



SCIENCE PLAN

URBANIZATION AND GLOBAL ENVIRONMENTAL CHANGE



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Science Plan

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Roberto Sánchez-Rodríguez, Karen C. Seto, David Simon, William D. Solecki, Frauke Kraas, Gregor Laumann

A long-term international research project developed under the auspices of the International Human Dimensions Programme on Global Environmental Change (IHDP) with significant financial support from the Asia-Pacific Network for Global Change Research (APN), the Consortium of Social Science Associations (COSSA), the French Ministry of Foreign Affairs (MAE), the German Federal Ministry for Education and Research (BMBF), the German Research Foundation (DFG), the Inter-American Institute for Global Change Research (IAI), and the SysTem for Analysis, Research, and Training (START).

International Human Dimensions Programme
on Global Environmental Change



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Preface

By the end of this decade, more than half of the world's population will live in cities. It is clear that the development of urban areas hold the key to many of the challenges we face in our interactions with the environment. This is one of the reasons why urban areas have become an increasing focus for the IHDP. The core project on Urbanization puts emphasis on global environmental change, both as driver and outcome of economic, political, cultural, social and physical processes in urban areas. In this way, urbanization is viewed as both endogenous and exogenous to global environmental change, and therefore they are approached as tightly-coupled.

This IHDP core project seeks to provide a better understanding of the interactions and feedbacks between global environmental change and urbanization at the local, regional, and global scales. To capture the benefits of urbanization and mitigate as well as adapt to negative environmental and socioeconomic impacts, a stronger collaboration between academics, political decision-makers and practitioners is encouraged. This includes a broad range of local, national, and regional actors working on urban and environmental issues. The core project on urbanization provides an innovative conceptual and methodological framework for this endeavour. It aims to become a platform co-ordinate of a network of professionals in this area of research for exchange of experience and knowledge. It facilitates co-operation within and among various world regions with respect to theories, models and methods, state policies and local initiatives related to Urbanization and Global Environmental Change.

As urbanization represents a critical topic of special policy relevance in today's world, the Scientific Committee of the International Human Dimensions Programme on Global Environmental Change (SC-IHDP) is especially pleased to approve this new Science Plan. The development of a well-crafted Science Plan is a pivotal step in the lifecycle of a global project, as it must provide clear guidance for priority research over a 5-10 year period. By this the Science Plan constitutes a framework to organize scientific diversity, connecting different research groups and scientific perspectives under common thematic foci. The ultimate objective is to make scientific research more effective and translate scientific knowledge in more coherent and visible ways into other societal contexts.

This Science Plan is the product of two years of a bottom-up, consultative process, which started in 2002. In March 2003 a "scoping report" was presented to the SC-IHDP. Roberto Sánchez-Rodríguez led the effort of developing a Science Plan for this new core project together with an international core group of scholars. The Plan was then sent for academic peer review and has been approved by the SC-IHDP. The main conclusion was that this new core project represents an unrivalled opportunity for addressing critical issues of worldwide importance that have not received adequate attention so far. The SC-IHDP acknowledged the integrative potential of the topic of

urbanization and the need to intensify work on it. It is also convinced that this project will provide critical insights and support to the partner programmes of the IHDP, i.e. DIVERSITAS, IGBP and WCRP.

The SC-IHDP would like to express its appreciation and thanks to all those who have collaborated in the design, development, drafting and reviewing of this Science Plan. The key to the future success of the IHDP is indeed the voluntary and collaborative action of the highly qualified and committed researchers involved in its Science Projects. Those who have collaborated in the urbanization process are too numerous to mention individually, but we must extend our special appreciation to the members of the group of authors of this Science Plan, Prof. Karen C. Seto (Stanford University, USA), Prof. David Simon (University College London, UK), Prof. William D. Solecki (Hunter College, New York, USA), Prof. Frauke Kraas (University of Cologne, Germany), Gregor Laumann (IHDP Secretariat, Bonn, Germany) and their Chair, Prof. Roberto Sánchez-Rodríguez (University of California, Riverside, USA), who have all invested so much effort over the past two years to complete this plan. We would also like to acknowledge the special contributions made by the other members of the scoping team, namely Prof. Bruce Caldwell (Australian National University, Canberra, Australia), Prof. Chris Cocklin (Monash University, Melbourne, Australia), Dr. Shobhakar Dhakal (Institute for Global Environmental Strategies, Kitakyushu, Japan), Dr. Ooi Giok-Ling (National Institute of Education, Singapore), Prof. Olga Medvedkov (Wittenberg University, Springfield, USA), Prof. Kwasi Nsiah-Gyabaah, Sunyani Polytechnic, Ghana), Dr. Aboul-Fetouh Shalaby (Cairo University, Egypt) as well as Maarit Thiem and Valerie Schulz (IHDP Secretariat, Bonn, Germany).

We would also like to express our special thanks to Prof. Charles Redman (Arizona State University, Tempe, USA), Prof. Ezequiel Escurra (National Institute of Ecology, Mexico City, Mexico), Prof. Susan Parnell (University of Cape Town, South Africa), Prof. Ben Wisner (Oberlin College, USA), and Prof. Woo-ik Yu (Seoul National University, Korea) who provided extremely useful advice at the final review stage aimed at enhancing the focus and value-added of the proposed research activities.

Finally, completing this Science Plan would not have been possible without the continuous generous support of our funding agencies, namely the Asia-Pacific Network for Global Change Research (APN), the Consortium of Social Science Associations (COSSA), the French Ministry of Foreign Affairs (MAE), the German Federal Ministry for Education and Research (BMBF), the German Research Foundation (DFG), the Inter-American Institute for Global Change Research (IAI), and the SysTem for Analysis, Research, and Training (START).

Completing a Science Plan, however, is not the end of a process. It is actually the beginning of launching a long, dynamic and challenging implementation process. The next step will be to strengthen the linkages between

research networks to integrate under this umbrella their on-going and past research activities in this field. This implies also researchers to prepare and submit new research proposals through national, regional and global funding mechanisms in order to carry out the new research priorities identified within the Science Plan. We are confident that future collaboration between human dimensions researchers, donors, the policy communities, practitioners will lead to mutually beneficial and significant research results.

The IHDP will continue to support this process with great interest and a view to ensuring that this Science Plan is effectively implemented.

Prof. Coleen H. Vogel
Chair, SC-IHDP

March 2005

Dr. Barbara Göbel
Executive Director, IHDP

Executive Summary

Urbanization - both as a social phenomenon and a physical transformation of landscapes - is one of the most powerful, irreversible, and visible anthropogenic forces on Earth. Many of the most important and significant changes associated with the impact of globalization are taking place in urban areas. More than half of the world's population live in urban areas and more than 90 percent of future population growth is likely to be concentrated in cities, and mainly in poor countries. Rapid growth of population and its concentration in urban areas have significant implications for the long-term outlook for humanity. Burdened with many problems associated with growth, urban areas are increasingly subject to dramatic crises. This is especially true in poor countries where economic and financial crises, together with fast and unbalanced growth of urban areas, have created fragmented spaces with high spatial segregation that aggravates the social exclusion characteristic of those societies. The aforementioned problems play an important role in the interactions between urban areas and global environmental change. These interactions create a diversity of impacts that can be grouped in two broad categories: those originating in urban areas that have a negative effect on global environmental change, and global environmental changes that have negative effects on urban areas.

Despite their growing importance, urban areas have been understudied in the analysis of global environmental change, with a majority of research placing emphasis on the impacts of urban areas on global environmental change. Research efforts focus particularly on the contributions of emissions of greenhouse gases and the heat island effect to global climate 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. Particularly critical are the conditions in poor countries.

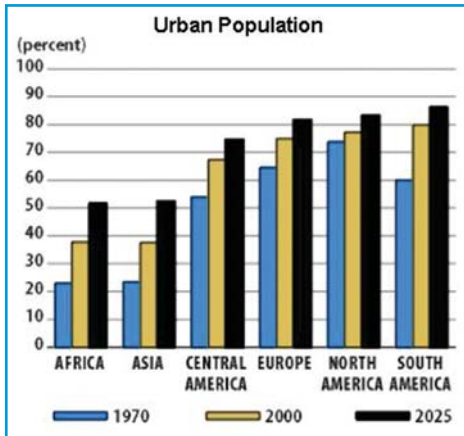
This core project seeks to fill this gap. Its goal is to develop a better understanding of the interactions and feedbacks between global environmental change and urbanization at the local, regional, and global scales. Its strategy is to create a multidisciplinary and interdisciplinary perspective of these issues through innovative conceptual and methodological approaches. Its science plan puts emphasis on global environmental change both as driver and outcome of human (economic, political, cultural, and social) and physical (urban structure, expansion, and land use) processes in urban areas. In this way, urbanization is viewed as both endogenous and exogenous to global environmental change, and the research strategy aims to study them as a tightly coupled system. The science plan of the core project has four thematic foci that cover the array of interaction between the urban and the global environment components of the Earth system. The conceptual framework starts with processes within the urban system that contribute to global environment change (Theme 1). A second focus (Theme 2) is on the pathways through which specific global environmental changes affect the urban system. Once these pathways and points of intersection are identi-

fied, the framework addresses the resulting interactions and responses within the urban system (Theme 3). Finally, the framework centres on the consequences of the interactions within the urban system on global environmental change, or feedback processes (Theme 4). These four thematic foci create a comprehensive perspective of the dynamic, diverse, and complex interactions between urban systems and global environmental change processes. Fundamental to the process are different levels of interaction and interconnectivity in the conceptual framework that focuses on:

- Interaction among dimensions within urban areas and global environmental change (social, cultural, economic, political, and biophysical)
- cross-temporal and cross-spatial scale approaches
- parallel and comparative studies across regions and time
- interactions among different actors and networks involved in complex dynamics in urban areas
- research that provides effective communication of results to the public and policymakers

The short, middle, and long-term strategies of the core project have been designed to accomplish the goals and objectives of the core project through its 10-year life cycle. They include actions for research, policy and educational outreach, and fund-raising. Together, they involve fostering an environment of continued learning and incorporating feedbacks to strengthen the core project as it evolves over time. However, this scientific plan, like any other plan, requires periodic assessments. The core project plans to organize annual workshops to assess the development of its research agenda, as well as large scientific conferences at the end of each five years to assess the development of the core project, enhance its visibility, and make re-adjustments for further development.

