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research findings for development policymakers and practitioners

Climate change and cities

International negotiations in Bali, Indonesia, in December 2007 failed to achieve consensus on targets for climate change mitigation (reducing greenhouse gas emissions). However, countries have agreed to negotiate mitigation targets for after 2012 by the end of 2009, when the countries meet again in Copenhagen.

The longer it takes to reach and implement global agreements on reducing emissions, the more adaptation will be needed for expected climate change, and the greater the number of cities (and other areas) for which protection will be impossible or too expensive.

The vulnerability of cities

Urban centres contain a large proportion of the people most at risk from the effects of climate change. Many urban dwellers face life-threatening risks from the increased intensity of storms, flooding and landslides that climate change is bringing. These and other impacts will also bring the threat of damage to their livelihoods, property, environmental quality and future prosperity.

Little attention has so far been paid to adaptation in urban areas. Although low- and middle-income nations are often perceived as predominantly rural, they now contain most of the world's urban population and most of its largest cities. Even Africa, long considered a rural continent, has two-fifths of its population in urban areas and a larger urban population than North America.

This issue of *id21 insights* looks at the risks and challenges faced in cities in Africa, Asia and Latin America due to climate change, and highlights practices and policies that could help them to adapt.

Adapting urban centres is important for protecting economies as well as people. Urban centres concentrate enterprises and jobs. In most nations they contain 60-95 percent of economic activities. In this issue of id21 insights, **Mozaharul Alam** describes Dhaka's vulnerability to climate change. Three other cities that are vulnerable to sea-level rise are described in a box on page 3.

The last 50 years has brought a 600 percent increase in urban populations in low- and middle-income nations. The concentration of people and economic activities in low-lying coastal zones has greatly increased, as shown by **Gordon McGranahan**, **Deborah Balk** and **Bridget Anderson** (see graphs on page 4). There has also been a rapid growth in the number of deaths and injuries and scale of economic losses from weather-related disasters – for example, the devastation caused by Hurricane Mitch in many urban (and rural) areas in Central America in 1998 and the devastation brought to Mumbai by flooding in 2005.

The relative contribution of climate change to these disasters is not known. Nevertheless, they do show the vulnerability of urban populations to the kinds of extreme weather events the intensity and scale of which climate change is likely to increase.

A crowded boat crossing a flooded road in Semra, East Champaran, in Bihar, India, during the 2007 floods. Millions were affected by severe flash flooding following particularly heavy monsoon rains across South Asia. Over 12 million residents were been displaced in India alone and many people were killed.
Jacob Silberberg / Panos Pictures, 2007

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The adaptability of cities

Most prosperous and well-governed cities should be able to adapt to likely climate change risks over the next few decades. As the Intergovernmental Panel on Climate Change Fourth Assessment Report notes, urban centres are often capable of considerable adaptation. They have had to adapt in order to function – for instance, creating stable sites for buildings, putting in place infrastructure and ensuring provision for water and drainage. In any well-governed city, many measures are in place to ensure that buildings and infrastructure can withstand extreme weather events.

Urban governments could ensure planned adaptation, with developments in each urban area reducing risks for inhabitants, enterprises and infrastructure. The required tools and methods are well-known and their effectiveness demonstrated in many locations. Durban's adaptation programme is described by **Debra Roberts**, outlining how adaptation can be integrated into urban development. **Hannah Reid** describes the emerging international regime to support adaptation.

For large, well-established cities, there are problems with adjusting existing buildings, infrastructure and land-use patterns to the new or heightened risks that climate change brings. But these can generally be addressed by long-term policies which spread the adaptation costs over long

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periods and by making use of potential synergies between reducing climate change risks and other environmental risks. Most of the risks from climate change comprise heightened levels of risks that are already present.

It would be a mistake to assume that the above – a logical, justifiable, fundable process driven by good science – is easily implemented. National governments can sign declarations at international conferences that recommend the needed measures but then ignore them. In addition, you cannot adapt infrastructure that is not there.

