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5 Urbanization and Sustainability in the 21st Century

It is particularly ironic that the battle to save the world's remaining healthy ecosystems will be won or lost not in tropical forests or coral reefs that are threatened but on the streets of the most unnatural landscapes on the planet.[1]

Cities: Burden or Blessing?

Preserving the rights of our children and grandchildren to health and happiness depends on what we do today about global environmental change. The battle for a sustainable environmental future is being waged primarily in the world's cities. Right now, cities draw together many of Earth's major environmental problems: population growth, pollution, resource degradation and waste generation. Paradoxically, cities also hold our best chance for a sustainable future.

Urban concentration need not aggravate environmental problems. These are due primarily to unsustainable patterns of production and consumption and to inadequate urban management. Urban localities actually offer better chances for long-term sustainability, starting with the fact that they concentrate half the Earth's population on less than 3 per cent of its land area. As Chapter 4 suggests, the dispersion of population and economic activities would likely make the problems worse rather than better. Adopting the right approaches in anticipation of urban growth can also prevent many of the environmental problems linked to urbanization.

From a demographic standpoint, not only do dense settlements have greater capacity than rural areas to absorb large populations sustainably, but urbanization itself is a powerful factor in fertility decline. Urbanization provides few incentives for large families and numerous disincentives.

Urbanization will not, however, deliver its benefits for sustainability automatically: They require careful preparation and nurturing. The previous chapter made this point with respect to the internal organization of cities. This chapter looks at how cities affect, and are affected by, global environmental problems.

Taking the Broader View[2]

People are already doing a great deal at the local level to make urban locations more habitable and environmentally friendly.[3] Cities can learn from each other and use positive experiences for their own benefit. However, finding local solutions to

◀ *Busy pedestrian crossing in Tokyo, Japan.*

current problems is not enough, given the rapid doubling of the urban population of developing countries in an era of economic globalization. Local strategies will have to be integrated into a more inclusive temporal and spatial framework to address broader problems and ensure longer-term sustainability.

The concept of global environmental change (GEC) provides such a framework. GEC is the sum of a range of local, national or regional environmental challenges.[4] GEC also denotes the impacts of these challenges, for example, changes in temperature and precipitation regimes that could increase the frequency of floods and droughts, raise sea levels or influence the spread of diseases and invasive species.

Policymakers must be aware that their local decisions have far-reaching effects and conversely that climatic or ecosystem changes may have a local impact. Both aspects require better information and a longer-term vision.

Urban areas both contribute to GEC, through the consumption of resources, land use and production of waste, and suffer its impacts. The full consequences of GEC will be felt only in the medium to long term. Because of this time lag, they are often ignored in favour of more immediately pressing environmental problems such as water supply, sanitation and waste disposal.

Yet policymakers must be aware that their local decisions have far-reaching effects and conversely that climatic or ecosystem changes may have a local impact. Both aspects require better information and a longer-term vision. Decisions being made today about energy sources, transportation systems and spatial planning will have a long-term impact on the regional and global biophysical processes that contribute to GEC. Solving current problems can help mitigate the impacts of GEC—but only if the interactions between local urban problems and regional and global processes are explicitly considered.

Such integrated thinking and planning can increase the resilience of urban areas to GEC-related shocks. For example, it can help to preserve healthy ecosystems or to ensure that new transportation, water supply and energy systems are built to withstand climate-related hazards. Conversely, actions aimed at long-term global issues may contribute to solving more immediate and local environmental problems.

Looking Beyond the Local

Urban areas depend on natural resources for water, food, construction materials, energy and the disposal of wastes. In turn, urbanization transforms local landscapes as well as ecosystems both local and further afield.

Mega-cities attract attention by their size and economic dominance. However, small and medium-sized cities, which currently house more than half the world's urban population and are expected to continue to have a predominant role, encounter similar challenges and pressures.[5]

Two issues in particular illustrate the interaction between urbanization and natural resources and their interaction with GEC. The first, changes in land use and land cover, has already been discussed at some length in Chapter 4. The present chapter gives more attention to the impact of climate change and variability.

