some of business owners, recognized the urgent need for city parks, playgrounds, walk-paths and open spaces for the underprivileged residents of Jeddah, with the scarcity of municipality parks. Moreover, to assist in depicting the modern urban image of the city of Jeddah, which is considered one of the most polluted cities in Saudi Arabia. This need turned into the vision and mission of a team of prominent businessmen, professionals, entrepreneurs and volunteers that become the founding members of a nonprofit foundation that was named FJP. FJP aim is to develop suitable environment for leisure, fulfilling the needs of the neighborhoods residents and improve the health, cultural level of the person, and the community. FJP works towards the creation and management of world class public parks and open spaces in Jeddah city. They accomplish their mission by working with the city municipality to allocate and release empty plots of land for parks development; they as well reach out to the private sector to finance the building of parks as part of their CSR. In addition, they also connect with local neighborhoods to customize the parks based on their specific needs to ensure maximum benefits.

Since these parks are initiated to develop its surrounding community, FJP team start by first studying the needs for open spaces in different neighborhoods. To fulfill this requirement, their team conducts in-depth research and need analysis in the community. Second, they approach local city authorities to secure and provide them with suitable plots that can be allotted for parks and recreational usage. Third, they enhance public and private participation by involving members of the local community, commercial and industrial institutions, and corporate entities to donate funds to support FJP efforts in their Corporate Social Responsibilities programs. Subsequently, the volunteer team of architects, urban planners, and landscape engineering design the park space by taking into the account the particular needs of each neighborhood. Finally, the volunteers who are mostly from the neighborhood youth, work with the neighborhood communities to understand their needs and enhance their awareness of the value of open spaces and parks. They create and participate in social and sports events designed to mentor and train the youth involved.

One leading example of FJP parks is «Amira Park». This park occupies 30,000 m<sup>2</sup> and has 148 palm trees, walk path 500 m long, stage area, and children playground. It is located in south Jeddah which is an area that witness the highest existing crime rates in the city. The aim of this park is to focus on developing underprivileged neighborhoods and to make an impact on the society by providing an outlet for the residents.

Considering the culture of the neighborhood residents, this park is specially operated for female and children. Therefore, the optimal goal of this park is to create a space for women of the neighborhood to venture out of their homes and have somewhere safe to go with their families. Many development and empowering programs such as educational, environmental, social and health programs are creating in the park to maintain the sustainability development of the surrounded community.

Amira Park was built after a survey that was conducted on the need of the community following Faisal Sports Park for boys also in the same neighborhood. The establishment of Amira Park has cost 17 million Saudi Riyal, which was donated by two businessmen who lived and grew up in the same neighborhood which holds a sentimental value. They also believe in the cause of the park and its location specifically. What's unique about this park is that it is maintained by volunteers from the surrounding community, 50 women in average, which makes its maintenance sustainable and rewarding.

To conclude, CSR is increasing in importance in Saudi Arabia, and have especially done so the last couple of years. Still, the understanding of CSR in the Kingdom and the different international standards of CSR differ in many ways, and especially it seems as the core values are different. It is argued that this should be a two- way- street, and that CSR- practices in Saudi Arabia have both a great opportunity to learn from international standards, but also have a lot to contribute with to these standards. However, there is a gradual change in the field of CSR going on in the Kingdom currently, and that will contribute to develop the Saudi Arabian society from all aspects. Then again, Saudi Arabia has proven to hold important values and experience in the field of CSR that could act as a great example to different societies outside the Kingdom to learn from.

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Friends of jeddah parks (n.d.). Retrieved March 18, 2011, from <http://www.fjpsa.org>



## **Building Corporate Resilience: A case study of the Spier Group's search for a sustainable, lower carbon future**

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The Spier Group, one of the better known wine producers in Africa, incorporates a number of directed strategies that are aimed at improving the sustainability of the business. These strategies include, amongst others, a target to lower carbon emissions (carbon neutrality); reduced water consumption and rain-harvesting (water sustainability); and waste minimization (zero waste). Spier's macro-goals for the medium-term take into account the vulnerabilities that the social-ecological system, in which the leisure and wine-making components of the business are embedded, is facing, such as eroding energy security, water scarcity, and the loss in biodiversity. Thus, in addition to impact-reduction goals, Spier also practices biodiversity conservation and environmentally friendly farming. In the Spier Group, sustainability reporting and associated tools, for example, greenhouse gas emissions calculations, offer a credible means of measuring progress on a trajectory to sustainability transition. Furthermore, efforts aimed at 'learning for sustainability' by training employees at all levels and building networks with learning institutions are underway; as are climate change mitigation efforts guided by industry alliances of climatologists, agricultural economists and farm-owners in the Western Cape Province of South Africa.

Interviews with senior managers and a desk top review of annual reports and strategic documents reveal that over the years, the Spier Group has indeed done much to establish sustainability as one of its brand pillars. In the early years of the business, community development was a strong driver and several related projects were undertaken to, for instance, empower previously disadvantaged farmers in the region, improve the local primary school, and create a high-level centre for leadership and learning on sustainability. Starting out as a business exploring diverse socio-economic and environmental aspirations, Spier set out on a journey of embedded sustainability, which meant moving beyond one-off external projects to transforming its own business operations. This required cascading shareholders' vision into top and senior management's performance measures. Various disparate efforts under the banner of sustainable development were consolidated, as was the reporting thereof in an annual sustainability report. At the same time, momentum was picked up on three key ongoing endeavours aimed at reducing the Spier Group's ecological footprint – the search for effective renewable energy solutions; experiments with wastewater treatment; and solid waste recycling. The senior management structure was amended in 2007, whereby the Managing Director for Sustainable Development was given a governance role. It was also believed that sustainability was sufficiently entrenched among the employees and managers to yield organisation-wide sustainability-oriented behaviour and innovation.

However, an in-depth study of the Spier Group's sustainability trajectory shows that there are inconsistencies in year-on-year reporting, delays in shifting the supply chain, and gaps in implementation, particularly in the area of energy efficiency and the adoption of renewable energy technologies. For example, a highly ingenious wastewater treatment plant, combining the best of engineering, art and metaphysics, was built on the estate just before the financial crash of 2008, while the operational and senior management are yet to implement cost and energy-saving solar heat pumps at the hotel complex, despite having access to reliable renewable energy vendors in the region. The group was awarded the Best Sustainability Report of the Year award in 2006, but the handing over of the sustainability reporting task in 2007 from one section of the organisation to another, meant that different data gathering, consolidation and presentation techniques were adopted, which impede comparability of environmental performance over the review period. For the last two years under review, management outsourced the production of sustainability reports to an external consultant with superficial knowledge of the Group's operations.