Hundreds of millions of urban dwellers have no all-weather roads, no piped water, no drains and no electricity supplies. They live in poor-quality homes on illegally occupied or subdivided land that inhibits investment in improved buildings. Many tenants have limited ability to pay rent and landlords have no incentive to invest in better quality buildings. Large sections of low-income urban populations live on floodplains or slopes prone to landslides, because these are often the only sites they can occupy within reach of income-earning opportunities.

Who is most at risk?

Much of the risk is concentrated among low-income households, as described by **Aromar Revi** for India and **Patricia Romero Lankao** for Latin America. The cities most at risk are those that are:

- least able to avoid the direct or indirect impacts because of their location – on the coast, by rivers, or where cyclones or hurricanes are common
- likely to be most affected by the impacts because of their physical form – poor quality buildings and lack of water supply and storm drainage infrastructure, for example
- least able to cope with the impacts due to a lack of local government capacity and funding to rebuild or repair damage, restore services and support households to rebuild homes and livelihoods.

The urban population most at risk are those who are:

- least able to avoid the direct or indirect impacts, because, for example, they live in poor quality homes and in areas with inadequate drainage systems, and are unable to move or change jobs if climate change threatens their livelihoods
- most vulnerable to the impacts, such as infants and elderly people who are less able to cope with heat waves or unable to flee quickly when a disaster is imminent
- least able to cope with illness, injury or premature death; or loss of income, livelihood or property.

What underlies this vulnerability?

For hundreds of millions of urban dwellers, most risk from the impacts of climate change is a result of development failures. In particular, risk is increased by the lack of capacity of local governments to provide infrastructure, disaster-risk reduction and disaster-preparedness, or their refusal to do so in 'illegal settlements'. This makes many people in poorer cities vulnerable to events to which wealthier, better governed cities can adapt.

The vulnerability of low-income urban dwellers to climate change is often put down to their poverty, but it is far more the result of local government failures or limitations. These, in turn, are linked to the failure of national governments and international agencies to support effective urban policies and local governance. Most international agencies have chosen not to invest in urban areas or to have any urban policies over the last few decades.

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See also

Adapting to Climate Change in Urban Areas: The Possibilities and Constraints in Low- and Middle-Income Nations, Human Settlements Discussion Paper, Climate Change and Cities I, IIED, London, by David Satterthwaite, Saleemul Huq, Mark Pelling, Hannah Reid and Patricia Lankao-Romero, October 2007 (PDF)
www.iied.org/pubs/display.php?o=10549IIED

'Chapter 7: Industry, Settlement and Society', by Tom Wilbanks, Patricia Romero Lankao et al, pages 357-390, *Climate Change 2007: Impacts, Adaptation and Vulnerability*, Cambridge University Press, Cambridge and New York, edited by Martin Parry et al, (forthcoming)

Adapting to climate change

Adapting to climate change means adapting to risks from observed or expected changes. Governments, enterprises and households will all have to adapt.

In most urban centres, community organisations and local non-governmental organisations are also important, especially where they are influential in building homes and communities and providing services within informal or illegal settlements.

Successful adaptation is about the quality of local knowledge, local capacity and willingness to act. City governments should have key roles, not only in changing what they do, but also in the adaptation they encourage and support. This includes:

- ensuring the availability of an appropriate and widely understood information base about climate change and its local impacts – this does not exist in most cities
- land-use planning that avoids high-risk areas and shifts activities away from them, including ensuring that low-income groups can find affordable land for housing on safe sites
- revising building and infrastructure standards, in ways that do not impose unaffordable costs
- planning and public sector investment that considers climate change. For example, much infrastructure needs to be designed to cope with likely changes over 50 to 100 years.

Development should increase people's ability to act to reduce their vulnerability to climate change – due to improved local knowledge and increased income – and increase poorer groups' ability to influence local governments' action.