Introduction

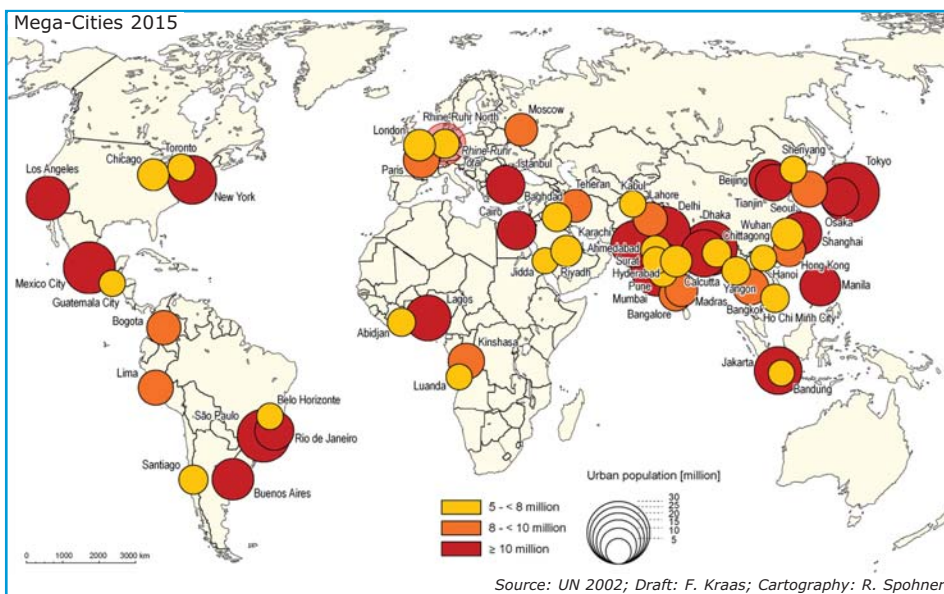


Source: UNCHS 2002

Urban areas are complex and dynamic systems that reproduce within their territory the interactions among socioeconomic, geopolitical, and environmental processes at local, regional, and global scales. Many of the most important and significant changes associated with the impact of globalization are taking place in urban areas. More than half of the world's population, approximately 3.3 billion people, is estimated to live in urban areas (UN 2004a, UN 2004b, UNCHS 2002, HABITAT 2001, Kraas 2000).

According to some projections, over 60 percent of the world's population will live in cities by 2030. The current world average annual rate of urbanization is 0.8 percent, but this rate varies widely, from about 1.6 percent for all African countries to about 0.3 percent for all highly industrialized countries. More than 90 percent of future population growth is likely to be concentrated in cities, and mainly in developing countries.

Today there are 19 mega-cities (i.e., with 10 million or more people); 22 cities with 5 to 10 million people; 370 cities with 1 to 5 million people; and 433 cities with 0.5 to 1 million people. In the year 2015, according to estimations there will be about 60 megacities with a total population of more than 600 million people (Bronger 2004, Kraas 2003, UNCHS 2002, Dege 2000, Heintel and Spreitzhofer 1998, Bronger 1997). Growth in the number



of mega-cities has begun to slow in Europe and the Americas, but the reverse is true in Asia and Africa. This is largely due to a shift in global demographic trends during the last decade. These two continents will host the largest numbers of mega-cities by 2015.

However, the fastest growing urban areas are medium sized cities (Montgomery et al. 2003). Although these cities face similar problems to those of mega-cities, they have significantly fewer resources to devote to the complex infrastructural, social and environmental issues associated with rapid urbanization.

A large majority of these new urban inhabitants will be poor. It is estimated that between one-quarter and one-third of all urban households in the world live in absolute poverty (UNCHS 2002). This percentage is larger in some regions. Poverty in Latin America is increasingly urbanized due to the continent's fast rate of urbanization and the overall increase in poverty and inequality there (Payne 2002, Rakodi/Lloyd-Jones 2002, World Bank 2001). The World Bank estimates that five out of every six additional poor people between 1986 and 1998 in that region were based mainly in urban areas (World Bank 2002a, Hentschel and Seshigiri 1999). A similar situation exists in Asia and the Pacific, where an increasing number of the entire region's poor live in urban areas (Montgomery et al. 2003, UNCHS 2002).

Cities are human artefacts and reflect, as well as influence, their inhabitants. This core project¹ focuses on the complex relationships among urban areas, Urbanization processes and global environmental change (GEC)². This comprises the physical dimensions of urban areas as well as the social wellbeing and quality of life of their heterogeneous inhabitants. Implicit in the conceptualisation of this research framework is the recognition of the political and institutional dimensions of Urbanization. Cities have administrative boundaries which define the spatial limits of urban decision-making and management, yet global environmental change operates across these and must also be addressed through a multitude of institutions and mechanisms at various geographical scales.

Rapid growth of population over recent decades and its concentration in urban areas have significant implications for the long-term outlook for humanity. Today, the demographic trends are increasingly complex, and regionally differentiated. In many parts of the world, population growth rates are falling, both as a result of rapid reductions (for diverse reasons)

¹ Since the IHDP is formally a GEC programme, technically its research programmes - of which this is one - are referred to as 'core projects'. We therefore adhere to this terminology. This Science Plan constitutes a framework for a programme of research that will comprise a number of individual research projects.

² Global environmental changes are defined as those that alter Earth system functioning and experienced globally (e.g. climate change) and those that occur in specific areas and the aggregate effects of which contribute to global change (e.g. land conversion) (Vitousek 1992).

in total fertility rates and (especially in parts of sub-Saharan Africa and now also South Asia) because of the ravages of the HIV/AIDS pandemic, in particular. Elsewhere, population growth is still considerable. There is also sub-national variation. However, for purposes of this core project, the central issue is that there is no simple, linear or direct relationship between population growth and composition, resource use and global environmental change. Therefore, it is impossible to 'read off' the one from the other; rather, there is a need for local research to establish such relationships in particular contexts. Even in some situations of zero or near-zero population growth, cities are growing and changing in their age, gender, ethnic/cultural/national and income/educational composition through processes of intra- and international migration - all of which will affect these relationships.

Now, at the beginning of the 21st century, systems of cities have become increasingly dominant in the world's social, economic, cultural, political, and environmental matrix. Urbanization has many positive as well as negative aspects and consequences. In the context of global environmental change, the emphasis has overwhelmingly been on urban areas as sources of environmental problems. It is therefore important for this core project to take appropriate account of their many positive impacts, including economic growth (Quigley 1998), technical innovation, access to information, efficient land and energy use, better living conditions, provision of clean water, and access to health care services. It is necessary to include the potentials and opportunities of urbanism to mitigate its current contributions to global environmental change and, conversely, the impact of global environmental change on urban areas and their inhabitants. In this context, this core project will also contribute to achieving the Millennium Development Goals (MDGs).



Urban areas are driving economic growth. Urbanization in the twentieth century established a network of competitive centres that set the physical reference points for today's globalization. Urban centres are the nexus of commerce and the gateways to the world's economy. The World Bank estimates that in poor countries as much as 80 percent of future economic growth will occur in cities (World Bank 2002). In some countries, a single city generates a large percentage of the

national GDP: Bangkok produces nearly 40 percent in Thailand, São Paulo 36 percent in Brazil, and Lima 43 percent in Peru.

Burdened with many of the problems associated with growth, cities are increasingly subject to dramatic crises, especially in poor countries. Unemployment, environmental degradation, deficiencies in urban services

and adequate housing, deterioration of existing infrastructure, lack of access to key resources, and violence are among the main areas of concern (Pile, Brook and Mooney 1999, Satterthwaite 1997, Gugler 1996, Pugh 1996, Fuchs et al. 1994, McGee and Robinson 1995, Haughton and Hunter 1994, Gilbert and Gugler 1992). These problems are exacerbated in poor countries where economic and financial crises, together with fast and unbalanced growth of urban areas, have created fragmented spaces with high spatial segregation that aggravates the social exclusion characteristic of those societies (Beall 2002, Coy and Poehler 2002, Pirez 2002, Lopez de Souza 2001). It creates a clear division between the formal and informal, the legal and illegal, the rich and poor (Roy and AlSayyad 2004).

The aforementioned problems play an important role in the interactions between urban areas and global environmental change. These interactions create a diversity of impacts that can be grouped in two broad categories: those originating in urban areas that have a negative effect on global environmental change, and global environmental changes that have a negative effect on urban areas.



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Studies in global environmental change have not considered the full extent of interactions between urban areas and biophysical processes, with a majority of the emphasis on the impacts of urban areas on global environmental change (Rosenzweig and Solecki 2001, Smith and Lazo 2001, IPCC 2001). Research efforts focus particularly on the contributions of emissions of greenhouse gases and the heat island effect in global climate 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. Particularly critical are the conditions in poor countries where the combined impact of global geopolitical and socio-economic processes (structural adjustment programs, economic, social, and political crises) and global environmental change have severe consequences on urban areas.

The increasing frequency and magnitude of climate-related natural disasters in urban areas during the last decade are some of the clearest indicators of the importance of those impacts. However, climate change is only one of a number of global environmental changes affecting urban areas (Rosenzweig and Solecki 2001). Research oriented to study these issues requires multi-dimensional and integrative perspectives capable of overcoming the limitations of current managerial approaches focusing on environmental problems isolated from their social, political, economical, and cultural context (Gibbs and Jonas 2000, Bryant and Wilson 1998, Redclift 1994). Critical in this regard is a better understanding of the interactions among social, econom-

ic, political, and environmental dimensions and how they shape the urbanization process (Ravetz 2000), and how this process is shaped by global environmental change.

Rationale

The specific focus of this new core project is the interactions between global environmental change and urban processes. These bi-directional interactions and processes may increase the rate, intensity and scale of urban and environmental change. Such change may be both positive and negative for different places and groups at different times, but the extent of potential negative changes represents a substantial challenge to the functioning, stability and sustainability of urban areas. Although these changes will be felt in both the global North and South, they will present a far greater threat in the latter.



Substantial knowledge has already been accumulated from disparate research on various aspects of urbanization and global environmental change. The strength of this new core project would lie in building on this foundation in creating an innovative and integrated approach. Urban studies have a long tradition in the social sciences (urban economics, urban sociology, urban anthropology, urban politics, and urban geography), in the engineering sciences (urban transportation, urban infrastructure, urban design), as well as in the professional field of planning (urban and regional planning, public administration). Contributions from the natural sciences have also expanded our knowledge of urban issues (urban climate, urban metabolism, ecological services, urban habitat conservation, urban geology and hydrology, urban environment). Finally, the health sciences provide key contributions to the identification of some of the most dramatic consequences of urban deficiencies and problems. Absent thus far is a framework that integrates the contributions from these disciplines. This missing perspective is fundamental for a better understanding of the complex interactions between global environmental change and urban processes. It is also essential to the formulation and implementation of appropriate policies to address the diverse array of consequences created by those interactions. Unfortunately, little of the existing research has explicitly situated urban systems³ within a global environmental change perspective except in isolated case studies. Since cities both contribute to, and are influenced by, global environmental change, this perspective is both necessary and timely.

³ The term "urban system" is used to describe the city as integrated and interacting with its environment, as opposed to the use of the term in parts of the literature as "system of cities".

The proposed IHDP core project on urban issues will create new multidisciplinary and interdisciplinary knowledge through innovative conceptual and methodological approaches. This represents an unrivalled opportunity for addressing critical issues of worldwide importance that have not received adequate attention to date. As stated above, these issues have severe social, economic, and environmental consequences for urban areas in rich and poor countries, particularly those areas already experiencing increasing urban and environmental stress. This will place IHDP in a unique position to facilitate mutual learning and cooperation between the North and South in an effort to provide a more adequate response to diverse issues in small, middle and mega-cities created by the interactions between urban processes and global environmental change.

Objectives

This core project aims to build better knowledge and understanding of the human dimensions of global environmental change in urban areas. The core project has the following objectives.

