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IHDP UPDATE

Urbanization and Global Environmental Change – An Exciting Research Challenge

Carbon Management and Clean Air: Opportunities in Urbanization to Link Research, Policy and Practice

By Louis Lebel, Antonio Contreras, Po Garden, Rodel Lasco, A.P. Mitra, Nguyen Hoang Tri, Ooi Giok-ling, and Agus Sari.

1. Opportunities

Urbanization in developing parts of South- and East-Asia is frequently portrayed as a process run out of control that drives environmental harms and social injustices. The juxtaposition of glass-fronted hotels and banks and the drab apartments and informal settlements in Jakarta, Delhi or Manila underline both inequities and opportunities. A stream of suits winding unconcerned through piles of plastic bags and scraps, picks at delicacies made on the banks by the unsuited. In the vacant lot behind the shop-front in Chiang Mai or Ho Chi Minh City we glimpse a vegetable garden, a cow grazing, and a flooded paddy with new shoots. Streets clogged with SUVs (Sports Utility Vehicles) and motorcycles pass people pushing wheelbarrows, pedalling bicycles and taxi-tricycles.

These are reminders that cities have sprung out from rural towns in very short time, often without much planning or restrictions on land-use. Self-organizing processes driven by land markets, speculation and innovative and adaptive entrepreneurs have shaped urban forms and functions. Air and water pollution problems have been accidental side-effects of growth. The pursuit of urban services has not been strongly pre-determined to particular means and ways, the point has been to get there. The contrasts are also a reminder against simple "urban-rural" dichotomies. Urbanization doesn't just make urban areas, but through it people re-define what urban is and where its interfaces lie with "other".

Urbanization provides opportunities to explore different ways of meeting people's needs and aspirations for comfortable shelter, mobility, good health and diet, diverse leisure activities, and meaningful work (1, 2). These alternative ways can have huge implications for emissions critical to health like NO_x, SO_2, VOC and PM, as well as greenhouse gases CO_2 and CH_4. High densities, compact urban forms and mass transit systems linking nodes, for example, can both reduce fossil-fuel use in daily commutes to and from work or school, but also help shape peri-urban residential and commercial development. Energy efficient housing and workplace designs and urban layouts with green spaces that are conducive to non-motorized local traffic can make life more convenient and comfortable without wasting energy on re-controlling climate. Industries located in urban and peri-urban areas through regulations and public pressure must be low emitters. It is probably in the newly urbanizing regions where efforts to shape urban form, function and people's daily behaviour through guiding infrastructure and public services can make the largest contributions to de-coupling growth in emissions from social development.

Photo by Vincent Kitio

Growing awareness of the importance of urban activities and environments has led to investments in monitoring, making inventories, building models and carrying out impact studies and assessments. Municipalities, local area government authorities and schools are learning about air

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Dear Readers of IHDP UPDATE,

You may have noticed that the present issue of IHDP's Newsletter looks somewhat different from what you've known so far. In fact, the International Human Dimensions Programme on Global Environmental Change is moving onto new horizons, challenges and accomplishments. At its 13th Annual Session (Norwich, UK, 27-30 March 2006), the Scientific Committee (SC), IHDP's governing body, has taken far reaching decisions for the programme's next decade. Indeed, after a successful period of consolidation, network building and production of high-quality science since 1996, IHDP is now looking forward to its phase II, a phase of implementation.

The SC wishes to dedicate this forthcoming decade in particular to three endeavors: (i) delivery of high-quality science on Human Dimensions of Global Environmental Change to practitioners from international, governmental and non-governmental entities; (ii) strengthening our capacity building and regional activities; and (iii) reaching out to the sustainable development community and agenda.

While the vertical and horizontal growth of our networks as well as their production and communication of state-of-the-art science will certainly continue, the three named goals will set the path for IHDP's near future – along with a broadened basis of partners, new cooperation models with other organizations, and a strengthened IHDP Secretariat. A new Strategic Plan 2007-2015 will be elaborated in the upcoming months to encompass all above mentioned aspects and goals.

It goes without saying that IHDP's crown jewels have been and will be the programme's core projects. We are therefore proud to present IHDP's most recent "baby", Urbanization and Global Environmental Change (UGEC), in this UPDATE. I wish all of you Happy and informative reading!

Best wishes,

Dr. Andreas Rechkemmer
Executive Director

pollution, making measurements and making demands. Cities are linking with each other, independently of national governments, to share ideas on how to reduce emissions.

It is conventional to assume that in urban environmental management, innovation comes from scientific research and capacity from training and experience. Scientific findings are seen to flow, almost inevitably, from a community of researchers to those in policy and practice. Models and decision-support tools are on-hand to help with communication, understanding and exploring options, in short to help science link to policy and practice.

Our preliminary studies of how scientific information about urbanization and its impacts on air quality and the global carbon cycle is being used in several urbanizing regions in Asia raises questions about this conventional view of science, policy and practice. How are these diverse activities changing the way knowledge is produced, shared and used? Are societies getting better at effectively linking knowledge and actions to improve air quality and reduce emissions growth?

In the rest of this essay we summarize preliminary findings of questions posed by the Global Carbon Project (3) and IHDP Urbanization and Global Environmental Change Project (4) to reflect more deeply on how scientific research could contribute to sustainability, in particular, with respect to moderating growth in harmful emissions. The ideas presented here are based largely on collaborative work by the U-TURN (Urban transformation and urbanization research network) in Thailand (Chiang Mai), Vietnam (Ho Chi Minh), Indonesia (Jakarta), India (Delhi) and the Philippines (Manila) (5).

2. Innovation, Capacity and Will

The creation of new knowledge, the capacity to understand and act on existing knowledge, and the willingness to learn from those efforts can each be made easier (or harder) by the way societies organize relationships between science, policy and practice.

Research and action agendas remain narrowly focused on "end-of-the-pipe" solutions. They improve techniques for capturing emissions, removing pollutants from fuels, and designing more efficient engines to run on better designed roads. But people buy bigger cars and travel further. Alternative ways of servicing or altering mobility needs are not explored. Urban form has not often been an explicit focus of trying to control vehicle emissions, but comparative evidence growingly points to the importance of compact urban forms that help reduce trip lengths and frequencies.

New knowledge may not be taken up by policy or practice because its relevance is not understood. The capacity of national and municipal agencies to assimilate and understand technical information about air quality and management options is often limited. Administrative fragmentation can separate expertise that should be integrated, for

example, with respect to land-use, transport and energy planning. Usually some intermediate organization is needed to help translate research into actionable information and policy needs into researchable questions.

Even if understood, the results of models, inventories and impact studies may not be trusted, especially when conducted by groups of different interests than those whose behaviour is targeted for change. The synergies and trade-offs in reducing emissions with local, regional and global impacts are not sufficiently acknowledged in either research or policy. Rather, groups with interests and agendas associated with one class of emissions argue for the importance of research or initiatives at that scale without considering interactions with other levels. This makes legitimacy hard to achieve. Dialogue and communication are important. In Jakarta, the non-governmental organization PELANGI and the Swiss Foundation for Technical Cooperation have played a valuable facilitation role in bringing air quality and transport issues onto public policy agendas. This eventually led to the successful introduction, for example, of dedicated bus lanes.

Public interest litigation through the Supreme Court of India has been crucial for shifts to compressed natural gas as well as unleaded petroleum actions that helped address air quality problems in New Delhi (6). More recently, the judiciary has been pro-active in ordering large scale demolitions of building structures and sealing premises that violate provisions of the New Delhi Master Plan.

Technical assistance activities that attempt to bring knowledge into policies and practices are relatively commonplace in the transport sector but far less obvious when it comes to other lifestyle and consumption issues. Building designs have major implications for emissions associated with, first, the manufacture of steel and concrete and, second, energy for the buildings' continued use as comfortable places to live and work in. Changes in both production and consumption matter. Rock and Angel (7), for example, describe how a large Thai firm, Siam Cement, has in many ways leapfrogged other similar firms in the industrialized world through actively pursuing new, cleaner technologies that have ultimately strengthened the knowledge and skills of their workforce.

Urban governments and research groups struggle with monitoring and evaluation. As a consequence, important opportunities for social learning by both researchers and practitioners have been missed. This is not to claim that informed and effective policies, regulations and laws have not been introduced. They have, but rather to underline that institutional arrangements which consistently and effectively link knowledge with action have not yet emerged in these cities. The conventional linear view of science, policy and practice, in which good research becomes policy then practice, is no longer tenable. In addressing urban air quality and carbon management problems, improved linkages between science, policy and practice

EDITORIAL

The connections and interactions between urbanization and global environmental change are increasingly intertwined and complex. Global environmental changes affect and are affected by most urban processes. Despite their growing importance, urban areas have been understudied in the analysis of global environmental change. Much less attention has been devoted to the study of the impacts of global environmental change on urban areas and the people who live in them. The new IHDP core project on Urbanization and Global Environmental Change (UGEC) seeks to fill this gap. Its goal is to develop a better understanding of the interactions and feedbacks between global environmental change and urbanization at local, regional, and global scales. The project is organized under four main themes: 1) Urban process that contribute to global environmental change; 2) Pathways through which global environmental change affects the urban system; 3) Interactions and responses within the urban system to global environmental change; and 4) Consequences of changes within the urban system on global environmental change. Recognizing that solutions to urbanization and global environmental change problems will require an interdisciplinary framework that includes a range of perspectives and participants, the project emphasizes the interaction and engagement of practitioner and research communities at different scales.

This issue of the IHDP UPDATE highlights research from UGEC, and the authors span the range of government officials, NGOs, and academia. The articles cover a breadth of geographic scales, from the global to the local. One theme of the articles underscores the need to understand urban form, urban growth patterns, and urban growth dynamics. Authors also agree on the importance of scientific research in contributing to sustainability, and the critical linkages among research, policy, and practice.

UGEC is seeking to develop regional and thematic networks of scholars and practitioners, and encourages international participation from researchers focused across a broad range of spatial scales, from local to the national, regional, and global. We are particularly keen to encourage energetic and innovative scholars from different parts of the world who would actively participate in UGEC (e.g., direct involvement in workshops, research projects and publications, establishment of regional and thematic networks, interfacing with the SSC).

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won't happen on its own, but rather will require institutional initiatives. The IHDP Urbanization and Global Environmental Change project (4) needs to address the links between urban science and policy, not only as a communication problem, but as interfaces amenable to policy-relevant and action-oriented research.

3. Knowledge and Action

Urbanization is a key collection of processes driving local and regional environmental changes. In the future these will intersect with, and be confounded by, global environmental changes (4). Most of the initiatives on urban air quality and greenhouse gas emissions have looked at ways to take off the shelf knowledge, in particular about fuels and emission control technologies and get these to be fitted and used effectively. There are some simple ways to help reduce emissions growth on this route, but they remain first steps. More radical initiatives are often needed to counter the growth in sheer number of point sources, for example, from rise in personal vehicle ownership and patterns of use.

Our understanding of other key issues in linking knowledge with action is modest. For instance, there is a need to integrate understanding of cultural, behavioural, and institutional issues with the existing emphasis on inventorying greenhouse gases and other even more immediately important atmospheric pollutants. Studies of households and communities that voluntarily shift to low-carbon lifestyles are needed. The critical matched comparisons between equivalent groups in urbanized and non-urbanized settings have not really been made – yet they need to be made. The issue of re-location and inter-city interactions through production-consumption relations must be addressed otherwise we risk de-carbonizing development in i.e. Tokyo at the expense of Jakarta (8).

But what this essay has argued is that this is not enough. We also need to view the interaction of science, policy and practice as a subject of study in its own right (9). We need to get a much better understanding of: Who and how are priorities for urban emissions research set? How is information shared? Are there any key individuals or organizations that "manage" the boundaries between science and policy with respect to air pollution? Whose knowledge is used in designing air quality control measures? Are institutional and other policy interventions treated as experiments and monitored and evaluated for their effectiveness?

Urbanization creates opportunities to simultaneously address the multi-scale challenges posed by emissions growth. Effective mobilization and action will ultimately benefit from a more nuanced perspective of how science, policy and practice interact.