Insurance can spread risks and reduce the financial hardships linked to extreme events. It can also provide incentives for adaptation and risk reduction. But only a very small proportion of urban households and enterprises have insurance.

For low-income groups, supporting the measures they already employ to reduce risk and vulnerability has more relevance – for instance, through community managed savings groups. In many countries, groups formed by people in 'slums' or informal settlements engage in risk management and risk reduction initiatives. These include upgrading slums and squatter settlements, developing new housing, and improving water supply, sanitation and drainage. In some cities, such groups have also developed detailed maps of informal settlements and collected data on who lives there to guide new infrastructure.

In Durban, South Africa, adaptation plans demonstrate the important role that local governments can and should play. Adaptation to climate change has to be built into the core of all urban planning and management. It is, however, difficult to get local governments to act on adaptation. There are always other priorities that seem more pressing and, at present, the information base on the likely local impacts of climate change is weak.

In most cities, planning for adaptation must first overcome an inadequate infrastructure base. Estimates of adaptation costs have yet to recognise this. Adaptation will need to address this deficit as well as making building improvements, strengthening of lifeline infrastructure and hazard modification (for instance repairing and strengthening flood, storm surge and coastal defences). All cities need effective disaster risk management plans, both to reduce risks and have in place appropriate responses. Good disaster-preparedness is a key part of adaptation.

However, adaptation means 'better coping', rather than removing risks. It does not remove or even reduce the urgency for mitigation: even for relatively low amounts of warming, there are natural and technical constraints to adaptation. Without strong and early mitigation, the difficulty and costs of adaptation will grow rapidly. While good development and adaptation to climate-change risks are complementary in important ways, most adaptation does entail opportunity costs.

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Urban adaptation in Latin America

Climate change will add to existing risks and stresses from extreme weather in Latin America. The number of weather-related disasters more than doubled between 1970 and 2005. This included two intense episodes of El Niño, which, together with land use changes, resulted in floods, droughts, landslides and other disasters. Many deaths resulted and the population, infrastructure and economic activities of both urban and rural areas were affected.

There is, of course, great variation between different urban centres within Latin America, in the risks they will face and in their capacities to adapt. Latin America has a long history of adapting to the impacts of climate variability, including extreme weather events. This includes some examples of autonomous adaptation such as better quality housing and improved house designs. Some adaptation is policy driven, but most is through disaster response rather than reducing risks and addressing the factors making poor people vulnerable.

The region's main arid and semi-arid areas face water shortage problems because precipitation has decreased, and this is likely to continue. The poor quality or absence of infrastructure in urban centres, and the lack of maintenance, have been key causes of dams failing and public hospitals, schools, bridges and highways collapsing during weather-related disasters. Only a very small proportion of housing is covered by disaster insurance.

The lack of transparency in allocating contracts for public works frequently leads to corruption and poor quality infrastructure and buildings. Many urban governments also have antagonistic relationships with low-income groups; for instance, refusing to provide infrastructure and services in informal settlements, even when these house 20-40 percent of a city's population.

Decentralisation of responsibilities to urban authorities should have helped address these issues, but often it has not been accompanied by increased revenues or revenue-raising capacity. In most countries, the reform of the state during the 1990s weakened many of the mechanisms that support adaptive capacity as the state withdrew from public transport, health care and public works.

However, there are examples of urban governments that have key roles as risk reducers, providing necessary infrastructure and services, guiding settlements development and regulating industries, transport and other hazardous activities that can produce disasters. The work of *La Red* (the network of social studies for the prevention of disasters in Latin America) has shown how good urban governance is central to adaptation and how much it can reduce risks and vulnerabilities to extreme weather events.

But adaptation requires addressing not only the risks but also people's extreme vulnerabilities to these risks. Adaptive capacity can be increased by:

- better and more stable incomes for poor people
- good education and health care, and good quality housing and urban infrastructure.