- To assist in the development of conceptual frameworks and methodologies capable of supporting the study and analysis of these interactions
- To guide the study of the interactions between global environmental change and urban systems with the ultimate goal of facilitating parallel and comparative cross-study analyses
- To identify the points and strength of interaction, the thresholds for change, and the direction of causality in a coupled human-environment urban system
- To facilitate the translation and communication of scientific research results to decision-makers, practitioners, and other end-users at the international, national, and local levels in the urban areas around the world

Conceptual Framework

The research community has struggled with designing suitable analytical frameworks to articulate, describe and understand the complex relation between society and the environment (Ehlers and Krafft 2001, Wolfrum 2001, Kasperson et al. 2001, Smith and Lazo 2001). Some of the contributions have attempted to describe the society-environment relation in ways that are useful to policymakers (Loh 2000, Daly and Cobb 1989). Others have sought to provide a more a conceptual framework (Fitzsimmons and Goodman 2001, Fitzsimmons 1989). These and other contributions recognize the need for multidimensional and integrative perspectives capable of overcoming the limitations of current managerial approaches focusing on environmental problems isolated from their social, political, economic, and cultural context (Gibbs and Jonas 2000, Simon 1999, 2001, Bryant and Wilson 1998, Redclift 1994). Critical in this regard is a better understanding of the interactions among social, economic, political, and environmental

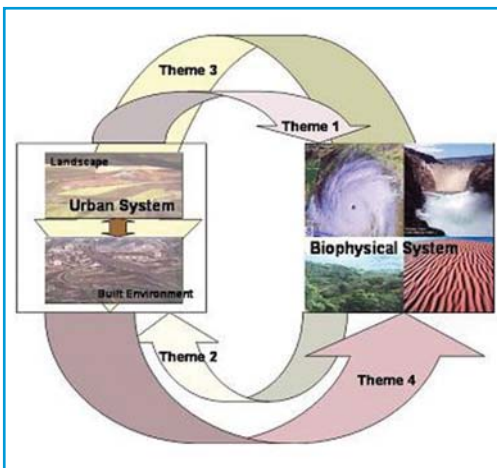
dimensions and how they shape the urbanization process (Ravetz 2000), and how they are shaped by global environmental change.

Other scholars have recognized the need to develop theoretical frameworks to provide an integrative approach to the interactions between urban areas and the environment. Interesting contributions have been made through the integrated assessment approach for sustainability in urban areas (Button 2002, Ravetz 2000, Rotman, van Asselt and Vellinga 2000), as well as approaches emphasizing urban metabolism (Warren-Rhodes and Koenig 2001, Tress et al. 2001, Newman 1999), and urban ecosystems (Mcintyre 2000, Tobin 1999, Rees 1997, Grove 1997, Pickett et al. 1997). These approaches provide valuable contributions to the development of theoretical frameworks for the human dimensions of global environmental change in urban areas.

In this regard, some scholars suggest that analyzing the network of social and economic activity through a landscape will allow researchers to determine the vulnerability to disruption if the social, economic and biophysical environment changes (Fraser, Mabee, and Slaymaker 2003, Mitchell 1999). By the same token, landscape planning (Fry 2001, Linehan et al. 1998, Wilson 1992) and long-term ecosystem analysis (Heemskerk et al. 2003, Parr et al. 2003) have pursued interdisciplinary approaches in an effort to incorporate multidimensional frameworks in the study of landscape.⁴ These contributions, together with those coming from the study of vulnerability

(Blaikie et al. 1994, 2003, Adger 1999, Bohle, Downing and Watts 1999) and social resilience (Folke et al. 2002, Carpenter et al. 2001, Puente 1999, Berkes and Folke et al. 1998), stimulate the development of analytical frameworks to study the impacts of global environmental change on urban systems.

These contributions are incorporated in the design of the conceptual framework of this core project. The Urbanization and Global Environmental Change Project has four the-



⁴ "There is an urgent need to link more effectively with the growing community of environmental social scientists to create more integrative, interdisciplinary teams to deepen understanding of the factors determining the vulnerability and resilience of the nature - society system to change.

The failure to engage seriously with the social and economic dimensions of environmental change is probably one of the main reasons why LTER is currently undervalued as a policy research field" (Parr et al. 2003: 6).

"Landscape is more than a scale and a set of interacting ecosystems. It is "a way of seeing the world and imagining our relationship to nature...It is something that we think, do, and make as a social collective" (Wilson 1992:12).

matic foci, which emerge from a conceptual framework of the interaction between the urban, and the global environment components of the Earth system.

The conceptual framework starts with processes within the urban system that contribute to global environment change (Theme 1). Theme 2 focuses on the pathways through which specific global environmental changes affects the urban system. Once these pathways and points of intersection are identified, the framework addresses the interactions and responses within the urban system, which result (Theme 3). Finally, Theme 4 centres on the consequences of the interactions within the urban system on global environmental change, or feedback processes.

The four thematic foci allow the core project to:

- develop an understanding of the interaction and feedbacks between urbanization and global environmental change at local, regional, and global scales, and
- create multidimensional integrative perspectives of each of the themes mentioned above capable of overcoming the limitations of current fragmented and managerial approaches focusing on environmental problems isolated from their social, political, economical, cultural, and biophysical dimension.

Critical in this regard is not only incorporating these dimensions into the analysis but also achieving a better understanding of the interactions among them.

The conceptual framework focuses on:

- cross-temporal and cross-spatial scale approaches;
- comparative analyses across time and space;
- research that provides effective communication of results to the public and policymakers.

Theme 1: Urban Processes That Contribute to Global Environmental Change (GEC)

Fundamental to the Urbanization and Global Environmental Change Project is an understanding of the underlying human and physical processes that contribute to global environmental change. Although urban processes and energy use (e.g., commuting patterns) can contribute to local environmental conditions (e.g., air pollution), the focus of the core project is on cross-scale interactions, with an emphasis on local urban processes that impact global environmental changes. This includes crosscutting themes that have strong connections to other IHDP core projects such as Land Use and Land-Cover Change (LUCC), Industrial Transformation (IT), and Institutional Dimensions of Global Environmental Change (IDGEC). For example, LUCC contributes directly to the goals of Theme 1 by providing insight on the proximate and underlying drivers of urban land use change; the carbon budget of cities can be estimated with results from the IT core project (water, transportation, energy use, production and consumption patterns) and the new joint IHDP-IGBP Global Carbon Project (GCP).

This theme starts with the assumption that urban processes contribute to global environmental change, and does not consider feedback mechanisms between human processes and the environment, which are developed in Theme 2. The starting point here is a unidirectional view of the impacts of urban lifestyles and consumption patterns on global environmental change, without evaluating their underlying processes.

1.1 How Do Lifestyle and Consumption Patterns Within Urban Areas Contribute to GEC?



Urban populations are characterized in part by lifestyles and consumption habits that are distinctly different from rural livelihoods. There is considerable research on the relationships between income and environmental indicators (e.g., energy and water consumption, waste and emissions). However, re-search is needed that examines the interactions among income and class, lifestyles (values and behaviours, e.g. among expanding elites and middle classes), and contributions to global environmental change across spatial scales and in different regional settings that take into consideration the roles of institutions and policies (Sklair, 2002, UNCHS 2001, James, 2000, Newman 1999, Parikh and Shukla 1995,, Djursaa and Krang 1998).

The core project will also seek to collaborate with other projects working on similar issues like the GCP or IT.

1.1.1 *How do the relaxation of state-led development and increased market and individualized decision-making as a result of politico-economic liberalization and privatization transform urban life and its impact on global biophysical processes?*

Over the last two decades, rapid and structural changes in the function and strength of the state to foster and manage growth and development in poor and rich societies around the world have had important consequences in urbanization patterns. The dominant neo-liberal ideology has led to the relaxation of state-led development. Research has documented how the declining role of the state and emergence of the market and increasingly individualised decision-making has transformed urban life. Much less attention has been focused on how those transformations of urban life impact on global biophysical processes (Jung Yong et al. 2000). The declining role of the state in regulating emissions of greenhouse gases from urban areas, or rapid urban expansion regulated by market forces, are examples of some of the transformations of urban life that impact global environmental change.

1.1.2 *How do rising incomes and associated consumption patterns in urban areas impact upon global resource demands under different cultural, social, economic and political circumstances?*

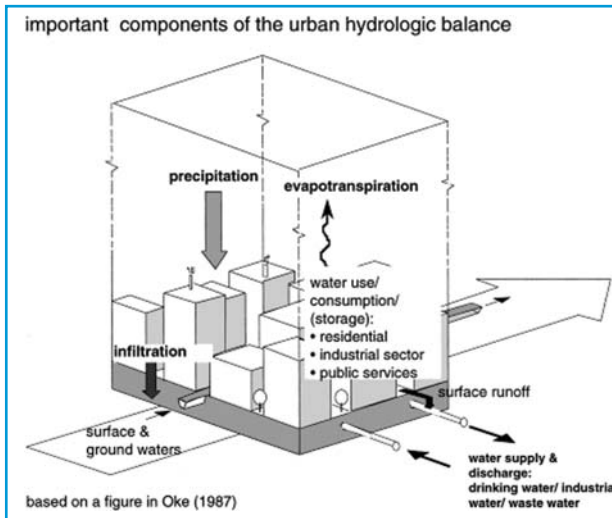
The concentration of economic growth in urban areas is associated with rising incomes and associated consumption patterns. Both of these consequences of economic growth often lead to increasing demand for, and pressure on, natural resources at the regional and global levels. For example, the demand for tropical hardwood in certain urban areas leads to severe mangrove degradation, deforestation, land use change, and loss of habitat and biodiversity in distant places. What are the major indicators of these impacts? Are there any significant difference by regions and typology of urban area? What are the major consequences for biophysical processes that can be identified to date?



1.1.3 *How does urban water demand impact upon regional and local fresh water supply, especially in water-scarce areas?*

One of the big challenges facing urban areas is to guarantee their supply of water. Scholars have created a useful debate about this issue, but more attention is also needed to the potential impact of current and future water demand in urban areas and its impact upon global fresh water supply. Although direct water demand in urban areas is small compared to agriculture or other users, longstanding and new urban areas already compete for scarce water resources in some regions (e.g., south-western US, the Middle

East, southern Africa, parts of central Asia, the Sahel). Meeting the MDG of providing potable water to the urban poor raises additional questions about longer term environmental sustainability of these urban systems.



Source: Pauleit & Duhme (2000)

On top of direct water demand, urban areas can also impact on regional fresh water resources through induced regional land use and land cover changes that modify the sustainability of watersheds. These include conversion of naturally vegetated areas to urban uses and to water-intensive recreational uses, e.g. swimming pools and golf courses (on the latter of which intensive fertiliser

use also contributes to groundwater contamination). An integrated perspective of the impact of urban areas on these resources will enable a more comprehensive assessment of the consequences for the biophysical system. This is an area where fruitful collaboration can be established between with the Global Water Systems Project (GWSP), the Global Land Project (GLP), and with international organizations (International Water Commission, UNEP).

1.2 How Does Urban Land Use and Land Cover Change Affect GEC?

Urban function and form are the physical manifestations of the interactions and conflicts among global, regional, and local forces in the urban space. Urban function and form also define the positive and negative bi-directional interactions with regional and global environmental change. Examples of these interactions are the impacts of different land uses within the urban areas on the creation of microclimates (Jazcilevich et al. 2000, Martinez and Jauregui 2000, Khan 1999, Marquez and Smith 1999, Jauregui 1998, Jauregui and Morales 1996); the health consequences of climate variability and climate change in urban areas (Kalkstein and Greene 1997, Patz and Balbus 1996, Kalkstein and Smoyer 1993); the lack of adaptation of architecture and urban design to local climatic conditions (Lazar and Podesser 1999, Simon 1992, Evans and Schiller 1991), aggravating energy demand and index of comfort for their inhabitants. There are extended causal chains created by these changes in urban function and urban form that affect the interactions between urban areas and global environmental change.