The case highlights that organizational drivers, underpinned by a sustainable micro-ecology perspective, and sustainability reporting on their own are not sufficient catalysts for change. A resilience-oriented approach holds promise as a more comprehensive framework for understanding the business as a complex adaptive system and developing recommendations to move the system onto a more sustainable path. When the twenty year history of the Spier Group's search for a sustainable configuration is charted, distinct phases of establishment, consolidation and contraction are displayed, closely aligned with the characteristics of an adaptive renewal cycle: growth, conservation, collapse and re-organisation. Agent-actors in the form of executive officers, with distinct leadership styles and external experts, brought in during different phases of the business' cycle reinforce the system's capacity to remain in a particular state by formulating and implementing mutually-reinforcing response strategies. Further, interviews revealed that the impetus for innovation in wastewater treatment came from an external driver: highly stringent national regulations with regards to water quality. Decision-makers within the business were then able to innovate in response to the external shock, as predicted by resilience theory. The innovation was also easier to implement as the business provided a safe, niche

environment for risk-taking by not being connected to the municipal sewage system. Similar exogenous variables (such as carbon capping) and niche environments are non-existent in the case of the adoption of renewable energy technology with all agents, including departments within the Spier Group's learning partner – Stellenbosch University, local vendors and leaders within the organisation, unable to assist the system in transitioning from a survival phase to a phase of re-organisation, which encourages innovation.

Based on this detailed case analysis, business leaders are encouraged to be cognisant of the phase their business is in and to formulate mitigation and adaptation strategies accordingly, to ensure corporate resilience. More importantly, it is recognised that agent-actors within a corporate system have limited capacity for affecting systems change in the absence of exogenous drivers such as government regulations informed by international treaties, or taxes. Thus, a better understanding of the larger social-ecological system, and related risk due the vulnerability of that system, is imperative for the modern corporate decision-maker.

Keywords: corporate sustainability, corporate resilience, social-ecological resilience, adaptive renewal cycle

## **GRI Reporting as a Tool for Corporate Responsibility towards Sustainable Development – A Case Study of Three Multinationals in the Forest Industry**

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To achieve the goals of sustainable development, business enterprises have increasingly launched corporate responsibility (CR) –programs which aim to integrate social and environmental responsibility throughout the firm in ways that benefit both society and the business. CR as such, can be seen as a tool for private sector to participate the efforts moving societies towards more sustainable future. Particularly, this is important for multinational enterprises (MNEs), which engage themselves in global markets. Due the increasing power of global market liberalism, now and in the future, MNEs will have an important role in the social and ecological development of the globe.

However, it is difficult to measure and describe the role, effectiveness and success of CR in directing business activities of MNEs' towards sustainability. This is where the transparent sustainability reporting plays an important role. To ensure the reliability of CR reporting, the adoption of consistent external reporting standards, such as the Global Reporting Initiative (GRI) has increased.

GRI is a network-based organization that pioneered the world's most widely used sustainability reporting framework. According to GRI, reporting can be divided into specific indicators, of which 9 are economic indicators, 30 are environmental indicators and 31 are social indicators.

However, also GRI is facing several problems. It is easier to express economic and environmental responsibility using quantitative indicators, partly also existing legislation on financial accounting and environmental regulation, whereas regarding social responsibility, apart from internal employee issues, neutral and quantifiable measurement is a much more complex task leaving room for interpretation. One illuminating example of this problem can be found in GRI reporting indicator on the impact assessment of the nature, extensiveness and effectiveness of company's programs measuring social impacts of operations on the local community. If we are analysing an MNE with locations around the world in both developed and developing countries, local communities and business-NGO relations tend to highly diverse, necessitating different approaches. In the reporting, a MNE can easily focus on the more successful examples while not being transparent on some of its CR "hot spots".

Despite the introduction of GRI in the late 1990s, the actual use of huge reporting information has also proven to be strongly inward biased towards companies the large companies themselves and the financial community to some degree (Brown et al. 200). Recently, GRI has started developing towards an integrated reporting, namely a framework that brings together financial, environmental, social and governance information in a more integrated and constant format. While GRI is being less commonly used by the wider group of stakeholders, such as the civil society and NGOs, an improved disclosure has not alleviated major corporate-civil society conflicts to happen. Consequently, the power of information-based civil regulation by GRI to strengthen governance based on mutual partnerships and to mobilize civil society in a positive way has been limited.

In the study we aim to research on corporate responsibility in one important natural-resource based industry, namely forest industry, which ongoing rapid internationalization and structural change under challenging financial pressures. By extending our previous quantitative analysis of profiling responsibility reporting and business strategies in 66 world's leading forest industry companies (Li et al. 2010), the research also builds on a previous a single company case on

MNE and NGO involvement (Kourula 2010). Our work is justified since important empirical questions remain in the forest industry, such as, whether CR is integrated into strategy in the MNEs, second; why a standardized reporting framework such as GRI is or is not being implemented in the company; what is the added-value of use of GRI in MNE; and finally, what is the role of CR and CR reporting in moving companies towards the goals of sustainable development.

This study uses a comparative qualitative case approach on selected forest industry MNEs based on a combination of interview and secondary data (reporting, company newsletters and other documentation). Three large-scale multinational forest industry firms all pursuing different strategies in terms of internationalization and geographical and product diversification were chosen for the study: Stora Enso, SCA and Sappi Ltd. These companies were also considered as leadership companies in terms of corporate responsibility according to our previous quantitative study, from which we have deepened the analysis to explore responsibility management, related organizational processes, as well as perceptions of drivers and interpretations towards company specific CR related issues visible in the recent years. Since time is an important dimension to be taken into account in the analysis due to organizational learning and knowledge transmission point of view, our empirical data has been collected from company reporting and from following certain incidents during the last 5 turbulent years in forest industry. Secondary data has been complemented using semi-structured theme interviews with the corporate responsibility and communication managers.

From the governance perspective, the results confirm existing scepticism on the power of CR reporting efforts such as GRI to move MNEs towards sustainable development regarding their core activities. Despite the use of GRI, there are still difficulties in comparison concerning the social issues which are highly important in achieving the goals of sustainable development. However, CR reporting and use of standardized efforts such as GRI, increase the external pressure for MNEs to change their unsustainable business activities, and this may have an increasing positive role in the future. Due the global operational environment of MNEs, Northern sustainability standards may transfer to the South through CR. From the industry perspective, results point lack of the need for sufficient company resources and capabilities, accommodating inherent divergences in background for education, work experience and strategic goals in CR and industry management.

### **Corporate Capacity for Climate Change and Urban Air Quality Management: An empirical assessment of Transportation firms in Jakarta and Hanoi**

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The movement of goods and passenger through public transport system in cities are a major contributor to local air pollution and green house gasses emissions caused by mobile sources. This paper attempts to measure the corporate capacity for climate change and urban air quality management based on an attitudinal survey designed for manager of the company in transportation sector in developing countries. We apply the capacity concept to evaluate their capabilities related to urban air quality management of their company and its impact on the resource allocation and fuel consumption and CO<sub>2</sub> emission. A structural equation model is used to capture cause-effect relationship among factors in corporate capacity for urban air quality management. Based on an attitudinal survey in Jakarta and Hanoi metropolitan areas in 2005 and 2006, we founds that instead of internal commitment, the external pressure such as resident, users and government agencies clearly affect on the capacity of company to perform best environmental practices in urban air quality management and also combating climate change effects. Furthermore, in case of Jakarta city, we found that the increasing the capacity of company led a less fuel consumption and increase the corporate productivity which automatically reduce CO<sub>2</sub> emissions.