Adaptation also means ensuring actions to reduce climate change risks are integrated into the everyday practices of urban planning, land use regulation, water management and infrastructure investment.

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See also
Latin America: How to Enhance the Resilience of Cities and the Urban Poor, Paper prepared for the Rockefeller Foundation's meeting on Building for Climate Change Resilience, Patricia Romero Lankao, 2007

Cities vulnerable to sea level rise

Estimates for expected sea level rise up to the end of the 21st Century vary from 18 to 59 centimetres. Any such rise would certainly increase the number of people flooded by storm surges, especially in cities already vulnerable. These cities include:

Alexandria. The Government of Egypt assessed the vulnerability of the most important economic and historic centres along Egypt's Mediterranean coast (Alexandria, Rosetta and Port-Said). The findings suggest that for a sea level rise of 50 centimetres, over 2 million people would have to abandon their homes, 214,000 jobs would be lost and the cost in terms of land and property value and tourism income lost would be over US$35 billion. This would also involve the loss of world famous historic, cultural and archaeological sites.

Cotonou is Benin's largest urban centre, with around 700,000 inhabitants. Large sections of the city's economy and residential neighbourhoods are at risk from sea level rise and storm surges. Beaches, roads and buildings have already been destroyed by the coastline's regression in the last ten years. Provision for drainage is inadequate, the city has no sewer system and only a small proportion of solid waste is collected. Most of the population lives in informal settlements.

Mombasa, Kenya's second largest city, has over 700,000 inhabitants. It is a major seaport serving many countries. Around one fifth of Mombasa could be submerged by a sea-level rise of 30 centimetres, with a larger area rendered uninhabitable or unusable for agriculture because of water logging and salt stress. Beaches, historic and cultural monuments and several hotels, industries and port facilities would also be affected. Mombasa already has a history of disasters related to climate extremes, including floods, which cause serious damage and often loss of life nearly every year.

Sources:

'Vulnerability Assessment of the Coastal Zone of the Nile Delta of Egypt to the Impact of Sea Level Rise', *Ocean and Coastal Management*, 37 (1), pages 29-40, by M. El-Raey, (1997)

'The Vulnerability to Climate Change of Cotonou (Benin): The Rise in Sea Level', *Environment and Urbanization*, 19 (1), pages 65-79, by Krystel M R Doussou and Bernadette Glehouenou-Dossou, (2007)

'Climate Change and Coastal Cities: the case of Mombasa, Kenya', *Environment and Urbanization*, by Cynthia B Awuor, Victor A Orindi, and Andrew Adwerah, 2008 (forthcoming)

Unfairness in the causes and risks of climate change

Most people facing the highest risks from climate change are not those who are most responsible for causing it. This can be seen in three aspects:

- **Individuals and households**: It is the high-consumption lifestyles of wealthy people that drive climate change. It is low-income groups in low- and middle-income nations, with negligible contributions to climate change, that are most at risk from its impacts. The differentials in greenhouse gas emissions per person can be very large – most low-income urban dwellers have very low consumption levels for fossil fuels and for energy-intensive food, and have very few capital goods.
- **Nations**: Most greenhouse gases have been emitted within the wealthiest nations, but low- and middle-income nations will bear most of the costs. Cotonou and Dhaka are at high risk from sea level rise and storm surges, yet the per capita contributions of their nations to greenhouse gases is one eighteenth that of the USA.
- **Cities**: Larger companies and corporations can quite easily move their offices and production facilities away from cities at risk. These corporations are adept at shifting production to locations where profits are maximised, and they can factor in risks from climate change. But most city dwellers cannot easily move because their homes, assets and livelihoods are tied to the city.