Land Cover Changes

Rapid expansion of urban areas changes land cover and causes habitat loss. Chapter 4 noted how the combination of urban population growth, decreasing densities and peri-urbanization could convert large chunks of valuable land to urban uses in coming decades.

The environmental challenges posed by the conversion of natural and agricultural ecosystems to urban use have important implications for the functioning of global systems. How serious they are depends on where and how urban localities will expand. They depend even more on the patterns of consumption that city populations impose.

"Urban footprints" spread well beyond the immediate vicinity of cities, particularly in developed countries. Rising incomes and consumption in urban areas lead to increasing pressure on natural resources, triggering land-use and land-cover changes in their zones of influence, sometimes over vast areas. This typically causes much

greater losses of habitat and ecosystem services than urban expansion itself.

For example, tropical forests in Tabasco were razed to provide space for cattle, in response to rising demand for meat in México City, 400 km away. Rising demand for soybeans and meat in China's urban areas, added to the demand from Japan, the United States and Europe, is accelerating deforestation in the Brazilian Amazon.[6]

The "urban footprint" concept, which has been used to describe this expansion of the perimeter of urban consumption, is now quite familiar.[7] But many people take it to mean that urban concentration itself is the problem, rather than consumption by a large number of more or less affluent people. Evidently, urban centres in poor countries do not have the same footprint as those in developed countries.

The concept of the environmental transition brings out the differences between cities in high- and low-income countries.[8] In cities of poorer countries, environmental problems are local and mostly concern health, such as inadequate water and sanitation, poor air quality (inside houses as well as outside) and limited or no waste disposal. As average incomes increase, these immediate problems are not so pressing, but changes in productive activities and consumption patterns increase the impact on surrounding rural areas. In more affluent cities, local and regional impacts have usually declined through extended environmental regulation, investment in waste treatment and pollution control, and a shift in the economic base from industry to services. But affluence increases impact on global environmental burdens such as climate change.

▼ *Afghan refugee children provide cheap labour on the scrap tire heaps in Peshawar, Pakistan.*

The issue of water is particularly relevant in this discussion. The dependence of cities on a guaranteed supply of water makes significant demands on global fresh water supplies. Cities already compete with the much larger demands of agriculture for scarce water resources in some regions such as the south-western United States, the Middle East, southern Africa, parts of Central Asia and the Sahel. In extreme cases—for instance, the Cutzmala system supplying México City—whole communities are flooded or relocated to make way for water supply infrastructure. This will be seen on a monumental scale should China complete the South-North Water Diversion.[9] Ultimately, cities outbid rural and agricultural users for available water supplies.[10]

Urban areas can affect water resources and the hydrological cycle in two other main ways: first, through the expansion of roads, parking lots and other impervious surfaces, which pollute runoff and reduce the absorption of rainwater and aquifer replenishment; and, secondly, through large-scale hydroelectric installations that help supply urban energy needs.[11]

These examples illustrate the complexities of addressing the impacts of cities on the biophysical system and highlight the need for a broad and integrated perspective.

Cities and Climate Change

Climate change and its ramifications on urban processes cover a wide spectrum. Climate-related natural disasters are increasing in frequency and magnitude. Their consequences will depend on a number of factors, including the resilience and vulnerability of people and places.

Climate conditions have always shaped the built environment. Since the 1950s, however, traditional patterns adapted to local climatic conditions have been increasingly abandoned. Globalization and rapid technological developments tend to promote homogenized architectural and urban design, regardless of natural conditions. With this cookie-cutter architecture comes increased energy consumption from the transportation of exogenous materials and from the utilization of a single building design in a variety of environments and climatic conditions without regard to its energy efficiency. In some places, energy is too cheap to motivate energy-efficient design; in other cases, developers ignore the costs, since sale prices do not reflect the future savings from higher energy efficiency.

