CHAPTER 6

CLIMATE CHANGE ADAPTATION RESPONSES IN URBAN AREAS

The lives and livelihoods of hundreds of millions of people will be affected by what is done (or not done) in urban centres with regard to adapting to climate change over the next decade. Action is urgently needed, both to address current risks and to begin building into urban fabrics and systems resilience to likely future risks. Most urban buildings and infrastructure are long lived; thus, what is designed and built now will have to cope with climate change many decades into the future. As a result, it is generally much easier to make provisions now for likely future climate-related risks – in infrastructure expansion, new buildings and new urban developments – than to have to retrofit buildings, redo infrastructure and readjust settlement layouts in the future.

As noted in Chapter 4, urban centres already concentrate a large proportion of those most at risk from the effects of climate change. This includes a high proportion of urban centres with very large deficits in infrastructure, as well as in the institutional and financial capacity needed to reduce these risks. Urban centres also concentrate the enterprises that generate most of the world's gross domestic product (GDP) and provide livelihoods for around two-thirds of the world's economically active population.[1] In most urban centres, buildings, infrastructure and services will have to cope with an increasing scale and range of climate impacts. Furthermore, as most of the growth in the world's population over the next few decades will occur in the urban centres of developing countries[2] – many (if not most) of which are already unable to provide adequate living conditions for their populations – it is likely that a major proportion of these new urban residents will be living in settlements that do not have the needed resilience to climate change.

Yet, adapting urban areas to climate change is not a new 'standalone' task or responsibility that can be allocated to one single stakeholder. It requires changes in the ways that almost all sectors of government, business and households behave and invest. In addition, much of what is needed to make cities resilient to climate change within the next few decades is no more than 'good development' in the sense of the infrastructure, institutions and services that meet daily needs and reduce disaster risk. As this chapter discusses, however, this is not easily achieved, as particular institutions and funding sources are given responsibilities for 'climate change adaptation' not for 'development that incorporates climate change adaptation'. Many discussions of climate change adaptation start with a discussion of the risks that climate change is bringing or may bring and then consider what needs to be done to address this – without considering how the climate change-related risks fit within other risks. What most urban centres in developing countries need is not a climate change adaptation programme but a development programme – meeting already existing deficits in provision for water, sanitation, drainage, electricity, tenure, healthcare, emergency services, schools, public transport, etc. – within which measures for climate change adaptation are integrated.

The first section of this chapter discusses what is meant by adaptation, adaptive capacity and similar terms, as applied to urban centres. The second section reviews household and community responses to the impacts of climate change and highlights the major challenges to community-based climate change adaptation. This is followed in the third section by a similar review of the responses by city and municipal governments. This review provides the basis for a discussion in the fourth section of the main issues that need to be addressed to develop effective city-based climate change adaptation strategies. The fifth and sixth sections discuss the financing and other key challenges of urban climate change adaptation, respectively. The final section provides some concluding remarks and lessons for policy.

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UNDERSTANDING ADAPTATION

It is important that there is clarity in what is meant by adaptation, adaptive capacity and adaptation deficit. Drawing on the definitions of the Intergovernmental Panel on Climate Change (IPCC),[3] *adaptation* to (human-induced, or 'anthropogenic') climate change is understood to include all actions to reduce the vulnerability of a system (e.g. a city), population group (e.g. a vulnerable population in a city) or an individual or household to the adverse impacts of anticipated climate change. Adaptation to climate variability consists of actions to reduce vulnerability to short-term climate shocks

(whether or not these are influenced by climate change) – for instance, as a city government ensures that the drainage system can cope with monsoon rains. Most of the measures for adapting to climate variability (which will be taking place in most well-governed cities) will also contribute to climate change adaptation (as a co-benefit).

The outcome of successful adaptation is *resilience* – and is a product of governments, enterprises, civil society organizations, households and individuals with strong adaptive capacity.[4] For cities or particular urban neighbourhoods, it indicates a capacity to maintain core functions in the face of hazard threats and impacts, especially for vulnerable populations. It usually requires a capacity to anticipate climate change and plan needed adaptations. The resilience of any population group to climate change interacts with its resilience to other dynamic pressures, including economic change, conflict and violence.

The outcome of successful adaptation is resilience

Adaptive capacity is the inherent capacity of a system (e.g. a city government), population (e.g. a low-income community in a city) or individual/household to undertake actions that can help to avoid loss and can speed recovery from any impact of climate change. Adaptive capacity is the opposite of *vulnerability*.[5] The risks that have to be reduced by adaptation can be direct, as in larger and/or more frequent floods, or more intense and/or frequent storms or heat waves; or less direct, as climate change negatively affects livelihoods or food supplies (and prices), or access to water needed for domestic consumption or livelihoods. Certain groups may face increased risks or costs from measures taken in response to climate change – including adaptation measures (e.g. measures to protect particular areas of a city from flooding that increase flood risks 'downstream') and mitigation measures (e.g. a greater emphasis on new hydropower schemes that displace large numbers of people from their homes and livelihoods).

The lack of adaptive capacity to deal with problems caused by climate variability and climate change is … related to the scale of … the adaptation deficit

Elements of adaptive capacity include knowledge, institutional capacity, and financial and technological resources. Low-income populations in a city will tend to have lower adaptive capacity than high-income populations because of their lower capacity to afford good-quality housing on safe sites. There is also a wide range among city and national governments in their adaptive capacities, relating to the resources available to them, the information base to guide action, the infrastructure in place, and the quality of their institutions and governance systems.

The most important and effective form of adaptation is to stop the process that generates increasing levels of hazard and risk (i.e. mitigation)

The lack of adaptive capacity to deal with problems caused by climate variability and climate change is strongly related to the scale of what can be termed the *adaptation deficit*: the deficit in infrastructure and service provision and in the institutional and governance system that is meant to be in place to ensure adaptation. Of course, this depends heavily on the competence and capacity of local governments and the quality of the relations between local government and populations at risk within their jurisdiction. In many developing country cities, the main problem is the lack of provision of basic city infrastructure and the lack of capacity to address this. This is one of the central issues with regard to urban climate change adaptation because most discussions on this issue focus on needed adjustments to infrastructure to climate-proof it. However, cities cannot climate-proof infrastructure that is not there. In addition, new sources of funding for climate change adaptation have little value if there is no local capacity to design, implement and maintain the needed adaptation measures, or no interest within local government in working with the populations most at risk (which in many urban contexts, as noted in Chapter 4, are concentrated among low-income households living in informal settlements and slums).

Ultimately, the most important and effective form of adaptation is to stop the process that generates increasing levels of hazard and risk – that is, to slow the growth of, halt and then reduce greenhouse gas (GHG) emissions or other measures to reduce global warming (i.e. mitigation).[6] Failure to mitigate will lead to the failure of adaptation, as climate change risks become increasingly severe. So adaptation and mitigation are not alternative strategies, but complementary ones that need to be pursued together.

It was the failure of the world's governments to reach agreement to reduce GHG emissions during the 1990s that has made the need to greatly increase adaptation capacity so urgent. It is now too late to stop the increase in climate change-related hazards in the short term. Even if the world's governments do reach agreement on the need for rapid reductions in global GHG emissions and actually implement the measures needed to achieve this, the GHG emissions already generated and the time-lags in global systems[7] still mean increasing hazard and risk levels for most urban centres – and, therefore, an increasing need to adapt. Adaptation can reduce the adverse impacts of climate change considerably; but, generally, it cannot remove all adverse impacts – especially if the needed agreements to reduce global emissions have not been achieved. So there are limits to what adaptation can protect. There will also be an increasing number of locations that become permanently beyond adaptation – because the needed measures to protect them are considered too expensive (e.g. particular coastal zones inundated by sea-level rise) or technically unfeasible. Such consequences are often referred to as *residual damage*, and the number of such locations (and populations at risk) is likely to rise without successful mitigation (see Figure 6.4).

As described in more detail later in this chapter, adaptation can be undertaken by different actors – for instance, by individuals, households and commercial enterprises. This may be within government programmes or completely independent of government (in which case it is generally referred to as *autonomous adaptation*). Different levels of government (from national through regional and city-wide to district or ward) and different sectors of government have responsibility for many of the needed adaptations or for providing the regulatory framework – or the carrots or sticks – to encourage other actors to adapt. Adaptations that are planned in anticipation of potential climate change are termed *planned adaptation*. Generally, government agencies have the responsibility to provide information about current and future risks, and provide frameworks that support individual, household, community and private-sector adaptation. However, governments often do not fulfil this role, and community-based and other civil society organizations may

be the initiators and supporters of planned adaptation. As has long been evident in initiatives to improve conditions in informal settlements, a proactive civil society may be required to galvanize government and to demonstrate what can be achieved.[8]

In recognition of the fact that much adaptation to climate variability (and climate change) takes place through the conscious efforts of particular communities, the IPCC has highlighted the importance of what is termed *community-based adaptation*. As discussed in more detail in a later section,[9] community-based adaptation has particular importance where local governments lack adaptive capacity. Yet, it also has importance within effective local government-driven adaptation because of the knowledge and capacity that it can contribute. For urban areas, there is a danger that its relevance will be both overstated and underplayed at the same time. On the one hand, it will be overstated because community-based organization and action cannot provide the city-wide infrastructure and service provision and city-region ecosystem services protection and management that are so central to effective adaptation. On the other hand, however, the importance and effectiveness of community-based adaptation can be underplayed as the policies and practices of governments and international agencies fail to recognize the capacity of community-based organizations to contribute to adaptation or, if they do, they lack the institutional means to support them.[10]

There are also actions and investments that increase rather than reduce risk and vulnerability to the impacts of climate change and these are termed *maladaptation*. Examples of this include the shifting of risk from one social group or place to another; it also includes shifting risk and costs to future generations and/or to ecosystems and ecosystem services. Many investments being made in cities are, in fact, maladaptive rather than adaptive, as they decrease resilience to climate change. Indeed, the very process of 'unmanaged' urban expansion usually brings with it increasing risk as inappropriate sites are developed and as infrastructure provision fails to keep up. Removing maladaptations and the factors that underpin them are often among the first tasks to be addressed before new adaptations.