The size, scale, and form of cities and their likely future growth trajectories will be critical to global environmental change. The environmental challenges posed by the spatial configuration of urban land use have been and will continue to be enormous: infrastructure requirements of extensive versus compact cities, energy implications of commuting patterns, impact of urban expansion on global food security. The conversion of natural and agricultural ecosystems to urban uses has massive implications for Earth system functioning, and while there exist numerous regional and local case studies (Yan and Wei 2004, Milesi et al. 2003, Schneider et al. 2003, Seto et al. 2000, 2002 Masek 2000), the global rate and extent of urbanization as a transformation of the landscape are poorly documented. Even less understood are the impacts of urban form in the 'global south'. For example, many of the existing studies on urban heat islands have been conducted in temperate zones, and yet most of the future urban growth will occur in the global south. These are also regions of the world with economies that rely heavily on dirty technologies. Hence, more studies are needed in semi-tropical and tropical areas.

Perhaps the most conspicuous cases are in the primate mega-cities and their Extended Metropolitan Regions (EMRs) of Southeast Asia and Latin America (McGee and Robinson 1995). Here rapid growth and economic restructuring in cities like São Paulo, Mexico City, Bangkok, Singapore/Johor Bahru, Jakarta, Hong Kong/Shenzhen and to a lesser extent Manila, geared increasingly to internationally competitive export and financial service provision, have created stark contrasts between rich and poor, pollution level, legal and illegal areas within the cities. Urban areas are undergoing new dynamics and, as a consequence, are facing new spatial and organizational challenges as they seek to manage local urban development within a globalizing world (Lo and Yeung 1996, 1998, Rakodi 1997, Gilbert 1996). However, modifications to urban form and function are also part of the urban dynamics in intermediate centres. The incorporation of ecological services in urban planning and urban design is an encouraging effort to promote more sustainable urban forms (Tress et al. 2001, Madaleno 2000, 1999, Pauleit and Duhme 2000, Bouland and Hunhammar 1999, Inoguchi et al. 1999, Roseland 1997).



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Substantial collaboration can be established under this research area with other core projects Collaboration with the GLP and the ESSP joint project on Global Environmental Change and Food Security (GECAFS) as well as IHDP-IT and the GCP would help these projects to create integrated perspectives on this research question.

1.2.1 *How do urban form and functions affect GEC?*

Recent contributions in urban studies have highlighted the importance of urban form and function in the understanding of urban life and processes. For example, the role of urban form and function in defining patterns of growth changes in land use within the urban area and the peri-urban areas, infrastructural and transport needs, social conflicts, and a series of environmental problems associated with urban areas (pollution, environmental health). However, more research is needed to understand the impacts of urban form and function on biophysical processes. This includes the implications of land use zoning, transport infrastructure and movement of commodities and people for energy use and emissions and their relative contributions to climate change. Attention to the heat island effect of urban areas sheds some light on the impact of urban areas on global environmental change, but research in this area often considers urban areas as a whole without making much distinction between the role of urban form and function. Studies documenting the creation of microclimates within urban areas and their association with certain urban functions as well as construction technologies and building materials are helpful in this regard (Jazcilevich et al. 2000, Jauregui 1998). However, a more comprehensive approach is needed to understand these connections and their significance for a possible global aggregate effect of local urban heat islands on climate change in order to develop appropriate and practical policy implications.



1.2.2 *How does the process of urban and peri-urban land conversion affect GEC?*

Peri-urbanization refers to a highly dynamic process where rural areas, both close to but increasingly also distant from, city centres become enveloped by, or transformed into, extended metropolitan regions (Simon, McGregor and Nsiah-Gyabaah 2004, Aguilar and Ward 2003, Mbiba and Huchzermeyer 2002). These changes generally are not sudden or uniform, but rather piecemeal and ongoing processes. In the most general sense, the development of peri-urban areas involves a complex adjustment of social and ecological systems as they become absorbed increasingly into the sphere of the urban economy. Peri-urban areas fulfil key functions for urban areas, from the supply of inputs (e.g., food, energy, water, building materials), to biodi-

versity and the provision of ecological services (e.g., wildlife corridors) (Yankson and Gough 1999). They also suffer the negative consequences of urban areas (e.g., pollution, urbanization pressures and land use changes, degradation of natural resources).

Peri-urban areas also function as a key interface between urban and rural areas through the provision of essential services to rural areas. Despite their importance, and the establishment of some specific research programs relating principally to natural resources (e.g., the Peri-Urban Interface programmes of the UK Department of International Development's Natural Resources Systems Programme; and of the



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Scientific Committee on Problems of the Environment (SCOPE)), the study of peri-urban areas has been neglected in most urban and environmental studies. One of the critical areas where more research is needed is on how land conversion in peri-urban areas affects global environmental change. Some of these land conversions take place in the adjacent peri-urban areas of cities, but on other occasions they take place in distant places.

There are significant opportunities for collaboration between this core project and the GLP in this particular area, as well as with the new LOICZ core project, with its emphasis in coastal zones. Both projects emphasize land transformation processes, the competition on productive land utilization and the management of land resources. Joint areas of interest with LOICZ are in particular how the urbanization of coastal zones does impact upon aquatic food chains and water quality. Common areas of concern with the GLP would be for instance how the aggregate impact of conversion of land to urban uses affect regional and global hydrological cycles. This is particularly urgent for semi-arid areas where causal patterns of land transformation in peri-urban areas and their effect on global environmental change need to be explored (e.g. to what extent groundwater extraction causes desiccation and/or salinization and consequent land-use/cover change that in turn contribute to global environmental change through changes in albedo, rainfall, etc.).

1.3 What Are the Zones of Influence of Urban Systems, and How Do These Social and Biophysical "Teleconnections" Affect GEC?

Although urban processes may originate in an urban area, their impacts are usually not confined to the city boundaries. Urban processes have the potential to affect social, cultural, economic and ecological functions and dynamics of lands distant from the urban core (Folke et al. 1997, Satterthwaite 1997, Wackernagel and Rees 1996, Pugh 1996, Rees 1992). For example, urban

growth in Mexico City led to land-cover changes in Tabasco 400 km away through the deforestation of tropical forests to open space for cattle-raising in the late 1950s, 1960s and 1970s (Barkin 1978). The driving force behind the transformation of tropical forests to cattle ranches is to supply meat for the capital city. Similarly, the coastal regions of Brazil, Vietnam and Thailand have become suppliers of shrimp and other aquaculture products for global urban demand (Uthoff 1996). These economically driven changes in land-use and land-cover in turn can cause changes in culture and social dynamics. Thus urban systems have 'zones of influence' well beyond the immediate metropolitan area. These influences and effects in distant places are defined as 'teleconnections' similar to the definition in the El Niño/Southern Oscillation (EN/SO) context (but very different in meaning from this term used in relation to information and communications technologies (ICT)). The understanding of phenomena induced by teleconnections related to urban processes is a highly relevant contribution to the development of the earth systems approach to global change. It can be an instrument to foster co-operation on issues cutting across core projects like IT, the GLP and GECAFS and also link to the discourse on institutions and governance within IHDP.

- 1.3.1 *How do consumer demands in one urban area affect biophysical (ecosystems, water cycle, biodiversity, etc.) and social systems (economies, cultures, land-use dynamics) at different distances beyond the immediate urban boundary that can lead to global consequences?*

Attention provided to the impact of urban areas on biophysical and social systems has focused on the regional and local consequences. Studies documenting those impacts illustrate the broad range of positive and negative consequences created by the urban dynamics. Less attention has been provided on the global consequences of those impacts. A broader perspective and a better understanding of how consumer demands in urban areas leads to biophysical and social changes is needed in the study of the interactions between urban areas and global environmental change.

Particularly important is the use of a dynamic approach documenting changes in consumer patterns through time, and the differentiated impacts of urban consumer patterns in different societies.



- 1.3.2 *What are the implications of these changes and land conversions associated with urban and peri-urban processes for the biophysical system (biodiversity, climate variability and climate change, water cycle, etc.)?*

Land conversions introduced by urban consumption patterns have regional consequences for the biophysical system that can lead to global consequences. Often these consequences are interconnected and can affect several areas of the biophysical system. Although this project does not focus on the biophysical system per se, it seeks to better understand its

interactions with urban areas. The project foresees collaboration with other global environmental projects (LUCC, the new GLP, GECAFS) and other research initiatives like the Long Term Ecological Research (LTER) building interdisciplinary and integrated perspectives capable of providing a better understanding of those interactions and their implications for the environment and societies.

Theme 2: Pathways Through Which Global Environmental Change Affects the Urban System

Global environmental change and its manifestations have a wide spectrum of effects on urban processes. The increasing frequency and magnitude of climate related natural disasters in urban areas during the past decade are some of the clearest indicators of the magnitude and significance of those impacts. There is, however, a broad range of pathways through which global environmental change affects the urban systems. These impacts will depend on a number of factors, including resilience and vulnerability of peoples and places, and are associated with other socio-economic and political forces and processes. We need to better understand the pathways through which specific types of global environmental change affect local and regional human processes and well-being such as economic activities, livelihoods, urban life, migration patterns, social well-being, and human health.

This is an area where collaboration with other core projects from IHDP, the Earth System initiative and with international organizations (UNFCCC, UNEP, UNDP, UNCHS, World Bank, OECD, IDB) can have fruitful results and useful policy outcomes in the near future that can help achieve the Millennium Development Goals.

2.1 What Are the Main Processes by Which GEC Affects Human Behaviour and Interactions?

Current attention to the impacts of global environmental change has begun to focus on the vulnerability of urban areas and individuals to the negative consequences of those impacts. The current research on vulnerability from the human dimensions of global environmental change community has enhanced our understanding of the potential impacts of global environmental change on urban areas. However, there is still a need for an integrated perspective that enables analysis of the main pathways by which changes in the global environment affect and modify human behaviour in urban areas. A limited number of detailed case study materials is available at this point (except case studies in London and New York City (Rosenzweig and Solecki 2001)). The interactions between global environmental change and urban areas include myriad processes not considered within vulnerability analysis. Some of those interactions do not have dramatic consequences like those associated with climate-related natural disasters, but they still have significant consequences for urban life and functions. In the case of climate, some of those consequences are associated with social life within urban areas, the decline of economic activities, labour productivity, and urban livelihoods. For example, changes in average and extreme temperatures or in the intensity and length of seasons can have significant consequences for the importance of economic activities in some urban areas (e.g., tourism), the productivity of workers, and the use of urban space for social interaction (comfort index within the urban area).

2.1.1 *How do changes in biophysical processes and their manifestations (e.g., flooding, sea level rise, drought) affect migration and settlement patterns?*

Global environmental change can modify migration settlement patterns between rural and urban areas or within urban areas. Drought, flooding and other consequences associated with global environmental change can be strong drivers of these demographic changes. Migration is often a desperate means to alleviate extreme pressure on the livelihoods of people, mainly the low-income groups of societies. It is also a coping and adapting mechanism to global environmental change. For example, severe floods in the Yangtze Basin, China, in 1998 and 2002, caused by a combination of climate variability and human-induced land-cover changes, displaced millions of people, mainly subsistence farmers and villagers. The devastation caused by a tsunami at the end of 2004 displaced millions of people in Southeast Asia. Many of them increased the migration flow to large urban areas in those countries. Similar examples occur in Mexico, India and other poor countries. The rapid rate of urbanization at a global scale, together with the size of the population and the social conditions associated with it (a strong increase in poverty and in-equity during the last decades), illustrate the need to achieve a better understanding of the consequences of global environmental change in migration and settlement patterns.