References:
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Urban Landscape Patterns and Global Environmental Change: Complex Dynamics and Emergent Properties

By Marina Alberti, Charles Redman, Jianguo Wu, John Marzluff, Mark Handcock, John M. Anderies, Paul Waddell, Dieter Fox, Henry Kautz, and Jeff Hepinstall

The future of Earth ecosystems is increasingly influenced by the pace and patterns of urbanization. Cities are growing rapidly worldwide. At an average annual growth rate of 1.8 per cent, by the year 2030, approximately 61% (5 billion) of the estimated world population (8.2 billion) will live in cities: 57.1 percent of the population of developing countries (4.0 billion) and 81.7 percent of that of the developed countries (1.0 billion) (UN 2003). Already 4 percent of land area is occupied by urban and built-up areas--more than 471 million ha--and this is expected to increase at even a greater pace due to suburban sprawl particularly in North America and Europe (WRI 2000). Urbanization significantly influences ecosystem function (Grimm et al., 2000; Alberti et al 2003) through increased fragmentation and degradation of natural habitats (Marzluff, 2001), vast simplification of species composition (Blair, 1996), large disruption of hydrological systems (Booth and Jackson, 1997), and drastic modifications in energy flow and nutrient cycling (Vitousek et al., 1997; Grimm et al., 2000). Changes in ecological conditions that result from these actions affect the quality of the urban and global environment and, ultimately, people's health and wellbeing.

Important progress has been made in studying interactions between human and ecological systems (Grimm et al., 2000, Pickett et al., 2001, Alberti et al 2003). Yet we are just beginning to understand the interactions between patterns and processes in human dominated landscapes. In particular we do not know how local interactions of human and biophysical processes affect the landscape patterns of metropolitan regions. While many competing models have addressed the relationship between urbanization and ecosystem function (Grimm et al., 2000; Pickett et al., 2001), few have asked questions to directly address how human and ecological patterns emerge from these interactions. Nor have they investigated how these patterns control the distribution of energy, materials, and organisms in human-dominated ecosystems at the local and global scale.

Urban Landscape Patterns as Emergent Phenomena

A new research project at the University of Washington (UW) and Arizona State University (ASU) funded by NSF as part of the Biocomplexity Program investigates the complex coupled human-natural system dynamics of Seattle and Phoenix metropolitan areas. The study aims to empirically test hypotheses about how the interactions of human agents, real estate markets, built infrastructure, and biophysical factors drive current patterns of development and how these patterns affect human and ecological function in these two different bioregions. The study employs a pattern-oriented hierarchical approach to model how complex agent-based interactions generate landscape patterns at multiple temporal and scales. This research addresses four questions: 1) How do dynamic landscape systems evolve to generate emergent patterns that we see in urban landscapes? 2) What nonlinearities, thresholds, discontinuities, and path dependencies explain divergent trajectories of urban landscapes? 3) How do emergent urban landscape patterns influence biodiversity and ecosystem functioning? and 4) How can planning integrate this knowledge to develop sustainable urban landscape patterns? The model implementation will be based on a dynamic probabilistic relational model (DPRM) in which parameters and spatial rules are estimated empirically from two longitudinal land cover and land use data sets developed for the Seattle and Phoenix Metropolitan Areas.

Modeling Complex Urban Landscapes

Ongoing research in Seattle and Phoenix has shown complex dynamics of urban landscapes. An essential aspect of complex systems is nonlinearity, which leads to multiple states (Levin, 1998). Urbanizing regions have multiple steady and unstable states. The state of an urban ecosystem is driven between natural and sprawl states by the amount and pattern of urbanization (Figure 1).

Urban sprawl leads to the shift from a natural steady state of abundant and well-connected natural land cover to a second steady state of greatly reduced and highly fragmented natural land cover (Alberti and Marzluff 2004). The natural "steady" state of natural land cover depends on natural disturbance regimes. The sprawl state is a forced equilibrium that relies on incomplete account of the ecological costs of providing human services to suburban development. The sprawl state is characterized by a low density urban pattern, highly fragmented landscape, increasing substitution of ecological functions with human functions and highly reduced capacity of ecological functions to support human functions.

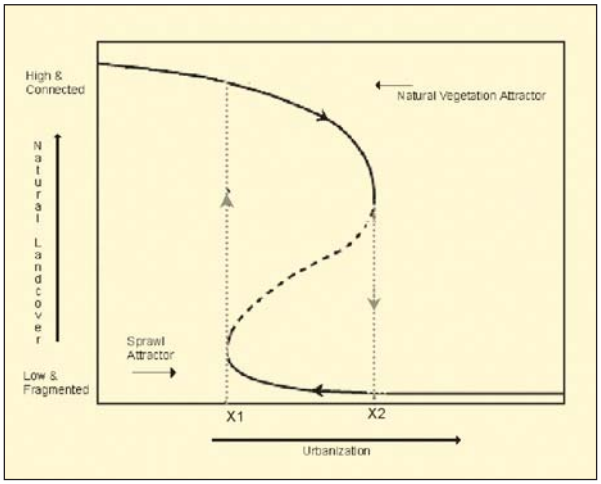

Figure 1. Multiple Equilibria in Urban Landscapes (From Alberti and Marzluff 2004)

We hypothesize that similarly to other ecosystems described by Scheffer et al. (2001), in urban ecosystems, changes from one state (characterized by a set of processes) to another (characterized by a new set of processes) can be triggered either by the action of slowly changing variables or by relatively discrete shocks. For example, the ecological condition of an urban stream can change from good to poor as a result of incremental loss or degradation of riparian vegetation, or by substantially paving the drainage basin as a result of a large development or built infrastructure or by the both of these changes acting simultaneously. On the long term, what controls the ability of an urban ecosystem to support both its ecological and human function can be affected by slow changing variables (i.e. climate change) or discrete shocks (i.e. hurricane Katrina) that can force the system over a threshold.

We also hypothesize that urban landscapes are spatially nested hierarchies in which the hierarchical levels correspond to structural and functional units (Wu and David 2002). Using a hierarchical modeling approach we aim to identify the structural and functional units at distinct spatial and temporal scales of human and biophysical processes and specify the agents and rates of processes that characterize and distinguish the levels in the hierarchy. The hierarchical patch dynamics perspective emphasizes both the vertical structure (linkages between scales or organizational levels) and horizontal structure (spatial patterns) of the urban landscapes (Wu and David 2002). This perspective allows for a more realistic representation of the relationships among patterns, processes, and scales that lead to emergent properties of heterogeneous urban landscapes.

The study proposes to apply a dynamic probabilistic relational model (DPRM) approach as proposed by Sanghai et al. (2003) to represent a heterogeneous and hierarchically structured domain such as the urban landscape. While first order Markov models have been widely used in data mining, most are limited because they assume stationarity of transitions, do not include spatial and temporal dependencies and cannot represent multiple state classes that exist in most real-world domains (Anderson et al. 2002). DPRMs extend Hidden Markov models by imposing a hierarchical, relational structure on the set of states.

The overarching goal of this project is to develop a better understanding of complex human-ecological dynamics leading to urban development patterns such as sprawl, one of the most pressing and controversial problem. This knowledge is essential to aid planning and management of urban regions in the two urban metropolitan areas. The findings will also aid by providing simulation tools to assess the ecological impacts and feedback of alternative strategies for urban development and ecological conservation.

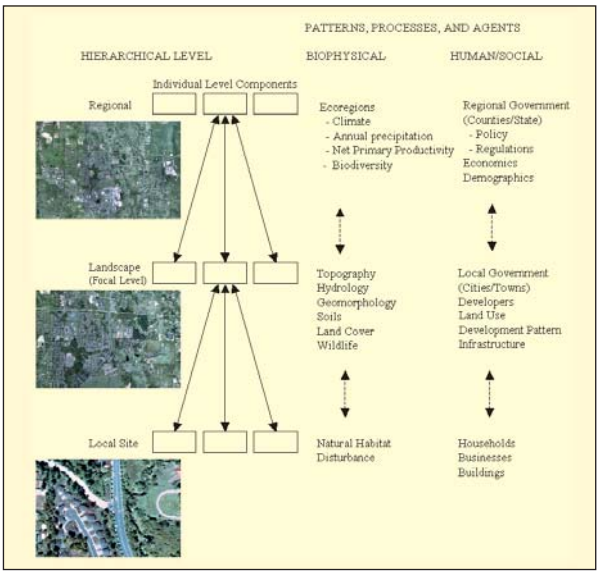

Figure 2. Conceptual Model of Urban Landscape Dynamics: conceptualization of the hierarchical relationships between biophysical and human patterns, processes, agents at three levels of spatial hierarchies (Based on Wu and David 2002)

Acknowledgments

This article is based on the biocomplexity project description BE/CNH: Urban Landscape Patterns: Complex Dynamics and Emergent Properties (Alberti PI: BCS 0508002). The project is a joint effort by the UW Urban Ecology Research Lab (www.urbaneco.washington.edu) and the ASU Global Institute of Sustainability (http://sustainable.asu.edu/gios/). Other research associates and assistants at the Urban Ecology Research Lab involved in the project include: Stefan Coe, Debashis Mondal, David Hsu, Dave Oleyar, Andrew Bjorn, and Karis Puruncajas.

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Urban Modeling, Global Environmental Change, and Policymaking in Developing-World Cities

By Michail Fragkias

1. Introduction

Scientists have been trying to understand the evolution of urban-ecological systems, connecting the process of urban land-use change – and its socioeconomic and biophysical drivers – to ecological functions and vice versa. At the same time, calls for sustainable development have increased the pressure on policymakers in the developing world to improve decision-making capacities regarding land-use, transportation and environmental policies (Boulanger and Bréchet, 2005). In order to sustainably cope with the high urban population growth projected for at least the next 25 years (United Nations, 2004), the assessment of environmental (and socioeconomic) impacts of urban policies through quantitative (science- and policy-oriented) models is required. Medium-sized cities of developing countries – expected to attract the majority of the projected growth (IHDP, 2005) – face a scarcity in human, technological and financial resources employed in various levels of land-use policymaking; the collection of reliable data and the use of more advanced quantitative methods in planning practice and policymaking thus becomes difficult or impossible. Given the number and underlying motives of different approaches to modeling and their current emphasis on western-world cities, policymakers of developing world cities face hard choices regarding alternative modeling approaches. This article is an initial exploration into the mechanics of increased policy relevance of research conducted across the four Themes of the Urbanization project. The article also looks at the criteria that need to be evaluated before selecting a modeling approach adequate for multifaceted policy-making at the urbanization and environment interface.

2. Focus on Developing World Cities

Developing nations are faced with projections of rapid urbanization (United Nations, 2004). Between 2000-30, developed countries will contribute only approximately 12% of their current urban population to the increase of global urban population. Urban areas of the less developed countries will absorb nearly all growth of the world's total population. By 2030, Asia and Africa will each have more urban dwellers than any other major area, with Asia alone accounting for over half of the urban population of the world (which now is one of the least urbanized regions in the world). 20 out of the 25 highest estimated average annual urban population rates of change between 2000-30 are projected for African nations (UN, 2004). Countries with significantly high existing urban population in the turn of the century (above 10 million urban residents) and around or higher than average (2.3%) estimated annual urban population rate of change for that period include (ranked in descending order) Ethiopia, D. R. of the Congo, Pakistan, Bangladesh, Nigeria, Vietnam, Indonesia, Saudi Arabia, India, Egypt, Philippines and China (Figure).

While estimates regarding the growth of urban population are available, we do not know how they will compare to the extent, rate of growth and the pattern of physical urban growth. Assuming similar urban expansion patterns to those experienced to date, the amount of urban land could double or easily more than double (Seto and Fragkias. 2005). The comparative importance of extent, rate of change or pattern within the urbanization and global environmental change framework is great; distinct spatial manifestations of urban growth have the capacity to drive the occurrence and intensity of environmental effects. From a population perspective, negative environmental effects of city size could theoretically be balanced by increased capacity in the abatement of these negative effects; rates of change of urban population do not seem solely correlated with environmental problems. From an urban development perspective, all three are important while pattern – a priority for the Urbanization project – appears to be more significant and less understood. Unfortunately, documentation of environmental problems in developing world cities is scarce, with less information provided the smaller the size of the city (United Nations, 2001).

3. Models for Science and Policymaking

Quantitative research at the interface of Themes 1 and 2* of the Urbanization core project is being actively pursued within several scientific disciplines: Earth observation/remote sensing science, land-use change science, urban economics/politics/geography and urban ecology. These fields are still disconnected (although the first

* Theme 1: Urban processes that contribute to global environmental change
Theme 2: Pathways through which global environmental change affects the urban system

informs the others through the identification of evolution of urban morphology and the trajectory of land-use patterns for the study of urban growth). Considerable progress in modeling was achieved by the LUCC project with the identification of intertwined biophysical, socioeconomic and political processes at different scales affecting land-use change. Within urban ecology, urban land-use change is seen to affect biodiversity, net primary productivity, nutrient and material cycling and disturbance regimes; we do not yet have a lot of evidence on the spatially explicit impact of urban spatial structure – form and density – on the environment and ecosystem function (Alberti, 2005). Landscape ecology models and metrics have been developed and are increasingly being used for the spatially explicit monitoring of urban and peri-urban ecosystems (Seto and Fragkias, 2005). Understanding the mechanisms connecting socioeconomic and political environments, urban form and ecology can provide policy insight for policy makers towards sustainable – or minimum impact – cities.