## Corporate Future Responsibility

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Recent volatile economics represent the rear side of a coin that in front shows growing scarcity of resources. An expanding lack of future-oriented competences eventually led to an extremely narrowed goal setting that usually comes along with individual or organizational faint. In turn, continued corporate cupidity hampers ecological systems to recover, as these get overexploited. This dilemma accelerates the race of human wisdom against consequences of economic imprudence. According to a current study about “future capacity building” that examines corporate strategies for sustainable change, dozens of internationally leading companies agree on that judgment. The key is to implement corporate future responsibility, and to turn traditional career paths that mainly emphasize cost reduction and short-term profitability into a process of human capacity building that allows to amalgamating technological, economic, social, ecological and managerial development.

## Investigating Corporations’ Behaviors to the “Energy Saving and Pollution Abatement policy”- A Case Study in Qingdao, China

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In the three decades after China’s opening, remarkable economic growth has helped China to be one of the most important emerging powers in the world. However, it has not come without prices. China is suffering serious environmental and energy problems. For example, Due to the coal-dominated energy consumption, China becomes the second source of global carbon dioxide (CO<sub>2</sub>) emission as well as the largest contributor to global sulfur dioxide (SO<sub>2</sub>) emission, which makes China one of the three major acid rain polluted area in the world.

Therefore, to reduce pollutants emission and improve energy efficiency is inevitable course for China to achieve sustainable development. “Energy saving and pollution abatement policy” was approved as two legal-bounding targets for the 11th Five Year planning (2006-2010) in 2006: (1) energy saving- energy intensity per capita GDP needs to be reduced by 20% at the end of the 11th Five-Year Plan; (2) pollution abatement- both the emission of SO<sub>2</sub> and chemical oxygen demand needs to be abated by 10% at the end of the 11th Five-Year Plan.

In this study, 120 corporations were surveyed in Qingdao at the end of 2008 to analyze corporations’ awareness, attitude and actions to the policy of energy saving and pollution abatement. The 120 corporations cover 24 industries according to the secondary industrial classification in China; and they consist of 25 Chinese state-owned corporations, 32 Chinese private corporations, 35 foreign corporations and 28 joint ventures. 98 corporations belong to small scaled corporation, 7 corporations are large scale corporation, and other 13 corporations in between are medium sized. This paper investigated corporations’ behavior from scale, ownership, current environmental performance on energy using and pollution, target market and listed situation perspectives. And we found:

- More than half corporations thought the policy would constrain their development, especially those small corporations performing poorly in environment; only a few Chinese state-owned and foreign corporations with good environmental performance considered it was good to long-term development.
- In general, corporations responded to pollution abatement more actively than energy saving due to different monitoring authorities. And 26 in 27 corporations taking no action were small corporations with poor environmental performance.
- Environmental performance and how corporations thought about the policy impact and importance are highly correlated with each other. It seems foreign investment from USA, EU and Japan has better environmental awareness generally. Small sized Chinese corporations as well as a few small foreign corporations from South Korea and Taiwan consist of the most passive part answering to the policy. No significant difference appears among industrial categories.
- Most corporations took more than two measures in action, and measures in promoting production process and management are commonly adopted. Investing in equipment is the most popular approach for pollution abatement while not for energy saving. The policy meanwhile provides drive and environmental direction for adjusting products structure and outdated disadvantaged production facilities.

Further research found that corporate properties as scale, ownership, current environmental performance on energy using and pollution, target market and listed situation have impact on the corporate responding conduct and progress. Summarize these impact factors, we found that current environmental performance has strong relationship with their policy responding performance. Corporations with low energy efficiency performed poorly to energy saving, while those with high pollution level performed below average for pollution abatement.

It implicates that the national policy of energy saving and pollution abatement and its task allocation to corporations could contribute to outdated production facilities less environment-friendly significantly under the condition of strict implementation. And the given environmental requirements also drive corporations to achieve targets by various approaches, with which also help corporations to gain other benefits, such as updating and adjusting product structures, lowering pollution discharge fee. That may be the co-benefit for China's economic transformation.

Acknowledge: This research is supported by the Fundamental Research Funds for the Central Universities, and the Research Funds of Renmin University of China(10XNF055):Cooperation Environmental Behavior——Micro Perspective of Energy Saving and Pollution Reduction.

### **Modeling the Eco-Innovative Capacity of Small and Medium-Sized Enterprises in Developing Countries – A Case Study of Companies in Romania**

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The paper presents an analysis of the decision making processes regarding eco-innovation in Romanian Small and Medium Sized Enterprises (SMEs) in the context of the new European Union requirements.

Seen at a European level as the way of the future, in which regards the valuation of the growth potential in a volatile environment, eco-innovation has been taken into consideration as support for larger competitiveness and growth objectives, at first in the Lisbon Agenda and more recently, in the Europe 2020 Agenda. At their current stage as normal actions in the industrial dynamics, eco-innovations have started as mere responses to negative externalities, under the triad: economic growth, social development and environmental protection. The European requirements are set, based on the Kyoto Protocol, and have 2020 as deadline. In this respect, the European Council creates three goals to be reached by this deadline: the reduction in Greenhouse Gas emissions, the energy from renewable sources and the increase in energy efficiency, all included in the Energy-Climate Package.

In this context, the need of new economic models, integrating environmental concerns into productions emerges. The optimality of eco-innovations must be, in this view, analyzed regardless of the size of the organization, more so in SMEs, regarded as less favored in the information diffusion. If multinationals benefit from a large support network at an international level, drawing information from various sources, SMEs are often isolated, thus reducing their capacity to have access to the newest research.

This paper tests this hypothesis of isolation of SMEs in the Romanian market and analyses the integration the European requirements into their usual production processes in an environment of reduced information and funding. The main question aimed to be answered is whether the decision making processes are altered by this type of external factors (European requirements focused on 'doing good deeds') and, if so, to which extent.

The research methodology is straight forward: starting from the concept of eco-innovation and its taxonomy, it outlines the current requirements regarding this new element to be considered in the decision making process (DMP). At this stage, a sample of Romanian managers of SMEs (20, across industries) are asked to answered an in-depth questionnaire on their current DMP and the way it may be affected by eco-innovation, seen as requirement, not part of a Corporate Social Responsibility strategy. Their answers are compared to the answers of a 10 managers of multinationals, in order to determine the isolation hypothesis. At a second stage, the paper focuses on discovering the DMP models governing the integration of eco-innovation, in view of drawing a model of eco-innovative capacity at the level of SMEs.

The novelty of the research is the focus on the eco-innovative capacity of SMEs, as opposed to multinationals. The similarity of the Romanian market with other South-Eastern European countries, as well as other emerging economies, allows the extrapolation of the results at an international level, in view of improving the quality of the integration of eco-innovations into the normal activity of SMEs.

This work was supported by CNCSIS-UEFISCSU, project number PN II-RU TE\_328/2010.