HOUSEHOLD AND COMMUNITY RESPONSES TO THE IMPACTS OF CLIMATE CHANGE

National governments are meant to represent the interests of their citizens in international discussions on allocating responsibility for climate change mitigation and in developing international funding sources and institutions and other forms of support for adaptation. Similarly, local (metropolitan, city and municipal) governments are, in principle, responsible for implementing climate change adaptation measures at the local level.

However, risk reduction and resilience to risk also depend on actions taken by households and by community-based organizations. And for a large section of the urban population in developing countries, little can be expected of local and national governments as they currently lack the capacity or willingness to provide the basic infrastructure and services that are central to adaptation.

Where local governments are weak or ineffective, household and community strategies become more important for reducing climate change risks and impacts in urban areas. In such situations, urban residents have long had to cope with a wide range of risks to their lives and livelihoods. Many of the measures that they take to cope with risk are responses to extreme weather, including flooding, extreme temperatures and landslides – although the root cause of the risk is often far more related to the lack of infrastructure or the lack of safer sites that they can afford. In many locations, household and community strategies have developed over years or even decades to prevent loss of life and damage to property. Yet, they have very limited capacities to substitute for government investments in 'hard' infrastructure, which is essential for risk reduction. Since these responses are generally small scale and cannot address the underlying root causes of vulnerability,[11] they have frequently been ignored. However, supporting these local responses should be one aspect of an overall adaptation strategy for urban areas. In doing so, these coping strategies can be enhanced to ensure that the investments made by low-income urban residents contribute to building their resilience.

Where local governments are weak or ineffective, household and community strategies become more important for reducing climate change risks and impacts in urban areas

Studies in informal settlements exemplify the importance of what individuals and households do for themselves – and, for many of these, the importance of family and sometimes of friends and neighbours in providing help. This range of measures taken to help cope with extreme events can be divided into two:

- those that are *preventive* (that remove the hazard or exposure to it); and
- those that are *impact minimizing* or *impact reducing* (better quality defences against the hazard or assets that help recovery).[12]

Supporting … local responses should be one aspect of an overall adaptation strategy for urban areas

The discussion below starts by reviewing examples of household and community responses to climate change, and concludes with an assessment of challenges to household- and community-based adaptation.

Household responses

Individuals and households take measures to reduce risks from extreme weather events such as flooding or extreme temperatures. Likewise, wealth helps individuals or households to buy their way out of risks – for instance, by being able to buy, build or rent homes that can withstand extreme weather in locations that are less at risk from flooding. Higher-income groups can also afford the measures that help them to cope with illness or injury when they are affected (the medical treatment needed, taking time off work) or when their assets are damaged (e.g. through compensation from insurance). Many of these measures also reduce risks for a wide range of hazards; a good-quality secure home with

good infrastructure and services removes or greatly reduces a great range of risks, including most of those related to climate change. Savings schemes can be drawn on to help cope with a wide range of stresses or shocks, including those arising from extreme weather.

Those unable to get or afford these take other measures to reduce the impacts of hazards that they cannot avoid. These can be seen as contributing to adaptation in that they reduce vulnerability to hazards,[13] and many can be considered as strategies in that they include a coherent range of measures that respond to changes in risk levels. A study of this in Indore (India) showed the complex and varied measures by which low-income households living in areas often flooded adapted to flooding.[14] They were prepared to live in homes that flooded regularly because of other advantages that these sites provided – namely, access to low-cost housing, and central city locations close to jobs, to markets for the goods that they made or collected (many earn a living collecting waste), and to health services, schools, electricity and water. Households and enterprises took both temporary and permanent measures to minimize the impacts of flooding – for instance, by raising plinth levels, using flood-resistant building materials, choosing furniture that is less likely to be washed away, and ensuring that shelving and electric wiring are high up the walls, above expected water levels. Many households had suitcases ready, so valuables could be carried to higher ground when floodwaters are rising, and contingency plans for evacuating persons and possessions (e.g. first to move children, older persons and animals to higher ground, then to move electrical goods, then lighter valuables and cooking utensils):

> *When we see very dark clouds up the hills, we expect heavy rains to come. So we get ourselves prepared by transferring our valuable things on our very high beds which are reached by climbing ladders. Also, children who sleep on the floor are transferred to the high beds.*[15]

Low-income households … were prepared to live in homes that flooded regularly because of other advantages that these sites provided – namely, access to low-cost housing, and central city locations

More established residents had also learned how to get compensation from the government for flood damage. None of these measures reduced the flooding; but they certainly reduced the impacts of flooding upon health, assets and livelihoods.

In Lagos (Nigeria), a city with very large deficits in infrastructure and large sections of the population at risk from flooding (see Box 6.1), interviews with the inhabitants of four informal settlements close to the coast showed that they considered flooding as their most serious problem, although flood risks varied by settlement and within each settlement.

A study in Korail (Bangladesh) documented a range of household measures to reduce loss from flooding and high temperatures and facilitate recovery (see Box 6.2). Similarly, a study of flooding problems faced by residents of low-income communities in Accra (Ghana), Kampala (Uganda), Lagos (Nigeria), Maputo (Mozambique) and Nairobi (Kenya)[16] showed a comparable mix of measures to reduce impacts. In Nairobi's informal settlements (where around half the city's population live), responses to flooding included bailing water out of houses, putting children on tables and, if necessary, moving them to nearby unaffected dwellings, digging trenches around houses, constructing temporary dykes or trenches to divert water away from the house, and a range of ways to stop water from coming into homes. Residents also moved to higher ground as floodwaters rose. Similar measures were taken by households in Accra, Lagos and Kampala. In addition, in Kampala, some residents undertook collective work to open up drainage channels. In Lagos, one resident stated the following: 'There has not been assistance from anyone. Neighbours cannot assist because everybody is poor and vulnerable. I am planning to quit this place because it is horrible living here.'[17]

Box 6.1 Household and community responses to flooding in informal settlements in Lagos, Nigeria

The location of Lagos on a narrow low-lying coastal stretch bordering the Atlantic Ocean puts it at risk from sea-level rise and storm surges. However, it is the lack of attention by state and local governments to the needed storm and surface drains and other infrastructure, and also to land-use management, that has created most of the risks from flooding. The city has expanded rapidly and much of the population growth has been housed in informal settlements in marshy areas or near the lagoons. Many new urban developments have taken place on floodplains (as mangroves have been cleared and wetlands filled) or on stilts over the lagoon.

Interviews with inhabitants of four informal settlements close to the coast showed that flooding was the most serious problem that they faced, although flood risks varied by settlement and within each settlement. In one of the communities (Makoko), for instance, residents living next to a channel were more severely affected than other residents. Floodwaters almost always entered homes and floods lasted for up to four days. Over 80 per cent of respondents reported that they had been flooded three or four times during 2008. Most interviewees listed the poor drainage system as the main cause of the floods, with the effects of 'overpopulation' also listed in terms of more household wastes disposed on streets or in drains and the encroachment of drainage channels by buildings.

Almost all respondents highlighted the shortages of potable water after flooding, with 91 per cent mentioning the impacts of flooding upon their health and increased medical expenses. Most also noted how floods deny them job opportunities. There were some community initiatives to clear blocked drainage channels; but most responses were by households as they constructed drains, trenches or walls to try to protect their houses or filling rooms with sand or sawdust. Foodstuffs and other household items were also stored on shelves or cupboards above anticipated flood levels. Three-quarters of respondents received assistance from family and friends after flood events; far fewer received assistance from government or religious organizations.

Source: Adelekan, 2010

Box 6.2 Household responses to reducing risks from flooding in Korail, Bangladesh

Korail is one of the largest informal settlements in Dhaka (Bangladesh). It covers 90 acres (36.4ha) and has a population of more than 100,000. When the site was first settled it occupied the high ground; but as the population expanded, houses were built closer to or even over the water of the adjacent lake and reservoir. Despite the risks, this is considered a good location for employment by its residents, as it is near high-end residential and commercial areas. It thus attracts people mostly in service jobs such as cleaners, rickshaw pullers and workers in ready-made garment industries.

Interviews with households living near the water's edge and on higher ground focused on their experience of climate variability, hazards and coping strategies. Those interviewed highlighted how any climate hazard reduces earnings through missed working hours or even days. They took action in response to flooding and water clogging and in response to rainfall that was anticipated (e.g. the regular monsoon rains) and unexpected. Before heavy rainfall, some moved to safer locations. This was not an option for most residents though, as it meant losing assets, disrupting livelihoods and losing the right to stay and live in that location. Most impact-minimizing actions were part of regular practice – for instance, making barriers across door fronts, increasing furniture height (e.g. putting them onto bricks), making higher plinths and arranging higher storage facilities (e.g. placing shelves higher up on the walls). To help cope with very high temperatures, creepers were grown in courtyards to cover roofs and other materials are put on roofs to reduce heat gain; most households used some form of false ceiling or canopy made out of cloth (a popular practice in rural areas, adopted in urban houses).

For houses near or on the water's edge, structures are on stilts, with platforms constructed higher up the stilts. These also have better ventilation than houses inland. Wooden planks for flooring are preferred as they suffer less from water clogging once floods subside after heavy rainfall. Stilts also mean expansion is possible over the lake. During flooding or water clogging, most residents sleep on furniture, use moveable cookers for food preparation (that can be used on shelves or on top of furniture); some shared services with unaffected neighbours. Other measures include making outlets to help get the floodwater out of the house.

Half the households interviewed save regularly with community-savings groups or non-governmental organizations (NGOs), and savings were important for coping with flood impacts. Many households also bought building materials throughout the year so they had these to use in rebuilding, after flooding. Half the households reported that they feel able to ask relatives or friends for help after a disaster.

Source: Jabeen et al, 2010

In Dar es Salaam (Tanzania), residents in Tandale (Kinondoni Municipality) take a range of measures to protect themselves and their houses when flooding occurs. These include temporary relocation and placing easily damaged items (such as mattresses) in the ceiling areas of houses. Some households have constructed additional walls around their houses to prevent floodwater from entering.[18]

The above examples show that most household responses are impact-reducing, ad hoc, individual short-term efforts to save lives (e.g. to sleep on high tables or wardrobes and move family members to safer sites), or to protect property (e.g. making barriers to water entry at the door, digging trenches to steer water away from the door, making outlets at the rear of the house so water flows out quickly).

