Urbanization and climate change risk

All successful urban centres provide proof of the ability of human societies to adapt to the particular physical and climatic conditions in which they are located. While disaster events have long had the capacity to disrupt urban communities, livelihoods and economies, climate change presents a new and systematic challenge to urban development and sustainability. Last year was the fifth warmest year on record and the decade 2000–2009 was warmer than the previous two record-breaking decades. In 2009, severe climate events included: a record-breaking heatwave which badly affected major urban centres in southern Australia; drought-related food shortages in Kenya which affected slum dwellers in Nairobi; and heavy rains which caused floods in many towns across central Europe.

This chapter explains the need for a specific focus on climate change and how it impacts urban centres, while recognizing that good practices in disaster risk reduction are at the core of climate change adaptation in most instances. Firstly, it assesses the ways in which climate change will affect patterns of risk, using both a geographical analysis (the distribution of risk between cities) and a social analysis (the distribution of risk within cities). This highlights how, without adequate adaptation, the increase in disaster risk in the next few decades is likely to be unprecedented through more intense or frequent storms, more intense precipitation and more serious heatwaves and drought. Secondly, it illustrates the ways in which efforts to reduce risk from disasters will increasingly need to incorporate an explicit awareness of climate change issues. Finally, it looks at the ways in which cities can address climate change – both through reducing greenhouse gas emissions and through adapting to cope with the consequences. These practices are particularly important in the global context of increasing urbanization and the need to improve the well-being of urban residents – including issues of mobility, shelter and food supply – without increasing energy use and greenhouse gas emissions.

Responding to climate change requires improving existing structures and building the capacity of departments responsible for urban development and environmental management – and their links to the institutions responsible for disaster response. At the same time, climate change adaptation can be used as an entry-point to develop more effective environmental strategies that meet the needs of urban residents. If properly addressed, adapting to climate change can help cities to meet a wider range of desirable objectives concerning liveability, service provision and the reduction of disaster risk. This will require a sharing of knowledge and skills between the two communities of practice, so that climate change practitioners can learn from the experiences of disaster risk reduction, and disaster risk reduction can cope effectively with new climate challenges.
The growing policy focus on climate change has led to the development of new institutions and the use of new terminology, some of which differs from that used in disaster risk reduction.

The **Intergovernmental Panel on Climate Change (IPCC)** is the global scientific body established by the United Nations Environment Programme and the World Meteorological Organization (WMO). It produces *Assessment Reports* (most recently, the *Fourth Assessment Report* in 2007) that summarize the state of knowledge on climate change and its potential consequences. Its preparation for the *Fifth Assessment Report* acknowledges a need for greater attention to adapting cities to climate change and incorporating knowledge and experience on disaster risk reduction.

The **United Nations Framework Convention on Climate Change (UNFCCC)** provides the global legislative framework for reducing global warming and responding to climate change and convenes the annual meeting for negotiating emissions reductions and adaptation financing known as the Conference of Parties, or COP (e.g., COP15 in Copenhagen, held in December 2009).

**Greenhouse gases**  are gases that absorb and emit radiation of specific wavelengths, leading to the trapping of heat in the earth’s atmosphere, a process known as the **greenhouse effect**. Although the process occurs naturally and is important in supporting life on earth, the emission of carbon dioxide, nitrous oxide, methane and other gases as a result of human activity has raised the concentration of these gases sufficiently to result in **anthropogenic climate change**.

**Adaptation** is an adjustment in natural or human systems in response to actual or expected climate change in order to reduce its harmful impacts. It may take place before the impacts are felt, may be planned through deliberate policies, or may be spontaneous. It can involve individuals, communities, local governments and nation states.

In the climate change arena, **mitigation** refers to a reduction in atmospheric greenhouse gases, thereby limiting the extent of anthropogenic climate change. It involves both reducing the quantities of emissions and enhancing the ability of natural and human systems to absorb greenhouse gases.

---

**Changing patterns of risk: The effects of climate change**

Although the earth’s climate has always been dynamic, over the last 100 years global temperatures have been rising largely as a result of human activities, a process known as anthropogenic climate change. This has been driven by the production of greenhouse gases – and their increasing concentration in the atmosphere – since the industrial revolution. Observed changes include an increase in the global average temperature of 0.740 degrees Celsius, increased ocean temperature and acidity, a decline in snow coverage in the northern hemisphere, more frequent and intense extreme weather events, shifts in the distribution of animal and plant species, and a rise in global average sea levels of 17 centimetres. The IPCC’s *Fourth Assessment Report* concluded that likely future changes in climate include warmer and fewer cold days and nights, warmer and
more frequent hot days and nights, increased frequency of warm spells and heatwaves over most land areas, increased frequency of heavy precipitation events over most areas, increased areas affected by drought, increased intense tropical cyclone activity and increased incidence of extreme high sea level. These changes will result in a range of impacts on urban areas, as shown in Table 6.1.