The use of new architectural and urban forms, new materials and innovations such as air conditioning have driven up both energy costs and cities' contributions to greenhouse gas emissions. Technological advances have also permitted the rapid growth of cities in places

Mother carries her child through filthy streets in Port Au Prince, Haiti. One of the poorest places in the Western Hemisphere, it lacks garbage collection services.

previously considered uninhabitable. For instance, the American city of Phoenix has boomed thanks to engineering projects that diverted water from the Colorado River; city water in the Saudi Arabian city of Riyadh comes largely from desalinization plants.

Urban form and function also help define the nature of the interactions between cities and local climate change. For example, the "urban heat island effect" results from the impacts of different land uses in urban areas, creating microclimates and health consequences.

The urban heat island effect is an increase in temperatures in the urban core compared to surrounding areas. The size of the urban centre, the type of urbanization, urban form, function and land use all contribute to the effect. As villages grow into towns and then into cities, their average temperature increases 2 to 6°C above that of the surrounding countryside.[12]

Urban designs and forms that neglect local climatic conditions and lose the cooling effects of green areas tend to aggravate the heat island effect. Cities of poor countries in the tropics are particularly affected.

Rapid urban growth, combined with the potent impacts of climate variability and climate change, will probably have severe consequences for environmental health in the tropics (causing, for example, heat stress and the build-up of tropospheric ozone), which can affect the urban economy (for example, yield of labour and economic activities) and social organization.

In a vicious circle, climate change will increase energy demand for air conditioning in urban areas and contribute to the urban heat island effect through heat pollution. Heat pollution, smog and ground-level ozone are not just urban phenomena; they also affect surrounding rural areas, reducing agricultural yields,[13] increasing health risks[14] and spawning tornadoes and thunderstorms.

Human health in urban areas may suffer as a result of climate change, especially in poor urban areas whose inhabitants are least able to adapt. They already suffer from a variety of problems associated with poverty and inequity. Climate change will aggravate these. For example, poor areas that lack health and other services, combined with crowded living conditions, poor water supply and inadequate sanitation, are ideal for spreading respiratory and intestinal conditions, and for breeding mosquitoes and other vectors of tropical diseases such as malaria, dengue and yellow fever. Changes in temperature and precipitation can spread disease in previously unaffected areas and encourage it in areas already affected. Changes in climate and the water cycle could affect water supply, water distribution and water quality in urban areas, with important consequences for water-borne diseases.

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Poverty and Vulnerability to Natural Disasters

Cities are highly vulnerable to natural crises and disasters: Sudden supply shortages, heavy environmental burdens or major catastrophes can quickly lead to serious emergencies. The consequences of such crises are multiplied by poorly coordinated administration and planning.