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Concrete areas of collaboration will be established with other international initiatives on global environmental change. The Population-Environment Research Network (PERN) can serve as a resource pool to inform this discussion within the urbanization core project and vice versa (the process of urbanization is closely linked to the research on population dynamics, including migration and demographic developments). The problem of sea level rise has been particularly expounded in the context of the GECAFS focus on the Caribbean and LOICZ focus on coastal zones. Rising sea levels are assumed to intensify population pressure and the prevalent competition on land resources, by consuming or salinating the most productive coastal lands utilized for agriculture, urban settlements, tourism and recreation alike. Sea level rise can also become a major threat to urban areas in coastal zones.

2.1.2 *How do changes in biophysical processes affect urban life (urban economy, livelihoods, social life)?*

Urban studies have made significant contributions to our understanding of urban systems. We have a better understanding of the urban economy and social life within urban areas, the role of politics and culture in urban life, and the construction of the urban space. Urban scholars have also provid-

ed more attention to environmental issues during the last decade. The emergence of environmental justice research and the documentation of pollution problems and their consequences on human health have been key factors behind the attention to these issues. However, analysis needs to be undertaken on how global environmental change affects urban life. Changes in biodiversity, land use and land cover; the water cycle, and climate have potential impacts on different aspects of urban life. Broader knowledge on these impacts is needed to assist communities and individuals in preparing, coping and adapting to these changes. The consequences of global environmental change can be more dramatic than chronic environmental problems in some urban areas. In some cases, global environmental change will incorporate a new set of problems, and in others it will aggravate already critical environmental problems (i.e., air quality problems in some metropolitan areas like Mexico City, Santiago, São Paulo, New Delhi, Manila, Bangkok, and even in intermediate and small cities).

2.1.3 *How do changes in biophysical processes affect human health in urban areas?*

Among the most important consequences of changes in global biophysical processes are impacts on human health. Urban living conditions make urban residents, particularly in poor countries, sensitive to problems related to severe deficiencies in the supply and operation of public services, infrastructure, sanitation, and health service. Many of these urban areas already face environmental problems and their inhabitants suffer malnutrition, poor housing conditions and other problems associated with poverty and inequity. All these conditions play a role in aggravating the negative consequences of changes in biophysical processes in urban areas. For example, changes in climate variability and climate change (temperature and precipitation) can expand the threshold of tropical vector-borne diseases (malaria, dengue, yellow fever) to areas currently unaffected by them (Krafft, Wolf and Aggarwal 2003, Epstein 1994, Patz and Balbus 1997, Tayanc, et al. 1997). They can also speed up the spread of diseases in already affected areas. Analysis needs to be undertaken how increase in temperature, together with urban processes, increases the occurrence and severity of vector-borne diseases in urban areas, particularly in the tropical and subtropical regions.

The dearth of urban services and dense living conditions mentioned above fosters the reproduction of mosquitoes, aggravating the hazards for human health. Deficiencies in housing and urban conditions (infrastructure, public service, urban form) in poor countries can also aggravate the negative consequences of high temperatures, increasing the morbidity and mortality associated with heat stress. Insufficient infrastructure and transportation options in urban areas can exacerbate the consequences of climate change on local air pollution (tro-



ospheric ozone). Changes in climate and the water cycle could affect water supply, water distribution, and water quality in urban areas with important consequences in water borne diseases in poor countries.

The core project shares the research interest on the consequences on human health in urban areas related, directly and indirectly, to global environmental change with the ESSP Joint Project on Health and Global Environmental Change, which is currently under development. Although there are differences in approach between the two projects, there are also common elements that will facilitate the collaboration in the near future. This core project does not expect to duplicate the research efforts of the Human Health Project. It will rather use the information and knowledge coming from that project to create a better understanding of health issues associated with global environmental change in urban areas. It will also seek to contribute to the Human Health Project by providing a better understanding of urban variables.

2.2 How Do GECs Contribute to Shaping the Built Environment?

The broad range of impacts from global environmental change on urban areas triggers responses of adaptation and resistance. Those responses and actions depend on the local conditions and resources in each urban area, and they often end up modifying the built environment. There is a long tradition of how the built environment in human settlements has adapted to the local physical geography. Some of the best-



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known examples include the use of traditional and current knowledge to adapt architecture and urban design to climatic conditions. This adaptation process has a significant impact on the types of construction and on the ways that urban areas are built (form and function) (i.e., the Maya, Mediterranean or Arab urban settlements in tropical regions, or Toronto, Montreal and other cities in temperate zones). Other examples show how adaptations to biophysical cycles modify land use within urban areas and define the way a city grows (flood protection in the Netherlands, for example). Despite current knowledge about some of these issues, there is no comprehensive perspective of how global environmental change contributes to shaping the built environment. This knowledge is needed to provide better linkage between research results in the global environmental change scientific community and policy-making.

2.2.1 *What are the main elements of GEC that shape the built environment through the impact and influence of global environmental change?*

Historically, climate has shaped the built environment in urban areas (Manzanilla 1997). Since early urban settlements in Mesopotamia, climate

has played a major role in the design of constructions and urban areas. The rapid development of technology during the second half of last century has modified traditional construction patterns around the world, often substituting traditional knowledge of how to better adapt to local and regional climatic conditions. Those changes have been based on significant energy costs (air conditioning, new materials, and new architectural and urban forms). Climate change and climate variability often aggravate the deficiencies of poor adaptation to climate conditions and the dependence on artificial coping mechanisms mentioned above). However, climate change is not the only component of global environmental change that shapes the built environment. Changes in the water cycle can also shape the form and growth of urban areas (Boland 1997, Kirshen 1995, Hartley et al. 1994). Sea level rise in coastal areas also has an impact on the shape and form of urban areas, as well as their vulnerability to inundation (Gornitz and Couch 2001, Jacob et al. 2001, Kullenberg 2001). Broader knowledge and understanding of these areas will provide useful information to national and local decision-makers about the way that global environmental change processes shape the construction, form, and function of the built environment. This knowledge is particularly useful to influence growth and development policies for urban areas in both rich and poor countries and assist them to better adapt to the potential negative consequences of global environmental change.

2.2.2 *How can a regional typology be established of how GEC has shaped the built environment in urban areas?*

The establishment of a typology will help to identify similarities and differences in how global environmental change has shaped the built environment in urban centres across regions. An important component of the typology will be a historical perspective of the impact of environmental variables shaping the urban space in different societies and regions. This historical perspective will expand and complement current knowledge of the built environment of urban areas across regions. The results of this study will complement those obtained from the previous question. Together, they will contribute to creating a broader and more integrated framework to analyze growth and development policies in urban areas. They will also provide concrete areas of interaction with decision-makers.

2.3 **How Do GECs Affect the Resource Base upon Which Urban Systems Rely?**

It is now understood that global environmental change affects the pool of natural resources and ecosystem services upon which urban systems rely. Urban areas depend on vast resources for the supply of critical ecological services (the supply of energy, building materials, food, water as well as green areas for recreational and ecological services). The study of these services for urban areas is in an embryonic state and it has not fully incorporated the potential impact of global environmental change. For example, the urban corridor in southern



California and northern Mexico (Los Angeles, Orange County, San Diego, Tijuana and Rosarito) depends on imported water from northern California and the Colorado River. These already stressed watersheds can be significantly affected by climate change. Some studies document a potential decline of up to 10 per cent of water in the Colorado River under certain global warming scenarios (Gleick et al. 1995, Nash and Gleick 1993). Future water supply in urban southern California could face difficult challenges under such scenarios. Similar potential long-term impacts were defined in a study of climate change in the New York metropolitan region (Major et al. 2001). They indicated that the water supply would be adversely affected by climate change during the 21st century. A significant number of urban areas currently face similar challenges to guarantee their supply of critical natural resources (water, energy, food, etc.). This illustrates the strong need for a better understanding and knowledge of the state of these resource pools, how they are likely to be impacted by global environmental change, and probable consequences of those impacts for urban areas.

2.3.1 *What are the geographical areas where GEC will probably have major impacts on the natural resources upon which urban areas rely?*

More information and knowledge about this topic will address a critical issue in planning growth and development in urban areas around the world. Currently, there is little attention to understanding the availability and quality of the pools of natural resources for each urban area. Planning and development approaches focus on intra-urban issues with little consideration of the dynamic interactions between urban areas and regions. The urban metabolism (Warren-Rhodes and Koenig 2001, Tress et al. 2001, Newman 1999) and urban ecosystems approaches (Mcintyre 2000, Tobin 1999, Rees 1992, 1997, Grove 1997, Pickett et al. 1997) have addressed the issue of natural resources upon which urban areas rely. Their contributions have helped us build a better understanding of this critical issue. There is, however, a need to expand the scope of that research and to incorporate the impact of global environmental change. The results of this research will provide valuable information to regional and urban planners and enhance our understanding of the implications of global environmental change for society. This is also an area where significant collaboration can be established among national and local decision-makers and researchers.



Theme 3: Interactions and Responses Within the Urban System

Urban issues and their interaction with environmental systems need to be understood within the framework of geopolitical, socio-economic and environmental processes. Collectively and individually, these processes shape the physical dimensions of urban growth, the level and characteristics of the urbanization process, and the type of interactions between urban areas and the environment (van Vliet 2002). They also shape the driving forces of global environmental change (O'Brien and Leichenko 2000, Newell 1999, Hamza and Zetter 1998). Considering urban growth only as the outcome of local forces creates an incomplete perspective of complex realities. Some evidence of these global processes is provided by: the dynamic movement of financial capital or transnational industrial operations around the world, the spread of a 'free market' ideology that influences investment in urban



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services and infrastructure, the daily migrations of thousands of people between rural and urban areas, and the displacement of people by military conflicts. The combined global, regional and social processes result in very heterogeneous urban spaces; one of fragmented built environments with clear divisions between the formal and informal, the legal and illegal, the rich and poor, although in complex, dynamic and uneven ways rather than as simple dichotomies.

The impact of global environmental change on urban systems and the responses to these impacts within them are shaped by the interactions among the above-mentioned socioeconomic and geopolitical processes and environmental dimensions. The construction of the built environment in urban areas (urban form and function) and the way it modifies the local landscape is the end result of those interactions. The built landscape and the social groups occupying it have differentiated capacities to cope, adapt, and resist the impacts of global environmental change.

This core project will study the interactions between social processes and the built environment with the landscape in order to understand the differentiated impact of global environmental change on urban systems and the response of those systems to these impacts. Theme 3 is an area where substantial collaboration and contributions can be created between this core project and other IHDP (GECHS, IDGEC, IT, GLP, LOICZ, LUCC) and ESSP projects (GCP, GECAFS, GWSP) other international research initiatives (Resilience Alliance, Millennium Ecosystem Assessment, LTER), and between this core project and international and regional organizations

(UNCHS, UNDP, UNFCCC, World Bank, OECD, Metropolis, IAI, START, APN) and local institutions.

3.1 How Do These Interactions Between the Human and the Physical Systems Shape the Impact of GEC?

Differences in the historical paths of growth and the driving forces behind urban growth create regional differences in urban systems between rich and poor countries. These differences play important roles in shaping the impacts of global environmental change. However, the heterogeneity and complexity of urban areas demand not only an analysis at the urban system level but also a detailed intra-urban analysis. This comprehensive perspective will provide the basis for a better understanding of how the interactions between the human and the physical systems shape the impact of global environmental change.