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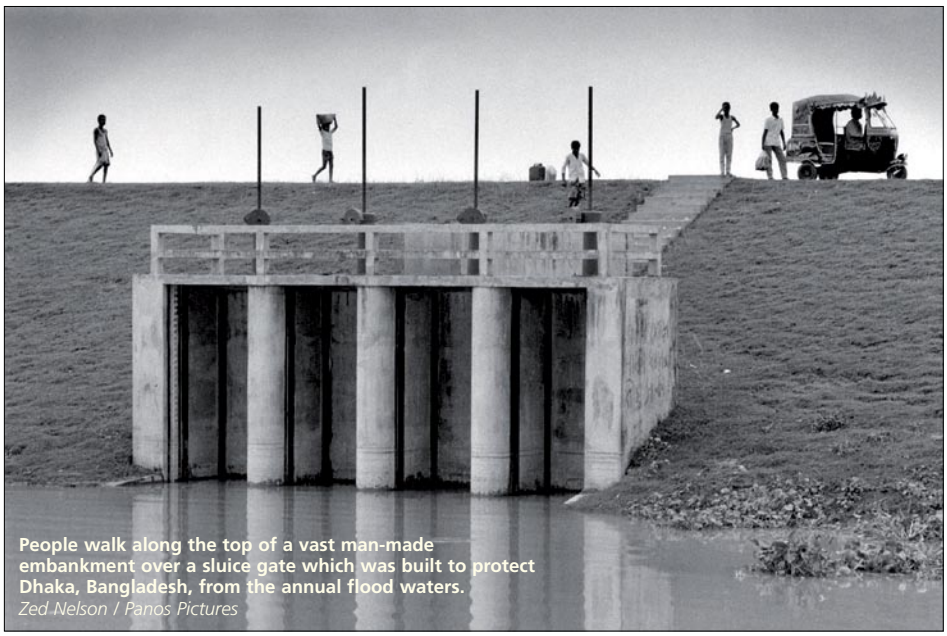
Floods in Dhaka

Dhaka has over ten million inhabitants and has been central to Bangladesh's economic success in recent years. The city is already very vulnerable to flooding, especially during the monsoon season, as shown by five major floods since 1980. The 1988, 1998 and 2004 floods were particularly severe and brought large economic losses.



People walk along the top of a vast man-made embankment over a sluice gate which was built to protect Dhaka, Bangladesh, from the annual flood waters.
Zed Nelson / Panos Pictures

When major floods occur they hit around half the city's area. They are mainly caused by spillover from surrounding rivers and rainfall that generates runoff beyond the capacity of the drains. The provision for infrastructure and services has not kept pace with the city's population growth.

The 40 percent of the population living in slums and squatter settlements are most severely affected by floods, water-logging and other associated problems. The unequal development and management of utilities and bad management of water and waste water are caused by both non-compliance with national policies, rules and regulations and insufficient resources.

Climate change will affect Dhaka in two main ways: through floods and drainage congestion and through heat stress. Melting glaciers and snow in the Himalayas and increasing rainfall will lead to more frequent flooding (water-logging, drainage congestion from river floods and excessive rainfall during the monsoon already cause very serious damage). Furthermore, Dhaka may also face 'heat island' problems, because temperatures in the city are a few degrees higher than in surrounding areas.

Infrastructure, industry, commerce and utility services are key sectors at risk from flooding. The impaired performance of these sectors during and after flooding increases the vulnerability of city dwellers, with economic and social class dictating the severity of that vulnerability. The loss of life and livelihoods, and impacts on human health, are particularly severe for lower-income groups.

Measures have been taken to improve air quality and protect the city from devastating floods, but far more is needed if Dhaka is to adapt to climate change. Recent erratic rainfall brought unusual urban flooding as a result of drainage congestion and inadequate facilities for pumping water from inside the flood embankment.

Are existing flood management measures adequate to address future flooding, which is anticipated to be more frequent and intense? Such measures could include:

- Spatial planning for unbuilt areas of Dhaka should ensure that these areas avoid flooding and avoid contributing to flood risks for the whole city.
- Changes to the design of the embankment and provision of adequate pumping systems to drain rainwater from the city.
- City-wide adaptation to allow Dhaka to cope with the changes in intensity and pattern of rainfall under a warmer climate.