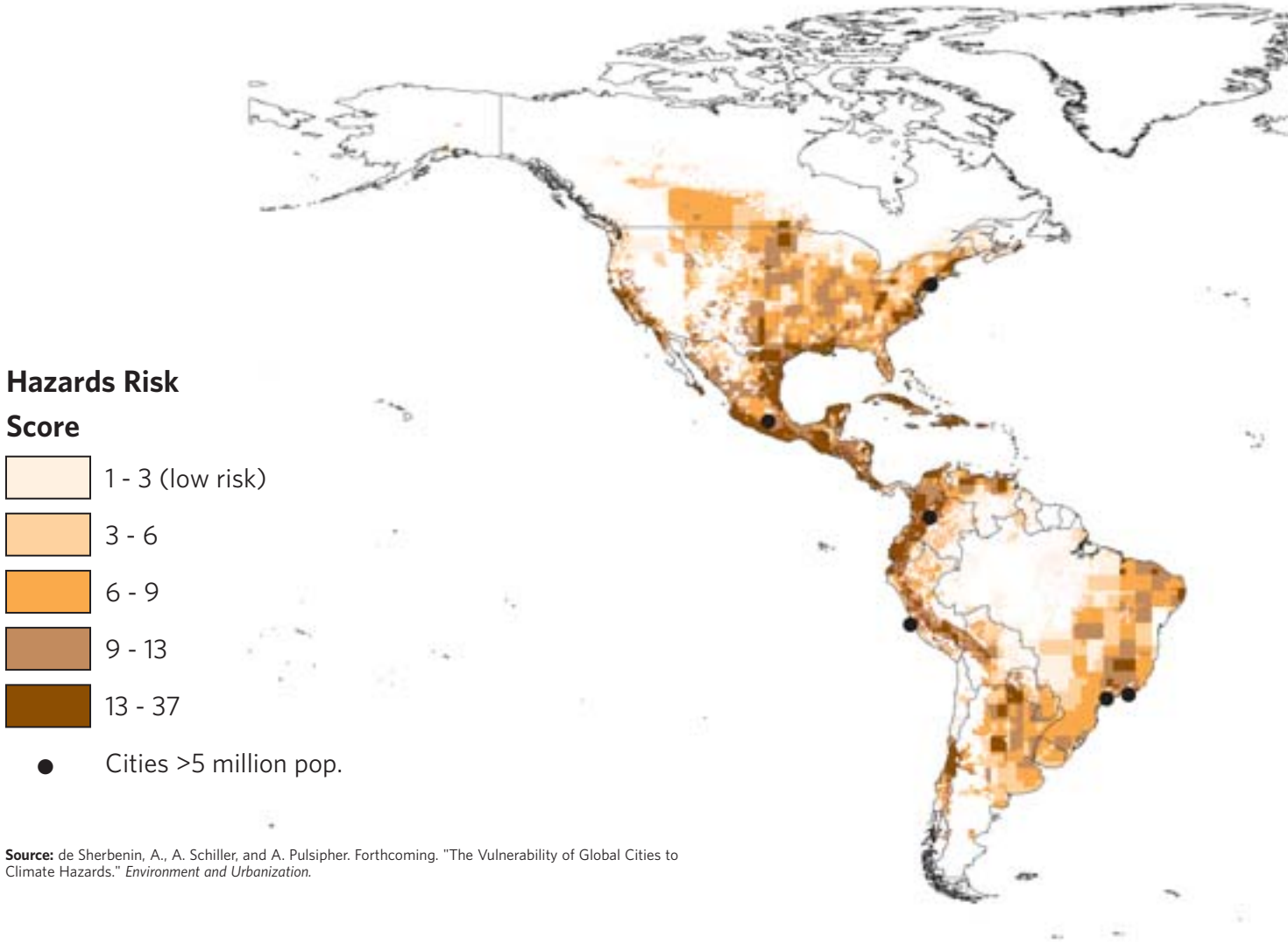
Natural disasters have become more frequent and more severe during the last two decades, affecting a number of large cities (see Figure 7). The United Nations Environment Programme (UNEP) reports that, between 1980 and 2000, 75 per cent of the world's total population lived in areas affected by a natural disaster.[16] In 1999, there were over 700 major natural disasters, causing more than US$100 billion in economic losses and thousands of victims. Over 90 per cent of losses in

human life from natural disasters around the world occurred in poor countries.

The impacts of GEC, particularly climate-related hazards, disproportionately affect poor and vulnerable people—those who live in slum and squatter settlements on steep hillsides, in poorly drained areas, or in low-lying coastal zones.[17] For example, decades of informal settlements on hillsides surrounding Caracas, Venezuela, contributed to the devastating impact of the December 1999 flash floods and landslides, which reportedly killed 30,000 people and affected nearly half a million others.[18] Hurricane Katrina's impact on New Orleans (Box 23) shows that developed countries are also not immune to such wide-scale disasters.

Drought, flooding and other consequences of climate change can also modify migration patterns between rural and urban areas or within urban areas. 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. Similar examples can be seen in India, México and other poor countries. Many such "environmental refugees" never return to the rural areas from which they were displaced.