## **Do corporations respond to consumer demand for sustainability, or does ‘corporate sustainability’ construct ‘the sustainable consumer’?**

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This paper is based on research into corporate sustainability communications conducted in the UK through participant observation in a specialist sustainability communications agency and through interviews with elite practitioners of corporate sustainability and communications. It is part of a wider project that contributes to the sociology of sustainable consumption through an empirical, historical and theoretical analysis of corporate sustainability communications. The study examines the institutional organisation and everyday practices that produce sustainability communications and explores the understandings of practitioners. This paper contributes to a more sociologically adequate account of the relation between ‘corporate sustainability’ and sustainable consumption.

Clearly there are many drivers to the adoption of corporate sustainability programmes and the development of sustainable products and services, including: consumer demand; pressure from civil society; regulation (existing or anticipated); institutional isomorphism; and changing corporate cultural norms. However, of these, consumer demand occupies a particular position - as the ideological *raison d’être* of consumer society, the motor of the economy and the presumed animator of consumer-facing brands.

The story of consumer demand for sustainability serves many masters, which otherwise have potentially competing agendas. For campaign groups, demonstrating consumer demand for sustainability (whether positive or negative, in terms of damage to brand reputation) translates political and ethical demands into the self-interest of corporations; for practitioners of ‘sustainability communications’ and advocates of sustainability within corporations consumer demand similarly provides a ‘bottom-line’ justification. Arguably, for government, the idea of consumer demand for sustainability serves as a proxy, enabling government to abdicate responsibility from making complex and contentious regulatory choices.

Without denying the existence of a highly motivated constituency of ‘citizen-consumers’ and the growing awareness of sustainability issues among the wider public, market research demonstrates fairly limited consumer demand for genuinely sustainable consumption. Moreover, there is widespread evidence of a generalized consumer cynicism towards corporate communications concerning sustainability. Yet at the same time there is a huge increase in the appetite of corporations for sustainability programmes and for integrating sustainability into brand ‘offers’.

Production and consumption are intermediated by both purposeful attempts of civil society organizations claiming to represent ‘the sustainable consumer’; to influence corporations, and by the strategic efforts of corporations to understand consumer practices and motivations around sustainability, in order to guide their own development of sustainability practices, products, services and brands. The stakeholder engagement function of corporate social responsibility programmes can be seen as the firm’s attempt to pre-empt and co-opt the first of these processes. At the same time brand management can be seen as both another means for such co-optation and as intimately tied up with the second process of consumer research.

This paper argues that the notion of consumer demand for sustainability is mediated and constructed through the practices and discourses of both of these processes. At the interface of the two, ‘sustainability communications’ emerges as a field in its own right, produced by a dedicated group of ‘expert knowledge workers’.

Sociological accounts of marketing and advertising have examined how practitioners construct a “proxy” or “virtual” consumer – sometimes “constructed in their own image” (Slater and Tonkiss 2001:178) – as a key part of their practice. Similarly this paper argues that practitioners of corporate sustainability communication construct a proxy ‘sustainable consumer’ and thus can play a performative and structuring role in the construction of ‘consumer demand for sustainability’.

The role of ‘sustainability communication’ practitioners as ‘cultural intermediaries’ and of corporate communications more widely are under-studied areas in the sociology of sustainable consumption. At the same time a growing body of sociological studies that take an empirical, practice-orientated approach to the study of ‘knowledge workers’ and ‘cultural intermediaries’ have as yet contributed little to understandings of sustainable development.

A further contribution of the paper is to articulate issues of sustainability with the discourse and practices of brand management, which seek to ‘co-produce’ the brand with the consumer. Daniel Miller has suggested how theoretical models (such as neoliberal economics) achieve performative, structuring agency through their instantiation in powerful institutions – what he calls “virtualism”. This paper argues that brand management operates in a similar way, instantiating its model of consumer society through the institution of the corporation.

Seeking to engage the consumer in sustainability practices, the corporation engages in the practices developed for the 'co-production' of brands. Furthermore, it will be argued that a certain isomorphism exists between 'brand practices' and this producer enabling of sustainable consumption; such that it can be argued that corporate engagement with sustainability intensifies processes in which 'brand practices' become important in the social world and, to the extent that 'sustainability' is integrated into brand 'offers,' brand management plays a key role in constructing 'the sustainable consumer'.

Lastly, through exploring the mechanisms by which agents within corporations construct 'the sustainable consumer' the paper informs the debate over the ways in which 'corporate sustainability' represents business-as-usual (or even the co-optation of the radical demands for sustainability) on the one hand or, on the other, whether there is transformative potential within 'corporate sustainability' offering to live up to the challenges of sustainable development.

### **Sustainable Development: Self-Efficacy as a Key to Action**

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Sustainable development is at root a social, not a technological problem. It is a problem that will not be resolved until people believe it is within their power to solve it. Increased information alone, especially bleak and frightening information, is unlikely to address the problem. For example, it does not appear that people need convincing that the Earth's climate is changing. Polls taken in 2010 in the US and Britain show between 70 to 80 percent of the people polled believe that climate change is occurring and is caused by human activity. They know what the problem is; yet without a belief in their personal and collective efficacy to address climate change they are largely unable to respond (Bandura, 1997).

It is perhaps ironic that in recent years many large businesses, businesses whom some might blame for our consumerist society, have adopted sustainable policies and practices. Even though they have used their sustainable practices to demonstrate that they are doing the "right thing," many companies also see these practices as competitively advantageous rather than burdensome. For example, Walmart, Interface, Inc., and General Electric (GE) have adopted sustainable products, policies, and methods that have reduced their costs, sped the development of innovative products, and enhanced their reputations. Interface, Inc., an international manufacturer of sustainable carpets and upholstery, is sharing its successful sustainable practices with other companies. It was instrumental in assisting Walmart to develop policies and practices that seek to create zero waste and to use 100% renewable energy. These businesses recognize (1) how specific actions can lead to direct sustainable outcomes and (2) they know how to implement these actions in their companies. Having seen that it is possible to be a profitable and sustainable company, other companies may also adopt sustainable policies in order to compete with these early adopters.

How then can the successful experience of companies like Interface be replicated and transmitted to other societal elements, whether individuals, businesses, or governments? We suggest that the concept of "agency through collective efficacy" is a useful and, indeed, already successful framework within which to promulgate sustainable practices. Self-efficacy, that is, knowing what is needed and believing that one can do it, is one of the more heavily researched and substantiated concepts in modern psychology (Bandura, 1997). It describes how people come to be optimistic or pessimistic about life's challenges, persistent or despairing at solving problems, and resilient or frail in adversity. Individuals learn how to be efficacious through experience, by observing others, via persuasion, or by redefining their emotional states (e.g., anxiety as excitement, not terror). No one can do everything, however. Thus, we may allow others to be our efficacy agent by proxy. In matters of health, our physician is often our proxy efficacy agent. Our most challenging tasks, such as sustainable development, are resolved through collective efficacy. No one person put a man on the moon nor did an individual eliminate smallpox. It required a collective belief that if certain actions were taken, actions that were within the group's or nation's collective ability, the desired end would result.