Research-oriented models may not necessarily be the most appropriate tools for policymaking which requires a more integrated approach and leads to a different end product. Research-oriented models inform policy models, but the latter are at times simpler implementations of the former. They also are not designed to provide definitive quantitative answers while a clear quantitative output is often the desired product of a policy-oriented model. Policy-oriented models focus on their predictive function (not merely as a test of their validity but as their capacity to prescribe policy); they do not, as a rule, target a high depth of causation knowledge, although some could compete on the grounding in theory with research models. Also, policy-oriented models are typically less innovative and employ well-tested methodologies. They are designed so that the producer of the model is not necessarily the user of the model.

Plenty state-of-the-art integrated (large-scale) urban models exist that attempt to fill the gap between science and policymaking, functioning as planning support systems. It is remarkable that, overwhelmingly, their regional focus has been western-world cities. Usually the integration signifies the synthesis of land-use, transportation and environmental components into a single dynamic framework. Since several competing subcomponents exist or can be developed for integrated models, different choices for integration results in models of different flavors, such as UrbanSim (Waddell, 2002), MODULUS (Engelen et al., 2000), CURBA (Landis, 2001), and What If? (Klosterman, 2001) among many.

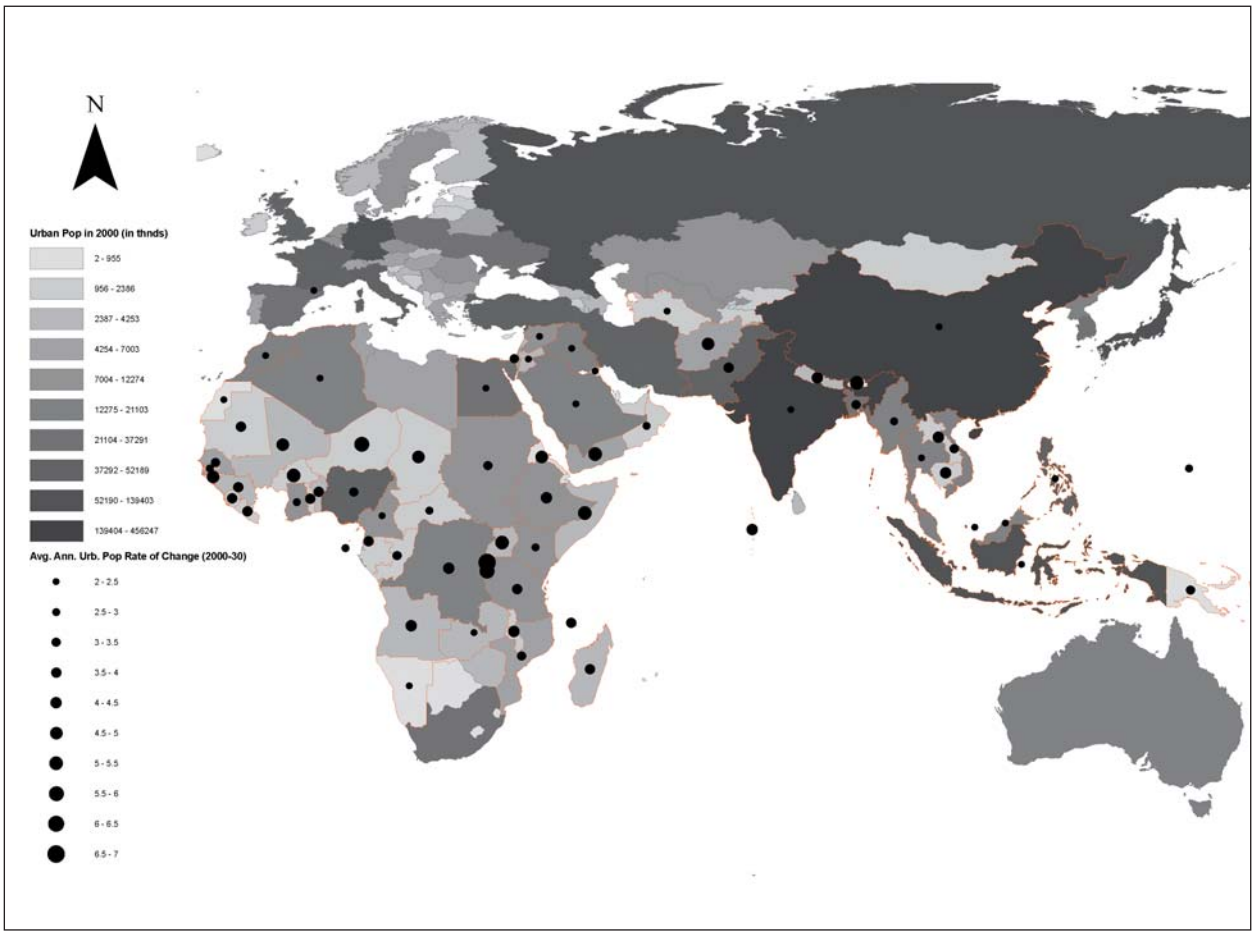

Figure. Countries in Africa and Asia with above average expected urban population rate of change (in percent) between 2000-30 – in red administrative boundaries – and their 2000 urban population levels (in thousands)

While almost exclusively applied in developed world settings, the tiny minority applied in the developing world has focused on mega-cities or near future mega-cities. The research community will have to explore whether available integrated models are feasible and can address policymaking issues in developing world cities. Realistically, due to problematic data collection and availability in developing world nations, the application of current models could encounter significant problems. The question should be answered on a case-by-case basis considering the variation of resources available per geographical region.

4. Criteria for Modeling Choices

A policymaker faces dilemmas and tradeoffs in the choice of suitable context-specific modeling tools. Efforts to operationalize a new urbanization and global environmental change conceptual framework targeting policymaking should follow known criteria established in the past for operational sustainable development models. Assuming that environmental concerns are integrated in the modeling approach, choice can be assisted by the evaluation of criteria on the multi- and inter-disciplinary potential, a longer-term (intergenerational) focus, uncertainty management, capacity to handle local vs. global or intra- vs. inter-metropolitan scales and the centrality or active participation of the policymaker (Boulanger and Bréchet, 2005).

The research community should consider four additional criteria that can specifically target the application in developing world environments: downward scalability, hybridity, feedback mechanisms and open-source architecture. Scalability is usually defined as the ease with which a system can be modified to fit the problem area and is associated with the idea of modularity. A potentially useful feature of integrated (large-scale) urban models adaptable to developing world settings is downward scalability. A highly-applicable model should be able to work around missing information through a modular structure that would not only allow for missing peripheral components but also alternative core and peripheral components (adjusting for the fact that different regions have different environmental priorities). This can be achieved by a capacity for interchangeability of simple (less data intensive) and complex components (given that the output can be adapted accordingly for use in other components). Due to the variety and combination of ecosystem types around the world, non-modular integrated models would suffer limitations. A way to measure the sensitivity of results to this process should also be established, since the model could lose accuracy in simpler forms.

Hybridity suggests that no single modeling methodology can capture all aspects of the spatiotemporal data generating process. As LUCC research has shown, the relatively recent incorporation of agent-based methods in land-use change modeling, for example, allows capturing complex and emergent phenomena that other methods cannot; such methods are also expected to eventually lead to more accurate simultaneous prediction of pattern and location of urban growth. Feedback mechanism modeling is also very important for an integrated approach that crosscuts Themes 1 and 2 of the Urbanization project. Feedback mechanisms are characteristics of dynamic models that can also address more widely chaotic behavior, threshold effects and path-dependence. One can easily imagine a continuous loop of feedback from the landscape ecology to the urban economy and land-use system (e.g. the effects of land-use pattern – such as open spaces – on urban spatial structure that further shapes land-use pattern through a price mechanism). Additional important criteria include the degree of spatial explicitness and the validation of results – especially, validation of urban form/pattern e.g. through spatial landscape metrics. An open-source architecture signifies access, right to alteration and free distribution of the source code of a system's implementation. It is highly desirable from an academic (due to the unhindered access to scientific progress) and a resource-strained developing world standpoint. A good example of open-source architecture is the – data intensive – planned Open Platform for Urban Simulation (Waddell et al, 2005).

The delineation of applied frameworks for policymaking through the IHDP Urbanization and Global Environmental Change Project could significantly impact the evolution of global ecological-urban systems in developing-world cities. But what should some early priorities for the project be? Firstly, ecologically and environmentally sensitive hotspots of urbanization in developing-world cities should be clearly identified and an emphasis should be placed on the collection of missing data. The project's research goals could be advanced by the organization of a workshop that assesses availability and gaps and prioritizes needs for data per geographical region. Secondly, the community should evaluate models targeting policymaking with the understanding of the varying degree of their applicability depending on the region and size of the city. Developers of policy-relevant models should also be convinced of the need to create adequate models for a developing world city setting and the introduction of downward scalability in their models. Finally, digesting lessons learned by other core projects (such as the LUCC project) and close contact with new projects (such as the Global Land project) is also desirable.

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Global Cities and Local Vulnerabilities

By Robin M. Leichenko and William D. Solecki

The vulnerability of cities and urban systems to global environmental change is a critical area of interest within the IHDP's Urbanization and Global Environmental Change Project. In this essay we explore how another major process of global change, namely globalization, is contributing to urban vulnerability to global environmental change hazards. We argue that globalization-related changes in urban spatial structure have brought a sharpening in the urban riskscape and in the differential level of household exposure to hazards and extreme events. After briefly describing how globalization is changing urban form, we identify key linkages between globalization, new urban spatial structures, and patterns of local vulnerability to global environmental change.

Contemporary globalization is causing a fundamental transformation of city form, structure, and organization (Solecki and Leichenko 2006). This transformation has three main components: 1) a shift to an urban metropolitan world (National Research Council, Committee on Population 2003; Hall and Pfeiffer 2000), 2) a spatial expansion of cities and urban decentralization (Leichenko and Solecki 2005), and 3) a global convergence of urban/metropolitan form (Marcotullio 2003). While globalization, particularly economic globalization, can be described as the metanarrative of these changes, this process is expressed at the local level by a variety of factors, such as rural-to-urban migration, regional infrastructure development, increased international trade and commerce, globalized consumer preferences, and the growth of transnational populations. The collective impact of these forces has been significant. For example, urban sprawl now observed in most large and medium-sized cities has been a result of the global diffusion and emergence of suburban living as a preferred 'modern' lifestyle for the middle and upper income classes in cities in both developed and developing countries (Leichenko and Solecki 2005).

Globalization-driven changes in the urban form of cities have had direct and indirect impacts on the vulnerability of metropolitan region residents and places. Below we illustrate four critical emerging linkages between globalization, urban form, and local vulnerability. In each case, we show that globalization-related shifts tend to exacerbate spatial inequalities and sharpen vulnerability differentials.

1. Consumerism and Environmental Amenities

The global spread of consumerism and consumption-based measures of success has changed the perception of what cities should be and where their residents should choose to live. While economic production-oriented measures traditionally have been used to characterize the business climate of a city or region, amenity values, especially environmental amenities, are increasingly used to describe places and desirable locales within them. In the contemporary context, amenities such as a clean environment, bucolic settings, and natural surroundings have become highly valued. It is to these locations that the emerging upper middle and upper income classes gravitate. The net result of this action is often greater social inequities within a city. The well-to-do move toward high amenity areas from which the poor and working class are shut out. In turn, these lower income groups are pushed toward places with comparatively fewer amenities and/or with greater risks. The draw of amenities is compounded by the fact, that high amenities sites often also are hazardous locations, such as coastal or hill slope properties. The settlement of these areas has brought increased potential for extensive property damage during catastrophic events. In developed societies with sophisticated hazards response capacity, the cost of disaster response and recovery to events at these sites typically are borne by the wider society. This, in itself, is another example of inequity, as the benefits of living in these high amenity locations are accrued by the wealthy, while the costs are spread to all.