Figure 7: Large Cities in Relation to Current Climate-related Hazards



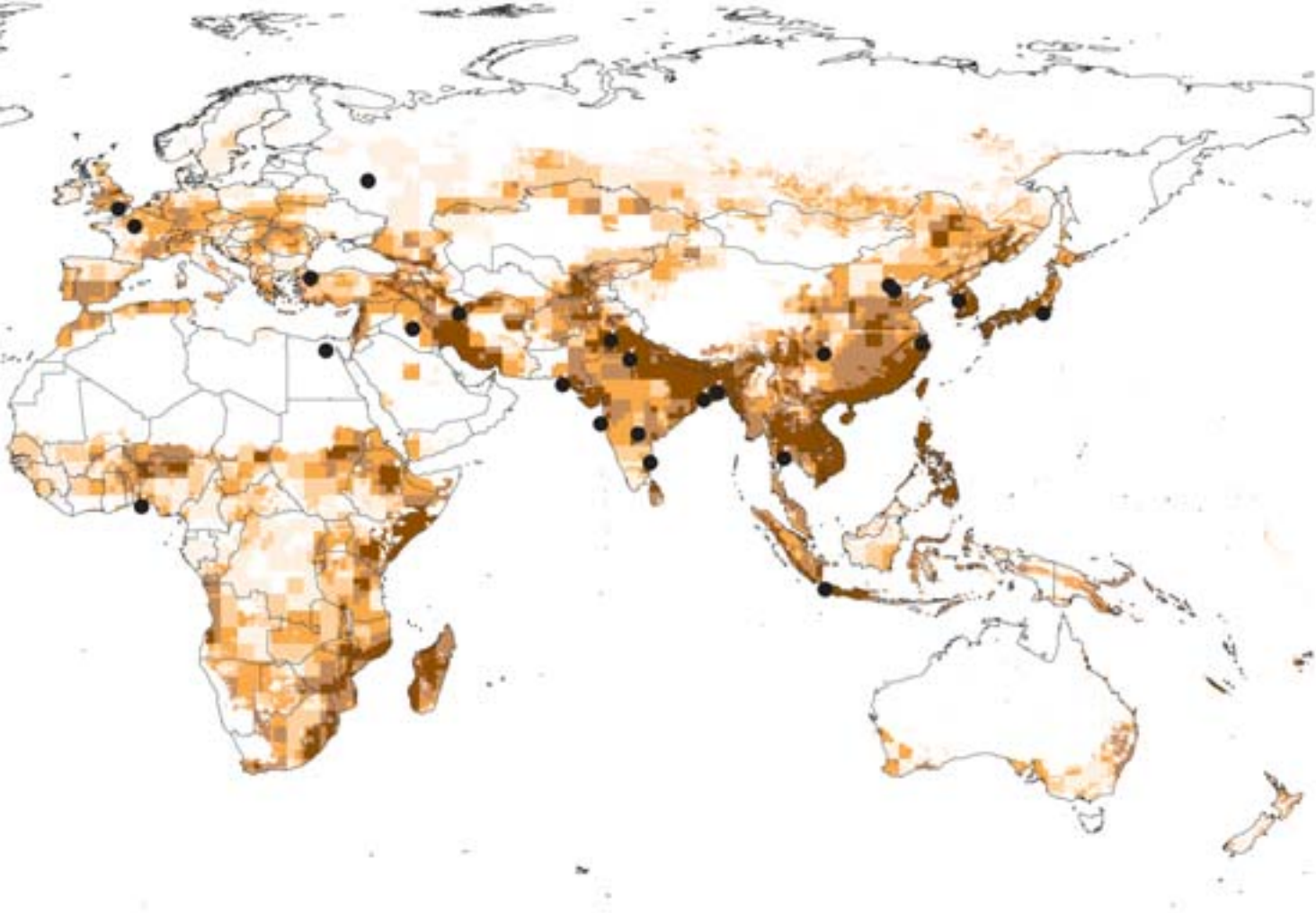
Source: de Sherbenin, A., A. Schiller, and A. Pulsipher. Forthcoming. "The Vulnerability of Global Cities to Climate Hazards." *Environment and Urbanization.*