Collective efficacy is the product of socially supported individual action. Social support may be generated locally, such as in a company, or nationally. Papa, et al. (2000) describe how a twice weekly, radio program initiated social change in an Indian village. Based on the villagers' collective discussions about the program, individual villagers rejected the practice of wife dowry, advocated for reduced fuel consumption, planted trees, and improved local sanitation. None of this was new to the villagers. Yet, their discussions enhanced their understanding about what needed to be done and how they could do it.

We propose to discuss how collective efficacy might be enhanced regarding sustainable development. Using a case study approach, our analysis will examine existing examples of corporate sustainable development from the perspective of collective efficacy. We will then propose how collective efficacy can be enhanced within the more general population.

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## **Linking System and Action Research in Sustainability Science**

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Complex system analysis (understanding complexity) and action research (towards transition) are key features of sustainability science. System analysis is thought to inform human (individual and collective) actions, the latter being oriented towards achieving more sustainable societies. Contrary to intuitive expectations, it is an open question in how far they fit together both theoretically and in empirical research. Theoretically speaking, the problem is that system theory and action theory are two different theoretical and epistemological schemes. According to a Luhmann-like system's approach for example, there is no conceptual space for actions in it. Empirically speaking, system analysis might inform human actions, but there are more elements to be considered in action research than only system's understanding. This is especially true for collective action, hence the type of institutional actions of utmost interest in sustainability science. Against this backdrop, the paper explores promising ways to link together system and action research.



# Bridging Organizations as Institutional Arrangements for Sustainable Development

Abhishek Agarwal & Alfred Posch

## Oral Presentations

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### Empowering Society for Better Business Sustainability Ecosystem

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This article presents a theoretical proposition based on the stakeholder theory for better Corporate Social Responsibility (CSR) practices, specifically, in the context of Malaysia. The aim of this article is to argue the need for the government initiative to help empower the local community and transform them to become a legitimate and powerful stakeholder. Understanding the concept and importance of CSR among the local community is still lacking compared to the communities of certain developed nations where the idea of CSR originated. In competing for the limited resources of the firm, communities need to understand that they also have a role in promoting better CSR. This study contributes to the literature by providing a fundamental explanation of why some CSR practices are mainly for public relations purposes. Firms operating in developing countries may have consulted with the community if they had experienced pressure to do so. This will contribute for a better environment in which both firms and the community work hand in hand for a sustainable livelihood.

### Measuring the Sustainability Performance of Infrastructure in an Eco-Industrial Park: A Real World Case Study

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The development of an eco-industrial park (EIP) involves much of the same process as a conventional industrial park: planning, infrastructure design, infrastructure construction, lot sales / leasing, business construction, business operation. To make an EIP, industrial ecology (IE) should be embedded throughout. A challenge then becomes measuring the depth to which IE was applied and sustainable industrial development was achieved.

This paper presents the important findings of the first attempt in North America to quantify the sustainability performance of infrastructure systems in an EIP, specifically the Innovista EIP in Hinton, AB. Infrastructure systems included: stormwater; water; roads; parks & trails; and energy. The impact of EIP buildings was also considered. These systems were considered from a project life cycle perspective, from planning through to operation. Indicators related to energy consumption, renewable energy consumption, greenhouse gas emissions, land protection / restoration, waste diversion, waste production, water consumption, and materials consumption were considered.

A benchmark "business as usual" baseline was created, representing how the land would have been developed without an eco-industrial approach. The preparation of a baseline considered information from local engineering standards, alternate bids, feasibility studies, industry research, common practices, and other regulatory guidelines.

It was observed that benchmark data for industrial land development is not commonly available, making it challenging to quantify the performance improvement offered by an EIP. In addition, the nature of construction tendering made data

collection a challenge. Nonetheless, several performance benefits were quantifiable, including a one time greenhouse gas emission avoidance of 44,700 tonnes eCO<sub>2</sub> and an annual projected greenhouse gas emission avoidance of 59,200 tonnes eCO<sub>2</sub> per year.

This work was completed as part of the Town of Hinton's 5.5 Million CAD funding from the Government of Canada Green Municipal Funds.

### **Establishing sustainable production in developing economies**

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Agenda 21 is soon twenty years old and has influenced the policies of nearly every nation state on the planet in that time. Because the larger industrial nations are more visible and make proportionately larger contributions to environmental degradation, they also receive the majority of attention from researchers and the media. However, it is in the best interest of all to watch the emergence of industry in smaller countries and to assist them in creating sustainable production from the beginning.

The constitution of Bhutan includes rigorous requirements against all industrial enterprises, which has promoted the concept of industrial symbiosis with the intention of achieving sustainable development even as their fledgling industries emerge. The case of Bhutan is interesting because they have incorporated elements of the Agenda 21 challenges into their constitution and this has been a driving factor in their industrial development. The country currently participates in three partnerships under the UN Commission for Sustainable Development as follows:

- Institutional consolidation for systemic planning and management toward poverty alleviation and environmental conservation in a framework of sustainable regional development in the Hindu Kush, Karakorum, Himalaya mountain complex
- International Partnership for Sustainable Development in Mountain Regions (Mountain Partnership)
- Strategic Partnership Among Benin, Bhutan and Costa Rica for Co-operation on Sustainable Development ( Program for South-south Cooperation)

Bhutan reported in 2004 on their progress toward implementation of National Sustainable Development Strategies. Since 1998, when they created the Bhutanese National Environment Commission, sustainable development has been an integral part of their national planning objectives, tightly linked to their poverty reduction strategy. They also reported that they are working toward the Millennium Development Goals.

Bhutanese industry is enabled by hydropower-generated electricity. This makes them an attractive site for energy intensive industry such as steel production, and they have become an important part of the supply chain for the construction industry in India, their primary trading partner.

This paper is based on an empirical case study to derive recommendations about approaches to future sustainable production in non-OECD lands. The author participated in a research program in 2009-2010 funded by the Danish government with the objectives of promoting use of cleaner technologies and use of environmental management standards.

### **The Assessment, Implementation, and Dissemination of Point – of – Use Water Treatment and Sanitation Systems in Nkokonjeru**

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D.M. Nover  
E.R. McKenzie  
G. Joshi  
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Project design and implementation of water treatment and sanitation technologies in the developing world often overlooks potential pitfalls because: 1) technical experts focus on technologies without considering cultural acceptability and 2) projects lack monitoring, evaluation, accountability, and project revision. Over the past five years, Engineers Without Borders (EWB) at the University of California-Davis (UC Davis) partnered with the Rural Agency for Sustainable Development (RASD), a non-governmental organization in Nkokonjeru, Uganda, to implement sustainable point of use (POU) water and sanitation systems. Four POU water treatment systems (i.e., clay filter pot (Filtron), solar disinfection (SODIS), chlorine treatment (WaterGuard), and colloidal silver (SilverDyne)) and two sanitation systems (i.e. Urine-Diversion toilet and Un-reinforced Concrete Dome slab toilet) were tested and implemented at RASD. While all four

water treatment systems effectively removed pathogens and sanitation systems confined excreted waste, cultural appropriateness and education were the most important drivers of project acceptance.