Table 6.1 Climate change impacts on urban areas

<table>
<thead>
<tr>
<th>Change in climate</th>
<th>Possible impact on urban areas</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Changes in means</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>■ Increased energy demands for heating/cooling</td>
</tr>
<tr>
<td></td>
<td>■ Worsening of air quality</td>
</tr>
<tr>
<td></td>
<td>■ Exaggerated by urban heat islands</td>
</tr>
<tr>
<td>Precipitation</td>
<td>■ Increased risk of flooding</td>
</tr>
<tr>
<td></td>
<td>■ Increased risk of landslides</td>
</tr>
<tr>
<td></td>
<td>■ Distress migration from rural areas as a result of crop failures</td>
</tr>
<tr>
<td></td>
<td>■ Interruption of food supply networks</td>
</tr>
<tr>
<td>Sea-level rise</td>
<td>■ Coastal flooding</td>
</tr>
<tr>
<td></td>
<td>■ Reduced income from agriculture and tourism</td>
</tr>
<tr>
<td></td>
<td>■ Salinization of water sources</td>
</tr>
<tr>
<td><strong>Changes in extremes</strong></td>
<td></td>
</tr>
<tr>
<td>Extreme rainfall/tropical cyclones</td>
<td>■ More intense flooding</td>
</tr>
<tr>
<td></td>
<td>■ Higher risk of landslides</td>
</tr>
<tr>
<td></td>
<td>■ Disruption to livelihoods and city economies</td>
</tr>
<tr>
<td></td>
<td>■ Damage to homes and businesses</td>
</tr>
<tr>
<td>Drought</td>
<td>■ Water shortages</td>
</tr>
<tr>
<td></td>
<td>■ Higher food prices</td>
</tr>
<tr>
<td></td>
<td>■ Disruption of hydroelectricity</td>
</tr>
<tr>
<td></td>
<td>■ Distress migration from rural areas</td>
</tr>
<tr>
<td>Heat- or cold-waves</td>
<td>■ Short-term increase in energy demands for heating/cooling</td>
</tr>
<tr>
<td>Abrupt climate change</td>
<td>■ Possible significant impacts from rapid and extreme sea-level rise</td>
</tr>
<tr>
<td><strong>Changes in exposure</strong></td>
<td></td>
</tr>
<tr>
<td>Population movements</td>
<td>■ Movements from stressed rural habitats</td>
</tr>
<tr>
<td>Biological changes</td>
<td>■ Extended vector habitats</td>
</tr>
</tbody>
</table>

Source: Adapted from Wilbanks et al. (2007)

The extent to which urban centres are vulnerable to these changes in climate is influenced by a variety of factors. The location of cities affects the types of climate hazards to which they are exposed, and whether they are particularly likely to be affected by higher temperatures, changing patterns in precipitation, sea-level rise or more frequent or severe extreme events. However, and more importantly, vulnerability to these impacts is mediated through the social and economic circumstances of the city and its residents, and through the ability of stakeholders and institutions to address the challenges of climate change, sometimes referred to as adaptive capacity. Because of this, cities in low- and middle-income nations are particularly vulnerable to climate change – indeed, the IPCC concluded that “the distribution of impacts and vulnerabilities is
still considered to be uneven, and low-latitude, less-developed areas are generally at greatest risk due to both higher sensitivity and lower adaptive capacity”.

It is also worth noting that most developing world cities – and the countries in which they are located – have contributed very little to the global greenhouse gas emissions that are causing climate change in the first place. At a national level, average annual per capita greenhouse gas emissions are more than 20 tonnes of carbon dioxide equivalent in many highly industrialized countries including Australia, Canada and the United States. At the opposite end of the scale, emissions from many sub-Saharan African countries including Burkina Faso, Malawi and Tanzania are less than 0.2 tonnes per capita per year – a more than 100-fold difference. The fact that urban residents in these countries are likely to be the worst affected means that supporting climate change adaptation is a vital environmental justice issue for the 21st century. In his address to the United Nations Summit on Climate Change in September 2009, IPCC Chairman Rajendra K. Pachauri spelt out what this could mean: “In Africa, by 2020, between 75 and 250 million people are projected to be exposed to water stress due to climate change, and in some countries yields from rainfed agriculture could be reduced by up to 50%. The impacts of climate change would be disproportionately severe on some of the poorest regions and communities of the world. My own analysis suggests that at least 12 countries are likely to tend towards becoming failed states and communities in several other states would show potential for serious conflict due to scarcity of food, water stress and soil degradation.”

Complex inter-linkages exist between the effects of climate change and the process of urbanization. It is likely that extreme events and gradual changes alike will, in many cases, contribute to increasing levels of mobility. In most of these cases, mobility (along with income diversification) will be an important strategy for households and communities to reduce vulnerability to environmental and non-environmental risks and thereby to cope with climate change. At the same time, however, high urban densities can increase vulnerability to climate change-related disasters – particularly because inadequate institutions and lack of infrastructure are often concentrated in areas where there are also high population densities of low-income urban residents. In particular, rural–urban migrants often have no choice but to settle on land that is already densely populated or in relatively vacant sections that are particularly prone to disasters. Cities can also concentrate adaptive capacities: economic resources, diversified food sources, a wide range of income-generating opportunities, transmission mechanisms for early warning systems and efficiencies of scale for emergency responses are capacities that have the potential to be much stronger in urban areas.