2. Marketization and Hazard Exposure

The marketization of housing and of urban land, and the rise of a private real estate economy makes desirable sites in a city increasingly valuable, and hazardous, low amenity sites relatively less so. As a corollary to quest for environmental amenities by the richer members of the urban society, poorer residents might be forced or encouraged to relocate away from expensive, high amenity places to less expensive locations which are often marginal or otherwise hazard prone, such as on floodplains, alongside highways, or adjacent to polluting facilities. In order to maintain the market value of high price sites, developers, property owners, and other interested parties through political and economic pressure also attempt to simultaneously secure additional amenities for the areas and push away any LULUs (i.e. locally unwanted land uses) which would negatively affect property assessments. Especially within large and decentralized metropolitan regions, the upper classes are now able to spatially distance themselves from the negative aspects of urban life (e.g. crime, pollution, traffic congestion) by living in socially controlled enclaves or even in gated communities, and by displacing environmental externalities onto poor or otherwise margin-

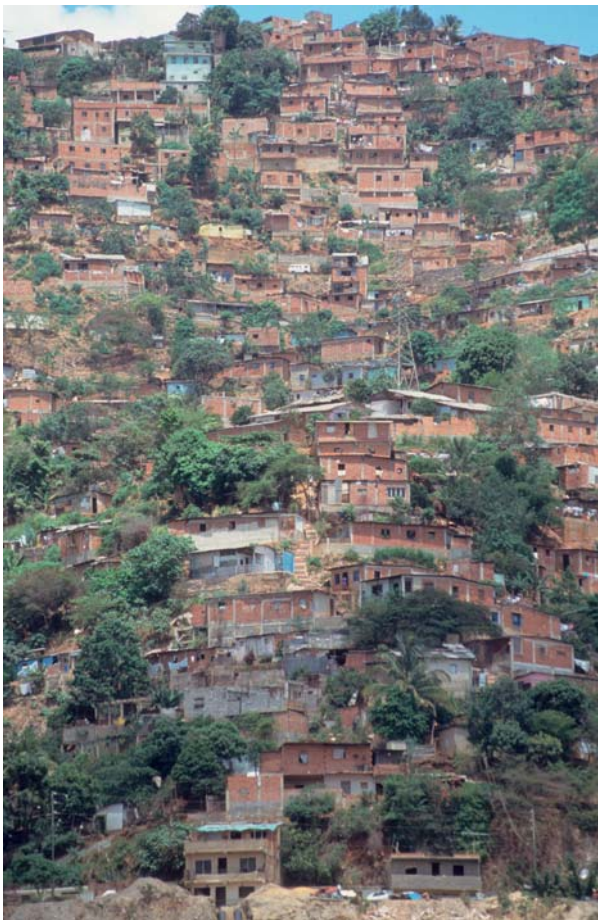
al populations in distant other parts of the urban region (Leichenko and Solecki 2006).

3. Metropolization and Hazards Response

Neo-liberal reform policies encourage political and economic fragmentation and the development of extended metropolitan regions around core cities and older satellite cities. These far-flung urbanized zones often stretch for a hundred kilometers or more. Within this extended patchwork of varying populations, physical conditions, and institutional capacities, one also finds a highly varied hazard landscape and widely varying levels of vulnerability. As a result, when an extreme event occurs some locations within the metropolitan area are much worse impacted than others. In some cases, the wealthy areas of the metropolitan region might be only minimally affected; meanwhile, lower income communities in the region could be severely impacted. The consequences of disaster can linger longer in severely impacted lower income communities because they lack the independent resources necessary to recover, and are often 'invisible' to larger regional governance authority because they are not critical to the primary business and government activity of the region or are remote from high profile locations such as the urban core or central business district. The case of Caracas, Venezuela illustrates this suite of phenomena. Neoliberal, reform driven decentralization in Caracas fostered the development of a sprawling metropolitan region with a haphazard quilt of local governmental units each of which constructed their own development strategy and plans (Mitchell 2000). This action discouraged the emergence of governance strategies that could promote regionally-integrated hazard response, as well as governance strategies that could promote economic integration and a deconcentration of poverty. In December of 1999, torrential rains hit the Caracas metropolitan region, relatively remote, highly vulnerable, poor, residential hill slope areas were most adversely affected. Conservative estimates had at least 10,000 dead and 150,000 homeless. The government response to the communities in the heavily impacted areas was slow because of the lack in coordinated response. While life in the wealthier sections of Caracas continued relatively unaffected, these poorer sections were devastated both by the extreme event itself and the ineffective response.

4. Decentralization and Resource Use Efficiency

The proliferation of a decentralized urban form is another indirect result of an increasingly globalized economy. Many of the emerging metropolitan regions throughout the world are spatially patchy as the new urban growth is uneven and discontinuous. These conditions hamper the development of new regional infrastructure and practices associated with more efficient natural resource use (e.g., region-wide water supply systems, electricity systems, and public transportations systems). This tendency also enhanced the potential for higher per capita consumption as increasingly wealthy and dispersed urban populations have access to new infrastructure and acquire more resource intensive technology (e.g., automobiles on new highways) (Dhakal 2005; Steemers 2003; Jenks and Burgess 2001). Two specific impacts on urban vulnerability from these changes can be defined. First, as new infrastructure and technologies are put into place in decentralized, sprawling cities, the wealthy are typically the ones that will most benefit. Whereas the poor might be living in shanty towns or substandard housing near new highways, it will be the wealthy that will use the highways for their automobiles.



Urban sprawl on slope, Caracas, Venzuela

With respect to water supply in developing country cities, it is often the wealthy that have access to clean drinking water available from new municipal infrastructure, while the poor must pay for higher priced drinking water from private vendors who sell it from a truck. Another aspect of vulnerability emerging from the condition of heightened resource use is the feedback into global climate change itself. Although much has been written about the 21st century as time of transition to a sustainable urban future, urbanization and consumerism of today to a large

extent is resulting in increased energy consumption and resource use particularly among the emerging middle and upper classes of the new urban global society.

In summary, we can see that connections between globalization and local urban form are changing the vulnerability of people and places within metropolitan regions. These connections result in an increasingly uneven and inequitable distribution of hazard exposure and disaster risk. An important area for future IHDP urbanization and global environmental research will be to examine how the projected tightening of globalization processes further transforms the spatial form of cities, and how these changes, in turn, affect vulnerability to all types of global environmental change hazards.

References:
http://www.ihdp.org/updateUGEC.references.htm
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Urbanization Research in China: Many Opportunities and Challenges

By Yan Xiaopei, Xue Desheng and Yin Xiaoying

Urbanization is viewed both as a driver and an outcome of global environmental change. Many human impacts on these changes originate in urban areas, and their consequences in turn have severe effects on urban areas. How to adapt to and cope with the impacts of global environmental change is thus one of the big challenges for Chinese cities. And what role can research on urbanization themes play in this regard?

Chinese urbanization has experienced rapid development since the reform and the opening up of the country. The urbanization level rose from 17.92% in 1978 to 40.5% in 2003. Current Chinese urbanization policies emphasize a characteristic Chinese road towards urbanization with an insistence on enhancing the urbanization level and coordinating the development among big, middle and small cities and towns. In Chinese academe, more disciplines have assumed urbanization research from different aspects, e.g., research by sociologists and geographers on the road to urbanization, research by demographers on the population aspect of urbanization, and others.

Globalization, global change and domestic socio-economic development have brought opportunities and challenges for Chinese cities. International and regional cooperation, the formation of new international divisions, and the global urban network system provide good settings for Chinese cities. But disparities between core and fringe in the world cities network will be broadened, and non-traditional disasters, such as financial crises in Southeast Asia and SARS, will endanger the urban social, economic, ecological and energy security even more than before. The Chinese central government has put forward scientific development views and an urbanization strategy. However, there remain strong disparities and disharmonies between rural and urban, as well as eastern and western regions, and between the urbanization administration and rapid urbanization. Chinese characteristics of urbanization research have not yet been systematized, and there is a lack of collaboration between the natural and social sciences, and between science and policy. Therefore, key scientific issues and priorities for research themes on Chinese urbanization need to be specified.

1. Key Scientific Issues of Research on Chinese Urbanization

Urbanization level measurement. The demographic indices method is always used to measure the urbanization level. However, in China, the statistic standard of urban population has changed frequently because of the changing standard definitions of city and town. The administrative areas of cities are often not consistent with their physical urban areas, which results in two different kinds of urban population statistics. Moreover, these statistics, without considering the transitory population, make for inaccurate measurements of urbanization levels. In order to get an accurate level of Chinese urbanization, some scholars have tried to modify the urban population statistics from the vital statistics, and others have attempted to set up a group of indices to measure the urbanization level. These improved methods, however, are not used in practice because of their subjectivity and poor generality. Measuring the level of urbanization is, therefore, a problem that needs to be solved urgently.

Centralization and decentralization. The question, whether China should develop a centralized or a decentralized urbanization process, poses a great argument which is observed by both academe and government. The theory of Developing Small Cities and Towns was

put forward in 1984 by Fei Xiaotong, a famous sociologist in China. Correspondingly, Hu Zhaoliang, a known economic geographer, brought the Strategy of Developing Big Cities in the same year. There are also many scholars who hold the Theory of Developing Middle Cities or other opinions. Some scholars have begun to pay attention to the phenomenon of urban regionalization since the concept of "megalopolis" was introduced into China in the 1980s. The theme of "centralization" was presented again, namely how to develop along a specific direction: centralized, decentralized, or centralization integrated with decentralization, is still a key issue for Chinese urbanization.

Efficiency and equity. Efficiency and equity are incompatible twins when it comes to numerous problems of the urbanization process. In general, it can be stated that growing efficiency leads to the loss of equity, and becoming equitable leads to the loss of efficiency. After 50 years of development and practice, we have recognized that "inequitable development" cannot be sustainable. And immense social inequity could lead to societal destabilization. Inefficiency and inequity pose great problems to the regional development of Eastern, Central and Western China, in urban and rural development, and within urban development.

Development and resource protection. Since the late 1970s, rapidly developing urbanization has driven the economy in China. But a booming economy has imposed great stress on the environment and resources, which makes the conflict between development, environment and resource protection more prominent. The model of traditional development, which relied on high consumption (Figure 1), results in a heavily polluted environment, an ecology greatly spoiled and natural resources quickly consumed. Especially in the urbanized regions, with a high density of industry and population, worsening environmental conditions affect the surrounding areas, and drive urbanization towards an ecological mess. Which developing model should be used to gain a balance between development and protection, is a problem to be solved in the process of urbanization.

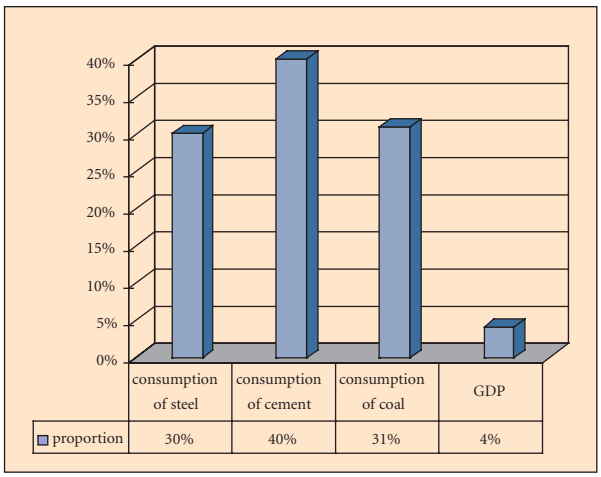

Figure 1: The proportion between main consumption and GDP in China, compared to the world (in 2003)
Source: Chinese Population Net. http://www.chinapop.gov.cn/, 2005

Dynamics and governance. The driving force of Chinese urbanization was often explained with a "Dualistic Theory Model" – top-down and bottom-up. Governments, enterprises, and individuals are the main actors joining in the urbanization process. But now there is a new urbanization trend in China. The traditional dualistic driving force is being replaced by a multi-driving force. At present, non-governmental organizations (NGOs) are rising as a third force besides government and citizens, and they play a more active role in the course of urbanization and urban governance.

Research on key issues of urbanization-related vulnerabilities can influence the decision-making process of urban development. The questions are: How can the division between research and urban development be bridged? How does urbanization drive environmental change at different scales of space? What impacts caused by environmental change might be produced? What do the responses to these impacts look like?

2. Priority Themes of Research on Chinese Urbanization

Resources and environment. The important questions here are: how to achieve intensive and sustainable utilization of land through transforming modes of economic development, adjusting urban land-use structure and upgrading spatial structures; and how to solve the reduced supply of water resources in both riverhead deficiency and water quality, through transforming modes of production, coordinating regional development and restructuring regional economies in urbanization research. It is important to search for new clean and highly effective energy sources as a motivation for urbanization and urban development. The aims of sustainable development, protection of urban ecosystems, and the enhancement of urban environmental quality are important topics for urbanization studies. This contains main aspects such as urban atmospheric environmental protection, urban water circulation and water protection, pollution of the soil, and noise pollution.