3.1.1 *What is the vulnerability of urban systems to climate change?*

The divergent rates and patterns of urbanization and the increase in poverty in urban areas are key elements in the rising vulnerability of urban areas to the negative consequences of global environmental change (Cross 2001, Hamza and Zetter 1998, Jimenez 1992). A pertinent example is how the transformations of the global economy have triggered important changes in the urban dynamics of the largest cities in poor countries since the 1980s (Aguilar and Ward 2003). These transformations are driven by foreign direct investment, large-scale capital movements, and structural adjustment programmes that tend to redefine the economic base of such urban areas and recast their territorial patterns (Seto and Kaufmann 2003). The outcome is a highly segregated urban space with extended urbanization in risk prone areas and strong deficiencies in the provision of public services. All of these are key elements in the vulnerability of urban areas to the negative consequences of global environmental change (Cross 2001, White et al. 2002, Burton et al. 2002, Pelling 1998,1999, 2003, Schreider et al. 2000, Uitto 1998). This core project will study regional differences in the vulnerability of urban systems and analyse how global and regional socioeconomic and geopolitical processes affect the vulnerability of urban systems.

In fact, urban areas prove to be highly vulnerable in crises and disasters: sudden supply shortages, heavy environmental burdens or major catastrophes can quickly lead to serious bottlenecks or emergencies for a vast number of people, or exacerbate those of the socially weakest groups among the population (Kraas 2003, Wisner 1999). Constraints and conflicts may acquire multiple dimensions, as



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they arise amid poorly co-ordinated administration and planning, the growing influence of an increased globalized economy, growing socio-economic disparities and intensifying environmental burdens. Hazards are therefore related to complex sources, factors, and networks.



The increasing vulnerability to natural disasters mentioned above, the health consequences of climate variability and climate change (vector-borne diseases, aggravation of air pollution, heat stress), and land-use and land-cover changes within the urban areas and the peri-urban areas are some of the outcomes of the cumulative impacts triggered by the recast of territorial patterns (Krafft, Wolf, Aggarwal 2003). However, the consequences of climate-related impacts also

include other climate related problems like the loss of productive activities, deficiencies in urban functions. These are processes common in a large number of mega-cities and intermediate urban centres in Latin America, Asia, and to some extent Africa.

Research on adaptation strategies in urban areas to the impacts of aforementioned global environmental changes requires a better understanding of the structural causes behind the vulnerability of urban systems to those impacts. This includes how local social, economic and political processes and their modification of the landscape influence and shape the creation of vulnerable areas and groups within the urban system.

Recent contributions to refining the concept of vulnerability have provided a multi-dimensional and multi-scale interpretation that represents a development from its frequently technical approach in disaster awareness and preparation (Blaikie et al. 1994, 2003, Adger 1999, Bohle, Downing and Watts 1999). The adaptive capacities and sensitivity to external stresses and perturbations both contribute to the vulnerability of people and places (Clark 2000). Here we should include vulnerability of sustainable urban livelihoods, particularly of the urban poor (Rakodi and Lloyd-Jones 2002, Moser 1998) - which is explored more fully in Question 3.3. Vulnerability analysis does not only constitute a direct contribution to one of the cross-cutting topics of IHDP, but links to the aim of the core project on Global Environmental Change and Human Security (GECHS) to foster empirical studies that are focused on which elements of environmental change actually threaten human security. The motivation to find efficient ways to map and analyse vulnerability in urban can also trigger significant collaboration with regional organizations (IAI, START, APN) and International organizations (UNEP, UNCHS, UNDP, World Bank, OECD).

3.1.2 *What urban systems are better able to adapt to climate change?*

There is a broad array of experiences of how urban areas have adapted to climate variability and climate change. A historical review shows successes and failures of different civilizations in adapting to climatic conditions. Less attention has been devoted to identifying and understanding how cultural, economic, political, and social dimensions have modified or derailed successful adaptation efforts to climate conditions, and why other societies failed to adapt their built environment to climate change. A more systematic and integrated research approach is required to incorporate these dimensions into the analysis.

3.1.3 *How are urban-rural land use dynamics affected by different levels of GEC and social responses?*

Urban systems maintain highly dynamic processes within peri-urban and rural areas that frequently lead to their evolution and transformation. Conceptual refinements stemming from recent studies on peri-urban areas have recently emphasized the importance of understanding them as part of the functional urban area. In East Asia, the combination of ill-defined property rights, export-driven policies, and imperfect land markets has contributed to the rapid growth of peri-urban areas (Seto 2004, Webster 2002). Peri-urbanization has become considerable in China, where foreign investments have transformed rural economies and communities, often resulting in major changes in social structure and human-environment relations. Peri-urbanization and its effects are not limited to coastal regions in Shanghai and the Pearl River Delta, but have penetrated into the interior regions of the country, including Chongqing and Chengdu (Seto 2004, Schneider et al. 2003; Webster and Muller 2002; Webster et al. 2003). The fast rate of change in rural and peri-urban areas in Asia and in other regions of the world demands broader attention to how urban-rural land use dynamics will be affected by different levels of



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global environmental change and social responses to them. Will these changes affect some of the social, economic, and ecological functions played by rural and peri-urban areas for urban areas? What will be the consequences for the urban areas, the rural areas, and global environmental change?

3.2 How Do the Interactions Between the Human and Physical Systems Shape the Responses to GEC?

Urban areas are complex systems created by social processes and their interactions with the landscape. Urban growth, form, function and life are the end result of a broad range of economic, cultural, social, political and technologi-

cal processes that interact dynamically among themselves and which ultimately modify the biophysical environment. Land use patterns, the reshaping of the landscape, and the form of the built environment are the physical manifestations of the interaction of those processes. A one-dimensional perspective of the responses of urban areas to global environmental change will provide only an incomplete perspective of the complex reality. A broader multi-dimensional and multi-scale approach is needed to achieve a better understanding of those responses. This is clearly a difficult task. The core project intends to use multidimensional concepts (socio-ecological resilience, livelihoods, and coping and adaptation) useful in the study of the responses of urban areas to the impacts of global environmental change. It aims to identify causal links, uni- and bi-directional pathways, and system responses to shocks and changes. It also plans to use its feedback capacity to incorporate knowledge and information generated in Theme 2 to the study of this theme.

3.2.1 *What are the coping strategies of urban institutions to GEC?*

Institutions play a significant role in helping urban systems to cope with, and adapt to, the negative consequences of global environmental change. Recent attention to the role of institutions in building sustainable development initiatives in urban areas provides a useful framework for this discussion (Steinberg and Miranda 2004, Spangenberg et al. 2002, Keivani and Parsa 2002, Button 2002). There are several research areas worth considering in this regard: a) the flexibility and willingness of decision-makers to accept global environmental change data and scenarios, b) the skills and resources of those institutions to design and implement coping and adaptation mechanism, c) the role of other local institutions in the design and implementation of those mechanisms, and d) the role of international institutions in those processes. Research on this topic is an area where significant collaboration can be established with IHDP's core project on the core project IDGEC. IDGEC looks particularly closely at concepts of institutional fit, interplay, and issues of scale, which might prove particularly relevant to the assessment of the links between global environmental change and local governance in urban areas.

3.2.2 *What are the feedbacks to the urban system as a consequence of these responses?*



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The complexity of urban systems aggravates the difficulty in assessing the feedbacks from the responses to the impacts of global environmental change. These feedbacks can be positive or negative and frequently appear as non-linear processes. The diversity and number of actors and social processes co-existing in urban systems create a wide range of expected and unexpected feedback loops. Society,

like nature, often has unexpected responses to sudden shocks (e.g., the Asian Crisis which was mainly triggered by urban economics). They are complex and adaptive systems where unexpected responses to extreme events are part of reality. There is an increasing recognition that the study of the interactions between urban systems and global environmental change requires considering the wide array of feedback loops that result from the responses to those interactions. Some documented cases illustrate the diversity of responses to flooding in urban areas (Rashid 2000; Sporton et al. 1999).

3.3 How Do the Impacts of GEC Affect Urban Livelihoods?

The study of the vulnerability of people and their resilience to the impacts of global environmental change, considers the consequences of shocks. Although the most dramatic impacts will likely be caused by those shocks (drought, flooding, heat waves, tsunamis, etc.), there is a diversity of other impacts that are not linked to sudden shocks. For example, changes in the length and frequency of seasons could affect water supply in urban areas, or changes in temperature and humidity not associated with heat waves would affect the livelihood of urban inhabitants, urban functions (economic activities, social interaction), and social well-being (environmental health). Livelihood analysis can provide a useful tool in studying these changes.

3.3.1 *What urban populations are more resilient to GEC?*

Recent contributions to the discussion of adaptation to global environmental change have focused on resilience. Borrowing from the concept of ecological resilience, scholars have extended the idea to consider a system composed by humans and ecosystems (Rockstrom 2003, Fraser et al. 2003). Socio-ecological resilience has been defined as "the capacity to absorb shocks while maintaining function. When change occurs, resilience provides the components for renewal and reorganization" (Folke et al. 2002, 9). According to the Resilience Alliance (http://www.resalliance.org/ev_en.php) the concept applies as: a) the amount of disturbance the system can absorb and still remain within the same state or domain of attraction, b) the degree to which the system is capable of self-organization, and c) the degree to which the system can build and increase the capacity of learning and adaptation (Carpenter et al. 2001).



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Socio- ecological resilience is a useful concept to facilitate study of the responses to coping with, and adaptation to, global environmental change. It allows multidimensional perspectives of the responses to the negative consequences of global environmental change among different social groups (individuals and households) within urban systems.

Particularly important is a better understanding of resilience among low-income groups who constitute the large majority of urban inhabitants in poor countries.

3.3.2 *How do individuals, households, and groups modify their livelihoods to cope and adapt to the impacts of GEC (especially the urban poor)?*

Livelihood analysis has evolved into a useful multidimensional and multi-scale concept used in rural studies (Bryceson 2002, Bebbington 1999), but recently also applied in the urban context (Rakodi and Lloyd-Jones 2002, Wood and Salway 2000). Livelihood analysis is a useful tool in the study of how individuals, households, and communities⁵ in urban areas adapt to the impacts of global environmental change. It incorporates the economic,

social, cultural, political and environmental dimensions of coping and adapting actions and how these dimensions interact among themselves at different geographical scales. Understanding how urban livelihoods, particularly those of the urban poor, are modified to adapt to the impacts of global environmental change, will help to define policies to orient urban growth and help urban communities to respond better to the negative consequences of global environmental change.



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⁵The term 'communities' implies a degree of social cohesion and common purpose. We do not impute homogeneity as even small settlements are often socially diverse and not free from conflict.

Theme 4: Consequences of Interactions Within Urban Systems on Global Environmental Change

The final theme of this core project falls under the rubric of feedbacks to the biophysical systems that result from mitigation, adaptation and responses within the urban areas to the impacts of global environmental change. This set of scientific questions constitutes a medium and long-term objective of this core project. The knowledge generated by the study of the previous themes will facilitate research on this last set of feedbacks.