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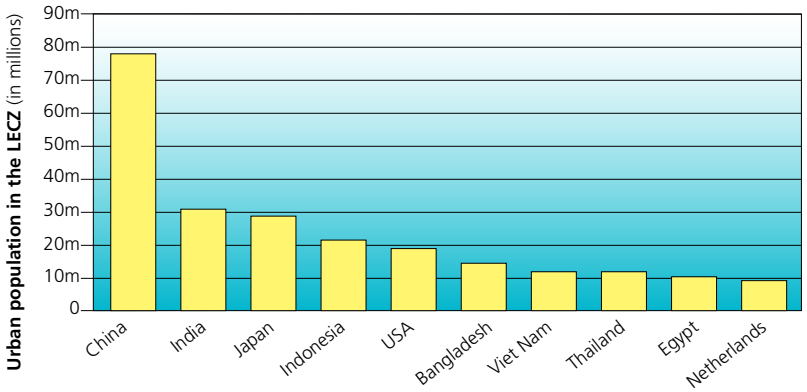
See also
'Vulnerabilities and Responses to Climate Change for Dhaka', *Environment and Urbanization* 19 (1), pages 81-97, by Alam, Mozaharul and MD Golam Rabbani, 2007

People at risk in urban coastal zones

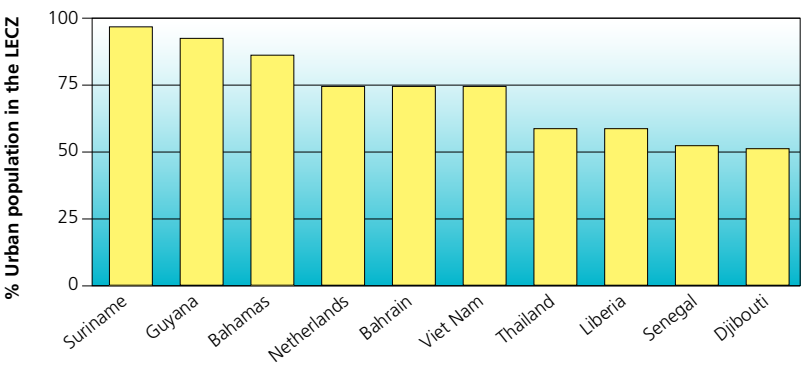
A high proportion of the urban population in low- and middle-income countries live within the Low-Elevation Coastal Zone (LECZ): the continuous area along the coast that is less than 10 metres above sea level.

Nations with the largest urban populations in the LECZ



Low-income and lower-middle income nations have a higher proportion of their urban population in this zone than high-income nations. As yet, the data are not available to assess exactly who among these people is at risk from a given sea-level rise.

Nations with the highest proportion of their urban populations in the LECZ



Source: Gordon McGranahan, Deborah Balk and Bridget Anderson, Environment and Urbanization (19) (1), pg 7, (2007)

Adaptation for India's cities

India's population is among the most vulnerable in the world to natural hazards, including storms, floods, droughts, earthquakes and landslides. India also has the world's largest rural population and second largest urban population.

Climate change is expected to increase the frequency and intensity of many existing hazards and bring an increased probability of extreme events and new hazards (for instance those linked to sea level rise).

The direct and indirect impacts of climate change will become key economic and political questions in South Asia, especially as they start to affect economic growth and dislocate the lives of millions of people, many of whom are city dwellers.

In Indian cities, vulnerability has typically contributed to overall risk more than hazard exposure has. The most vulnerable urban residents are the poor, slum and squatter settlement dwellers, and those who suffer insecurities. These insecurities arise from: poor governance; the lack of investment in infrastructure and in the commons; and strong connections between the political class, real estate developers and public agencies.

Who or what is at risk in a typical Indian city?