Industrial economies. Through comparable studies, it is necessary to do an all-aspect evaluation of urban economic growth modes and choices of sustainable economic growth modes in the context of economic transformation. The impacts of the adjustment of industrial structures on the economy and urbanization need to be researched. It is urgent to analyse the interrelationship between economic globalization, the optimization,

adjustment and upgrading of regional industrial structures, and urbanization. It is also important to discuss how to adjust the supply and demand structure, quicken the development during the industrialization stage, and promote rational mobility of production elements through urbanization.

Urban society and culture. With the deepening of urbanization since the 1980s, population movement, population growth in the urban interior, population structure and change, social and spatial segregation, as well as population policy and system, are the main research contents of urbanization subjects. Urbanization research should be consistent with the object of structuring a harmonious society, paying close attention to the social concerns of the present, and promoting the society to develop in stability and harmony. Employment, poverty, social and spatial segregation and social integration are regarded as prior research fields to be studied. With regard to urbanization and globalization, there should be a focus on how to absorb advanced foreign cultures into native traditional cultures, and how to pass on native traditional cultures, while, at the same time, integrating the development of different types of regional cultures.

Facilities. "Facilities" in this context comprises urban housing and urban infrastructure. Urban infrastructure includes transportation facilities, municipal facilities, and public facilities. The prior research field includes allocation of the transitory population's housing and low-income class's housing; it also includes scale and structure, as well as investment and financing of infrastructure, public policy and governance.

Governance. The setup of a corporate governance system (government, public and NGOs) is helpful to promote the urbanization process. At the governmental level, there are three main issues. One is the innovation of the household registration system, focusing on the spatial structure of urbanized areas, social equity and resource transformation. Another is the innovation of land system, focusing on the land requisition system, housing system, as well as planning and management system. The third is the innovation of the social insurance system, which is an important precondition of a balanced promotion of urbanization. With regard to the public and the NGOs, the corporate governance system of the government should be set up based on extensive investigation and research.

3. Research Strategy of the CNC* Urbanization Working Group

Since the establishment of the Chinese National Committee of IHDP in August 2004, we have fermented and established the Urbanization Working Group made up of about 50 domestic and international scholars and relevant governmental administrative staff.

It is obvious that governments, public, corporations, NGOs and science play respective roles in the process of Chinese urbanization. In present China, there are close contacts between science and government, but little contact between the public, corporations and government or science, which not only affects the development of the discipline, but also goes against the exertion of scientific results and products. Therefore, it is indispensable to restructure the network consisting of government, public, corporations, NGOs and science (Figure 2).

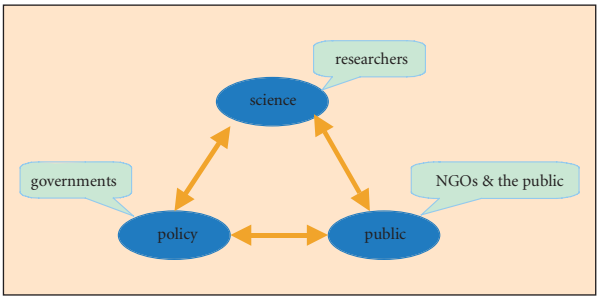

Figure 2:
Structuring the "science – government – public" network

As there is no functioning system of urbanization research in China, it is urgent to structure such a system, and to carry on corresponding scientific research through communication between disciplines. At the governmental level, those systems that cannot keep up with the rapid development of urbanization need to be reformed. There should be a concerted effort to implement the national urbanization strategy, to construct the public education system and to implement public education.

Finally, according to the opportunities and challenges facing the IHDP Urbanization and Global Environmental Change Project, under the globalization and development strategy of urbanization, a working platform, an academic communicating platform, and an operational platform should be established in the near future, in order to push the Chinese urbanization project successfully.

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Chinese Human Dimensions on Global Environmental Change Committee

Climatic Deterioration and Urbanization in Senegal

By Cheikh Gueye , Abdou S. Fall, and Serigne M. Tall

The geographic position of Senegal defines it as a Sahelian country that benefits from a Sudano-Guinean climate, thus forms better ecological conditions in the southern part of its territory. The country also boasts a maritime fa_ade to the West where a temperate climate has played an important role in the establishment of the greater part of its major cities. Senegal is spread out over 196,722 km2 for an estimated population of almost 9 million inhabitants. The resulting imbalances between North and South, East and West, both on an eco-geographical level and with respect to economic potential, significantly influence the internal mobility of the Senegalese.

In this study, we analyse the manner in which the degradation of climatic conditions has in turn stimulated the mobility of the Senegalese and contributed to reinforcing the role of urbanization. Indeed, like the majority of West African nations, particularly those of the Sahelian region, Senegal has experienced a complete upheaval of its climatic norms since the mid-1960s when a long period (1950-1967) of surplus rainfall caused the rapid growth of the overall population and an augmentation of rural population density. The climatic variable is certainly the most significant catalyst for migration towards urban centers, however there exist other possible responses that might reduce the influence of this factor in the mind of the potential migrant. The same is true with respect to the significance of the return of the heavy rains vis-à-vis the safety of recent constructions. Factors linked to urban ecology and to construction techniques are also important but their impact on the environment has been increased by the climatic variable. In one and the other case, the climatic variable is the trigger, but there is no mechanical link between periods of drought and the rhythm of departures, nor of the rhythm of depreciation of the urban environment.

In effect, Jean Leborgne1 points to three distinct periods of pluviometric deficit (1970-73, 1976-77, 1983-84) that punctuate the long period of drought in the Sahelian region between 1970 and 1990. The climate in Senegal is regulated by a rainy season (3 to 4 months) and a dry season (8 to 9 months), and the natural world proves extremely vulnerable to climatic variations. Because the Senegalese economy was largely based on agriculture (peanuts, millet, sorghum, rice, cotton, manioc, sugar cane, niébé, etc.), the chronic drought that began in the 1970s had an extremely traumatic effect on popular spirit, influenced landscape and overall activity, and caused a lasting perturbation of rural societies in Senegal, pushing them into exodus. This crisis inspired a massive migration towards the cities and, more and more, to foreign countries. In addition to other strategies, both isolated and long-term, the intensification of internal and international migration is the principal response of populations affected by this ecological crisis of the period between 1970 and 1980. There were, of course, other contributing factors aside from the drought, but this latter variable was pivotal in the degradation of the landscape, the upheaval of systems of production and the destabilization of living conditions in the rural context, causing the migration of rural populations to the cities.

Our study endeavors to identify the current implications of climatic changes on the transformation of urban centers. The intensification of migration to the capital and the corresponding rapid augmentation of the urban population, the renewal of relationships between the rural and urban communities, and the emergence of the notion of urban risk linked to climatic changes all represent axes of research and analysis to be investigated in this study.

The Drought Puts Rural Communities to the Test

Drought is a virtually continuous process of pluviometric deficit and of documented precipitational irregularities. The long and intense periods of pluviometric deficit that marked the Sahelian region between 1970 and 1980 also affected Senegal, particularly in its northern regions.

And during that period, certain years were particularly catastrophic with respect to limited rainfall, such as 1970 (653,6 mm) and 1972 (504,9 mm) because they were preceded by relatively rainy seasons (962,8 mm in 1969, 825 mm in 1971, 460 mm in 1977). The year 1983 (411 mm) showed even more of a deficit. Dagana in the delta of the Senegal River (in the North) only saw 68 mm of rainfall during the entirety of 1983. The deficits often surpassed 50% over the whole period. At the same time, the length of the rainy season was reduced overall, lasting only about two and a half months throughout most of the country. This period of drought was even more trying because it followed "a long 18-year period (1950-1967) during which rainfall was often excessive, the augmentation of the rural population was rapid, the

Pluviometric Average (in mm) by Decade in the Central-Western Regions of Senegal

Period	Bambey	Diourbel	Fatick	Kaolack	Khombole	M'Bour	Thiès	Tivaouane	Average
1960-69	645	650	690	727	622	754	595	543	657
1970-79	478	509	516	530	438	453	483	409	477
1980-89	471	411	599	549	481	465	411	436	481
1990-93	473	---	547	---	484	482	404	447	469
Average	525	518	592	602	507	551	485	458	530

Source: Agrometeorology Group FAO-SDRN, NOAA and AGRYMET

density of the rural population increased during this relatively wet period."3

As is evident in the table below, a decrease in the pluviometric average has been recorded in all regions west of Senegal that have lost, on average, close to 200 mm of precipitation over the course of the last thirty years (1960-1990).

As the table indicates, the decrease in precipitation became widespread after 1970. More than the total precipitation, it is the distribution of useful rainfall over time and across the country that significantly affects the development of pluvial agriculture. Drought, the unequal redistribution of the rural population, the need to leave fallow land used for peanuts crops, and the impoverishment of land suitable for agriculture leaves a good portion of arable land uncultivated.

The pluviometric decrease is manifested by a slippage of the isohyet 400mm to the south, by a late beginning of the winter season in the northern region of the country and by a corresponding shortening of the rainy season, a noticeable reduction of the number of rainy days. Nonetheless, the rural milieu of Senegal did not only suffer from climatic variations during the 1970s. Structurally, Senegalese agriculture is also very dependent on the world market. The elevated price of production greatly benefited those farmers who grew peanuts and cotton. However, elevated prices of essential materials and seed, coupled with decreased fertility of the soil, the lack of a political support network for the peasant class, and the overall discouragement of producers have brought about a decrease in the return on and production of peanuts.

The pressure on the soil is also responsible for a decrease in fertility of the earth which is barely allowed time to lay fallow. The rare regulatory mechanisms to which the peasants of the central-western region have access to are migration towards the South where a few listed forests still exist. This process contributes to an expansion of the drought outside of the Sahelian region. In Senegal, the peanut basin aged quickly and saw its vital energy migrate more and more towards Dakar and towards nearby mid-sized cities as well as to foreign countries like Italy, Spain, the United States, and others.

Rural Exodus and Urban Mutation: Dakar as Hub of Internal and International Mobility

If the drought has put rural milieus to the test, the capital, Dakar, has been the principal receptacle of the rural exodus and the principal site for observing the most pertinent problems caused by this migration and accelerated urbanization. The development of Dakar has manifested itself by a rapid spatial expansion resulting in equal shares from intrinsic demographic dynamism and migratory influx from regions of the interior. The Dakar conglomerate thus constitutes the most important site of socialization and invention of the Senegalese society. Precarious neighbourhoods have multiplied, spread out, and gotten denser, becoming official reference points in constant qualitative evolution.

Dakar has also become a veritable hub of internal and international mobility, both of which have diversified their sources and their destinations. Furthermore, the city is at once a zone of departure to foreign countries and a site of return for international migrants. It is a privileged site of investment for emigrants attracted by its profitability. This is even more the case in peripheral zones of the capital where real estate production is complex, land regulations unclear, and financial structures uncertain, but where a strong aspiration towards the accumulation of property and, therefore, towards a rapid renewal of modalities of the quest for urban soil, prevails. The transformation of urban milieus is constant, and verticalization becomes a new reference point that marks the landscape of peripheral neighbourhoods that are constructed and renovated by a new active force, the international migrants who heighten the tension vis-á-vis access to urban property.

However, the return of a normal quantity of rainfall is posing a threat to these settlements. Environmental balances have been rendered precarious by the overpopulation and urbanites have had to adapt. The water supply has become a recurrent and quasi-impossible problem to solve. According to this report, the existence or survival of Dakar is threatened by the decreasing water level and the insufficient mastery of water sources. The management of the urban environment and its numer-

ous constraints linked to the insufficiency of networks of water supply and purification remain an important challenge in the context of a return of rainfall.

The considerable weight of Dakar in the urban framework and the immobilization of secondary cities were the two dominant characteristics of the Senegalese urban network up until the 1970s. With the volunteer-based politics of urbanization initiated by the State, the process of decentralization of 1996, and the changes in the economic structure of the country, we have noticed an affirmation of a multitude of small cities and secondary cities. The emergence of numerous religious cities outside of the administrative or communal systems contributes to a disturbance of urban mechanisms that upset previously established schemes of urban creation. Touba, Mbour, Richard Toll, and Ourossogui are patent examples of this new urbanization. However, all the components of the urban network are experiencing new dynamics. These days, Senegalese cities experience a diversification of the original development factors and of its mechanisms, thus renewing the urban network in both its typology and its configuration.