The understanding of feedbacks between human responses and the earth system is of central relevance to the Earth System Science Partnership at large and cut across the scientific objectives of most of the core projects. The urbanization core project seeks to make significant contributions to both the theoretical development of earth system science as well as the practical understanding of the function of urban settlements within the earth system.

4.1 How Do the Results of Interactions Within the Urban System Modify the Impacts on Various Components of GEC (Climate Change, Sea Level Rise, Atmospheric Quality)?

Each urban area will generate a different set of feedbacks, depending on the intensity and diversity of responses, or the lack of them, to the impacts of global environmental change. For example, mitigation efforts to reduce the emission of greenhouse gases in urban areas have been supported by the Global Environmental Facility (GEF), Agenda 21, the UN Habitat Program and a diversity of governmental and non-governmental organizations. Have these efforts been successful? What are the implications for the global environment of their success or shortcomings?

4.1.1 *To what extent do different urban coping mechanisms affect greenhouse emissions, climate variability and climate change, and land use/-cover change positively or negatively at the regional and global levels?*

The study of how urban systems affect the global biosphere has provided insights into some aspects of the interactions between these systems. There is, however, much to be learned from these interactions in order to achieve a comprehensive perspective of global environmental change. For example, we now have a better understanding of the role of greenhouse gases in climate change, but we still need to understand better the role of coping mechanisms of urban residents and their responses to global environmental change in those processes.



The dynamic and often unexpected changes associated with the operation of new institutions created to address the impacts of global environmental change; changes in practices and behaviour within the urban functions (production, consumption, recreation, transport and mobility, livelihoods); changes in the urban structure and layouts. It is important to generate knowledge about the magnitude of these changes, their rates of change, and the trends in regions over time.

This is an area where significant collaboration could be established with other programmes and projects studying global environmental change. For example, potential collaborations with some of the new projects under IGBP II could facilitate a better understanding of how natural systems respond as the result of these interactions and how these responses affect global environmental changes.

4.1.2 *Are there significant differences in the aforementioned impacts among the various physical patterns of urban form and growth?*

Are these impacts related to specific physical patterns of urban form and growth? Can a relationship be established that is helpful to the creation of a typology of urban forms and impacts? Such a typology would facilitate the study of impacts in urban areas and their feedbacks on biophysical systems. It can also provide useful background information for detailed case studies and parallel studies between urban areas in different regions with similar characteristics and typology.

4.1.3 *How do urban institutions and governance mechanisms adapt to cope with the impacts of GEC?*

With the exception of research question 3.2.2, much of the foregoing text assumes implicitly that existing urban governance processes and institutions are robust and adaptable enough to be able to cope with the impacts of, and changes required by, global environmental change. It would be premature to make such an assumption, particularly in areas where the most severe impacts are likely to be experienced. Therefore it is entirely appropriate to undertake a strand of research within this core project that examines the existing institutional capacity and flexibility at the respective geographical scales, in relation to what may be required. Here there will be synergies with the work of the IHDP's IDGEC core project, at least as a starting point, where the global institutions and conventions addressing global environmental change are being studied. However, this proposed core project would build a distinct profile in terms of linking that macro-scale work to the national and sub-national levels, where actual experiences will be assessed and behavioural or modelling analyses carried out. Formal and

informal urban governance and institutional capacities have a role in addressing the urban-based sources of global environmental change and in mitigating the urban impacts of externally driven aspects of global environmental change.

As with the other themes, there will be both pure and applied dimensions, seeking simultaneously to address conceptual issues regarding organizational operation, capacity, flexibility and resilience, and to contribute towards enhancing these characteristics within existing institutions of governance in practice so that they can cope better with the increasing impacts of global environmental change.



Implementation Strategy

This section of the Science Plan is designed both to provide a strategic mechanism for review and dissemination of the work of the core project as a whole to the diverse groups of stakeholders identified below, and to serve as a framework to guide researchers engaged on individual projects within this programme in their more specific implementation and dissemination strategies.

Expectations

The expectations formulated here are general definitions of the priorities of this core project to help assessing what this core project seeks to achieve.

- This core project will help generating new knowledge on the bi-directional interactions between global environmental processes and urban societies by initiating, facilitating and synthesising contributions to the 10 main research questions (see table below).

Main Research Questions

Theme 1: Urban Processes That Contribute to Global Environmental Change

1. How do lifestyle and consumption patterns within urban areas contribute to GEC?
2. How does urban land use and land-cover change affect GEC?
3. What are the zones of influence of urban systems, and how do these social and biophysical “teleconnections” affect GEC?

Theme 2: Pathways Through Which Global Environmental Change Affects the Urban System

4. What are the main processes by which GEC affects human behaviour and interactions?
5. How do GEC contribute to shaping the built environment?
6. How do GECs affect the resource base upon which urban systems rely?

Theme 3: Interactions and Responses Within the Urban System

7. How do these interactions between the human and the physical systems shape the impact of GEC?
8. How do the interactions between the human and physical systems shape the responses to GEC?
9. How do the impacts of GEC affect urban livelihoods?

Theme 4: Consequences of Changes Within Urban Systems on Global Environmental Change

10. How do the results of interactions within the urban system modify the impacts on various components of GEC?

- Each research question will contribute to a better understanding of that particular theme and by this be part of an integrated perspective on the larger picture, which is conceptualised through the general research framework of this core project.
- The multi-disciplinary framework of this core project aims at bringing together research communities from different aspects and disciplinary realms of the research field covered by this core project. It is also expected to provide a platform for close interaction between practitioners and researchers on different scales. The framework offered in this document is designed to be a flexible mechanism, which evolves and changes over time through this interaction. It will move the primary focus of research on processes and dynamics rather than patterns and structures.
- In fact it will be an important overall feature of this core project to situate global environmental changes in the context of urban systems and translate abstract knowledge about global environmental change into local contexts of decision-making. This will be achieved by synthesizing case studies and research informed by local knowledge and action. New mechanisms will be developed for integrating case study findings across regions as well as new forms of generating and synthesising relevant information. Practitioners and end-users of knowledge are important actors in this process. Though many of these may not be capable or interested in contributing to the actual research process, this core project will encourage researchers to involve practitioners in framing the research questions and allow for a strong role of outreach and implementation in the study designs.
- The core project will encourage and support research on all scales of urban areas and try to achieve balanced attention to different levels of research and urban areas. By this it will help identifying gaps and shifts in the perception of cities.
- In order to accomplish these expectations, the utilization and development of new geo-spatial technologies will figure prominently (GIS, RS, decision-support systems etc.).



Strategy

The expectations reflect the broad vision regarding the overall contribution of this core project. They will be achieved by following strategic objectives on a short-term (3 years), medium-term (6 years), and long-term (10 years) basis. These objectives will be defined by the Scientific Steering Committee according to the requirements regarding research and outreach in the different stages of the core project and the resources expected to become available in that particular phase. The core project will need time to find sources of funding for research and to enhance its visibility within the scientific community, as well as among the diverse and broad community of decision-makers and organizations operating at the international, regional, and local levels in urban areas and global environmental change issues. This will include potential funding institutions for research. The short, medium and long-term strategies will also help obtain realistic outcomes from the core project throughout its active life cycle.

The short-term objectives will be oriented to facilitate the commencement of the core project within the initial resource constraints. Critical elements at this early phase are putting together research groups, the development of projects under a joint conceptual framework, and construction of feedback mechanisms to guarantee coherence between research and the objectives of the core project. Medium-term strategies are intended to strengthen the development of the core project, to enhance its visibility and linkages with end users of the research (local and national decision-makers, international and national organizations, NGOs, academia), to implement feedback mechanisms to incorporate lessons learned during the previous years in the future development of the core project, and to make adjustments as needed to fulfil the goals of the core project. Long-term strategies intend to facilitate the achievement of the overall research objectives of the core project, as well as its interaction with other global environmental change projects among the scientific community and among organizations addressing growth and development of urban areas. All these strategies include actions for research, visibility and outreach.

Research

The core project seeks to create incremental steps of knowledge through the outcomes and experience obtained from research carried out within the scope of the core project itself as well as information and knowledge from other collaborating projects. The initial phase of scientific research in the core project will depend on the contributions, commitment and effort of a core of researchers already engaged with this initiative and some additional scholars who have already expressed interest to be part of it. This research is expected to fulfil part of the research agenda of the core project. This will also enhance its visibility and facilitate the outreach to other scholars working on the interactions between urban and global environmental issues, international, national, and local organizations in those same areas, and funding organizations.



The scope of research topics of those scholars already engaged with the core project currently cluster mostly around Themes 2 (Pathways through which global environmental change affects the urban system) and 3 (Interactions and responses within the urban system to global environmental change). Hence the core project will focus on those topics during the initial stage of its activities. However, the core project will also reach out to scholars working in other topic areas of its research agenda in an effort to maintain a comprehensive perspective of the diversity and complexity of

topics related to the human dimensions of global environmental change in urban areas, and to facilitate a broadening of the research foci. The strategy is to construct regional networks of scholars by topic areas. The core project will encourage parallel studies to build knowledge across regions

on the subtopic areas of the interactions and responses to global environmental change in urban areas. The core project will also seek gradually to construct thematic networks for cross project co-operation around subject areas linking the Urbanization projects to the various initiatives mentioned in the plan (e.g. urban emissions and local development pathways; urban settlements, health and water; urban institutions and governance; peri-urban areas; vulnerability; resilience; urban settlements in coastal zones; urbanization and population research, etc.). This will be reached by a concerted effort together with other IHDP core project and ESSP joint project to conceptualise and develop activities in areas of shared interest.



It is expected that after its first year, the core project will progressively incorporate a larger number of scholars. The work on large parts of the agenda could be facilitated by capitalizing on the research interest and resources spent on urbanization in other projects. Furthermore, it would emphasize the cross-cutting character and relevance of the core project and its potential to link together initiatives disconnected so far. An endorsement mechanism for this core project may be developed if deemed necessary, but is certainly no requirement for a project to make a contribution to one of the research questions. This is particularly relevant for the research questions in Theme 1 and 2. However, particularly critical for the overall success of this core project will be new research initiatives contributing to Theme 3 and 4. They will need to be initiated by the Scientific Steering Committee with the aim to develop an integrative perspective and with the long-term objectives of the core project in mind.

This scientific plan, like any other, requires periodic assessments. The core project plans to convene an annual workshop to assess progress with its research agenda. The annual workshop will help the core project build the feedback mechanism required to update strategies of the core project needed to achieve its goals. The core project also plans to hold a scientific conference at the end of each five years to assess its development. The core project will welcome the participation of scholars, practitioners, international, national, and local organizations in the scientific meetings. These workshops and meetings will be designed as spaces of reflection about the knowledge and experiences generated by the core project that will enable further learning and development. They will also help the core project to assess the recent changes in the state of knowledge on these issues outside the core project, the recent trends of global environmental change issues in urban areas, and the new needs and resources of its regional networks. Where possible and appropriate, annual workshops or a quinquennial conference will be organized (to coincide with IHDP Open Meetings).

Implementation Mechanisms

Mainstay of this core project will be individual research projects, workshops and conferences to generate and exchange knowledge and ideas as well as other mechanisms to discuss the contributions in a more strategic manner and develop the overall conceptual framework. The character and function of activities will change over time and depend on the stage of development of the core project and the short-term, mid-term and long-term objectives aimed to accomplish. Some will be of relevance to scholars only and emphasise the reporting on research. Others may address more integrative and cross-cutting topics and involve also practitioners and the political arena at different scales (international, national, regional or local governments, NGOs, associations, UN-Agencies etc.). Generally, activities at an earlier stage of the core project will be aiming at conceptual development and the design of common frameworks and protocols, while they would have a stronger emphasis on synthesis, meta-analysis and the identification of research gaps. With progression of the core project the translation of scientific knowledge into other arenas and contexts will become increasingly important.