- people living in traditional and informal settlements, which are often in the areas most at risk from floods and wind-storms
- industrial and informal service sector workers, whose occupations place them at significant risk from natural hazards
- buildings that are vulnerable to wind, water and geological hazards; especially traditional and informal housing
- public and private infrastructure – transport systems; water, sewage and gas pipelines; drainage, flood and coastal defence systems; power and telecommunications infrastructure and critical social infrastructure such as hospitals, schools and emergency services
- ecosystems and the natural environment, especially wetlands, rivers, coastal ecosystems and groundwater systems.

Reducing urban climate change vulnerability needs a shift in public policy towards adaptation rather than the current emphasis on mitigation, which is led by wealthy Organisation for Economic Co-operation and Development countries. This policy shift must be grounded in the institutional, socio-cultural and political realities of India and recognise the different risks and adaptation needs of different cities. It must also focus on the poorest and most vulnerable people. This could be implemented by incorporating climate change risk assessment, adaptation and mitigation measures into India's ongoing national hazard mitigation programmes, and building strong links with existing urban renewal interventions.

Reducing urban climate change vulnerability needs a shift in public policy towards adaptation rather than mitigation

India needs a multi-level climate adaptation framework that works at national, state, city and neighbourhood level and brings together public, private and civil society sectors. The institutions and political will to execute this are weak or non-existent in most cities and states. These will need to be built, given incentives and linked to existing initiatives. Bottom-up community mobilisation will be crucial to adaptation that protects the interests of the poor and vulnerable. Without this, adaptation may bring a range of anti-poor interventions including a vicious cycle of displacement.

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See also
'Climate change risk: an Adaptation and Mitigation Agenda for Indian Cities', *Environment and Urbanization* 20 (1), by Aromar Revi, April 2008 (forthcoming)

case study

Durban adapts to climate change

Durban established an Environmental Management Department in 1994. Initially, the department examined how the municipality's strong developmental approach could incorporate environmental concerns.

Durban was one of the few cities in Africa to have a local Agenda 21 plan, in line with what governments agreed at the United Nations Earth Summit in 1992.

Various departments within the municipal government also became aware of the need to consider climate change in their plans – for instance for water supply and for health care. But municipal officials are unlikely to act if they have little idea of what climate change means for their city.

To address this, the Environmental Management Department initiated the development of a Climate Protection Programme in 2004. The roll-out of this programme has occurred in three phases:

Phase 1: Review and develop an understanding of the global and regional climate change science and translate this into an understanding of the implications of climate change for Durban. Key impacts include increases in temperatures, changes in the distribution of rainfall (long periods of no rainfall punctuated by short periods of intense rainfall), decreased water availability, increased range of water- and vector-borne diseases, sea level rise, and the loss of biodiversity.

Phase 2: Develop a 'Headline Climate Change Adaptation Strategy' for the city to highlight how key sectors within the municipality should begin responding to unavoidable climate change. Some interventions look to enhance and expand existing initiatives, such as the modelling of vector-borne diseases and their relationship to climate change. Others stimulate new activity, such as the 'climate-proofing' of the city's open space system through matrix management – the management of the urban landscapes surrounding natural areas in a way that assists the survival and dispersal of indigenous species – and the creation of north-south dispersal corridors.

Phase 3: Incorporate climate change into long-term city planning, which includes developing a model to simulate, evaluate and compare strategic urban development plans within the context of climate change. This seeks to understand the effects of climate change in Durban and allow a model-based assessment of the effectiveness of alternative approaches to mitigation and adaptation.

It will involve the use of greenhouse gas emissions accounting (producing an inventory of all the greenhouse gases produced by activities within the municipal area) together with an assessment of the city's vulnerability in key sectors, such as health, water and sanitation, coastal infrastructure, disaster management and biodiversity.

All cities need to consider how climate change will affect them. This example from Durban shows how the departments that most need to act on adaptation (such as water, energy, health, infrastructure, tourism and urban planning) must understand what climate change means for their work and future investments.