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Understanding Urban Growth in the Context of Global Change

By Annemarie Schneider

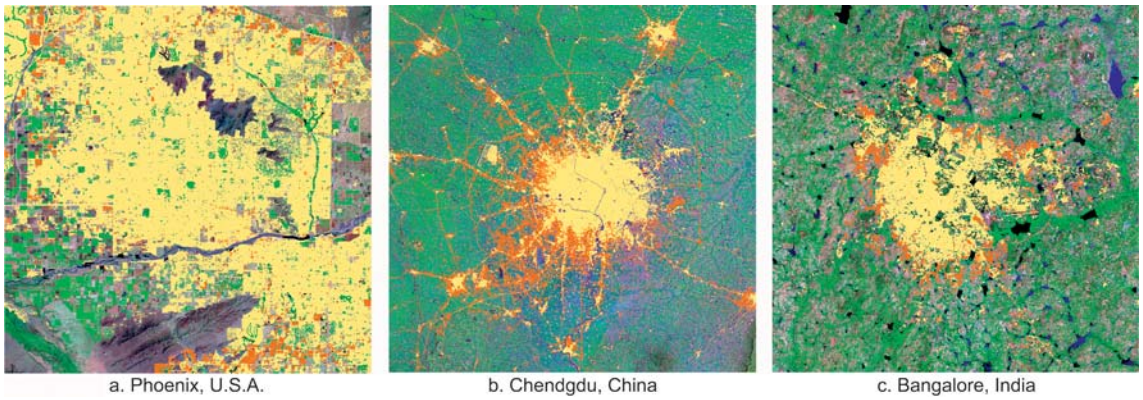
Increasing urbanization, economic globalization, and the acceleration of human-induced global environmental change are three of the most significant transformations occurring across Earth in recent decades. Cities and metropolitan areas are at the heart of each of these issues. The world's urban population has multiplied tenfold during the past century, rising from just 14% of the total population in 1900 to more than 50% today. Over 70% of economic activity is now concentrated in cities, and economic growth is influenced more and more by continued global integration and the struggle for cities to be competitive in the global marketplace. Associated with both economic development and urbanization are environmental impacts resulting from the rapid spatial expansion of metropolitan areas. Land conversion – in the form of decentralization, dispersion of the city, suburbanization, or fragmentation of the urban fabric – fundamentally alters the environment in a number of ways across local, regional and global scales. Despite growing recognition of the important and complex role of cities in economic, political and environmental systems across the world, comparative, global-scale research on cities has been severely limited.

The Study of Urban Areas: From Local to Global

Research in both the physical and social sciences has focused on the localized study of cities for more than a century, since the majority of the processes of interest occur within or near the city with outcomes that affect local residents, markets, and quality of life. However, global environmental change and economic globalization have prompted new concerns about the role of urban areas in global systems. Social science has a longer history of treating urban regions in a regional or global context, although the vast majority of work has focused on "global cities" and city-systems. The emphasis on "global cities" means that only a handful of economically prominent cities have been considered, while mid-sized and small cities (with currently the fastest rates of growth) have been neglected in global studies.

Regrettably, global-scale research on the urban environment lags further behind. While a growing volume of literature is dedicated to the impact of forested land or agriculture on the global environment, little to no attempt has been made to quantify the role of urbanized land in a similar manner (Lamptey et al., 2005). The reasons for this stem from a lack of reliable, consistent data on cities at regional to global scales, as well as the common misconception that the relatively small spatial extent of cities translates to only a minor impact on the environment. A number of recent reports and initiatives have highlighted the role of urban areas in global change (UN-HABITAT, 2003; IHDP, 2005; OECD, 2005), bringing new attention to the need for multi-scale research on the drivers and consequences of dynamic urban processes. The work presented here contributes to these efforts, and in particular, Theme 1* of the new IHDP Urbanization and Global Environmental Change Project. In order to understand urban processes which contribute to global environmental change, it is critical to have accurate and timely documentation of patterns of urban growth.

* Urban processes that contribute to global environmental change



a. Phoenix, U.S.A. b. Chendgdu, China c. Bangalore, India

Annemarie Schneider

Social and Environmental Impacts of Urban Growth

Urbanization of the world's population and conversion of the Earth's surface to urban uses are among the most visible and rapid of anthropogenic changes. In recent years, the most explosive population growth has occurred in developing countries, where urban populations are growing at an average 3.5 percent per year as opposed to less than one percent growth in more developed regions. As a result of this demographic shift, urban environments now have a significant influence on the majority of the world's population. Rapid and unbalanced growth of urban areas is of particular concern, since many traditional urban problems become exacerbated when cities become more dispersed, including deficiencies in urban services, infrastructure and housing, social fragmentation and isolation, spatial mismatch between jobs and housing that leads to higher unemployment, and increasingly long commutes.

As cities expand, it is becoming increasingly clear that environmental impacts may indeed occur at regional and global scales. First, cities are known to produce microclimatic changes through increases in temperature, surface albedo and subsequent convective activity, as demonstrated in the urban heat island effect. Local and global climate are connected in at least three ways: through the chemistry of the atmosphere, the role of combustion, and the potential interaction of local pollution policies with greenhouse gas control measures (Harvey et al., 2000). Second, cities appropriate a disproportionate share of the Earth's carrying capacity in terms of resource input and waste sinks, despite the fact that built-up areas account for only 1-3 percent of the Earth's land surface (Folke et al., 1997). Environmental impacts extend beyond city boundaries, including the conversion of natural ecosystems, loss of productive agricultural land, fragmentation of natural habitats, pollution of air, soil and water, changes to the water cycle, and reduced biodiversity (Alberti, 2005). Finally, environmental degradation in and around urban areas can lead to increased rates of natural hazards such as floods, landslides, and damaging storms.

Recent Research Efforts

Because of the central social, economic, political, and environmental role of cities and the large number of people in urban areas, changes in urban areas are likely to have far-reaching repercussions. Comparison of cities across regions and continents is crucial, because it provides a means to contrast the effects of different physical environments and management systems, to understand the differences in rates of urban growth, to determine the mechanisms that cause these variations and how these factors might change in the future, and to determine the regional to global impacts on the surrounding landscape. The focus of our research has been on two overarching questions: (1) How are urban areas changing across the Earth? and (2) What factors are responsible for these changes? The first question is the fundamental 'what' question needed to characterize trends in urban extent, urban form, and rates of change that are occurring across places. The second question is the more complex 'why' question, intended to explain the reasons behind the widely diverging rates and patterns of urban growth.

To monitor how cities are changing (Question 1), our research first focuses on mapping urban and built-up areas globally. Expanding on methods developed in the global land-cover change community, we used a data fusion approach to combine multiple sources of remotely sensed data with spectral and temporal information from 1 km MODIS data (Schneider et al., 2003; 2005a). Results were particularly effective for resolving the confusion between urban areas and other land cover types to establish a baseline map of urban location and extent not previously available. Results suggest that data fusion methodologies provide a repeatable, globally consistent way to map the location and extent of human settlements greater than one square kilometer.

While the results of the fused data global map are better than previously available products, continued validation efforts and feedback from users indicate that more detailed, finer spatial resolution maps are needed. Fortunately, two key developments have taken place in the field

of remote sensing since these initial attempts. First, additional sources of remotely sensed data are now available with improved spatial, spectral, and radiometric quality (e.g. 250-500m MODIS, SPOT, MERIS data). Second, new advances in classification algorithms, data fusion methods, and spectral and temporal unmixing techniques have occurred that provide increased capability for mapping urban extent. Our current work incorporates these new developments to map the fraction of impervious surface, vegetation, and other land cover types at a subpixel level across the globe, allowing users to modify the maps to suit their needs.

The coarse resolution of the global map hinders accurate characterization of changes in urban areas, however, since expansion of the built environment occurs at scales finer than one kilometer. To better tackle changes in urban extent, we rely on a more localized approach using medium-resolution remotely sensed data, pattern metrics and census data (Schneider et al., 2005b). A sample of 25 urban areas from different geographical settings and levels of economic development was used to examine the similarities and differences in urban form and growth that have occurred across mid-sized cities from 1990 to 2000. Using a simple set of urban growth metrics, results revealed four city 'types' or templates for growth: low-growth cities characterized by modest rates of infilling-type expansion, high-growth cities with rapid, fragmented development, expansive-growth cities with extensive dispersion at low population densities (occurring almost exclusively in U.S. cities), and frantic-growth cities such as those in China, that exhibit extraordinary rates of growth at high population densities (Schneider and Woodcock, in review). This work is critical for not only establishing a starting point for comparing amounts, rates and patterns of growth in cities across the globe, but for determining whether urban patterns outside of the U.S. are consistent with common conceptions of American urban sprawl. Results show that, although all 25 cities are expanding at the urban-rural boundary, the majority of cities outside the U.S. do not exhibit the large, dispersed spatial forms characteristic of American urban sprawl.

Understanding, documenting, and modeling the proximate and underlying driving forces that contribute to these types of spatial changes (Question 2), is a far more difficult feat than monitoring urban land (Question 1). A lack of accurate, comparable socioeconomic data at the level of the city and a shortage of appropriate methods for analyzing data across scales continues to impede investigation. In a simple, bivariate analysis, we examined the driving forces for each city's growth by connecting city- and national-level data on population, household, and labor fluctuations to measures of urban growth and dispersion (Schneider et al., forthcoming). Results show a limited relationship between urban expansion and population change, a factor traditionally thought to play a central role in land conversion (Figure 1). Comparison of

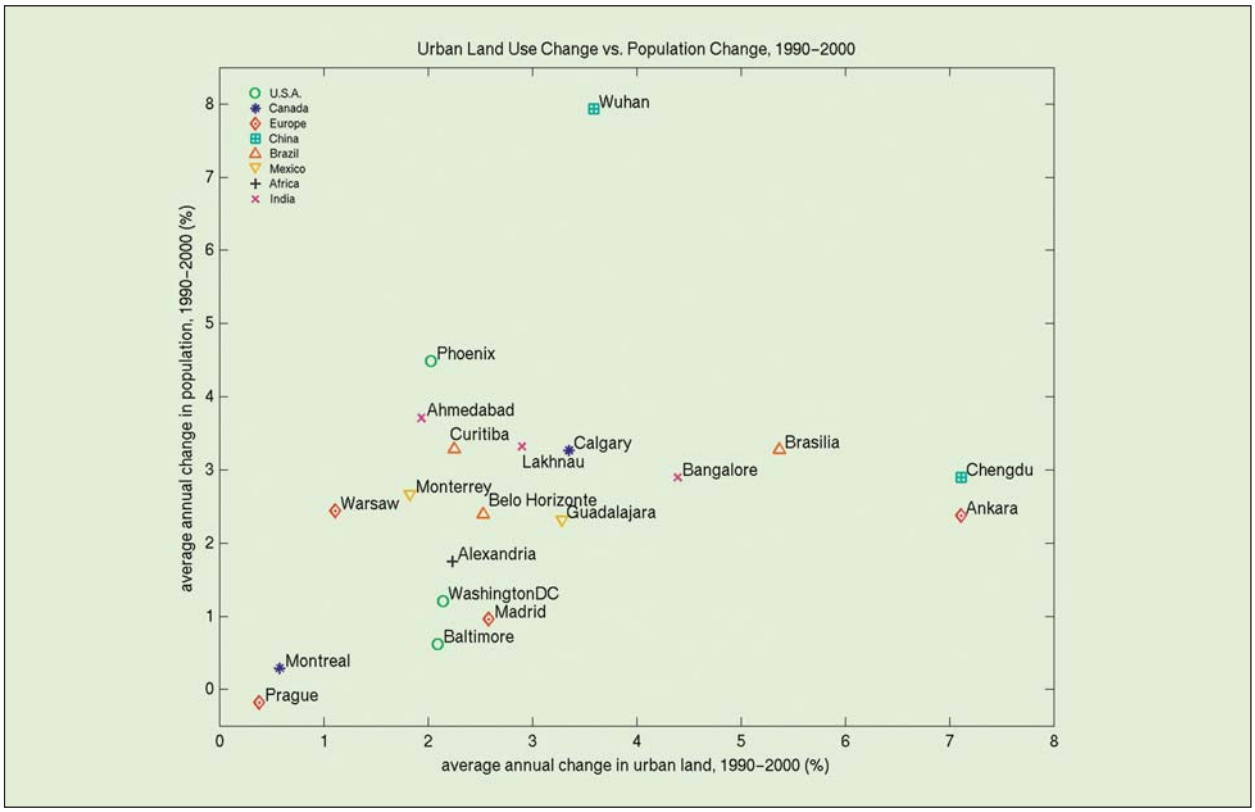


Figure 1: Average annual change in urban land plotted against the average annual percent change in population, 1990-2000, for each city. Cities not shown: Guangzhou, Dongguan.

urban land use to factors related to changing lifestyles and consumption patterns highlighted the importance of transportation infrastructure and fuel prices, but failed to reveal any significant relationship between changes in built-up land and recent alterations in household size and structure in many newly industrializing cities. Finally, some relationship between service sector activities and rates of dispersion is apparent, although additional data are needed to prove the validity of this association. Our current work focuses on understanding the interaction of economic and demographic indicators as mechanisms of change in urban environments.