After a one-year assessment, it was determined that community preference for water treatment system was driven by transparency of treatment method, cost, stigma, and ease of use. Clay pot filters were preferred because of ease of use and physical particle removal capabilities. However, high cost, lack of local production and transportation difficulties dictated that their use was not sustainable. Biosand filters were introduced as an alternative and although originally deemed to be too complicated, they have been accepted by the community. Un-reinforced Concrete Dome slab toilet was preferred over the Urine-Diversion toilet because the structure of the toilet was similar to tradition toilets in the community and the initial cost was lower. Both biosand filters and Un-reinforced Concrete Dome slab toilet have undergone production within the community and are being disseminated throughout the region.

Key partnerships such as, EWB –USA (headquarters) and EWB-Davis, EWB – Davis and UC Davis, EWB – Davis and RASD, were essential for the success of projects. Prior to implementation trip, EWB-Davis was required by EWB – USA to take an assessment trip to establish a relationship with their in county partners and determine the community issues and needs. Upon returning from the assessment trip, the EWB- Davis team was mentored by various faculty, research scientists, and engineers at UC Davis to come with appropriate technologies that could lead to potential solutions. EWB-Davis was required to present their research findings and proposed projects to EWB-USA to assess the sustainability. Agreements in terms of technology expenses, monitoring, evaluation, and accountability was established amongst RASD and EWB-Davis before the implementation of any technology or program. RASD conducted the year long assessment of the implemented technologies mentioned above. The information that RASD collected was critical in determining which technology would be most appropriate for the community. The success of the projects and the healthy partnership amongst EWB-Davis and RASD lead to establishing a working relationship with the Town Council in Nkokonjeru, Uganda and the United States Embassy in Kampala Uganda. Additional projects were created with the Town Council involvement and the US Embassy funded various RASD projects.

## **Examining Barriers to Open Source Appropriate Technology and Innovation through Collaboration with Information and Communication Technologies**

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The urgency to reach the Millennium Development Goals has never been more critical: rising world population, looming climate destabilization, peak oil and resource scarcities are adding serious complications to the prospect of sustainable development in all parts of the world. The full capacity of sustainable development information is largely untapped due to many issues of which poor communication, collaboration, and feedback are among the biggest barriers. Often times, information such as data and design on appropriate technologies, which would be useful to the global community to foster sustainable development is simply not shared. Project details, interviews, surveys, schematics and feedback are used in a target community, but go unpublished. Thus, "wheels are often re-invented", funds, time and expertise are underutilized simply because the knowledge that could have contributed valuable information to another project was not readily available. Fortunately the vast number of today's information and communication technologies (ICTs) offer a potential interface to share, collaborate and build on the ideas and solutions to today's biggest development problems. The Internet provides a massive opportunity to build, exchange and 'open source' information on an unprecedented scale, which holds great promise as a mechanism to achieve improvements in human development everywhere (Benkler, 2006). Advantages brought by open source technologies and ICTs offer palpable opportunities for development agencies worldwide to cut operational costs, increases both efficiency and effectiveness of their projects, engage community feedback and participation, and in general accelerate innovation, collaboration and diffusion. One such examples is the Galaxy Zoo project, which has showcased the potential of collective capacity through the use of personal computers in mapping over sixty million galaxies. This collaborative project initiated by NASA and UC Berkley demonstrated how tasks which would normally require highly trained individuals on full-time salaries can be performed by tens of thousands of volunteers with equal accuracy on a much lower budget (Timmer, 2010). In addition, there are wikis, forums, and groups dedicated to this new collaborative approach for sustainable development, which include: Appropedia, Science For Humanity, Ask Nature, the Open Sustainability Network, Kiva, Global Giving, and the Public Library of Science. Even the World Bank recently open sourced its data catalog with over 2000 indicators from its data sets, made it Google search compatible and available in 37 languages (World Bank, 2011).

Many of the development agencies are working in the field of appropriate technologies (AT). Appropriate technology is defined as such technologies that are easily and economically utilized from readily available resources by local

communities to meet their needs. AT development is an example of sustainable engineering, working within local contexts and designing with end-users in mind. The opportunity to scale up development through better collaboration and inter-linking has not gone unnoticed. Furthermore, organizations are also already recognizing the potential of building searchable databases on technology and projects, setting up interactive portals and linking technology seekers with providers and donors of open source appropriate technology (OSAT) (Buitenhuis, Zelenika & Pearce, 2010). Some of those organizations include Appropedia, Catalytic Communities, Engineering for Change, Kopernik, Practical Action, and Village Earth. While there has been progress there are still significant barriers holding back the development of OSAT. This paper identifies and probes for solutions to these barriers supported by a preliminary study designed to determine social barriers to the collaborative use of open source appropriate technology and how to increase efficiency through collaboration and ICTs.

A series of in-depth interviews were conducted in summer of 2010 to look further into the barriers standing in the way of appropriate technology for sustainable development. The interviewees consisted of academics with field-work experience, appropriate technology organizations, entrepreneurs and development and data activists. In total 17 interviews were completed with 20 participants. The academic researchers included professors from Arizona University, Cooper Union, Hope College, St. Thomas and Western Washington University. Non-Governmental and Not for Profit Organizations participating in the interviews included: American Society of Mechanical Engineers, Appropedia Foundation, Appropriate Technology Collaborative, Appropriate Infrastructure Development Group, Compatible Technology International, International Development Research Center Canada, Kopernik and Practical Action. The research also included feedback from the entrepreneurial sector - AYZH and Digital Green, as well as open data activist David Eaves and development and collaboration activist Vinay Gupta.

The study found that by far the most often identified barrier to the use of appropriate technology for sustainable development is the need for more collaboration with locals, NGOs and universities to share knowledge, feedback and link up those with technologies or know-how, to those who need the technology. The next biggest obstacles were i) the actual processes of technological dissemination, ii) costs of implementation, along with general funding and iii) time constraints. Other barriers included the importance of data and access to pertinent knowledge: iv) preliminary research to determine the appropriateness of given technologies and communities, v) feedback loops with those communities, vi) the importance of culturally robust technology, vi) demand-driven engineering, and vii) solutions with a diverse social and economic benefit.

Congruently, several participants spoke of difficulties in marketing appropriate technologies due to stigma of 'low tech', and the lack of general understanding that even low impact technologies (e.g. toilets, water purifiers, pumps, food grinders, etc.) can have life-changing benefits and have positive impacts on millions of lives.

All of these barriers have their roots in communication or information access and availability. As such, the preliminary analysis of the data strongly indicates that full utilization of ICTs, Internet platforms and open source philosophy could decrease or eliminate these barriers, which in return can expedite sustainable development. The participants were universally supportive of open access and open source and identified the positive potential of i) on-line databases of OSAT, ii) collaboration and iii) the use of open source/ open access software and technology to help cut operating costs and ensure compatibility. With a better collection, transmission and exchange of life-saving data, and with a greater emphasis on innovation through collaboration these results indicate that many existing programs could save the necessary time, funding and labor to increase their efficiency and effectiveness for the global collective good.