**The geographical distribution of climate change risk**

The types of information used to assess the potential threats from climatic hazards are past records of exposure to extreme weather events such as tropical storms, likely
impacts of changing precipitation patterns and susceptibility to sea-level rise and storm surges. However, exposure to risk is not the same as vulnerability. A 2009 WWF report on the risks of climate change in ten Asian cities concluded that Manila, Ho Chi Minh City, Shanghai and Dhaka were all highly exposed to climatic threats. Some cities that are also highly exposed – including Kuala Lumpur, Hong Kong and Singapore – were identified as being much less vulnerable, because they possess the adaptive capacity to manage threats. The most vulnerable cities, such as Dhaka, Jakarta and Manila, are both highly exposed and have relatively low levels of adaptive capacity.

Urban areas located in coastal areas are particularly exposed to sea-level rise. The low-elevation coastal zone – the contiguous area along the world’s coastlines that is less than 10 metres above sea level – covers just 2 per cent of the world’s land area but contains 13 per cent of the world’s urban population. By 2007, Africa had 37 cities with more than 1 million inhabitants and half of them are within – or have parts within – the low-elevation coastal zone. In Cotonou, Benin, coastal erosion is already affecting residential areas, fishing communities and the city’s industrial and tourism sectors. A sea-level rise of 50cm would lead to over 2 million people in Alexandria, Egypt, needing to abandon their homes and would cause financial losses associated with land, property and tourism income of over US$ 35 billion. Much of Lagos, Nigeria is also low-lying, and the low-income urban population there faces a worsening situation as floods become more severe from the combination of increasing frequency of storm surges, heavy rainfall of long duration or high intensity and inadequate drainage systems.

The East African coast is also expected to be affected by sea-level rise, resulting in potential adaptation costs of up to 10 per cent of gross domestic product. In Dar es Salaam, Tanzania, coastal erosion is affecting the area of Kunduchi Beach to the north of the city. Other activities – such as the dynamiting of coral reefs for fishing, sand extraction for construction and the removal of mangroves – will worsen the impacts of sea-level rise in this area. In Asia, large sections of Dhaka and Shanghai are only one to five metres above mean sea level, while much of Mumbai is built on landfill and is likely to suffer from more serious storm surges and increased frequency and intensity of extreme weather as a result of climate change. Perhaps not surprisingly, in all of these cases, it is mostly low-income households living in informal or illegal settlements that face the greatest risks from flooding. Salinization of drinking water and groundwater is also a concern, as many coastal cities derive water from just above salt fronts. As sea levels rise, so too does the likelihood of drawing in saline water for municipal water supply systems.

Another geographically specific aspect of climate risk is an increase in water scarcity, which will particularly affect cities located in semi-arid regions. As South American glaciers retreat, many cities in the Andes will face water shortages during the dry season. A study from the central Andes of Peru suggests that the largest city in the region, Huancayo, with a population of approximately 325,000, is already experiencing water
shortages. Retaining walls and small dams have been constructed on nearby lagoons, but now these interventions are being called into question as they may have contributed to water shortages, along with the increased demands that come with population growth, land-use changes and deforestation. The city of Quito will also face water shortages, as glacial retreat is exacerbated by increased sedimentation of waterways, land-use modification and increases in water use due to higher temperatures. Food insecurity in urban areas is also influenced by climate change impacts on agriculture as a consequence of water scarcity and other weather impacts on crop production.

Box 6.2 Cooperating on flood risk in Saint-Louis, Senegal

Saint-Louis is Senegal’s former capital and it had 180,000 inhabitants in 2002. The city is situated on three islands cut off from each other by the Senegal River, its tributaries and the Atlantic Ocean. Some areas of the city are less than 2.5 metres above mean sea level. The city has experienced recurrent flooding since 1990, caused by the rains and peak flows in the Senegal River. The rising river level is the result of the silting-up of the river bed, the dumping of household waste, the reduced area available for flood-water irrigation (as unplanned urbanization means these areas are now covered by houses) and a shallow water table that rises to the surface when the river swells and drains poorly during the winter season.

Who is affected by flooding?
Flooding in Saint-Louis generally affects areas inhabited by the lowest-income groups. The household economy of those most at risk from flooding is very fragile; after each flood, their poverty is increased. Schools generally take in the flood victims and two or three families may find themselves living in a single classroom and the school year may be reduced by several months. Economic activity also slows down as workplaces are under water.

The extent of the floods that occurred during the 2009 winter season led the Senegalese authorities to initiate the national disaster response plan to address the situation. Stagnant rainwater in the flooded areas, combined with a lack of clean water, inadequate drainage and wastewater and solid waste management (only 30 per cent of households have a regular solid waste collection and less than 10 per cent sewer connections) brings serious health impacts. Risks are further compounded by the proliferation of disease vectors (flies, mosquitoes, cockroaches, rats, mice, etc.), poor hygiene and high levels of overcrowding.