Urban growth is clearly a complex and diverse phenomenon. Considering the numerous social, economic and environmental impacts at local to global scales, it is imperative that we begin to understand the role that rapid urban expansion and dispersion play in these changes. Such changes may be both positive and negative for different places at different times, but the extent of potential negative changes represents a substantial challenge to the functioning, stability and sustainability of urban areas. Therefore, comparative, cross-scale investigation of urban areas is critical if we are to provide policy-relevant information to governments, land use managers, civil/transportation engineers and researchers in a timely and efficient manner.

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Visioning Sustainable Urban Transport – Case Studies for Boston and Bangalore

By Philip J. Vergragt

Introduction: Car Transportation and Climate Change

Individual transportation by cars in cities contributes a lot to greenhouse gas emissions and thus to climate change. Roughly 30-35 % of all CO_2 emissions worldwide originate from the tailpipes of cars. As energy efficiency in heating, cooling, and household appliances increases, the contribution of road transportation to global warming will become even greater. In the developing world, especially in India and China (Kobos et al, 2003), the number of cars will rise manifold in the next decennia, due to economic, income, and population growth.

In the cities of the Northern hemisphere, in the so-called 'developed' world, greenhouse gas (GHG) emissions will have to decrease by 80-90 % in the next 30-50 years in order to limit climate change within acceptable limits (Global Commons Institute, 2006). This reduction cannot be reached by technological innovations alone; other changes, including changes in lifestyles and behavior, will be necessary. In the Southern hemisphere, the developing world, there is still some room for growth in GHG emissions, but quite soon population growth combined with an increase in consumption will lead to similar challenges as in the North.

How can these challenges be addressed? This short paper describes a visionary approach that has been applied in two cities: Boston, MA, USA in the North, and Bangalore, India, in the South. Boston is the example of a prosperous city with a reasonably good public transportation system; but it is locked-in in a CO_2 emission level that is unsustainable. Bangalore in India is the example of a fast-growing, economically booming city in the South where car transportation is exploding causing congestion, air pollution, ultimately climate change, and where conflicts about public transportation hamper implementation of solutions.

1. The Case of Boston, MA, USA[1]

Boston is a major city on the East Coast of the USA, a centre of high tech industries and higher education. The Boston municipality has about 0.6 million inhabitants, but the Boston Metropolitan area has approximately 3 mio. inhabitants in an area of roughly 3600 sq km. Each work day, Boston's population doubles by workers who work in the central city. In 2004, the Metropolitan Area Planning Council (MAPC, 2006) started a visioning process, involving many stakeholders like local communities, businesses, civil society, church representatives, and professional groups. The question posed was how these groups would envision the greater Boston area in the next 25 years. Many of these constituencies envision Boston as greener, cleaner, more prosperous, with high employment and good education on all levels. However, the issue of 80-90 % CO_2 reduction is hardly ever men-

[1] This project is carried out by James Goldstein, Chella Rajan, Anna Fleder and author, and funded by EPA/NCER

tioned. This is in accordance with a study by Portney (2003) who investigated US cities who call themselves sustainable. Massive CO_2 reduction is nowhere on the agenda. This is understandable because most of the sustainability issues are framed as local issues, like economic prosperity, social justice, as well as clean water and air.

How can climate change and CO_2 reduction be addressed in an urban visioning process? Tellus Institute started a study in 2005 to address this question. This study is part of a wider endeavor undertaken by Tellus, called Great Transition Initiative (GTI, 2006). GTI is informed by earlier scenario studies undertaken by Tellus and the Global Scenario Group (Raskin et al, 2003). In "The Great Transition", six probable global scenarios are sketched: "Conventional Worlds" consisting of "Policy Reform" and "Market Forces"; "Barbarization" consisting of "Fortress World" and "Breakdown", and "Great Transitions" consisting of "Eco-Communalism" and "New Sustainability Paradigm". Policy Reform and Market Forces will not bring a sustainable world, while there is a real chance of Fortress World and Breakdown. For a Great Transition scenario, market forces and policy reform will not be enough; deep changes in institutions, lifestyles, and values will prove to be necessary. According to the essay the only change agent to accomplish that would be a Global Citizens' Movement.

How could a Great Transition be envisaged on the level of a large city? With this question in mind, Tellus started a study to challenge and improve MAPC's[2] visioning and planning exercise, in order to bring CO_2 reduction and ecological footprint reduction into this process. The study consists of two parts: constructing visions and scenarios of a Sustainable Boston in 2050, and developing strategies and actions how to get there (Boston Scenarios Project, 2006). Three visions were developed: Business as Usual, Policy Reform, and Deep Change. The visions consist of narratives and are underpinned by semi-quantitative scenarios. For Deep Change, narratives and graphs are developed for the Built Environment, Transportation and Land Use, Agriculture, Energy, Water Resources, as well as Health and Well-being.

These scenarios were presented to and discussed by a group of leading Boston academics and activists. They all endorsed the necessity of trying to realize a Deep Change scenario, and they launched many ideas on how to bundle local actions and activities, how to work on education and awareness raising, how to try to overcome fragmentation and inertia, and how to energize the local community.

For urban transportation and land use, the Deep Change scenario envisions a 70 % CO_2 reduction by 2050. In the box we present parts of the narrative:

[2] Metropolitan Area Planning Council

… Citizens are predominantly living and working near public transportation hubs. Public transportation is attractive because of high speed, frequency, and comfort, and convenient payment. Its use is encouraged by employers who offer free or reduced cost transit passes as a benefit, and a high fraction of offices and workplaces being situated near transportation hubs. Easy access to transit stations is provided by an extensive car-sharing program, as well as pick-up shuttle services using electric vehicles, underground parking spaces near stations, and high quality provisions for bicycle storage.

Individual car use has decreased as alternative public and private transportation options have become convenient. Transit includes a number of modes: "bus rapid transit", rail, light rail, car-sharing, taxis, and ferry services. Walking, cycling, shared taxis, and high-speed transit have become easy, attractive, quick, comfortable, and less expensive than driving and parking, especially in the inner core communities. All public fleets and most private cars are hybrids or run on hydrogen that is produced from renewables or natural gas … Electric and fuel cell bicycles are common to help overcome adverse wind and ascents; bicycle lanes are common on most major roads.

… A large part of downtown Boston is closed for individual cars except certain categories (high-occupancy, all-electric or hydrogen vehicles; electric multi-occupancy taxis). In this area public transit is free; bicycle facilities are readily available (lanes, storing, zip-car-like renting system) …

2. The Case of Bangalore, India[3]

Bangalore is the fourth largest Indian city and the principal cultural, administrative, commercial and industrial centre of the state of Karnataka. Bangalore Urban District

[3] This study has been carried out by Seema Parakh under supervision of Halina S. Brown (Clark University) and the author.

is spread over 2190 sq km. From 1991 to 2001, Bangalore's population grew from 4 million to 6.5 million, and by 2010, it could grow to 8.5 million. Today, it is a centre for high-tech manufacturing and research. In 1991, total software exports from Bangalore were USD 60 million, increasing to USD 2000 million in 2001. The IT industry represents 30 percent of Bangalore's economy, employs about 300,000 people, and contributes to 32 percent of the total taxes.

Faced with the challenges of rapid urban growth, Bangalore's public infrastructure and services are strained. Buses and auto-rickshaws are the primary public transit modes. Private cars, two-wheelers, taxis, private vans, and bicycles are also used. There is increasing pressure on the State Government to provide efficient services and effective infrastructure.

A review of the transportation history of Bangalore reveals numerous plan developments since 1960s. None were implemented mainly due to financial constraints and lack of political will. Recently, a Bus Rapid Transit system was stalled and there is controversy about a metro system. Most recently (end of 2005), a study has been commissioned to prepare another Comprehensive Traffic and Transportation Plan.

Initial interviews with the main stakeholders in 2004 revealed that most transit agencies work independently from each other on issues like infrastructure development and maintenance, resulting in 'transit chaos'. The aim of this research project is to contribute to the understanding of how structured multi-stakeholder dialogue may lead to learning and trust building. Multi-stakeholder visioning workshops will be instrumental in achieving a shared vision; interactions that occur amongst the key stakeholders in such a workshop could lead to learning and trust building. This research was a joint project by Clark University, Tellus Institute and Janaagraha (a prominent Bangalore NGO), and is consistent with Janaagraha's mission of practicing participatory democracy.

A visioning workshop was organized under the sponsorship of Janaagraha in August 2005, with 19 participants representing 15 institutions. The scope of the workshop was to explore future pathways on institutional reform and the design of an Integrated Bangalore Public Transit System (I-BPTS). The workshop facilitated participation of bureaucrats, technocrats, process consultants, educators, as well as representatives of the urban poor and of civil society. They were able to reflect in semi-systematic way on the institutional reform and the I-BPTS design to (re)define the problem, search for solutions and reach a consensus on the problem definition. The workshop contributed to an emergence of a platform for further development of a shared transit vision for Bangalore. The brainstorming sessions in groups led to creative inputs from all the stakeholders.

3. Conclusions

Drawing on several authors, Berkhout (2006) calls visions "Pseudo-facts that guide behavior", "Cognitive structures that orient behavior and define roles", and "Metaphorical structures, consistent with underlying values". He views visions as mapping a 'possibility space'; a heuristic device for problem defining and problem solving; a stable frame for target setting and monitoring progress; a metaphor for building actor-networks; a narrative for focusing capital and other resources. Every plan of action requires an image or a vision and visions with greater 'interpretive flexibility are more effectively diffused.'

When used appropriately, visions are powerful devices that can orient and structure actions and behaviors. They have the power to inspire societal actors to investigate and test alternatives – from technology to behavior to culture and institutions. Shared visions may unify competing or warring interests by creating a shared framing of a situation.

This article has shown that visions of sustainable transportation systems could be developed for cities as different as Bangalore and Boston. For each of the two cities, these visions could contribute to strategies and pathways on how to reach a sustainable transportation system. In Boston, the main hurdle is lack of awareness and lock-in of entrenched institutions. In Bangalore, institutions are both fragmented and overwhelmed by problems of fast economic development.

The next step is to demonstrate how the power of visions is effective in advancing "deep change" processes in land-use planning and transportation, leading to deep reductions in GHG emissions. The hypothesis is that back-casting (looking back from a future vision to the present) (Weaver et al, 2000; Vergragt, 2005) could be an effective tool.

The research described fits into two of the main themes of the IHDP Urbanization and Global Environmental Change Science Plan: Themes 1 and 4. Theme 1 is about Urban processes that Contribute to Global Environmental Change: it contributes to Themes 1.1.1. (dominant liberal ideology leading to increasing car transportation in cities) and 1.1.2 (rising consumption patterns). It also contributes to Themes 4.1.1. (coping mechanisms of urban residents) and 4.1.3 (existing and desired urban governance processes). While the Science Plan is mainly focused on analysis and on the better understanding of both causes and mitigation efforts of GEC, the present research aims at developing new approaches that may help to advance change processes, both in governance and in civil society.

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Article 1: Carbon Management and Clean Air (page 1)

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Article 3: Urban Modeling, Policymaking (page 7)

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Article 4: Global Cities and Local Vulnerabilities (page 10)

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Article 6: Climatic Deterioration and Urbanization in Senegal (page 15)

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Article 7: Understanding Urban Growth in the Context of Global Change (page 17)

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Article 8: Sustainable Urban Transportation (page 20)

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ICLEI World Congress 2006, Cape Town, South Africa

The Local Governments for Sustainability (ICLEI) World Congress 2006 was held in Cape Town, South Africa, from February 27 through March 3, 2006. Convening every three years, the Congress aims to provide mayors, local government politicians and staff, representatives from international agencies, national governments, donors and other partners with the opportunity for peer exchanges, knowledge-sharing, capacity building and on-site visits and exhibits.

This year's Congress themes were "Protecting Global Common Goods, Building Sustainable Communities and Cities, and Implementation Instruments." The IHDP Project on Urbanization and Global Environmental Change participated in the Congress and the Pre-Congress Researchers' Symposium February 24-25. The motivation for the Researchers' Symposium is the recognition that researchers and local government practitioners share a common interest in addressing complex urban environmental problems and that there is an urgent need for dialogue among these communities. The Researchers' Symposium was built on the outcomes of the Conference on Sustainable Urban Development-From Research to Action, held in Nanning, China, November 2005. The Researchers' Symposium identified four broad areas for action: 1) Identifying and establishing formal relations between research communities and local governments; 2) Ensuring that research is focused on information needs of local governments and providing information that informs and enhances policy and implementation practices; 3) Improving the communication between partners during the research process and enhancing the communication and broad dissemination of research results to the broader community; 4) Improving linkages between international research efforts relevant to sustainable urban environments such as the Urbanization and Global Environmental Change Project, and local level research activities.