Community responses

Community-based adaptation is a process that recognizes the importance of local adaptive capacity and the involvement of local residents and their community organizations in facilitating adaptation to climate change.[19] The starting point for community-based adaptation is the individual and collective needs of the residents in a community and their knowledge and capacities. It is based on the premise that local communities have the skills, experience, local knowledge and motivation, and that – through community organizations or networks – they can undertake locally appropriate risk reduction activities that increase resilience to a range of factors, including climate change.[20] It also recognizes (or assumes) a capacity among the residents in any 'community' to work together. The central principles of community-based adaptation are that it works at the level of the community: it is about communities making choices rather than having them imposed from outside. Advocates of community-based adaptation question the value and effectiveness of top-down adaptation approaches as they see the difficulties of getting these to be pro-poor, locally appropriate and locally accountable.

Community-based adaptation to extreme weather, water constraints or other risks to which climate change contributes is a pragmatic recognition of the limitations or inadequacies of government action on adaptation. It may be the responsibility of government to provide and maintain infrastructure that can deal with extreme events; but for those areas and populations inadequately served by these, community responses can play a significant role in reducing risks or impacts. As such, community-based preparedness is an important part of resilience to extreme weather events whose timing and magnitude are likely to become less predictable as a result of climate change.

The starting point for community-based adaptation is the individual and collective needs of the residents in a community and their knowledge and capacities

To date, community-based adaptation has primarily been practised in rural areas. However, communities in urban areas can also have an important role in determining the most effective responses to help them address the challenges of climate change. For instance, over the last few years, a growing number of studies have examined the responses of low-income households and communities living in informal settlements to extreme weather-related risks, especially floods. In the four informal settlements of Lagos (Nigeria) described above that have to cope with regular flooding (see Box 6.1), there were some community initiatives to clear blocked drainage channels, although most

actions were taken by households. The same is true in Korail (Bangladesh), although some households had taken part in initiatives to clean and clear drains (see Box 6.2).

In practice, the development of infrastructure which reduces climate change impacts is often beyond the capabilities of even the best organized and most representative community organizations. For example, developing a drainage system that actually stops or greatly reduces flooding – especially in high-density settlements on high-risk sites with little or no drainage infrastructure and space for new infrastructure – is usually beyond the means of community organizations. This is not to say that it cannot be done; community-directed slum and squatter upgrading has achieved this; but this is where they get appropriate support from government, as in the *Baan Mankong* (Secure Tenure) programme in Thailand.[21] The Orangi Pilot Project Research and Training Institute (in Karachi, Pakistan) has also demonstrated that households in informal settlements can join together to fund and manage the installation of sewers and drains and do so at scale.[22] However, this was facilitated by the fact that most informal settlements in Pakistan's urban areas developed with grid layouts and space for roads and paths (under which the sewers and drains could be installed). In addition, the local government's water and sanitation authority came to support this by providing the trunk sewers and drains into which the neighbourhood initiatives could be integrated. What these and other cases show is how effective risk reduction is possible if household, community and government investments and actions work together in a coordinated manner.

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Effective risk reduction is possible if household, community and government investments and actions work together in a coordinated manner

This point is illustrated by discussions with two communities that had experienced serious floods and with emergency managers in the two urban communities of Mansión del Sapo and Maternillo, located in the north-eastern municipality of Fajardo in Puerto Rico.[23] These discussions focused on flood hazards, causes and possible solutions. They showed good community knowledge of flood hazards (each community produced a map of the extent of flooding) and its causes. However, the residents' maps differed from those of the emergency managers – especially highlighting the risks for those living close to a drainage channel. They also differed in terms of sources of floodwaters (residents included urban runoff, whereas the emergency managers only considered river overflow).[24] Both communities highlighted solutions that were beyond their own capacities and that set responsibility for addressing the problems with government. Yet, the problem here was both the limitations in what government was likely to do and the limitations in the technical solutions proposed. From a flood risk reduction perspective, it was important to have a stronger community engagement that recognized the need for disaster preparedness because of the limits in what the structural measures that government undertakes or should undertake could achieve. This community engagement should include monitoring local conditions that can cause floods or exacerbate their impacts and acting on this (e.g. drainage channel maintenance) and flood preparation plans (including, where needed, plans for evacuations). Here, resilience to climate change depends not only on technical measures and structural solutions, but also on household and community capacity to cope better with extreme weather events that are less predictable in their magnitude and timing. This is a point that has relevance for most urban centres and settings.

Almost everything that [community-based savings groups] do contributes to greater resilience and reduces risks

The constraints on community capacity in the absence of government support are highlighted by a study of 15 disaster-prone slums in El Salvador. Here, too, there was a mix of household and community responses to climate change-related risks. Households recognized that flooding and landslides were the most serious risks to their lives and livelihoods, although earthquakes and windstorms, lack of job opportunities, and water provision and insecurity from violent juvenile crimes were also highlighted. They invested in risk reduction, for instance, by improving their homes, diversifying their livelihoods or having assets that could be sold if a disaster occurred. Many households received remittances from family members working abroad, and these were especially important in providing support for post-disaster recovery. A complex range of issues did, however, limit the effectiveness of community responses. The residents received no support from government agencies. Indeed, most residents viewed local and national governments as unhelpful or even as a hindrance to their efforts.[25] Furthermore, although residents were organized in community-based organizations, none of these were representative of the communities.

Where there are representative community-based organizations, the possibilities of building resilience to climate change are much greater. In many countries, there are now national federations of slum and shack dwellers that have community-based savings groups as their foundation. Although very few of these savings groups have climate change adaptation programmes, almost everything that they do contributes to greater resilience and reduces risks. This often includes many measures taken in response to the extreme weather events that they have long had to cope with. It usually includes measures that make their houses safer – either through support for upgrading (e.g. in Orissa, India, *Mahila Milan* (Women Together) groups developing homes that can withstand cyclones and rainfall) or through acquiring new, safer, more secure land sites upon which to build.

Most of what these federations are doing is building the resilience of low-income households to almost all climate change risks. For instance, a savings account can be drawn on, whatever the shock. Yet, the contribution that these federations make to climate change resilience needs to be appreciated. To give but one example from the 30 or so countries that have national federations of slum/shack dwellers: in Dar es Salaam, the Tanzania Federation of the Urban Poor has been active in building resilience in low-income urban communities through a process of community organization. This began with savings schemes and enumeration exercises (which provide maps and details of all households in informal settlements), and has expanded to include identification and purchasing of land for housing.

The practice of saving regularly has both instrumental benefits (the ability of savers to access funds when neces-

Box 6.3 Risk reduction by the Homeless People's Federation of the Philippines

The Homeless People's Federation of the Philippines is a national network of 161 urban poor community associations, with more than 70,000 individual members. It represents communities and their savings groups from 18 cities and 15 municipalities. The federation and its community associations are engaged in a wide range of initiatives to secure land tenure, to build or improve homes, and to increase economic opportunity. The federation also works with low-income communities residing in areas at high risk from disasters, assisting in reducing risks, or, where needed, in voluntary resettlement; or in community-driven post-disaster reconstruction.

The federation's responses to disaster events provide relevant insights for community-level responses to climate threats. The principles behind, and processes of, disaster risk reduction and climate change adaptation have many similarities. Both address the hazards that will affect particular locations and individuals, and they share an acknowledgement of the importance of addressing root causes of vulnerability.

The federation is engaged in three main activities that build resilience and facilitate adaptation to climate change:

- First, the interventions of the federation have a strong focus on land and shelter. Unsafe housing that cannot resist extreme weather events, located on land that is at risk of a range of climate-related hazards, is often at the core of vulnerability for low-income urban residents. The failure of local and national governments to address this issue is one of the main factors contributing to risk. By working collectively to acquire land and to obtain financing to build more resilient structures, federation members have addressed this aspect of vulnerability.
- Second, collaboration with the state ensures that interventions can take place at a larger scale. An active and well-organized body of citizens and community organizations can provide the impetus for local authorities to support locally based adaptation strategies. In Iloilo, a coastal city that frequently suffers from extreme flooding, the federation has been actively involved in the planning process for a flood control project, and has been able to encourage particular interventions that meet the needs of the group's members.
- Finally, collective savings at the community level act to provide a source of funds that can be used for pre-event preparation and post-event response, as well as for longer-term support of livelihood activities. More importantly, the process of saving builds trust among members of savings groups and enables them to make collective responses to immediate threats and to develop strategies for future actions that strengthen livelihoods and build resilience. Strong local organizations can prevent the sense of dependency that often results after disaster events. In Bikol Province, savings groups helped participants to define and realize their own preferred development response to a devastating mudslide generated by Typhoon Reming in November 2006. According to the federation's regional coordinator, Jocelyn Cantoria, 'the adoption of the savings programme [has shown that the communities] can be self reliant and not be dependent on government dole-outs … they have shown that they can collectively contribute to their own development and to that of the municipality as well'.

The Homeless People's Federation has a national programme that includes the organization and mobilization of low-income communities in high-risk areas. For these communities, the federation promotes and supports the scaling-up of community-led processes for identifying and acting on disaster risk that includes secure tenure, adequate housing, basic services, disaster risk management and, when needed, relocation. Activities range from community visits; consultations; preparation of settlement profiles and enumerations; hands-on training; learning exchanges; temporary/transitional housing construction; land acquisition; participatory site and housing design; planning, construction and management; engagements and advocacy and building learning networks among high-risk or disaster-affected communities. A review of lessons learned from the federation's experience highlighted the following:

- Savings groups within the settlements affected helped to provide immediate support for those affected by the disasters.
- Existing community organizations within high-risk settlements can help to provide immediate relief and foster social cohesion with tools to support them taking action to resolve longer-term issues, such as rebuilding or relocation. Representative community organizations are needed to manage difficult issues – such as who gets the temporary accommodation; who gets priority for new housing; and how to design the reblocking that accommodates everyone. In communities lacking such organizations, visiting federation leaders encouraged and supported their formation and capacity to act.
- The visits to the disaster sites by teams of community leaders from the federation and community exchanges that support the survivors' learning on savings management, organizational development, community surveys and house modelling – developing life-size models of houses to see which design and materials produce the best low-cost housing – have proved to be an important stimulus for the development of community organizations.
- Community profiling and surveys helped to mobilize the people who were affected, and also helped them to get organized and to gather data about the residents and the disaster site needed for responses. It also supported them by showing their capabilities to the local government.
- The importance of being able to obtain land on a suitable well-located site, in situations where relocation is necessary, was highlighted.
- The importance of having regional organizations to support each settlement when disasters affect many different settlements was emphasized.
- Supportive local governments and national agencies are important in that they help with much of the above. This is important with respect to getting access to land and/or obtaining land titles, as well as in the form of high-level political support to obtain more rapid response from bureaucracies.