Responding to vulnerability
The strategy of the Senegalese non-governmental organization (NGO) Enda-Tiers Monde in response to flooding in Saint-Louis has been based not on building infrastructure but on strengthening local governance. Stakeholders come together to engage in dialogue and exchange views in order to find solutions to problems that are beyond their individual skills or capacities. An action plan has been developed and is managed by a steering committee, which ensures that the programme’s information, education and communication activities are implemented smoothly. Plays, exhibitions, media broadcasts, teatime ‘chats’, interviews, photo exhibitions, intensive awareness-raising campaigns, open-air conferences and public
feedback have all been used to help change behaviour.

Activities focus primarily on:
- digging paths to evacuate stagnant water
- regular maintenance of drainage channels
- disinfecting stagnant water, in association with the national hygiene department
- placing sandbags to help inhabitants get about within the neighbourhood itself.

The authorities use local labour for some drainage works and women’s groups are involved in awareness-raising activities to combat diarrhoea and measures to be taken to prevent malaria and other diseases. NGOs work closely with the state’s decentralized structures (health and sanitation departments, fire brigade, etc.) to raise awareness and change the population’s behaviour.

The social distribution of climate change risk

Social factors account for a large proportion of the variability in vulnerability to climate change impacts. Firstly, poverty and marginality are key contributors to vulnerability. Exposure to climate risk is particularly evident for households and communities living in sites that are exposed to storm surges, flooding and landslides and which lack the resources and options to modify these effectively. Low-income urban residents are particularly vulnerable to climate change for a variety of reasons, including:

- greater exposure to hazards (e.g., through living in makeshift housing on unsafe sites)
- lack of hazard-reducing infrastructure (e.g., roads allowing emergency vehicle access)
- less adaptive capacity (e.g., inability to move to less dangerous sites or access savings or insurance)
- less state provision of assistance
- less legal and financial protection.

Secondly, climate change is expected to exacerbate pre-existing gender dimensions of vulnerability. On top of the well-documented and disproportionate impact of disasters on women’s morbidity and mortality, climate change will impact women’s livelihoods by reducing economic opportunities and will increase the burden of reproductive labour, for example, through a growing burden of child disease (see Table 6.2).

Thirdly, age greatly shapes vulnerability to the consequences of climate change. Children have higher susceptibility to diseases caused by poor sanitation or spread by vectors. Climate change may reduce availability of potable water, both through absolute scarcity and through increased spread of bacterial diseases, and vectors such as mosquitoes may expand their range due to rising temperatures. In addition, very young children have less capacity to cope with high temperatures and less ability or knowledge to respond rapidly to disaster events, and can suffer long-term damage to their cognitive
<table>
<thead>
<tr>
<th>Aspect of vulnerability</th>
<th>Contribution to urban vulnerability</th>
<th>Contribution to climate vulnerability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gendered division of labour and ‘poverty of time’</td>
<td>Women have prime responsibility for ‘reproductive’ labour; lack of time to engage in ‘productive’ labour</td>
<td>Limited financial assets to build resilience and to cope with disaster events</td>
</tr>
<tr>
<td>Gender-ascribed social responsibilities</td>
<td>Women have prime responsibility for ‘reproductive’ labour; lack of time to engage in ‘productive’ labour</td>
<td>Additional domestic responsibilities when access to food, water and sanitation are disrupted; additional time required to care for young, sick and elderly</td>
</tr>
<tr>
<td>Cultural expectations of gender norms</td>
<td>Constraints on women’s mobility and involvement in certain activities</td>
<td>Higher mortality from disaster events due to lack of skills and knowledge</td>
</tr>
<tr>
<td>Unequal entitlements to land and property</td>
<td>Limited access to productive resources</td>
<td>Limited ability to invest in more resilient land or shelter</td>
</tr>
<tr>
<td>Higher representation of women in informal sector</td>
<td>Lower wages and lack of financial security</td>
<td>Damage to homes and neighbourhoods affects women’s incomes more severely as income-earning activities are often undertaken at home</td>
</tr>
<tr>
<td>Safety and security in public spaces</td>
<td>Limited freedom to use public space</td>
<td>Particular problem in temporary accommodation/relocation sites; high rates of sexual abuse and violence</td>
</tr>
<tr>
<td>Limited engagement of women in planning processes</td>
<td>Urban plans fail to meet particular needs of women and children</td>
<td>Climate adaptation plans fail to meet needs of women and children; failure to incorporate women’s perspectives may result in higher levels of risk being accepted</td>
</tr>
</tbody>
</table>

and social development as a result of early experiences. Heatwaves particularly affect elderly residents of temperate cities where the building stock is not suited to continuous high temperatures – the 2003 European heatwave was associated with more than 70,000 additional deaths across the continent.