An important implementation mechanism will be the development of regional networks to account for the particular constellations of urban processes in different world regions (see section "Research"). These networks will involve researchers, practitioners and relevant Organizations representing political decision makers. It was expressly stated as an expectation this core project would encourage to involve practitioners in framing the research questions and allow for a strong role of outreach and implementation in the study designs.

In accordance with this strong core project focus on both scientific knowledge and the translation of this knowledge into the context of local decision-making there will be different kinds of publication depending on the audience. These will include peer-reviewed as well as grey literature and book or paper series to publish

- Parallel case studies and research findings
- Comparative studies by researchers and practitioners
- Meta-analyses and synthesis reports

Other information sources will include a high-profile website which will also serve as a virtual discussion forum, clearing house and data repository.

Visibility and Outreach

An important component of the core project will be its visibility and outreach. As mentioned above, the core project will make a continuous effort to reach out to other scholars working in subtopic areas of the core project and allow them to link into a network. This assimilation will allow the core project progressively to address its comprehensive research agenda and

generate the expected outputs. There will be an effort to achieve a balance between young and senior scholars participating in the core project. This balance is convenient to guarantee the core project's future development. The core project will also seek balance in terms of the regional representation of scholars and geographical and thematic coverage of research areas.

Beyond scholars, the core project will also make an effort to reach out to, and when possible, incorporate as part of its research teams, some of the actors who are end users of the research results from this core project at different levels (international, regional, national, and local). Urban issues have a large number of stakeholders involved in improving local conditions at different scales, from national governments to local authorities, planners, public officials and a diversity of civil society actors at the city, neighbourhood, and household levels. The level of human agency in this topic is significantly higher than in many other areas of the human dimensions of global environmental change. These resources constitute a formidable structure to implement policies and programs at a diversity of scales.

The translation of scientific research into concrete policies is a key element in the success of research efforts in the human dimensions of global environmental change. Decision-making regarding global environmental change should be incorporated into other economic, social, cultural, political policies that form part development and operational programs in urban areas and in societies at large. For example, adaptation to climate variability and climate change in urban areas should be part of a broader urban policy or specific sectoral policies like the management of natural hazards and disasters, infrastructure development, urban-region development, etc. This new IHDP core project on urban areas offers unique opportunities in this regard. Urban issues are gaining increasing attention from a number of international organizations and national and local governments. The UN Habitat programme, UNEP, UNDP, the World Bank, the OECD, the European Union, the Inter-American Development Bank, the Asia Pacific Network, and many other international organizations sponsor a number of initiatives addressing a diversity of urbanization issues relevant to economic growth, the social well-being of urban inhabitants, urban governance, and the urban environment. Although some of these efforts were first established some decades ago, a significant number of them were launched only within the last few years. These efforts illustrate a trend in the creation of international networks of cities to facilitate the exchange of information and capacity building at the local level on urban and environmental issues. Some of the most important networks are:

- Metropolis
- The International Union of Local Authorities (which will merge with the United Towns Organization to form United Cities and Local Governments in 2004)
- The International Council of Local Environmental Initiatives (ICLEI)

- The American Union of Capital Cities (cities in Latin America and Spain)
- The International Solidarity Fund of Cities against Poverty
- Global Community Initiatives
- Global Cities Dialogue (GCD)
- The MegaCity TaskForce of the International Geographical Union (IGU)

Two brief examples help illustrate the focus, scope and outreach capacity of these networks:

Metropolis is an international association of 76 global cities. It works towards developing solutions to problems in large cities (planning, development, the environment, the economy, infrastructure, communications, and transport). One of its programmes, the Cities Alliance launched in 1999, has two ambitious components:

- city development strategies focusing on the stakeholders vision of their city, its economic prospects and its priorities for action and investment;
- city-wide and nation-wide slum upgrading to improve the living conditions of at least 100 million slum dwellers by 2020.

Metropolis also provides training services on urban and environmental issues (Metropolis Training Institute) directed to elected representatives, managers and executives of metropolitan governments.

The *International Council of Local Environmental Initiatives (ICLEI)* is an association of local governments implementing sustainable development, and is the principal body responsible for taking forward the Local Agenda 21 initiative that emerged from the 1992 Rio conference on Environment and Development. Its membership is estimated at more than 400 cities, towns, and counties in different parts of the world (in both poor and rich countries). Its agenda concentrates on three major programmes: A Local Agenda 21 Campaign, a Cities for Climate Protection Campaign, and a Water Campaign. Its international services include training programmes for local governments. ICLEI and Metropolis have created partnerships with a number of international organizations (World Bank, UNEP, UNCHS, and the International Union of Local Governments among others).

ICLEI, Metropolis and the other networks mentioned above represent a diversity of outreach capacity, scope, experience, and resources. They are also an interface to reach a large number of local governments and stakeholders in urban areas throughout the world. These networks are valuable assets to this IHDP core project on urbanization. They offer the opportunity to disseminate information and knowledge on the human dimensions of global environmental change in urban areas to decision-makers and stakeholders at a local level in both developed and developing countries. In fact, IHDP could play a major

role in adding value to the agenda of these networks. Currently, these networks and other international organizations with a key interest in urban issues (World Bank, UNEP, UNCHS, OECD, and IDB) do not consider issues related to the human dimensions of global environmental change in their programmes. Although the programmes of these institutions cover a wide range of urban and environmental issues directly associated with a broad perspective of the human dimensions of global environmental change in urban areas, only a few of them have a direct reference to the human dimension. Some exceptions are ICLEI's program on Cities for Climate Protection Campaign, and to some extent UNCHS focus on natural disasters and eco-cities. But even these programmes represent only a fragmented perspective of the diversity of topics covered by the human dimensions of global environmental change in urban areas as explored in this science plan.

While the city networks and their sponsoring organizations have not yet focused on the human dimensions of global environmental change, they provide the potential infrastructure to facilitate the transformation of scientific knowledge into policy and programs at a local level. The resources devoted by these organizations to disseminate information and to train local governments and stakeholders are excellent channels and opportunities to transmit the knowledge and information generated by the IHDP and other partners to a wide range of actors involved in urban life. This IHDP core project on urbanization would be a perfect complement to the above-mentioned international initiatives seeking to improve urban, social, and environmental conditions in urban areas.

The current international attention to urban areas also opens opportunities to the development of a new programme on the human dimensions of global environmental change in cities. International organizations like the World Bank and United Nations system have expanded their attention to urban issues and they sponsor a number of initiatives in poorer countries. But perhaps more the most interesting and innovative initiatives are those emerging from the networks and partnership established among cities through out the world. These initiatives represent an effort to create North-South and South-South co-operation. This core project will seek to capitalize on this growing interest in urban areas, for example, by providing assistance in the preparation of National Communications by poorer countries under the UNFCCC and to carry out studies proposed in Stage II adaptation. Urbanization is one of the critical topics neglected so far in these processes. IHDP participation could provide valuable scientific input to enhance the role of international organizations (UNDP, UNEP, World Bank), as well as a number of the organizations mentioned above and a diversity of local stakeholders.

Funding

It would be highly desirable for IHDP to obtain at least some core funding for an international project office (IPO) to kick-start this core project and to

ensure its effective and continuous management, not least in terms of the regular review and workshop/conference mechanism that is envisaged. This would make a substantial contribution to the dynamism and success of the core project. The individual research projects will certainly refer to grants available from various funding sources and programmes. But clearly, if momentum were to depend entirely on the results of research grant applications to diverse funding bodies by individual scholars or teams established to tackle particular theme questions, then the core project would launch slowly. The funding of an IPO would also need to include resources to build up new connections between scientific and other communities (NGOs, practitioners, stakeholders) and reflect on the core project development on a meta-level through integrative and synthesising activities. This will need to be considered a long-term, strategic investment of funding agencies and not limited to the level of research project funding alone. Some of the potential funding opportunities for this core project are:

- The U.S. National Science Foundation has identified rapidly urbanizing areas as a research focus, and there are a variety of programs within NSF that might be good targets of fund-raising efforts by IHDP
- The World Bank and the Global Environmental Facility focuses on issues addressed in the science plan of this core project
- Development agencies in several countries (US, Canada, UK, several countries in the EU, Japan) have funded projects focusing on urban and peri-urban issues that are closely linked to global environmental change.
- The German Federal Ministry of Research has launched a call for proposals on research for sustainable development of the mega-cities of tomorrow. This research focus highlights the rapid growth of small and medium sized cities and encourages research and implementation partnerships between German researchers and cities in developing countries to manage this growth with intensive stakeholder participation throughout the projects.
- Some private foundations have also funded research on urban issues closely associated with global environmental change

The topic of urbanization is an opportunity for funding agencies, to invest in bringing actors together operating discrete or even isolated so far within a common, coherent format of decision-making for sustainability.

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List of Acronyms and Organizations

APN	Asia-Pacific Network for Global Change Research
BMBF	Bundesministerium für Bildung und Forschung (German Federal Ministry of Education and Research)
DIVERSITAS	International Programme of Biodiversity Science
EMR	Extended Metropolitan Regions
EN/SO	El Niño/Southern Oscillation
ESSP	Earth System Science Partnership
GCD	Global Cities Dialogue
GCP	Global Carbon Project (ESSP joint project)
GDP	Gross Domestic Product
GEC	Global Environmental Change
GECAFS	Global Environmental Change and Food Security (ESSP joint project)
GECHS	Global Environmental Change and Human Security (IHDP core project)
GEF	Global Environmental Facility
GIS	Geographical Information System
GLP	Global Land Project (IGBP/IHDP core project)
GWSP	Global Water Systems Project (ESSP joint project)
IAI	Brazil Inter-American Institute for Global Change Research
ICLEI	International Council of Local Environmental Initiatives
ICT	Information and Communications Technologies
IDB	Inter-American Development Bank
IDGEC	Institutional Dimensions of Global Environmental Change (IHDP core project)
IGBP	International Geosphere-Biosphere Programme
IGU	International Geographical Union
IHDP	International Human Dimensions Programme on Global Environmental Change
IPCC	Intergovernmental Panel on Climate Change
IPO	International Project Office
IT	Industrial Transformation (IHDP core project)
IULA	International Union of Local Authorities
LOICZ	Land-Ocean Interactions in the Coastal Zone (IGBP/IHDP core project)
LTER	Long Term Ecological Research
LUCC	Land Use and Land-Cover Change (IGBP/IHDP core project.)
MDGs	Millennium Development Goals
MEA	Millennium Ecosystem Assessment
NGO	Non-Governmental Organization
NSF	US National Science Foundation
OECD	Organization for Economic Co-operation and Development

PERN	Population-Environment Research Network
RS	Remote Sensing
SC-IHDP	Scientific Committee of the IHDP
SCOPE	Scientific Committee on Problems of the Environment
SSC	Scientific Steering Committee
START	SysTem for Analysis, Research, and Training
UCLG	United Cities and Local Governments
UN	United Nations
UN HABITAT	United Nations Human Settlements Programme
UNCHS	United Nations Centre for Human Settlements
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UTO	United Towns Organization
WCRP	World Climate Research Programme

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