Sources: Reyos, 2009; Dodman et al, 2010a

sary) and organizational benefits (the relationships of trust built up within small savings groups that allow their members to work on collective solutions to larger problems). Small-scale loans managed by these savings groups and repaid over short time periods provide much needed capital for livelihood activities, or responses to shocks and stresses. The creation of savings organizations also provides the basis by which individuals and households can come together to identify and acquire residential land on sites that are less at risk of flooding. Local initiatives have also built resilience through improving the supply of potable water (reconnecting and managing water kiosks); engaging in capacity-building for hygiene promotion; and implementing innovative small-scale solid waste management strategies.

In the examples given above from Orissa and Dar es Salaam, the savings groups and their federations not only organize and act, but also seek partnership with, and support from, government agencies. This is also the case in the Philippines, where there are some interesting and highly relevant examples of community-based responses to extreme weather events that were driven by savings groups formed by low-income groups and the Homeless People's Federation of the Philippines, of which they were members (see Box 6.3). The Philippines is regularly affected by earthquakes, volcanic eruptions, typhoons, storm surges, landslides, floods and droughts. Many low-income urban residents groups live in high-risk sites and have poor-quality housing; they also have little or no protective infrastructure and less resources to call on after disasters. Risk levels have probably increased and are likely to continue increasing because of climate change. The response of the Homeless People's Federation is to get household, community and local governments to work together, as neither of them have the resources and capacities to reduce risks by themselves.

The limitations in local government capacity – or … unwillingness … – mean that what households and communities in informal settlements do are often the only adaptation responses that are actually implemented

Although communities are taking action to adapt to climate change-related risks, such as floods and high temperatures, they face a number of challenges in this respect. As noted earlier, there are limits to what community-based action can achieve in urban contexts. Much adaptation (and disaster risk reduction) needs the installation and maintenance (and funding) of infrastructure and services that are at a scale and cost beyond the capacity of individuals or communities. However, the limitations in local government capacity – or local government unwillingness to work with those living in informal settlements – mean that what households and communities in informal settlements do are often the only adaptation responses that are actually implemented. Furthermore, it is mostly low-income households and communities who have to rely on community-based actions and community preparedness because they are located in more vulnerable sites, their homes are of poorer quality and they receive less protection from infrastructure or insurance. In this sense, middle- and high-income groups face much lower levels of risk, and usually have much less need for community-based action to remedy deficiencies in infrastructure and services.

It is often difficult to get agreement and commitment from all inhabitants of a settlement for community-based actions

There are also difficulties in getting the needed cooperation among community residents for collective responses to climate change risks. This is partly related to the extent to which community organizations comprehensively represent the needs and priorities of those most at risk or most vulnerable. In reality, community organizations are not necessarily accountable to, or fully representative of, all local residents and their needs.[26] In many contexts and societies, women and particular groups within communities (such as racial, ethnic or other minorities) face discrimination from other residents or resident organizations and lack voice. It is not surprising, then, that it is often difficult to get agreement and commitment from all inhabitants of a settlement for community-based actions.

In urban areas in developing countries, an additional challenge relates to the need for community-based adaptation to focus on using, protecting and enhancing the assets available to the urban poor.[27] As such, it includes the use of a range of assets to make livelihoods more resilient so that

Table 6.1

Examples of asset-based actions at different levels to build resilience to extreme weather

Areas of intervention	Asset-based actions		
	Household and neighbourhood	Municipal/city	Regional or national
Protection	Household and community-based actions to improve housing and infrastructure. Community-based negotiation for safer sites in locations that serve low-income households. Community-based measures to build disaster-proof assets (e.g. savings) or protect assets (e.g. insurance).	Work with low-income communities to support slum and squatter upgrading informed by hazard mapping and vulnerability analysis. Support increased supply and reduced costs of safe sites for housing.	Government frameworks to support household, neighbourhood and municipal action; risk reduction investments and actions that are needed beyond urban boundaries.
Pre-disaster damage limitation	Community-based disaster preparedness and response plans, including ensuring that early warning systems reach everyone, measures to protect houses, safe evacuation sites identified if needed, and provision to help those less able to move quickly.	Early warning systems that reach and serve groups most at risk; preparation of safe sites with services; organization for transport to safe sites; protecting evacuated areas from looting.	National weather systems capable of providing early warning; support for community and municipal actions; upstream flood management.
Immediate post-disaster response	Support for immediate household and community responses to reduce risks in affected areas, support the recovery of assets, and develop and implement responses, including cash-based social protection measures; plan and implement repairs.	Encourage and support active engagement of survivors in decisions and responses; draw on resources, skills and social capital of local communities; rapid restoration of infrastructure and services.	Funding and institutional support for community and municipal responses.
Rebuilding	Support for households and community organizations to get back to their homes and communities, and plan for rebuilding with greater resilience; support for recovering the household and local economy.	Ensure reconstruction process supports household and community actions, including addressing priorities of women, children and youth; build or rebuild infrastructure and services to more resilient standards.	Funding and institutional support for household, community and municipal action; address deficiencies in regional infrastructure.

Source: adapted from Moser and Satterthwaite, 2008

they can cope with a range of challenges, some of which can be predicted and others of which are unforeseen. In this context, community-based adaptation and pro-poor adaptation are intrinsically linked. Pro-poor adaptation raises important questions about the types and aims of responses; who bears any costs; who is involved; and who benefits.[28] It also needs to address the range of reasons why the urban poor are disproportionately vulnerable to climate change, including their greater exposure to hazards, the lack of hazard-reducing infrastructure, the lack of state provision for assistance after extreme events, and the lack of legal and financial protection.[29]

Table 6.1 presents an asset-based framework to support resilience to extreme weather that includes protection (much of it reducing disaster risk), pre-disaster damage limitation, immediate post-disaster response, and rebuilding.[30] An asset-based approach helps to identify the asset vulnerability to climate change of low-income communities, households and individuals, and considers the role of assets in increasing adaptive capacity. Strengthening, protecting and adapting the assets and capabilities of these groups is necessary to reduce urban poverty, while making them better able to cope with gradual climate change and extreme events. However, as illustrated in the table, a number of actions cannot be undertaken by households and communities alone, but need to be addressed at the municipal/city or national level. Such actions are the focus of the next section.

LOCAL GOVERNMENT RESPONSES TO THE IMPACTS OF CLIMATE CHANGE

As noted in the previous section, the main responsibility for implementing policies to address the impacts of climate change in cities rests with local governments. Yet, many city governments around the world have so far failed to accept and/or act upon this responsibility, with the result that many households and communities have been forced to implement climate change adaptation measures on their own. As the discussion above has shown, however, there are significant limitations as to what community-based adaptation can achieve. A partnership approach – involving households and communities, but also the various levels of government and other partners – is the most effective way to implement climate change adaptation strategies.

In some places, local governments have taken note of the damaging impact of particular storms or heavy rainfall that have highlighted risks that climate change is likely to exacerbate.[31] Elsewhere, the perceived vulnerability of urban economies, populations, assets and infrastructure has encouraged more local government engagement, including some local governments in middle-income countries for whom an adaptation agenda seems more relevant since it addresses local concerns and can include co-benefits with development.[32] These responses have varied from an initial consideration of likely risks and threats to some particular infrastructural investment and physical interventions, to the development of plans and strategies.

However, and as noted above, the primary responsibility for developing national policies and programmes on climate change adaptation rests with national governments. National governments are also custodians of the interests of urban (and rural) residents in international climate change negotiations, and in the development of international funding sources and institutions, and other forms of support for adaptation. Thus, the first part of this section briefly reviews national frameworks that support climate change adaptation in urban areas. This is followed by a discussion of what is done at the local level with respect to climate change adaptation. It describes how a small, but growing, number of city governments around the world have begun to recognize the threats posed by climate change, first in developed and later in developing countries. It provides examples of cities in countries that are at various stages of climate change impacts assessments, as well as examples of cities that have developed adaptation strategies, before briefly reviewing the links between climate change adaptation and disaster preparedness.

Community-based adaptation and pro-poor adaptation are intrinsically linked

National frameworks that support adaptation in urban areas

Figure 6.1 outlines the required steps in developing national climate change adaptation policies and programmes. Although the Organisation for Economic Co-operation and Development (OECD) report where this figure originally appeared used the figure to illustrate what was happening at the national government level, the figure fits well in a consideration of what city governments are doing and which of the steps they are taking (and which they are not). As indicated in the figure, adaptation planning and implementation have to be based on an *assessment* of historical and present climate conditions, projections of climate change, as well as current and future implications on vulnerability and impacts. Such assessments are the foundation of adaptation policies, which may be understood as the formulation of *intentions to act*, on the one side, and *adaptation actions*, on the other. The former include identification of adaptation options and discussions of how these fit in with other existing policies. The adaptation actions include the establishment of institutional mechanisms to guide and implement adaptation action; the formulation of new adaptation policies and modification of existing policies to take adaptation into account; and the explicit incorporation of adaptation measures at the project level. Figure 6.1 also illustrates how adaptation actions undertaken now influence the assessment of future climate change impacts.