Finally, in addition to morbidity and mortality as a result of one-off events, climate change will also result in qualitatively different patterns of health burdens on urban populations. Weather and climate also influence air pollution-related mortality and morbidity, the prevalence of mosquito- and tick-borne diseases and the spread of water- and food-borne diseases, e.g., through survival of bacterial pathogens and the transportation of disease organisms into water supplies. In northern Mexico, heatwaves have been correlated with increases in mortality rates; 10 per cent of summer deaths are associated with heat strain in Buenos Aires, Argentina; and records show increased cases of diarrhoea in Peru.
Addressing the causes of climate change: The role of cities in climate change mitigation

Ultimately, reducing the risk of climate change requires global strategies to limit the atmospheric concentration of greenhouse gases. Without substantial coordinated efforts to reduce emissions, vast areas of the earth’s surface – including many large urban centres – will be affected by catastrophic changes in their climate. For instance, the IPCC’s *Fourth Assessment Report* noted the possibility of global warming causing a partial de-glaciation of the Greenland ice sheet and the West Antarctic ice sheet, which would contribute to a sea-level rise of several metres that would imply major changes in coastlines and inundation of low-lying areas. But the time frame for this is uncertain and this change could be prevented if governments follow IPCC recommendations for emissions reduction.

In this regard, climate change mitigation can be seen as the most effective form of climate change-related disaster risk reduction, and is an area in which cities can play a key role. As stated previously, most of the earth’s population has made a minimal contribution to climate change and the burdens of mitigation ought not to be borne by these societies. In high- and many middle-income nations, however, urban areas need to be at the forefront of taking responsibility for climate change and reducing their emissions accordingly. Although the contribution of urban areas to global greenhouse gas emissions cannot be accurately quantified, the consumption behaviour of wealthy urban residents is a significant contributor to this. Similarly, various mitigation activities can also yield substantial public health benefits, including greater levels of physical activity and lower levels of air pollution.

A range of urban activities and sectors contribute considerably to greenhouse gas emissions. These include energy supply (direct and through electricity generation from thermal power stations), transportation, industry and waste. Urban authorities are able to contribute to emissions reductions in different ways, for example, by providing improved public transportation options or by providing incentives for homeowners to fit more energy-efficient appliances. Cities such as New York and London demonstrate that large and dense urban settlements offer opportunities for reducing carbon footprints – the average resident of New York generates just 30 per cent of the emissions of the average American and the average London resident generates just 55 per cent of the emissions of the average UK resident. Indeed, long-term planning to reshape urban form and structure may result in much more efficient public transportation infrastructure that meets both environmental and social needs. However, efforts to reduce emissions also need to take a ‘consumption-based’ approach, recognizing that many of the goods and services consumed by urban residents (particularly in more affluent countries) – including food, energy and consumer goods – are associated with emissions from outside the urban area itself and frequently from other countries.
Several initiatives – including the C40 Climate Leadership Group and Cities for Climate Protection, sponsored by ICLEI-Local Governments for Sustainability – help share knowledge and good practices between cities involved in reducing their greenhouse gas emissions. Urban authorities in low- and middle-income nations have also begun to exploit opportunities to generate ‘carbon credits’ through reducing emissions from solid waste management and other activities. At the same time, however, it must be ensured that these efforts do not divert attention from the strong adaptation needs that face many residents of these cities.

**Box 6.3 Urban flooding in Ireland**

Much of urban Ireland was thrown into chaos by widespread flooding in the same week in November 2009 that the Irish Academy of Engineering (IAE) published a landmark report *Ireland At Risk – Critical Infrastructure and Climate Change* which warned that storm surges combined with a sea-level rise of 50cm would mean that a one-in-100-year flood could happen as often as every five years.

Rainfall totals were the highest on record for November in many places and river levels reached record heights as the Irish Red Cross deployed volunteers and ambulances to assist in evacuations and to ensure that vital health personnel were able to report to work.

Months later the island nation, whose major cities all lie on the coast, was still counting the cost. In County Cork alone, it was estimated that flood damage ran to 100 million euros as a dam equipped with a new 50-metre-wide spillway designed to cope with an extreme flood, failed to cope. The River Lee burst its banks and flooded the centre of Cork, Ireland’s second largest city.

“Failure to act now will put our society at an unacceptable risk,” said the IAE’s president, Michael Hayden. “You’ve only to think of Hurricane Katrina for an example of how climate change coupled with poor planning and zoning decisions can lead to social and economic disaster.”

In a week when the country’s major rivers burst their banks, the academy warned that homes in coastal cities could become uninsurable unless urgent measures were taken and cited Benjamin Franklin’s adage: “An ounce of prevention is worth a pound of cure.”

The IAE further predicted that unless urgent action was taken to strengthen critical infrastructure the following would happen: changing rainfall patterns would affect water supplies; rising sea levels would inundate coastal cities and towns; severe weather incidents would damage energy installations, hospitals, telecommunications, railways and other critical infrastructure, and contaminate water supplies.

The Irish *Sunday Tribune* newspaper noted in an editorial other factors that played a role in the November flooding which saw thousands of people evacuated from their homes: “The legacy of the past decade has been one of appalling and corrupt planning decisions which have allowed building on flood plains; building regulations that allowed uninsulated, energy-inefficient homes to be thrown up anywhere, anywhere; inadequate flood management schemes which at times have been poorly managed; and now last week, the failure to have a fully working flood emergency plan in operation should the worst happen has added to the misery of tens of thousands of people.”
Reducing the effects of climate change: Local planning for adaptation and disaster risk reduction

Much recent climate change policy has stressed the ‘co-benefits’ of mitigation strategies: the ways in which reducing greenhouse gas emissions can meet broader goals of increased energy independence, lower costs and higher quality of life. However, for a large proportion of the world’s urban population, this is of limited value as their emissions are already extremely low but there are many strong co-benefits between climate change adaptation and development. This includes disaster risk reduction but also addresses slow-onset changes such as the salinization of groundwater which affect the accumulation of risk over time.