In addition, a review of changes in weather and extreme weather events over the past few decades can help identify who is most vulnerable to some aspects of climate change. The damage to infrastructure from high tides and waves in March 2007, for example, helped alert many government officials in Durban to the kinds of impacts that climate change will bring.

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See also
www.durban.gov.za/durban/services/departments/environment/climate-change

The international agenda

Within the science community, there is now broad consensus on the reality of human-induced climate change. The Intergovernmental Panel on Climate Change concludes, in its Fourth Assessment, that it is 90 to 99 percent likely that the rise in global atmospheric temperature since the mid 19th Century has been caused by human activity.

The report predicts that the average global temperature may rise by about 3 degrees Celsius by the end of the 21st Century, while sea level could rise by as much as 59 centimetres. Heat waves and periods of heavy rainfall are very likely to become more frequent.

The United Nations Framework Convention on Climate Change (UNFCCC) requires high-income countries to help the countries most at risk from climate change to adapt. Under the UNFCCC and its Kyoto Protocol, several funds have been established to support this:

- The Adaptation Fund supports 'concrete adaptation' activities. Unlike the two funds below, it is based on private sector replenishment through carbon markets.
- The Least Developed Countries Fund has already supported the development of National Adaptation Programmes of Action (NAPAs) in these countries.
- The Special Climate Change Fund is for all developing countries and covers adaptation and other activities such as technology transfer, mitigation and economic diversification.

The Least Developed Countries, acknowledged as being amongst the most vulnerable to climate change, are being supported to develop NAPAs, which specify their urgent and immediate adaptation needs.

Donors in countries including Canada, Germany, the Netherlands, Japan, the United Kingdom and the United States have allocated funding for adaptation activities, including research and some pilot projects. These include 'climate proofing' of existing projects and programmes (for example, funding the additional costs of making a dam better able to cope with the greater fluctuations in water availability) and 'stand alone' adaptation projects (such as new projects in the Small Island States struggling to cope with sea level rise).

Shopkeepers sit in the middle of a muddy thoroughfare in Kibera slum, Nairobi, which has hundreds of thousands of inhabitants. The streets often flood during the rainy season. There is little sanitation and inadequate infrastructure.
Sven Torfinn / Panos Pictures, 2006

Despite these international and bilateral efforts, a fully conceived, integrated and functioning regime for adaptation has yet to emerge. Progress has been made, but few adaptation measures are in place. In part, this is due to limited funds. The costs of adaptation are high: at least several billion US dollars per year for low and middle income countries alone. Existing funding sources will provide only a small fraction of this.

Funding is not the only challenge. Adaptation must be embedded in all aspects of policy making, planning and investment, at all levels and draw in the private sector:

- Countries need help to integrate climate risks into development projects and strategies. This will require greater institutional capacity. For example, urban planners often lack the capacity to ensure that city development minimises emissions and risks from climate change impacts.
- National policymakers are largely unaware of the potential impacts of climate change in different sectors. Planning in sectors such as health, agriculture, fisheries and forestry often fails to consider potential future climate change impacts.
- Vulnerability to climate change can be affected by the choice of development path, so each country needs to ensure adaptation is factored into its own planning at a strategic level.

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Useful web links

Intergovernmental Panel on Climate Change, Working Group II
www.ipcc-wg2.org/

Oxfam UK, Climate Change Issues
www.oxfam.org.uk/resources/issues/climatechange/introduction.html

Tyndall Centre for Climate Change Research
www.tyndall.ac.uk/research/programme3/index.html

IIED, Climate Change Group
www.iied.org/CC/index.html

Stern Review: The Economics of Climate Change
www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

United Nations Framework Convention on climate Change
http://www.unfccc.int/documentation/items/2643.php

Glossary of climate change acronyms
http://www.unfccc.int/essential_background/glossary/items/3666.php

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