A partnership approach – involving households and communities, but also the various levels of government and other partners – is the most effective way to implement climate change adaptation strategies

The report from which Figure 6.1 is drawn also classified OECD countries in three categories with respect to the criteria in Figure 6.1. According to this review (undertaken in 2006), 7 OECD countries were classified as being in early stages of impact assessments; another 27 countries were undertaking advanced impact assessments, but were slow in the development of adaptation responses; while only 5 OECD countries had advanced impact assessments and were

The primary responsibility for developing national policies and programmes on climate change adaptation rests with national governments

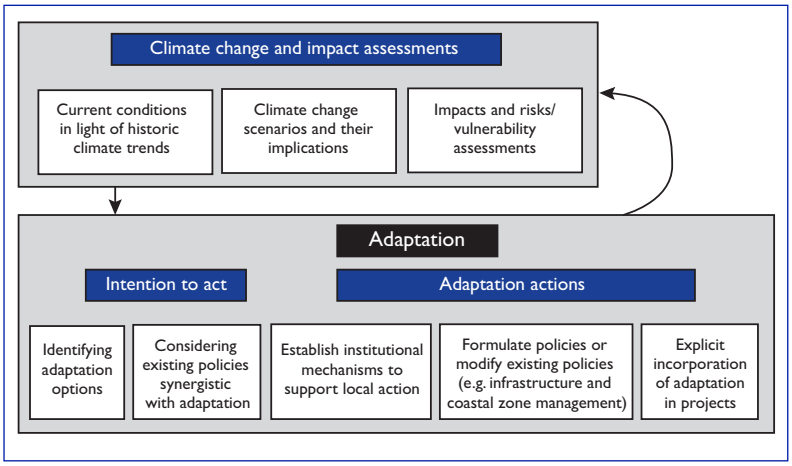

Figure 6.1

The main stages of city-based climate change adaptation

Source: based on Gagnon-Lebrun and Agrawala, 2006, Figure 6

moving towards implementing adaptation. This and other assessments[33] show that relatively few national governments are moving towards implementing adaptation initiatives. A review of what governments in developing countries are doing on adaptation suggested that many are initiating or sponsoring studies of the likely impacts of climate change; but rarely is urban adaptation given much attention.[34] Many countries have developed National Adaptation Programmes of Action (NAPAs)[35] and most recognize the need to strengthen local capacity to plan and act – including changing local building and infrastructure standards and land-use plans. Yet, these NAPAs have rarely engaged the interest of the larger, more powerful national ministries or agencies, or of city or municipal governments. Many give surprisingly little attention to urban areas, given the importance of urban economies to national economic success and, for most countries, to the incomes and livelihoods of much of the population.[36]

Relatively few national governments are moving towards implementing adaptation initiatives

It is also difficult to ensure that NAPAs do not become just another policy document that gets little or no action on its recommendations:

> *Countries are already bombarded with international obligations, which place considerable strain on already overloaded institutions with limited capacity, and which may well lead to duplication of effort and reduction in policy coherence.*[37]

Funding agencies that support climate change adaptation may judge … deficits in infrastructure and services as being outside the scope of climate change adaptation

It must also be remembered that NAPAs' effectiveness depends on their catalysing and supporting local assessment and action. It has been suggested that what is needed is city-focused City Adaptation Programmes of Action and local-focused Local Adaptation Programmes for Action.[38] As stressed throughout this chapter, risks and vulnerabilities for all aspects of climate change in urban areas are greatly shaped by local contexts and influenced by what local governments do or do not do. Effective adaptation needs to be based on a good understanding of the local context and strong local adaptive capacity. It needs City Adaptation Programmes of Action and, very often, smaller-scale Local Adaptation Programmes for Action that incorporate community-based adaptation – especially for the settlements or areas most at risk. Much more needs to be done in terms of 'mainstreaming' adaptation to climate change within national policy-making processes[39] and putting in place the systems and structures that encourage and support city-driven and locally driven adaptation. Perhaps more to the point, unless adaptation is seen by national and city governments in developing countries to be complementary to development agendas, it will not get considered.

Local government responses in developing countries

As noted above, there are not many examples of cities in developing countries that have initiated climate change adaptation policies. The bulk of the examples that exist are cities that have started the process outlined in Figure 6.1 by assessing the risks posed by future climate change. Some such examples are outlined below, followed by a discussion of the experiences of cities that have taken this assessment one step further by showing a concrete intention to act through the development of adaptation strategies.

Assessing climate change risks and the scale of the adaptation deficit

Generally, the first evidence of an interest by city or municipal government in climate change is an interest in assessing the scale and nature of likely risks. Yet, this assessment is not easily done for most developing country cities because of the lack of basic data on environmental hazards and risks (or even of an accurate and detailed map with all settlements on it). It is thus important to note (again) that most climate change-related risks (at least in the next few decades) are an exacerbation of risks already present, which are the result of the inadequacies in local governments' capacities or willingness to manage and govern urban areas. Thus, there is a large deficit in the basic infrastructure and services needed to address not only risks related to extreme weather and water constraints, but also 'everyday' risks. A city where much of the population live in areas that are frequently subjected to floods – because these areas lack storm and surface drains (and often because areas at risk of flooding are among the only areas where low-income groups can buy, build or rent accommodation) – is a city that is more at risk from more frequent or intense rainstorms. The deficits in basic infrastructure and services are not the result of climate change, and funding agencies that support climate change adaptation may judge these (often vast) deficits in infrastructure and services as being outside the scope of climate change adaptation. Box 6.4 gives some examples of the scale and nature of these deficits.

Three examples are provided below of cities for which this first step (i.e. of mapping the tasks at hand) has been taken – namely, Georgetown (Guyana), Bangkok (Thailand) and Dhaka (Bangladesh). These three examples show how climate change risks come to be identified and discussed, and highlight the initial thinking of what measures are needed to address these. Nonetheless, there is still the need to incorporate measures to address these risks into city plans, land-use management, infrastructure investments, service provision, and building and planning codes, and

Box 6.4 The scale of adaptation deficit in selected cities

Dar es Salaam.[a] This is the largest city in Tanzania, with more than 3.3 million inhabitants in 2010, compared to less than 0.2 million in 1960.[b] As a coastal city, it faces climate change-related risks from sea-level rise and coastal erosion, flooding, drought and water scarcity, and the disruption of hydroelectricity generation. These issues are much exacerbated by the mismatch between the growth of the city (and the city economy) and the capacity of the local governments within Dar es Salaam. Some 70 per cent of the population live in informal and/or illegal settlements and most lack adequate provision of basic infrastructure and services, including piped water supplies and provision for sanitation, drainage and solid waste collection. Low-income residents in the city are already coping with a range of climate-related challenges, particularly related to seasonal flooding. Uncollected garbage blocks both natural and artificial drainage channels, which causes flooding after heavy rainfall.

Dhaka.[c] Bangladesh is frequently identified as one of the countries most at risk from the effects of climate change. Its large and rapidly growing capital Dhaka is particularly at risk; a population that grew from 0.5 million in 1960 to 14.6 million in 2010[b] has long outstripped the expansion of infrastructure, including flood protection. This is a city already very vulnerable to flooding, especially during the monsoon season – as shown by major floods in 1954, 1955, 1970, 1980, 1987, 1988, 1998 and 2004. The 1988, 1998 and 2004 floods were particularly severe, with very large economic losses. These were mainly caused by the spillover from surrounding rivers. The city has a very large deficit in terms of the proportion of the population living in slum areas, with overcrowded, poor-quality housing that lack piped water, sewers and drains.

Lagos.[d] The location of Lagos (Nigeria) on a narrow lowland coastal stretch bordering the Atlantic Ocean puts it at risk from sea-level rise and storm surges; much of the land in and around Lagos is less than 2m above sea level. Yet, it is the lack of attention by state and local governments to the needed storm and surface drains and other infrastructure, and also to land-use management, that has created most of the risks from flooding. The city has expanded rapidly – from less than 0.8 million in 1960 to 10.5 million in 2010[b] – and much of the population growth has been housed in informal settlements in marshy areas or near (or even over) the lagoons. Much of the city lacks the infrastructure needed to limit floods; a high proportion of residents lack not only storm drains, but piped water, sanitation, electricity, all-weather roads and solid waste collection. To this is added the lack of maintenance of storm drains (especially de-silting before the rainy season), the drains and gutters blocked with solid wastes (because of no household solid waste collection service) and the unauthorized buildings that encroach on drains. The expansion of low-income settlements in areas at high risk of flooding (many on stilts) is largely because there are no safer sites available that they can afford.

Sources: a draws on Dodman et al, 2010b; b UN, 2010; c draws on Alam and Rabbani, 2007; Ayers and Huq, 2009; Roy, 2009; d draws on Adelekan, 2010; Iwugo et al, 2003; Adeyinka and Taiwo, 2006

there is much less evidence of this taking place. The section of the city government that prepares (or commissions) these initial assessments may have little political support within the city government or may be unable to convince the more powerful sectoral agencies within the government to change their plans and investments in response to the risks identified.[40] Inevitably, any forward-looking risk-reducing investment programme that needs serious funding will face competition from other sectors.

In Guyana,[41] the coastal zone that includes Georgetown holds 90 per cent of the country's population and much of the economy. Its highest point is only 1.5m above sea level, with much residential land, including the capital Georgetown, below the sea level at high tide. Large sections of Georgetown's population experience regular floods.[42] Adaptation planning for the densely settled areas around Georgetown has been conducted by an international management consultancy firm, with the intention of identifying and analysing adaptation investment options. Risks were assessed through analysing major climate hazards, identifying the major assets at risk and assessing the vulnerability of these. The main climate hazard facing Guyana, and particularly the densely populated areas near Georgetown, is flooding caused by heavy rains. A variety of scenarios have been developed to estimate the potential for financial losses in the public, agricultural, industrial and commercial, and residential sectors in 2030.

In Georgetown, there is also evidence of the second stage of city-based adaptation – identifying adaptation options and considering existing policies that are synergistic with adaptation (see Figure 6.1). Key adaptation interventions that were identified as being economically attractive included the expansion of early warning infrastructure; the improvement of building codes for new construction; the maintenance of drainage systems; and the upgrading of drainage systems. In each of these cases, there was a cost-benefit ratio of less than 1.0, implying that such measures were economically viable. Several adaptation measures were assessed quantitatively. These include:

- *Infrastructure measures:* repairing and maintaining the sea wall.
- *Health measures:* flood-proofing health clinics, sanitation and water, emergency response system.
- *Financial measures:* cash reserve, contingent capital, strengthening the primary insurance market.

Of these, repairing and maintaining the sea wall, developing an emergency response system and providing contingent capital were seen as generating the most important benefits. Sections of the sea wall are in disrepair and upgrades are needed to protect against coastal flooding; emergency response capabilities currently do not exist; and risk financing can provide money in the case of a crisis event.