Sea Level Rise: Not If but When, and How Much?[19]

One of the alarming prospects of climate change is its impact on sea level rise and its potential consequences for coastal urban areas. Coastal zones have always concentrated people and economic activities because of their natural resources and trading opportunities. Many of the world's largest cities are on seacoasts and at the mouths of the great rivers. Both urban and rural areas of coastal ecosystems are the most densely populated of any in the world.

These populations, especially when concentrated in large urban areas within rich ecological zones, can be a burden on coastal ecosystems, many of which are already under stress. They are increasingly at risk from seaward hazards such as sea level rise and stronger storms induced by climate change.

Sea level rise, especially if combined with extreme climatic events, would flood large parts of these areas. It would also introduce salt water into surface fresh water and aquifers, affecting cities' water supply, and modify critical ecosystems supplying ecological services and natural resources to urban areas. It would inevitably provoke migration to other urban areas. Coastal settlements in lower-income countries would be more



23 THE KATRINA DISASTER IN NEW ORLEANS[1]

Hurricane Katrina made landfall on the Gulf Coast of the United States on 29 August 2005. It killed over 2,800 people, destroying lives, leveling homes and leaving hundreds of thousands of survivors homeless. An estimated 9.7 million people living in Alabama, Louisiana and Mississippi experienced the hurricane-force winds. Katrina had its greatest effects on the city of New Orleans and in coastal Mississippi, but caused devastation as far as 160 km from the storm's center along much of the north-central Gulf Coast.

Across the three states hardest hit by the storm, about 4.9 million people, or some 41 per cent of the population, live in coastal areas. About 3.2 million people live within the imminent or occurring flood area. Poor people were the most affected by the hurricane. African-Americans and the elderly were more likely to reside in a flooded area and were more likely than non-elderly whites to die as a result of the flooding.

vulnerable and lower-income groups living on flood plains most vulnerable of all.

The first systematic assessment of these issues shows that low elevation coastal zones (LECZ) currently account for only 2 per cent of the world's land area but 13 per cent of its urban population.[20] Despite lower urbanization levels, Africa and Asia have much larger proportions of their urban populations in coastal zones than North America or Europe (see Table 1).

Such differences reflect the colonial heritage of Africa and Asia, where major cities grew as ports and export nodes of raw materials.[21] Asia stands out, as it contains about three quarters of the global population in the LECZ, and two thirds of its urban population.

The concentration of larger settlements in LECZ is striking. Thus, some 65 per cent of cities with more than 5 million inhabitants intersect that zone, compared to only 13 per cent of those with less than 100,000 people.

Given the real and increasing threats of global environmental change in LECZ, the continuation of present patterns of urban growth is of some concern. From an environmental perspective, uncontrolled coastal development is likely to damage sensitive and important ecosystems and other resources. At the same time, coastal settlement, particularly in the lowlands, is likely to expose residents to seaward hazards that are likely to become more serious with climate change.

Continuation of present urbanization patterns will draw still greater populations into the low elevation coastal zone. In particular, China's export-driven economic growth has been associated with intensive coastal migration (see Figure 8). Bangladesh, despite its lower rates of economic growth and urbanization, is also witnessing a marked shift in population towards the LECZ.

Protecting coastal residents from risks related to climate change would require mitigation and migration away from the lowest-elevation coastal zones. It would also demand modification of the prevailing forms of coastal settlement.

Such interventions would evidently be easier in *new* urban areas. Avoiding policies that favour coastal development while imposing more effective coastal zone management would be crucial. However, such measures require a vision, a commitment and a long lead time.