Karen Seto

Linking the Sciences of Global Environmental Change to Society and Policy, Ubatuba, Brazil, November 2005

Over the past 25 years it has become widely recognized that human activities are transforming the earth on a global scale through alterations to earth system processes and through the cumulative effects of many changes (such as land-use and land-cover change, biodiversity loss, ecosystem fragmentation, urbanization) that, in aggregate, contribute to the degradation of environmental resources and services on a global scale.

The complexity of processes and interactions has given rise to an interdisciplinary and international global environmental change (GEC) science. Growing public concerns about global change and the ability of vulnerable ecosystems to sustain human welfare, result in increasing pressure to ensure connections and communication between science and policy-making, in particular with regard to decision needs of governance and policy-making. Science must become more integrative, involving the natural and social sciences in a collaborative way in order to provide sound scientific understanding in support of sustainable development.

This science-policy interface, is the focus of the rapid assessment project initiated by IAI* and SCOPE** in November 2005 in Ubatuba, Brazil. It brought together some 45 international experts from a wide spectrum of disciplines to discuss and draft their assessment of current GEC science knowledge and its linkages to societal concerns and governance with a focus on the Americas. Chapters produced by four cross cut discussion groups examine:

- The challenge of steering research towards policy relevance: lessons learned from 10 years of the Inter-American Institute for Global Change Research (IAI) projects
- Stakeholders and GEC science
- Delivering global environmental change science to the policy process
- Communicating science to the media, decision makers and the public

These chapters will be published together with background papers on cooperative global change science projects which were submitted prior to the workshop, and an overview synthesis chapter, in volume form in the SCOPE Series under the Island Press imprint in late 2006, early 2007.

Maureen Woodrow

* The Inter-American Institute for Global Change Research (IAI) is an intergovernmental organization established in 1992 and supported by 19 countries in the Americas. It has generated a wealth of knowledge on such topics as biodiversity, biogeochemistry, land quality, ecosystem function, climate change and variability, regional hydrology and oceanography. Some of the IAI's cooperative research networks (CRN) have significant extension and policy components because their themes explicitly address human dimensions such as risk management, land or other resource use (e.g. CRNs on land-use change, fisheries, disasters). Others have synthesized scientific findings into high-level advocacy (e.g. CRN on biodiversity in the Millennium Assessment). Other large science projects in the Americas such as the LBA (Large Scale Biosphere-Atmosphere Experiment in Amazonia)

have made strenuous attempts to improve communication with politicians; www.iai.int

** The Scientific Committee on Problems of the Environment (SCOPE) was established by the International Council for Science (ICSU) in 1969. It brings together natural and social scientists to identify emerging or potential environmental issues and to address jointly the nature and solution of environmental problems on a global basis. Operating at an interface between the science and decision-making sectors, SCOPE's interdisciplinary and critical focus on available knowledge provides analytical and practical tools to promote further research and more sustainable management of the Earth's resources. SCOPE's members, 38 national science academies and research councils, and 22 international scientific unions, committees and societies, guide and develop its scientific programme; www.icsu-scope.org

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International Organizations and Global Environmental Governance – The 2005 Berlin Conference

The pressing problems of global environmental change have challenged the international research community to generate new theoretical understandings, methodological refinements and empirical knowledge of its institutional dimensions. Most of this work, however, has concentrated on the principles, norms, rules and decision-making procedures that underlie the emerging system of global environmental governance. More systematic work will be needed to better understand the actors at the international level that identify, analyse, manage and evaluate the pressing problems of global environmental change. This particularly applies in the case of the plethora of intergovernmental organizations and programmes that are entrusted with assisting in the mitigation of, and adaptation to, global environmental change. These organizations were hence the central focus of the 2005 Berlin Conference on the Human Dimensions of Global Environmental Change, which was held 2-3 December 2005 in Potsdam under the title "International Organizations and Global Environmental Governance".

Altogether, about 200 colleagues from 30 countries participated, with roughly 100 plenary and panel presentations. Keynote addresses were given by the former German Federal Minister of the Environment, **Jürgen Trittin** on "Reforming International Organizations for Global Environmental Governance"; by Professor **Klaus Töpfer,** the then Executive Director of the United Nations Environment Programme, who spoke on the "Environmental Reform of the United Nations: The Role of the UN Environment Programme"; by Professor **Thomas Risse,** the Director of the Center for Transatlantic Foreign and Security Policy, Freie Universität Berlin, who lectured on "New Modes of Governance"; and by **Pieter van Geel,** Netherlands' Secretary of State for the Environment, closed the conference with an outline of his vision on "Reforming International Organizations on Global Environmental Governance."

Four semi-plenary sessions addressed more specific questions: In one session, **Johanne Gélinas,** Commissioner of the Environment and Sustainable Development of Canada, elaborated on "Evaluation of Organizational Policies Regarding the Integration of Environmental Issues and Sustainability". Other panellists included **Klaus Jacob,** Freie Universität Berlin, Germany and **Heino von Meyer** of the Organization for Economic Cooperation and Development. A second parallel semi-plenary session focused on the results and new directions of the 8-year international IHDP research programme "Institutional Dimensions of Global Environmental Change" (IDGEC), with presentations by **Oran Young,** the Chair of IDGEC; **Leslie King,** Chair of the Synthesis Conference planning group, and **Frank Biermann,** Chair of the New Directions in Institutional Research initiative. A third semi-plenary addressed "Teaching Global Environmental Governance", with presentations by **Sonja Wälti,** Hertie School of Governance; **Kirsten Jörgensen,** Freie Universität Berlin; and **Ruben Mnatsakanian,** Central European University, Hungary. In the fourth semi-plenary, research group leaders of the Global Governance Project – **Steffen Bauer, Bernd Siebenhüner, Klaus Dingwerth** and **Philipp Pattberg** - presented first results of their project.

The about 100 papers presented in the various parallel panels addressed a variety of new research findings, insights, methods, and theories in the growing field of the study of international organizations. Empirical examples of the research presented includes agencies of the United Nations system, ranging from the UN Environment Programme to the secretariat of the UN climate convention; intergovernmental agencies outside the UN system, such as the Organisation for Economic Cooperation and Development, or the World Bank; regional integration schemes such as the European Union, the African Union, or the North American Free Trade Agreement; new forms of intergovernmental mechanisms that have some actor-quality, such as the Intergovernmental Panel on Climate Change; nongovernmental transnational actors, such as Greenpeace, the World Wide Fund for Nature or the Global Climate Coalition; and novel multi-stakeholder organizations beyond the state, such as the Forest Stewardship Council or the World Commission on Dams.

Regarding these types of actors, all papers elaborated on one or more of four core themes of the 2005 Berlin

Conference: 1) Environmental effects and influences of international organizations in global environmental governance; 2) Design of international organizations and programmes in order to understand how different types of organizational design influence the effects of organizations; 3) Institutional and organizational interlinkages and the role of international organizations in larger regimes (including interplay of international organizations within the UN system); and 4) Analysis of policy integration within international organizations.

Frank Biermann, Bernd Siebenhüner, Anna Schreyögg

Conference papers and other conference information are available at **http://web.fu-berlin.de/ffu/akumwelt/ bc2005/papers.html.**

In Brief

British Global Change Researchers and Social Scientists Hook up with IHDP

Senior representatives of the UK Global Change Committees agreed to increase collaboration with the International Human Dimensions Programme on Global Environmental Change (IHDP). This decision was taken at a UK-IHDP get-together during the IHDP Scientific Committee Meeting in Norwich, UK, from 27 to 30 March 2006.

The British Economic & Social Research Council (ESRC) will support regular events such as seminars and workshops, with one concrete follow-up step being a capacity building workshop and forum for young African and British scientists. While UK scientists are already active within IHDP research projects, such as Industrial Transformation, Urbanization, or Food Systems, it was agreed that more remains to be done in order to link UK global change research to an international agenda.

IHDP SC Meeting: Entering a New Decade

As IHDP is entering its second decade and has successfully consolidated its work of the first 10 years, the IHDP Scientific Committee decided on developing a long-term strategic plan. With the main foci science, policy relevance, capacity building, and outreach, the strategic plan will be presented at the next Scientific Committee Meeting in 2007. New Chair of the IHDP SC is **Oran Young** from the Bren School of Environmental Science and Management at the University of California (Santa Barbara), taking over the SC leadership from **Coleen Vogel** (Witwaters University, Johannesburg). **Roberto Sánchez-Rodriguez** (UC Mexus, University of California) has stepped back as the SC Vice Chair to concentrate on his new role as Scientific Co-Chair of IHDP's new Core Research Project UGEC (Urbanization and Global Environmental Change). SC members **Geoff Dabelko** (Woodrow Wilson Center for Scholars, Washington), **Roberto Guimaraes** (United Nations Division for Social Policy and Development, New York), and **Hebe Vessuri** (IVIC, Caracas) are the new SC vice chairs. Longstanding SC member **Elinor Ostrom** (University of Indiana) has rotated off the Committee. We are thanking all for their commitment!

At the Secretariat in Bonn, the International Science Project Coordinators **Gregor Laumann** and **Debra Meyer-Wefering** have left – both for a new position within the realm of global environmental change research. We wish them all the best and we will miss them! New faces at the Secretariat include **Falk Schmidt** and **Nils Harder** as Science Consultants, **Alexia Duten** as Assistant Conference Manager, **Petra Friedrichs** as Financial Coordinator, as well as **Jens Marson** and **Mareike Kroll.** Jens will also concentrate on conference management, while Mareike will take over the student assistant post previously filled by **Nora Reich** who has left to concentrate on the completion of her studies. Finally, we are looking forward to have our colleague, **Lis Mullin,** back with us in the office (as of June) after her maternity leave.

ConAccount 2006:
"Dematerialization Across Scales: Measurement, Empirical Evidence, Future Options"
September 13-14, 2006, Vienna Austria

Back to back with a policy dialogue
"Dematerialization Why and How?"
September 15, 2006

Further information and online submission of abstracts:
http://www.iff.ac.at/socec/conaccount2006/

Land-Use and Land-Cover Change Local Processes and Global Impacts

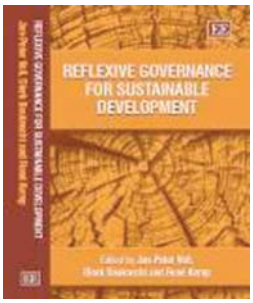
Editors: Eric Lambin and Helmut Geist

The edited book synthesizes research achievements by dozens of scientists related to the Land-Use/Cover Change (LUCC) project of the International Geosphere-Biosphere Programme (IGBP) and the International Human Dimensions Programme on Global Environmental Change (IHDP). It summarizes relevant findings on global land-use change which arose from value-adding activities of the LUCC project, starting in 1995 and extending until its termination in October 2005. The main intention is to describe how human modification of land cover became a major driving force of Earth System changes over the past 300 years, a period of most rapid transformations, with fundamental implications for current landscape configurations. In writing this book, current knowledge and understanding is reported on the rates, causes/pathways, impacts, future scenarios/models, policy implications and new research directions in the field of land-use/cover change.

Springer, Series: Global Change - The IGBP Series
2006, approx. 220 p. 44 illus., 20 in colour,
Hardcover 85,55 €
ISBN: 3-540-32201-9

Reflexive Governance for Sustainable Development

Editors: Jan-Peter Voß, Dierk Bauknecht and René Kemp



Innovations are introduced in the hope that they will have positive impacts on their targets, but also in the certain knowledge that there will be negative and unintended effects as well. In time, these less desired effects may also come to generate innovative and adaptive responses in a continuous, 'reflexive' process. This book sets out to analyse the consequences for sustainability research and policy analysis. This collection, by many of the leading thinkers in the field, blends sophisticated theoretical discussion with practical perspectives on how to deal with the conundrum 'the only thing certain about the future is that you'll be wrong about it!'
Frans Berkhout, Vrije Universiteit Amsterdam, The Netherlands

This book deals with the issue of sustainable development in a novel and innovative way. It examines the governance implications of reflexive modernization and the condition that societal development is endangered by its own side-effects. With conceptualizing reflexive governance the book leads a way out of endless quarrels about the definition of sustainability and into a new mode of collective action.

Edward Elgar 2006, 480 pp, Hardback, USD 135.00/ GBP 79.95; ISBN13 978 1 84542 582 1

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