Any forward-looking risk-reducing investment programme that needs serious funding will face competition from other sectors

Additionally, these are relatively low-cost interventions. Thus, some substantial adaptation benefits can be achieved for relatively low costs. This approach has great value in identifying the most cost-effective adaptation responses at the city level, and can help local and national officials to identify the most appropriate interventions. However, it would probably be best used in association with detailed social analysis to ensure that adaptation activities meet human development needs as well as being cost effective from a financial perspective.

The Metropolitan Administration of Bangkok (Thailand) has also begun mapping the climate change-related risks that the city will face; based on this, it is proposing a variety of policy-based, infrastructural and environmental responses (see Table 6.2).[43] Bangkok is vulnerable to a range of climate threats as a result of its location on a low-lying plain affected by subsidence, close to the sea and subjected to regular monsoon rains. A risk management approach is assessing the potential consequences of climate change and identifying appropriate responses. An initial risk assessment – which highlighted flooding, storm surges, drought and risks to the security of the water supply – has been conducted, and these risks will be analysed more extensively to inform adaptation interventions. More overarching adaptation measures will include capacity-building activities, improved communication between scientists and city officials, encouraging the development of climate change risk assessments at the local level, and raising awareness of climate change in homes and communities.

Box 6.4 highlights the climate change-related risks faced by Dhaka (Bangladesh). This is a city with a relatively long history of environmental and climate change awareness, policy and action. It was the first of the least developed countries to complete its National Adaptation Programme of Action (NAPA), and there is a significant effort by the national government to integrate climate change within sectoral plans and policies. The Dhaka Metropolitan Development Plan is intended to meet many climate adaptation needs. For example, a strategic approach to planning could help to enhance response capacity; increased public participation in the planning process could raise public awareness of climate-related threats; and the implementation of sites and services schemes could reduce the vulnerability of the urban poor and enhance their resilience.[44]

At the city level, large-scale flood protection measures are an essential component of an adaptation response. Since 1989, an extensive system of embankments has been constructed, and further investments of this type are currently planned.[45] Canals and drainage systems are currently being renovated, and the banning of polythene bags has helped to reduce the clogging of the city's drainage system.[46]

Within Africa, South Africa is unusual in having discussions within several city governments on climate change adaptation … moving beyond risk assessments to discuss what should be done to address the risks

Moving from risk assessments to adaptation strategies[47]

Within Africa, South Africa is unusual in having discussions within several city governments on climate change adaptation and thus moving beyond risk assessments to discuss what should be done to address the risks. A number of South African cities have thus developed plans for adapting to climate change. These have been made possible through the strong support of a range of stakeholders, including universi-

Table 6.2

Adaptation measures for Bangkok, Thailand

Climate change impact	Adaptation measures		
	Community infrastructure and operations	Business and commercial	Residential health and general population
General long-term rising temperatures of 3°C–5°C	• Urban design • Tree-planting • Water conservation • Insect and pest controls	• Actions to reduce urban heat island, including building design and green spaces	• Better insulation • Design for efficient cooling • Pest and insect controls • Water conservation
Ground and surface water quantity and quality	• Water-use restrictions • Optimize reservoir releases • Expand storage capacity • Greater regulation of surface and groundwater withdrawals	• Water efficiency and conservation programmes • Water pricing • Irrigation practices	• Water efficiency and conservation programmes
Sea-level rise (especially in Bang Khuntien District)	• Land-use planning • Construction or improvement of levees and dykes • Creation of water reservoirs	• Coastal protection • Phased retreat • Modifications to operation of port	• Land-use planning • Ecosystem protection
Extreme weather-related events (windstorms, prolonged rain, river flooding, drought)	• Emergency preparedness plans • Construction or improvement of levees and dykes • Elevation of buildings • Land-use planning • Increase resilience of electricity network • Improve emergency communications	• Emergency preparedness plans • Flood-proofing of buildings • Elevation of buildings	• Emergency preparedness plans • Flood-proofing of homes • Publicly sponsored flood insurance • Behavioural changes for disaster preparation (e.g. emergency supplies)
Increased frequency and intensity of short-duration heavy rains	• Increased size of storm drains, etc. • Increased water-absorbing capacity of urban landscape	• Increase water-absorbing capacity of large paved areas	• Storm sewer protection and maintenance • Landscape design to reduce rapid runoff
Increased frequency and intensity of heat waves, droughts and smog episodes	• Use of air conditioners • Heat contingency planning • Reduction of urban traffic • Planting of trees	• Use of air conditioners • Rescheduling protection when necessary	• Use of air conditioners • Public education on behavioural responses

Source: based on Bangkok Metropolitan Administration, 2009, Table 6.1

ties and local authorities. The transition to democracy in 1994 generated new local government structures which included a specific mandate and focus on environmental management, alongside a significantly revised development agenda. This section reviews the experience with developing such climate change adaptation plans in Durban and Cape Town.

Durban has one of the most interesting experiences in developing climate change adaptation plans and strategies because of the innovations that it has demonstrated, and because of the documentation of the internal processes by which it advanced and by which it was constrained.[48] Durban is South Africa's largest port and city on the east coast of Africa, with a population of 2.9 million people in 2010.[49] The local government structure responsible for managing the city is known as eThekwini Municipality. During the 1990s, the municipality had become a leader in the field of local-level environmental management[50] and had also initiated some work on mitigation. The city's planning for adaptation built on these experiences.

Between 2004 and 2006, eThekwini Municipality developed a locally rooted climate change adaptation strategy.[51] This is encapsulated in the Headline Climate Change Adaptation Strategy, which addresses both direct and indirect issues in links between climate change and human health, water and sanitation, coastal zone management, biodiversity, infrastructure and electricity supplies, transportation, food security and agriculture, and disaster risk reduction. Initially, the development of this high-level strategy did not result in any additional innovation or movement from the 'business-as-usual' scenario in terms of municipal functioning and the plans and investments of the larger and more powerful sectors. Climate change risks were seen by other sectors in government as too generic and the risks it outlined too distant; there was also an assumption by many that these were the responsibility of the city's environmental department. There were also other factors drawing attention away from it, such as high existing workloads and urgent development challenges and pressures. The municipality's disaster management unit was an obvious ally – but it lacked capacity and was seen by the municipality as a responsive relief agency, and thus not an influence on infrastructure investments or city planning.

As a result, and in order to engage municipal line functions more effectively in targeted and prioritized climate change adaptation, the adaptation planning process was deepened through the development of more detailed sectoral municipal adaptation plans. At this stage, particular attention was paid to three high-risk sectors (water, health and disaster management) since these form a natural cluster of integrated functions, thereby offering opportunities for cross-sectoral integration and coordination. This sectoral approach has proved to be more successful in facilitating meaningful action, and in time will be rolled out across all relevant municipal sectors. It is through the identification of issues that are relevant to particular sectors within government that their engagement is ensured. Also important for this is that they see climate change adaptation as directly linked to development (and their development and investment plans). As a staff member from eThekwini Municipality's Environmental Planning and Climate Protection Department has noted:

> *... the more sectoralised approach to adaptation planning now being adopted in Durban has had the effect of encouraging a greater interaction amongst the line functions than occurred during the development of the cross-sectoral [Headline Climate Change Adaptation Strategy]. This can be linked to the clearer definition of tasks and objectives that has emerged from the more detailed understanding of sectoral needs and limitations.*[52]

Climate change risks were seen by other sectors in government as too generic and the risks it outlined too distant; there was also an assumption by many that these were the responsibility of the city's environmental department

While climate change has emerged as a significant issue in municipal plans in Durban, and staff and funds have been allocated to climate change issues, the emergence of climate change advocates among local politicians and high-ranking civil servants has been a slower process. However, this is changing, as the mayor and other key officials become more actively engaged in the climate change debate. A process of community-level adaptation planning has now also been facilitated in order to complement and extend the municipal-level interventions. Specific adaptation interventions have included:

- increasing the water-absorbing capacity of the urban landscape;
- improving urban drainage and storm-sewer design;
- increasing natural shoreline stabilization measures;
- utilizing storm water retention/detention ponds and constructed wetlands;
- land-use planning to avoid locating structures in risky areas;
- working with industry to reduce water demand;
- increasing food security;
- using environmental management as the basis for creating 'green jobs'.

Moving from strategic plans to specific projects will require additional stages of planning and dedicated sources of financing

The progress in Durban depended on the mobilization of political support for adaptation, and the presence of engaged and motivated stakeholders. However, moving from strategic plans to specific projects will require additional stages of planning and dedicated sources of financing.[53] For this purpose, four institutional markers may be identified for assessing progress in any city towards climate change adaptation:[54]

1 the emergence of an identifiable political/administrative champion(s) for climate change issues;
2 the appearance of climate change as a significant issue in mainstream municipal plans and in stakeholder discussions;
3 the allocation of dedicated resources (human and financial) to climate change issues;
4 incorporating climate change considerations within political and administrative decision-making.

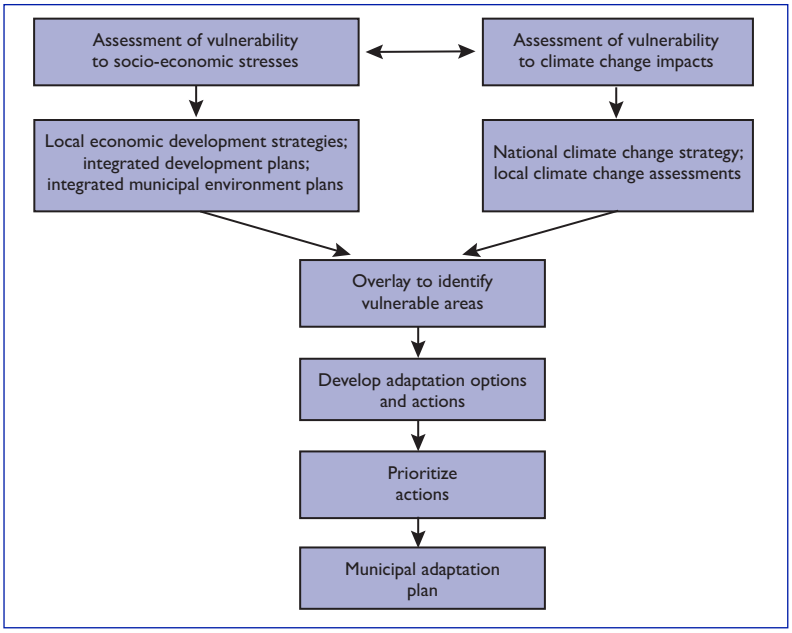

Figure 6.2

Process for developing a municipal adaptation plan in Cape Town, South Africa

Source: Mukheibir and Ziervogel, 2007

However, and perhaps obviously, the integration of climate protection considerations within political and administrative decision-making is unlikely to be a smooth process. Anything that affects budget lines and Durban's current desired development path will be contested.[55]

In Cape Town (South Africa), a framework has been proposed for the development of a municipal adaptation plan for climate change (see Figure 6.2) in a document commissioned by the city government. The various steps involved in this process are complemented by two cross-cutting processes: stakeholder engagement is playing an important role in identifying vulnerable sectors and potential initiatives, and also brings politicians and decisions-makers on board; and an assessment of adaptive capacity (the ability of a system to respond to the impacts of climate change). The municipal adaptation plan should be the final output of this process; but a variety of intermediate documents will be produced, including vulnerability maps and assessments to highlight 'hotspots' where social and climate risk interact.