It is thus of considerable importance to plan ahead on the basis of good information and analysis. Unfortunately,

Table 1: Per Cent of Population and Land Area in Low Elevation Coastal Zone by Region, 2000

	Shares of region's population and land in LECZ			
Region	Total Population (%)	Urban Population (%)	Total Land (%)	Urban Land (%)
Africa	7	12	1	7
Asia	13	18	3	12
Europe	7	8	2	7
Latin America	6	7	2	7
Australia and New Zealand	13	13	2	13
North America	8	8	3	6
Small Island States	13	13	16	13
World	10	13	2	8

Source: McGranahan, G., D. Balk and B. Anderson. Forthcoming. "The Rising Risks of Climate Change: Urban Population Distribution and Characteristics in Low Elevation Coastal Zones." *Environment and Urbanization.*

▲ *Victims of Hurricane Katrina in New Orleans, United States, try to save some of their precious belongings.*

environmental considerations have not as yet had much influence on settlement patterns. Altering these patterns would require a proactive approach that is rarely found, given the priority placed on economic growth. This, in turn, will require awareness-raising and advocacy.

Adapting to Climate Change

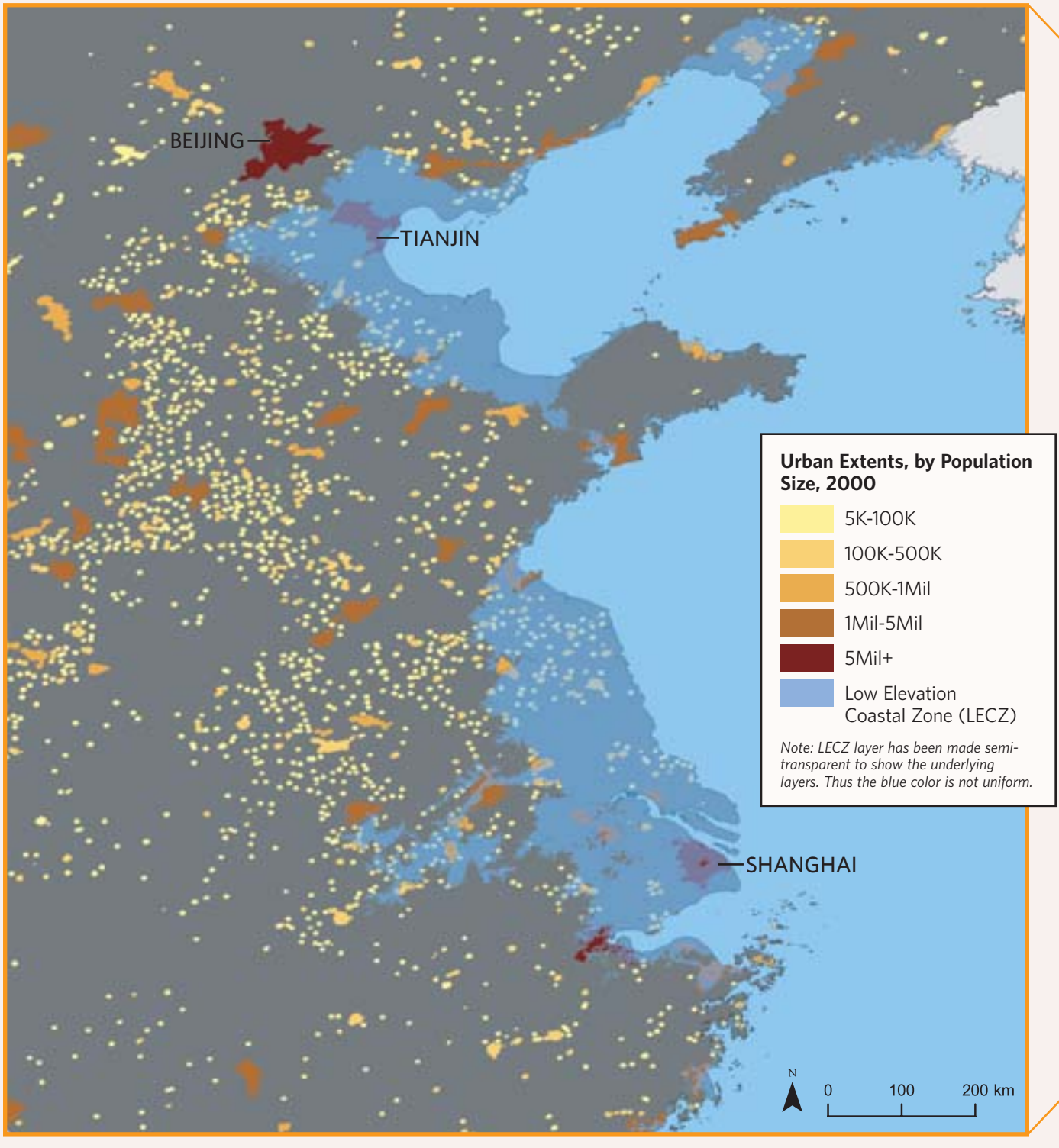
Other interactions with climate may not have the dramatic consequences associated with natural disasters, but they still have significant consequences for urban life and functions. For example, changes in average and extreme temperatures, or in the intensity and length of seasons, can have a significant influence on such things as economic activities (for instance, tourism); productivity of workers; use of urban space for social interaction; comfort index; water supply, distribution and quality; and energy demand.