For practical purposes such as policy design, the distinction between natural variability (including extreme events) and incremental variability due to climate change is trivial – the key is to recognize and address underlying factors causing vulnerability. A starting point for reducing climate risk, therefore, is a better understanding of the particular hazards and vulnerability faced by urban centres. This is a context-specific process but there are several underlying principles that can be followed. Firstly, projected climate scenarios and their potential impacts need to be understood but their limitations also need to be known. Future projections contain a wide range of uncertainties in relation to both the absolute extent of climate change and the ways in which this will be experienced at the geographical scale of the city. Secondly, a detailed analysis needs to be undertaken to identify the most vulnerable groups, areas, sectors and how they may be affected – a process that has much in common with assessing vulnerability to disasters. Thirdly, the combined impacts of direct and indirect factors need to be taken into account – recognizing both the effects of climate change and the implications for urban residents of policies formulated to address these. Finally, existing capacities to respond and adapt must be assessed. With the exception of the climate projection component, this is already good practice in identifying vulnerability to a range of extreme events.

Climate change adaptation and disaster risk reduction that meet the needs of the urban poor

Urban governance is increasingly accepted as a multifaceted process involving a range of stakeholders, including civil society organizations, the private sector, the academic and research community, and the formal mechanisms of local government. Building
Box 6.4  After the storm

After the storm a tentative blackbird chorus, silent throughout it, started cheeping again. The city, for fear of a worse overflow, had unlocked dams, so water levels rose at an alarming rate; the rivers burst their banks, swamping fields in a sea of rain, and flooded low-lying districts in one go, the waters sparing neither man nor beast. Square miles shrank as a sudden deluge rushed from the rain-sodden hills. Ye nymphes of Bandon, where were you when the great south-facing windows of heaven were opened and it bucketed down on quiet Munster? No one had imagined embankments would give way under the surge, the river Lee engulfing market towns’ water mains, drains and residential lanes. It struck in late November, so by and large no ripening crops suffered, no standing grain, but haylofts were awash and much of the hard work of the summer proved to be in vain. Reservoirs, lakes poured down in a tide of mud submerging farms. An astonishing six inches fell in a single night from inky cloud. Not much distinction now between sea and land: some sat in dinghies rowing where they’d sown, navigating their own depth-refracted ground and scaring rainbow trout among the branches. Global warming, of course, but more like war as if dam-busting bombers had been here: aerial photographs of the worst-hit areas showed roads, bridges, basic infrastructure devastated, the sort of thing you expect in China or Louisiana but not in Cork. Detritus of the years, carpet and car, computers and a wide range of expensive gadgetry went spinning down the river with furniture and linen, crockery, shoes and clothes, until it finally gave over; not everyone had full insurance cover.
resilience to disasters and climate change requires the involvement of all these actors. However, it is important that responses take into account the particular circumstances of the urban poor who are generally the most vulnerable both to extreme events and to slow-onset changes. There are several specific ways in which adaptation to climate change and disaster risk reduction can take this into account:

**Ensure that infrastructure works for the poor.** New infrastructure – particularly for the provision of water, sanitation and drainage – is an important aspect of urban adaptation to climate change and to building broader resilience. Yet too often, existing infrastructure is poorly maintained. Often it is poor maintenance of storm and surface drains that contributes so much to flooding – for instance, for many cities, the need to de-silt them and clear them of garbage before the monsoon rains come. Improving waste collection services from low-income communities can reduce flooding at times of heavy rain and can improve child health through reducing exposure to disease. Effective transportation systems can enable low-income groups to live in safer physical surroundings while still being able to access employment and livelihood opportunities.
Support slum and squatter upgrading. Where large numbers of people live in poor-quality housing in informal settlements, improving housing and getting basic infrastructure in place is a priority for adaptation. However, it is important to make sure that these new houses and infrastructure are constructed in such a way that they can withstand likely future changes in climate. In association with this, it is important to address related social issues: people and communities who are healthier, better educated and with secure tenure are more able to deal effectively with a wide range of shocks and stresses, including one-off extreme events and climate change. Ongoing action to improve the provision of public services can provide households with a firmer base from which to face the challenges of climate change. Urban planning, management and governance are all now firmly on the IPCC agenda.

Reconsider zoning, planning and building regulations. Zoning and planning controls have often served to exclude a large proportion of the urban population in low- and middle-income nations from legal land markets. The identification of ‘vulnerable’ land in preparing for climate change should not be used in the same way. Instead, these controls can be used to help provide appropriate and safe locations for low-income households while reducing their exposure to the risks of flooding, slope failure and other disasters. The application of building standards that are appropriate to local contexts, including affordability, and used in ways that support incremental improvements can make housing resistant to extreme weather, while still enabling poor residents living in self-built or artisan-built constructions to upgrade at an appropriate pace and cost.
Ensuring climate and disaster preparedness in key urban sectors

Engaging with a wide range of stakeholders is key to ensuring that adaptation and disaster risk reduction actions meet the needs of a broad cross-section of urban residents. This approach has been used by several major stakeholders and projects as the means of engaging in climate change adaptation in urban areas. Both the Asian Cities Climate Change Resilience Network and UN-Habitat’s Cities in Climate Change Initiative use multi-stakeholder engagement processes to support urban adaptation. However, many specific actions need to be taken at a sectoral level. As Table 6.3 shows, many of these specific actions in water supply provision, storm and flood-water management, public health, energy and transportation meet both climate change and disaster risk reduction objectives.