There are many relatively wealthy cities that need major upgrades in their infrastructure that should take account of likely climate change impacts

However, in Cape Town, as in all cities, it will be difficult to get the attention of senior politicians and civil servants with regard to climate change adaptation. For instance, in the summary of Cape Town's integrated development plan,[56] no mention is made of climate change adaptation. For Cape Town and many other cities, the first real engagement with climate change adaptation is likely to be through responses to disaster risk. In May 2010, the City of Cape Town's website described the long-range weather forecasts that indicated the possibility of above normal rainfall for the coming winter months and the measures that were being taken to cope with them by various city departments.[57]

Local government responses in developed countries

Adaptation responses in cities in developed countries are generally much easier to formulate, implement and fund, although not necessarily easier in terms of getting the needed political support. Yet, such cities do not have very large deficits in infrastructure; most or all of their population live in buildings that meet building standards and are served by piped water supplies, sewers, drains and solid waste collection. These cities also have a range of regulations and controls that (when implemented) reduce risks, as well as measures and institutional arrangements that ensure rapid and effective response to disasters, thus limiting their impact when they happen, especially for those who are most at risk.

While the scale of risks and of the populations exposed to them are much smaller and the local capacities to address these much larger, this does not mean that adaptation is necessarily given the priority that it deserves. There are many relatively wealthy cities that need major upgrades in their infrastructure that should take account of likely climate change impacts. In general, most cities in developed countries need to expand their capacity to anticipate and manage extreme weather events. There are also cities that are on sites that are or were relatively safe without climate change, but that now face new levels of risk. For instance, many coastal settlements, whether villages, towns or cities, face increased risks from sea-level rise. Climate change is likely to bring more extreme and frequent heat waves to most regions, with higher risks in large cities or particular 'heat islands' within such cities. Many cities will face constraints on freshwater supplies. However, although adaptation plans for urban centres in developed countries will have many characteristics in common, the particular mix of needed measures will be very specific to each urban centre. For instance, and as discussed below, the measures to adapt to sea-level rise in the adaptation plans of London (UK), Melbourne (Australia) and Rotterdam (The Netherlands) take different forms, and their integration within other measures is specific to each city.

There are also many cities in developed countries where climate change risk, to their governments, seems a distant threat as they are struggling with economic decline. In developed countries, there have been major spatial shifts in where economic growth and new investment concentrate, which have left many cities that were formerly centres of industry and economic success in decline. In such cities, it is difficult to get much attention to climate change adaptation.

As with earlier discussions of cities in developing countries, the first step is to get a sense of what new or increased risks climate change will bring and what impacts these will or may bring. The examples discussed below – from London, Melbourne and Rotterdam – illustrate this first step.[58] The next step after this is the intention to act (see Figure 6.1) – seen in the identification of adaptation options, including all the sector-specific actions needed for this or to support this; this, too, can be seen in these three cities.

The Greater London Authority has developed a climate change adaptation strategy that provides the basis for adaptation actions. As one of the world's wealthiest cities, London has far more abundant financial and technical resources than most other cities.[59] Yet, it faces particular climate risks as a result of its location (on the River Thames), the age of much of the city's infrastructure, and the dense

Box 6.5 Key risks identified by the climate change adaptation strategy of London, UK

The climate change adaptation strategy of London identifies responses to three key climate risks: floods, drought and overheating.

The *first* risk, from flooding, is linked to sea-level rise, increased tidal surges up the River Thames (that runs through London), and wetter winters with more frequent and intense heavy rainfall (leading to increases in peak river flows of between 20 and 40 per cent). A series of 'decision pathways' have been developed by the UK Environment Agency (a national governmental body) to respond to this. The Thames Barrier, constructed between 1974 and 1982, is a key part of this strategy – along with 298km of floodwalls, 35 major gates and over 400 minor gates. Although this was not designed with climate change in mind, it is a key part of London's protection against flooding and it has been used far more frequently since 1990. The most recent assessments suggest that in all but the most extreme scenarios, the Thames Barrier will continue to protect London from flooding, although towards the end of the 21st century it may become necessary to use green spaces adjacent to the River Thames to store floodwater.

A city-wide water strategy seeks to reduce the effect of the *second* risk – that is, from water shortages – which are expected to become more frequent as climate change accentuates the seasonality of rainfall. Reducing demand for water will increase the length of time required until drought measures are required – and will also save money and reduce carbon dioxide emissions. The water strategy proposes the following four steps for balancing the supply and demand of water:

1 *Lose less:* reduce the loss of water through better leakage management.
2 *Use less:* improve the efficiency of water use in residential and commercial developments.
3 *Reclaim more:* use reclaimed water for non-potable uses.
4 *Develop new resources:* adopt new resource options that have the least environmental impact.

The *third* risk is from overheating (i.e. when temperatures rise to a point where they affect health and comfort). Overheating also increases demand for energy-intensive cooling (which may lead to power shortages and contribute to increased GHG emissions), a rise in demand for water (increasing pressure on limited water resources) and damage to temperature-sensitive infrastructure. Four courses of action are being used to reduce risks:

1 urban greening to reduce the intensification of temperatures by the urban heat island;
2 designing new and adapting existing buildings and infrastructure to minimize the need for cooling;
3 ensuring that low-carbon energy-efficient measures are used where active cooling is required; and
4 helping urban residents to adapt their behaviour and lifestyles to higher temperatures (a key component of this is ensuring that 'vulnerable' people are identified and provided with suitable social and medical assistance).

Source: Nickson, 2010

concentration of administrative, commercial and financial activities that are essential to national – and, indeed, global – finance. The adaptation strategy identifies responses to three key climate risks: floods, drought and overheating (see Box 6.5). This strategy relies on the contributions of a range of agencies, operating at the scale of the urban area of London as well as at the national level.

The Greater London Authority has also recognized that the provision of ecosystem services – which may help in the conservation of biodiversity, reduction of pollution or improvement in the aesthetic value of surroundings – can also generate benefits in responding to climate change (see Table 6.3). There are strong co-benefits for adaptation (reduced flood risk and offsetting of urban heat islands), mitigation (reduced energy demand, support biodiversity) and development (reduced noise and air pollution, increased provision for recreation/leisure).

The adaptation strategy of the City of Melbourne (Australia) identifies four main climate risks: reduced rainfall and drought; extreme heat wave; intense rainfall and windstorm; and sea-level rise (see Table 6.4).[60] It also identifies seven urban systems where adaptation actions are needed: water; transport and mobility; buildings and property; social, health and community; business and industry; energy and communications; and emergency services. The risk management process that was used to analyse these risks included a stage of evaluating risks and deciding whether these are acceptable or not. If the risks are deemed to be unacceptable, then they are treated through a process of adaptation. Throughout, the process is monitored and reviewed, and is linked with communication and consultation. The proposed adaptation measures are intended to reduce the likelihood or consequence of a particular risk or to increase the level of control over it, thereby making it tolerable. These have also been sub-graded to identify whether they fall into the categories of 'control critical', require 'active management', require 'periodic monitoring' or are of 'no major concern'. The risks, key themes and key actions are summarized in Table 6.4.

The Greater London Authority has … recognized that the provision of ecosystem services … can also generate benefits in responding to climate change

Table 6.3

Ecosystem services provided by green spaces and street trees, London, UK

	Green roofs/walls	Street trees	Wetlands	River corridors	Woodlands	Grasslands
Reduce flood risk	✔✔	✔	✔✔✔	✔✔✔	✔✔	✔✔
Offset urban heat island	✔✔	✔✔	✔✔	✔✔	✔✔✔	✔
Reduce energy demand	✔✔	✔✔			✔	
Reduce noise/air pollution		✔✔			✔✔	
Support biodiversity	✔✔	✔	✔✔✔	✔✔✔	✔✔✔	✔✔✔
Recreation/leisure	✔		✔	✔✔	✔✔✔	✔✔✔

Source: GLA, 2010, Table 7.1

Table 6.4

Key risks and adaptation strategies in Melbourne, Australia

Risk	Key themes	Examples of specific actions
Drought and reduced rainfall	• Maximize water-use efficiency • Diversify water supply • Maximize water harvesting • Improve waterway and bay health	• Save water through demand management strategies and behavioural change • Structural modifications to treat and/or harvest alternative water supplies • Increase installations of rainwater tanks for toilet flushing • Investigate the use of artificial turf on sports fields
Intense rainfall and wind event	• Better drainage and storm water capture • Early public warning system • Integrated emergency services • Better public knowledge and safe behaviour • Minimize debris potential • Increased infrastructure standards	• Drainage improvements at flash flood points on transport system • Continued upgrading of storm water infrastructure • Communications programmes to build capacity for dealing with transport delays in extreme events
Heat wave and bushfire	• Cooler surroundings, inside and out, through improved infrastructure • Better public knowledge and safe behaviour • Heat-wave early warning system	• Develop and implement heat wave response plan • Identification and care of high-risk populations • Implement changes to urban form to reduce heat-island effect
Sea-level rise	• Future-proof planning for sea-level rise • Better protection for existing low-lying developments • Better flood control through revised drainage planning • Measures to improve resilience to exposed infrastructure	• Modelling of flood risk and infrastructure impacts to sea-level rise • Development of suitable planning guidelines to reflect findings of modelling • More extensive storm water capture and reuse • Alteration of at-risk residential buildings to facilitate entrance and exit during significant floods

Source: City of Melbourne, 2009

Two 'high value' (or cost-effective) adaptation measures have been identified that have the potential to provide benefits across many risks:

1 *storm water harvesting*, which can assist in reducing the impact of flash-flooding events through storing excess storm water while simultaneously storing water for use in times of drought; and
2 *passive cooling*, which can reduce the heat-island effect by reducing temperatures both inside buildings and at street level, therefore reducing overall exposure to the effects of heat waves.