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## **Coping with the Resource Degradation Caused by Underuse of the Satoyama Commons in Japan**

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Many studies have demonstrated that the degradation of shared resources or commons occurs due to overuse of those resources by many competitors. In response to the problem, scholars have conducted a substantial amount of empirical research and have developed many theoretical frameworks that address the problem. A lesser-known fact

is that the destruction of resources also occurs when certain types of commons are underused. There is a worrisome lack of empirical research that aims to understand how we can cope with the degradation of underused commons. Our case study on Japan's *satoyama* (economically productive rural landscape) commons shows that the degradation of shared resources may occur due to their underuse or non-use, which happens when there are few competing users and demonstrates that combining market-based instruments and non-market-based instruments can help us cope with the degradation from underuse or non-use of the *satoyama* commons in Japan

In Japan, community-based resource management has been traditionally successful in addressing the degradation of the overuse of the *satoyama* commons when many competing users vie for the resources. However, lately, cases studies of the *satoyama* commons in different parts of Japan have demonstrated high economic growth and rural-to-urban migration, and land-use changes have caused people to leave the *satoyama* commons, creating many changes in community-based resource management. The Sub-Global Assessment (SGA), which followed the approaches of the Millennium Ecosystem Assessment (MEA), has already identified a long list of regionally and globally valuable ecosystem services that the *satoyama* can generate. The key ecosystem services include regulating services (such as flood regulation), provisioning services (such as food safety) and cultural services (such as traditional festivals). However, scholars and practitioners do not yet know how we will manage these commons sustainably, since degradation due to underuse is a new phenomenon. Our study shows that a combination of market-based instruments, such as eco-tourism and organic farming, and non-market-based instruments, such as the formulation of useful institutional arrangements involving interdependent, regional and global stakeholders, can help a region cope with the underuse or non-use of the *satoyama* commons.

### **Green-Energy Cluster Development: Analysis of a Bridging Organization in Worcester, Massachusetts, United States**

Jennie C. Stephens  
Steve McCauley  
Lisa Kwiatkowski  
Jing Zhang  
Mary-Ellen Boyle

The potential of “green jobs” and a “green economy” has caught the attention of many individuals and institutions throughout the world who are striving to create sustainable, long-term economic opportunities for their communities. The envisioned potential involves multiple components revolving around “green energy”, new and emerging energy technologies, and social/cultural change associated with the growth and development of a more sustainable energy system. One focused regional initiative to promote a “green energy” cluster and associated “green jobs” has been developing in Central Massachusetts in the Northeastern USA, where a diverse set of stakeholders, including politicians, universities, businesses, local citizens and activists have embarked on an effort to facilitate the integrated development of an emerging cluster of activity focused on sustainable energy. An intermediary organization named “The Institute for Energy and Sustainability (IES)” created and supported by the state-government with logistical support from two local, private universities has been designed to foster collaboration and communication among various stakeholders in the region with an ultimate goal of developing a green-energy cluster in the region. This research assesses the evolution of this bridging organization from its inception in 2008 until the present through analysis of interviews with key actors. Two Worcester universities, Clark University and Worcester Polytechnic Institute, have been involved in the founding of the IES and have been working with politicians and state-level business and government leaders in the development of this multi-stakeholder university-community initiative focused on stimulating the growth of a clean energy industry in the region. This research analyzes the early phases of development of this organization, with a particular focus on the collaborative and synergistic contributions from three distinct sectors: the public sector, the private sector, and the higher education sector. Initial findings suggest a diversity of perceptions and visions of the potential and the focus of the IES as an intermediary organization, a critical anchor-institution role of the local universities, and some limits to the mechanisms and processes by which IES is engaging and collaborating with a broad constituency.

### **Review of the level and typology of people's participation in Agricultural production cooperatives: A case study of Hamedan province**

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The article analyses the level and typology of different groups of people's participation (PP) in Agricultural production cooperatives. As agricultural cooperatives are the main activity in the rural cooperatives, participation was studied in such projects. Hamedan province was selected as a suitable area for the study since several agricultural cooperatives had been established in this area. The selected cooperatives were including two production cooperative from the province. The level of PP was explored by how much people were involved in the selected case studies. To increase the validity and reliability of finding of the study both qualitative and quantitative methods were used to collect data. The necessary data and information was gathered using several methods of data collection including: survey, direct and participatory observation, documentary review, interview with key participants, and PRA techniques.

In summary, participation had given some opportunity to people to participate in the development of a part of their own cooperatives. Although their participation had not been actively in early stages of project activities such as problem identification and planning and decisions made by special groups of people but a reasonable progress regarding PP has been achieved during the implementation stage though it had been limited in monitoring and control of activities.

### **Sustainable Planning & Development for Grassroots: Lessons Learnt from a Microstudy in India**

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Planning for the development and welfare of its citizens is the most important duty of every nation, be it developing or developed. In fact, planning is not only an essential for poverty alleviation and development, but is acceptably the most effective agent for bringing about sustainable and positive changes in a traditional society.

In almost all nations of the world, plans and programmes for the development of the masses are formulated at macro level, by the administrators, bureaucrats and elite (people who rarely or occasionally have any contact with the people at the grassroots). The chief aim of most developmental plans is to bridge, as much as possible, the gap between the underprivileged, uneducated, rural populace and the educated, aware mainstream of the nation. Despite this, views of people at the micro level are rarely taken into consideration while formulating or implementing schemes meant for their welfare.

It is this fact that leads to the familiar situation where despite colossal amounts of resources being spent in welfare schemes, the desired results are not achieved, since the beneficiaries do not respond positively. In other words, they do not accept the developmental plan or take only a superficial interest in it.

The present paper, based on a micro level study, tries to bring to light the fact that despite being theoretically sound and formulated with the best intentions, ignoring a few basic practicalities can lead to the failure of even the most well planned schemes. To prove the aforesaid, planned developmental schemes in one area, viz. that of education and vocational training, were chosen for evaluation. Primary data, collected via field work has been the base of the paper. Data collection was done through in-depth interviews, discussions and observations on the selected group. The universe selected for the purpose is the Tharu, a tribal community residing in the states of Uttar Pradesh and Uttarakhand, India.

It is expected that through the case study of the Tharu, one will be able to derive valuable insights as to what points should be kept in mind while planning is done by people at the macro level for people at the micro level. It will also bring forth how an anthropologists help and guidance can prove beneficial when sustainable developmental and welfare programmes are being formulated for indigenous groups.

## Confronting Social Equity in Central Puget Sound Transit Station Communities

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Equitable outcomes in community planning can be difficult to achieve when the organizations with the capacity to address such issues are not involved at the outset, decision-making processes do not reach target populations, and organizations with competing cultures and interests have not formed agreements.