The broad range of such impacts on urban areas should trigger responses of adaptation that are suitable to local conditions and resources. Adapting to local physical geography and climate conditions has a significant impact on the types of construction and on the ways that urban areas are built. Adaptation to biophysical cycles also modifies land use within urban areas and defines the way a city grows.

Despite growing knowledge about these issues, we still lack a comprehensive perspective of how climate change contributes to shaping the built environment, or how the built environment should adapt to likely changes in prevailing temperature and precipitation regimes.

Institutions play a significant role in helping urban systems to cope with, and adapt to, the negative consequences of global environmental change. For instance, the creation of international networks of cities is a new

Figure 8: China: Yellow Sea Coastal Region



Source: McGranahan, G., D. Balk, and B. Anderson. Forthcoming. "The Rising Tide: Assessing the Risks of Climate Change and Human Settlements in Low Elevation Coastal Zones." *Environment and Urbanization* 19(1).

Note: Hazard risk represents a cumulative score based on the risk of cyclones, floods, landslides and drought.

and hopeful trend in attention to urban environmental issues.[22] These networks seek to facilitate the exchange of information and capacity-building at the local level on urban and environmental issues, and can also become politically influential at critical junctures.

Local Actions, Global Consequences: Global Change, Local Impact

This chapter proposes that longer-term urban sustainability depends on policymakers' ability to take a broader view of the utilization of space and to link local developments with their global consequences.

A broader perspective improves the effectiveness of local actions while promoting longer-term sustainability. For instance, local planning for coastal development requires, at a minimum, a broader vision that connects proposed economic plans with such things as spatial aspects, land use, rates and characteristics of demographic growth, shelter and service needs of the poor, infrastructure, energy efficiency and waste disposal.

It also needs a vision inspired by global environmental concerns, in order to avoid damaging sensitive ecosystems and other resources. Both local and global perspectives, as well as good information, should determine the direction of future city growth.

Urban issues offer unique opportunities to translate scientific research into concrete policies. They involve a large number of stakeholders, at national, city, neighbourhood and household levels, including governments, the private sector and civil society. Given the increasing attention from a number of international organizations, and from national and local governments, raising global awareness starting from the local urban context should become easier.

Urban areas are also typically more affluent than rural areas and therefore better able to find local financing for major projects. Their effectiveness will ultimately depend on taking a more proactive stance, inspired by a vision of the actions needed now to guarantee longer-term sustainability.