Table 6.3 Examples of climate change and disaster preparedness goals and actions

<table>
<thead>
<tr>
<th>Priority planning area</th>
<th>Preparedness goal</th>
<th>Preparedness actions</th>
</tr>
</thead>
</table>
| Water supply                           | Expand and diversify water supply        | ■ Develop new groundwater sources  
■ Construct new surface water reservoirs  
■ Enhance existing groundwater supplies through aquifer storage and recovery  
■ Develop advanced wastewater treatment capacity for water re-use |
|                                        | Reduce demand / improve efficiency       | ■ Increase billing rates for water  
■ Change building codes to require low-flow plumbing fixtures  
■ Provide incentives (e.g., tax breaks, rebates) for switching to more water-efficient processes |
|                                        | Increase drought preparedness            | ■ Update drought management plans to recognize changing conditions |  
|                                        | Increase public awareness about impacts on water supplies | ■ Provide information on climate change impacts to water supplies and how residents can reduce water use in utility inserts, newsletters, web sites, local newspapers |
| Storm- and flood-water management      | Increase capacity to manage storm water  | ■ Increase capacity of storm-water collection systems  
■ Modify urban landscaping requirements to reduce storm-water runoff  
■ Preserve ecological buffers (e.g., wetlands) |
|                                        | Reduce property damage from flooding    | ■ Move or abandon infrastructure in hazardous areas  
■ Change zoning to discourage development in flood hazard areas  
■ Update building codes to require more flood-resistant structures in floodplains |
|                                        | Improve information to manage storm and flood events | ■ Increase the use of climate and weather information in managing risk and events  
■ Update flood maps to reflect change risk associated with climate change |
Public health

- Reduce impacts of extreme heat events
  - Improved early warning systems for extreme heat events
  - Open additional cooling centres during extreme heat events
  - Increase use of shade trees to reduce urban temperatures

- Improve disease surveillance and protection
  - Increase monitoring of known diseases and potential diseases moving into the area
  - Increase public education on disease prevention for vector-borne illnesses that could increase as a result of climate change

Energy

- Ensure consistency of energy supplies while expanding to low-income groups
  - Strengthening of overhead transmission and distribution infrastructure
  - Underground cabling for utilities
  - Reduced dependence on single sources of energy

- Reduce greenhouse gas emissions associated with energy use
  - Energy efficiency
  - Use of renewable sources

Transportation

- Ensure that transportation network functions despite changes in temperature and precipitation
  - Realignment or relocation of transport infrastructure
  - Improved design standards and planning for roads, rail and other infrastructure

- Ensure that transportation system facilitates rapid emergency responses
  - Effective emergency plans for utilizing transportation networks for evacuations, etc.

Source: Adapted from ICLEI (2007) and IPCC (2007)

Financing urban adaptation

Meeting the challenges of climate change will require considerable investment in infrastructure and services – particularly in low- and middle-income nations. However, many of the existing assessments of adaptation costs have been based on present investment in infrastructure and have not taken into account the infrastructure deficit (the current shortfall in infrastructure provision for cities under existing climatic conditions) present in many cities in low- and middle-income nations. Any realistic measure of the costs of adaptation in urban areas therefore needs to be informed by an analysis of current disaster risks and the required investment in housing, early warning systems and rapid and effective post-event responses including temporary accommodation, restoring access to services, supporting rapid return to damaged settlements and supporting rebuilding.

However, new funding pathways are currently being developed that are intended to support investment in adaptation to climate change. Some of these fall under the banner of traditional overseas development assistance. Others are coordinated under the UNFCCC, although their precise nature is the focus of ongoing UNFCCC
negotiations. However, there are no clear mechanisms through which international climate change adaptation funds can be transferred to local governments (including city authorities) and many urban interventions, including financing for large-scale infrastructural projects, fail to assess the likely impacts of climate change.

Towards urban resilience

The ultimate objective of disaster risk reduction and climate change adaptation is to produce resilient cities. Rather than focusing on anticipating specific hazards – whether these are short-term disaster risks or longer-term changes in climate – city stakeholders, particularly in low- and middle-income nations, ought to take a broader, integrated approach that addresses both current and future development needs. Resilience therefore takes into account the economic, social, psychological, physical and environmental factors that are necessary for humans to survive and to thrive. Locally rooted strategies to build resilience need to incorporate a strong focus on both disaster risk reduction and climate change adaptation and need to be embedded within a city’s institutional and organizational framework.