This paper analyzes the effectiveness of tools and templates dedicated to social equity as part of a new regional-scale program to establish sustainable transit communities through coordinated agreements between cities, employers, community groups and transit providers. The United States Central Puget Sound region is working to establish a strong commitment to social equity as it pursues a \$15 billion investment in a 52 mile high capacity public transit system. The region was awarded a Sustainable Communities Regional Planning Grant from the United States Department of Housing and Urban Development's Office of Sustainable Housing and Communities.

The grant program will pursue three approaches to design social equity into station area and transit corridor planning; (1) a Regional Equity Network that will mobilize residents and community groups representing diverse populations to participate in local station area and transit corridor planning, (2) an Affordable Housing Action Strategy that involves low-income housing organizations in partnering with cities to secure funding, confront legal constraints, and form policies that encourage and facilitate a wide variety of housing choices along the transit corridors, and (3) localized demonstration projects that exhibit these new commitments and serve as templates for future sustainable development activities.

The paper evaluates how equity has been utilized to define project objectives and the adjustments to organizational cultures and decision-making processes that have been necessary. These work elements are assessed against previous studies that discuss social capital as a component of local planning (Florida, 2002; Putnam & Feldstein, 2003; Wheeler, 2000), the integration of social initiatives into growth management planning and sustainable development (Beatley, 2000; Blackwell, 2002; Budd et al., 2008; Cuthill, 2010; Jepson, 2004), and the barriers to implementation for sustainable housing in targeted urban areas (Winston, 2010).

## Institutional entrepreneurship and eco-innovation in agricultural production

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Escalating climate change calls for innovations to reduce emissions of greenhouse gases (IPCC, 2007). Innovation in agricultural production is particularly important for two reasons: agriculture represents almost 25 % of GHG emissions globally (IPCC, 2007) and an increasing global population stresses the challenge of producing more food while at the same time reducing emissions (FAO, 2009). Thus, there is a need for eco-innovations in products, processes and technology to reach sustainable agriculture (Rennings, 2000; Halila and Hörte, 2006). For the development of such innovations, environmental policy has an important role to play (Kemp, 1997; Porter and van der Linde, 1995; Norberg-Bohm, 1999).

This makes it relevant to analyze the policy process within the agricultural sector. Here, Sweden provides an important empirical setting since the government has set a goal for a 40 % reduction of emissions from non-trading sectors (which includes agriculture) for 2020 (Swedish Government, 2009). Previous inquiries into eco-innovations point to the difference between radical and incremental innovations in production practices, products and technology and the concern that incremental innovations are insufficient to meet global environmental challenges (Hellström, 2007). From this perspective, radical changes in practices are needed. Institutional entrepreneurship research contributes to understanding how such radical changes may come about (Greenwood and Hinings, 1996; Hardy and Maguire, 2008; Battilana, Boxenbaum and Leca, 2009) but also how these attempts are sometimes constrained by rules, norms and beliefs (Holm, 1995; Seo and Creed, 2002). In the agricultural policy process, such constraints may consist in the prevailing regulative regime – e.g. the EU-CAP – but also of beliefs and norms concerning policy-making as such. This raises the question of what the scope for radical policy is and what the challenges consist of.

The purpose is therefore to explore the institutional entrepreneurship of policy-makers in the Swedish agricultural sector aiming for sustainable agriculture through eco-innovations.

The purpose is addressed through a case study of how actors within the national agricultural policy-making process address the issue of GHG reduction. A project led by the Swedish Board of Agriculture (SBA) was followed using qualitative interviews with policy-makers and representatives of various stakeholders involved. The project had the

purpose to develop strategies for reducing GHG emissions from agricultural production which included ideas of new products, new technology as well as changes in current practices. Qualitative methods were applied to allow for the participants to reflect freely upon the process and how they perceived the issues, thus revealing beliefs held and norms exposed. In total over twenty interviews were carried out with respondents from the SBA, the Ministry of Agriculture, research experts, farmer trade unions and environmental organizations.

Questions focused on how eco-innovation ideas had evolved, i.e. the discussions and investigations that these had gone through during the project. The analysis focused on interpreting what type of change the ideas represented and understanding how rules, norms and beliefs had affected the process that each idea had gone through.

The preliminary findings echo previous inquiries into institutional entrepreneurship revealing the contested nature of these activities (Hoffman, 1999; Levy and Scully, 2007). The SBA representatives are themselves in conflict over the issue, on the one hand believing that climate change is a fatal concern for mankind, while on the other hand being normatively committed to strengthen the competitiveness of the domestic agricultural sector. In addition, the SBA representatives do not know how and if the 40 % reduction goal for non-trading sectors will be implemented in this particular sector. Thus there is no clear goal on how much emissions are supposed to be reduced.

This ambiguousness could provide a scope for suggesting rather radical eco-innovations and respondents frequently site reports and research calling for radical changes (cf. Rockstrom et al., 2009). But it seems that the institutional context embedding the project works against such ideas. The norms regarding a legitimate policy suggestion, i.e. that it should show with low degrees of uncertainty the achieved reduction in emissions as well as what the price tag is, favors changes in well explored areas. Suggestions that are less explored raise more concerns and criticism – particularly from researchers participating through the advisory board. This creates a path-dependency in the process where project members find it easier to suggest the continuation of already applied strategies rather than new ones. Further, ideas that imply more consequences – such as changes in interrelated practices – entail more uncertainty and are therefore subject to criticism. Incremental changes within existing production systems are therefore advocated rather than changes that target the system as such. Increased resource efficiency is seen as the way forward despite simultaneous discussions of the future need for changes in the whole production system, e.g. to drastically reduce the reliance on industrially produced nitrogen (cf. Rockstrom et al, 2009).

The consequence is that eco-innovation ideas that are more radical, i.e. implying greater changes in production practices, are dropped or postponed until further researched whereas more incremental changes are advocated. This makes it difficult to come up with new eco-innovations that target the agricultural emissions sources identified as the main problems – such as N<sub>2</sub>O emissions from arable land, CH<sub>4</sub> emissions from ruminant cattle or CO<sub>2</sub> emissions from organogenic soils (IPCC, 2007). Instead it is suggested to increase the production of bioenergy from the sector which reduces emissions occurring in the energy sector.

Status hierarchies also seem to be important among the involved stakeholders. The arguments of scientists are awarded greater legitimacy than those of either project staff or environmental groups. These experts depart from the eco-efficiency paradigm understanding increased resource-efficiency as the best way to reduce emissions. This is reflected in the set up of the project where experts are involved directly through an advisory board whereas environmental groups make their comments through referral rounds occurring later in the process. Thus it becomes easier to ignore the suggestions and criticism from this latter group of stakeholders. In the case study this is exemplified through a struggle over whether organic farming can be understood as an eco-innovation that reduces GHG emissions.

This points to the existence of two interlinked sets of institutional elements framing the process – one concerning what a legitimate eco-innovation policy is and one concerning whose arguments is legitimate enough to affect eco-innovation suggestions.

The case thus illustrates some of the difficulties in developing radical eco-innovations, i.e. institutional entrepreneurship, and raises concern over the possibility of policy to forcefully address the escalating problems of climate change.

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