Many aspects of resilience are closely associated with a holistic approach to development. Individuals and households that have access to adequate food, clean water, healthcare and education will inevitably be better prepared to deal with a variety of shocks and stresses – including those arising due to climate change.

Box 6.5 Building resilience as a strategy for climate change adaptation and disaster risk reduction

Resilient towns and cities are able to withstand a variety of challenges. As well as helping to manage the challenge of climate change, increasing resilience generates a wide range of additional advantages. The Resilience Alliance and the Asian Cities Climate Change Resilience Network suggest that urban resilience involves the following components:

- **Redundancy.** When one system is disrupted, another system can provide similar services. For example, if individuals are trained in basic health and emergency responses, they are able to provide immediate support if transportation and communication systems are disrupted following an extreme event.

- **Flexibility.** The failure of a single system causes a minimal impact to other systems. For example, a city with a diversified economic base will avoid catastrophic failure if a single industry fails due to economic change or environmental disaster.

- **Capacity to reorganize.** Climate change will result in changing conditions – and resilient cities are able to introduce new structures, organizations and land-use measures in response to this.

- **Capacity to learn.** This ensures that future decisions are made on the basis of relevant information and appropriate forethought.

Source: ISET, 2009
Integrated actions and multi-stakeholder approaches

Creating more resilient towns and cities that are able to cope with disaster risks and climate change requires action by a range of stakeholders. These can include those who are (or are likely to be) affected, those who have technical expertise, those who have financial resources and those with authority for decision-making. These stakeholders can then come together as steering committees or working groups to address particular issues. As the Saint-Louis case study shows, the combined knowledge, skill and political influence of groups working together is able to generate more effective results than individual organizations working on their own. Development and humanitarian organizations can also modify their programmes, policies and practices to address climate change in urban areas more effectively. These organizations can also facilitate a range of household coping strategies through their actions.

Conclusion

Work got under way in earnest this year on the IPCC’s *Fifth Assessment Report* which will look closely at urbanization processes and is due for delivery in 2014. This is just one year prior to the ultimate date, 2015, set by the IPCC for global emissions...
to peak if the planet is to have a chance of limiting temperature increase to between 2 and 2.4 degrees Celsius. The general acceptance by the G8 of a 2 degrees Celsius ceiling may still be too much for many coastal cities’ defences and this needs to be recognized sooner rather than later when it comes to investment in disaster risk reduction. Entrenched dichotomies between climate change adaptation and disaster risk reduction need to be dismantled long before then to enable a focus on building urban resilience. The International Federation of Red Cross and Red Crescent Societies for example, in its Strategy 2020, addresses climate change adaptation “through scaling up disaster risk reduction measures and strengthening traditional methods of coping with disasters that are relevant in particular environmental contexts”.

Climate change will have both a quantitative and a qualitative impact on the risks facing urban areas in coming decades. In particular, the inability to predict future emissions scenarios and the lack of precise knowledge about the impacts that these will have on the global climatic system means that urban residents and authorities will have to deal with an increasing level of uncertainty around the frequency and intensity of extreme weather events. Many countries still have some way to go in order to catch up with reality: a WMO survey in 2006 showed that more than 60 per cent of its 189 members are inadequately equipped to warn populations against hazards, particularly in most vulnerable countries. It seems remarkable that it was only in April 2010 that 30 ministers in charge of meteorology in Africa met for the first time under the auspices of WMO and the African Union, given that Africa is so poorly equipped to deal with climate change at both urban and rural levels.

When combined with increasing levels of urbanization and ongoing social and environmental problems in towns and cities, risk and vulnerability for many urban residents are likely to be exacerbated. The impacts of climate change will be distributed unevenly within urban populations, with low-income groups being particularly vulnerable due to their greater exposure to hazards and their lower levels of adaptive capacity. A focus on building resilience to cope with uncertainty, rather than applying solutions based on specific scenarios, is therefore the best way of protecting the lives and livelihoods of urban residents.

The actions taken by urban authorities, civil society organizations and humanitarian agencies in urban areas can make a substantial difference to the ability of towns and cities – and their residents – to respond to disasters and climate change. For city dwellers in low-income and many middle-income countries, the biggest single issue is the infrastructure deficit – the inability of urban systems to deal with current climate variability. Many of the hazards and risks facing cities as a result of climate change are modifications to existing hazards and risks – and cities that are unable to deal with the challenges of today will be unable to deal with the new climate challenges of the future. Improved planning for disaster risks, including better short-term forecasting of shocks, is therefore also a key component for responding to climate change. At the
same time, the development of sound responses to existing patterns of risk will form a solid basis with which to deal with those that are genuinely new. These measures need to be considered within an overall framework of a global transition to a low-carbon economy in order to minimize the risk of dangerous climate change taking place in the coming decades.

Chapter 6 and Box 6.1 were written by David Dodman, Senior Researcher, Human Settlements and Climate Change Groups at the International Institute for Environment and Development, London. Box 6.2 was written by Khady Diagne from the NGO, Enda-Tiers Monde; Box 6.3 was written by Denis McClean, World Disasters Report editor; Box 6.4 is a contribution from poet Derek Mahon; and Box 6.5 was written by the Institute for Social and Environmental Transition (ISET).
Sources and further information