This concept of 'high value' adaptation can provide a useful tool for adaptation planning, as it indicates the interventions that can have the greatest impact. This is an important consideration, particularly in a context of resource scarcity.

Perhaps not surprisingly, many cities in The Netherlands are considering climate change adaptation measures. The Netherlands has centuries of experience in responding to the challenges faced by being low-lying and coastal. The City of Rotterdam – as a coastal city and one of Europe's largest ports – is particularly aware of these challenges and is aiming to be climate change proof by 2025.[61] The main threat to the city (and the main focus of adaptation measures) is from coastal flooding. Investment in adaptation is necessary to safeguard the health and security of the population, to prevent damage caused by climate change from being unmanageable, to increase the return on investments in the use of public spaces and infrastructure, and to ensure that solutions are innovative and attractive. Responses to climate change in Rotterdam address three key themes:

1 *Knowledge.* Knowledge for climate adaptation is being generated through cooperation with a range of relevant parties, including water and hydraulic engineering institutes, universities, businesses, water boards, housing corporations and developers. New research is being conducted into issues of flooding and heat stress, and knowledge is being exchanged with other port cities, both within and outside The Netherlands.
2 *Action.* This involves the implementation of projects designed to prevent flooding or to reduce its effects. This includes raising dykes, excavating areas to contain extra water, and flood-proofing buildings in areas that are likely to be flooded. In addition, a variety of interventions will be made to ease heat stress in the city – for example, by providing additional shade and cooling.
3 *Marketing.* The City of Rotterdam seeks to be at the forefront of adapting to climate change, and will create a distinct profile for itself as a positive example of a climate-adaptive city in a delta. This is important for relationships with urban residents, major stakeholders (including government agencies and universities) and other cities around the world.

The 1990s brought a shift in the way that disasters and their causes are understood, with much more attention being paid to the links between development and disasters

The links between adaptation and disaster preparedness[62]

The 1990s brought a shift in the way that disasters and their causes are understood, with much more attention being paid to the links between development and disasters.[63] In Latin America, many city governments began to explore this and implement disaster risk reduction measures. This was spurred by the numerous major disasters in the region and supported by decentralization processes and state reforms in many countries.[64] Several countries enacted new legislation that transformed emergency response agencies into national risk reduction systems.[65] Some city governments incorporated disaster risk reduction within development as they changed or adjusted regulatory frameworks, upgraded infra-

structure and housing in at-risk informal settlements, and improved urban land-use management with associated zoning and building codes.

This shift by local governments to disaster risk reduction has been driven by different factors. In some countries, it is driven by stronger local democracies (e.g. a shift to elected mayors and city councils) and decentralization (when city governments have a stronger financial base). Sometimes the trigger was a particular disaster event, such as the devastation brought by Hurricane Mitch in Central America (in 1998). Or it was a sequence of events, such as the Popayán earthquake (1983), the Armero mudslide (1985) and other disasters in Colombia. These events encouraged countries, and within these, city and municipal governments, to look more closely at the scale and nature of disaster risk and consider what investments and measures could be put in place to reduce disaster risks. Innovations here include those undertaken by specific local governments, but, as importantly, also those that involve cooperation and coordinated action among groups or associations of local governments. In several countries, there are also national systems to support local authorities and other stakeholders in disaster risk reduction.

These have relevance for climate change adaptation because many are reducing risk levels or exposure to risk for the extreme weather events that climate change is, or is likely, to make more intense, frequent or unpredictable. However, they also have relevance beyond this in that many measures to reduce disaster risk build resilience to a range of hazards. Also, strengthening the capacity to respond rapidly and effectively to disasters and to work with those affected to rebuild their lives, homes and livelihoods will serve all forms of disaster response, whether or not climate change had a role in the disaster.

By 2007 when the IPCC published its Fourth Assessment Report, adaptation to climate change was already taking place in some cities, although these were mostly driven by climate variability. Indeed, societies have a long record of adapting both agriculture and settlements to the impacts of weather and climate through a range of practices that include diversification, water management, disaster risk management and insurance.[66] Yet, climate change poses a new set of risks that may be substantially different from those experienced in the past, and the challenge for adaptation is to ensure that both development needs and the needs imposed by a changing climate (and their link to disaster risk) are met simultaneously.

TOWARDS EFFECTIVE CITY-BASED CLIMATE CHANGE ADAPTATION STRATEGIES

What can be seen from the examples above are the beginnings of city-based adaptation strategies in *some* cities. These are what might be called the early adapters as well as the early adopters.[67] Getting a more widespread attention by city and municipal governments to climate change adaptation will need clearer and more detailed risk assessments and a better understanding of how adaptation measures can serve and be integrated within development and disaster risk reduction. It also depends on whether local governments have the knowledge, capacity and willingness to act.

The experiences discussed above indicate that there is an obvious interest in reviewing adaptation responses to potential climate change impacts in different sectors – for instance, in potential damage to infrastructure, to city economies and to public health – and to specific groups that are more vulnerable. There is also an interest in how adaptation responds to the potential social and economic impacts of climate change upon individuals and households, including those relating to displacement and forced migration (and possibly to security). In each of these, there are issues of whose needs are served (and whose are not) by adaptation responses, especially in relation to income level, gender and age. Thus, a whole series of questions might be raised to assess the effectiveness of adaptation policies and practices, including, *inter alia*:

- Do adaptation measures focus on protecting or serving wealthier groups and districts?
- Are those living in informal settlements included and, if so, does this include all informal settlements or only those 'recognized' by the government or those who are more easily accessed?
- Do the particular risks and vulnerabilities women face because of their household, childcare and livelihood responsibilities, or the discrimination they face in getting access to services and finance that can support adaptation, get considered?
- Is the main response in adapting infrastructure to protect what are seen as the most economically important city assets, or to protect city populations with particular attention to those most at risk?

By 2007 … adaptation to climate change was already taking place in some cities, although these were mostly driven by climate variability

Climate change poses a new set of risks … and the challenge for adaptation is to ensure that both development needs and the needs imposed by a changing climate … are met simultaneously

As yet, too few cities have developed coherent adaptation strategies and even fewer have strategies that have begun to have a real influence on public investments and to get needed changes in building and infrastructure standards and land-use management. Most of the literature on climate change adaptation and cities is focusing on what should be done, not on what is being done (because too little is being done). For instance, some city adaptation strategies are justified, in part, by initial figures on the economic assets at risk or by the damage done by extreme weather in the past.[68] In most developed countries and some other countries, revisions to building and infrastructure standards that increase safety margins for likely climate change impacts are being considered. Public health responses to heat waves are being rethought, especially after the limitations revealed by the heat wave in Europe in 2003 – and some cities where heat waves have long been present have strengthened their capacity to reach and serve many of those most at risk. Many local governments have taken measures to manage freshwater resources better because of supply constraints; in many places, these often serve as the first steps for addressing additional water constraints brought by climate change.

Too few cities have developed coherent adaptation strategies and even fewer have strategies that have begun to have a real influence on public investments

Table 6.5

Examples of climate change preparedness goals and actions

Priority planning area	Preparedness goal	Preparedness actions
Addressing constraints on freshwater 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 reuse.
	Reduce demand/improve leak management.	• Increase billing rates for water (possibly with a pricing structure that charges more for high consumption). • Change building codes to require low-flow plumbing fixtures (e.g. shower heads that cut water use). • Provide incentives (e.g. tax breaks, rebates) for switching to more water-efficient processes. • Reduce leakage and unaccounted for water.
	Increase drought preparedness.	• Update drought management plans to recognize changing conditions.
	Increase public awareness about impacts upon water supplies.	• Provide information on climate change impacts upon water supplies and how residents can reduce water use – for instance, in leaflets sent to water consumers with their bills, newsletters, websites, local newspapers.
Storm and floodwater management	Increase capacity to manage storm water.	• Increase capacity of storm water collection systems and ensure their maintenance (which usually includes a need to extend solid waste collection services to all districts). • 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 or prevent development in flood-hazard areas. • Update building codes to require more flood-resistant structures in floodplains.
	Improve early warning systems for storm and flood events.	• Increase the use of climate and weather information in managing risk and events – including the systems that ensure populations at risk get warnings and are able and willing to move temporarily to safe locations when needed. • Update flood maps to reflect changes in risk associated with climate change.
Public health	Reduce impacts of extreme heat events.	• Ensure effective early warning systems for extreme heat events with particular attention to reaching those most at risk. • Consider what measures can serve those most at risk with particular attention to those living in heat islands and those most vulnerable to heat stress; can include opening 'cooling' centres during extreme heat events with provision to encourage and support those at risk to move there. • Encourage and promote modifications to the built environment that reduce heat gain, especially the heat-island effect. • Adopt measures within urban centres to reduce urban temperatures, including protection of open space, green space and use of shade trees.
	Improve disease surveillance and protection.	• Ensure effective surveillance systems for known diseases and potential diseases moving into the area, and act upon disease prevention and prepare healthcare system to respond. • Increase public education on disease prevention for vector-borne diseases and other diseases that could increase as a result of climate change.

Source: adapted from ICLEI, 2007

There are also issues regarding the social impacts of adaptation measures. For the many cities that need major investments in storm and surface drainage systems, their design and construction have the potential to displace informal settlements – especially those alongside existing drains and rivers – although there are good examples of this being avoided as drainage capacity is increased.[69] Measures to better manage water reservoirs and watersheds might include the displacement of informal settlements – although there are examples showing how this can be avoided.[70] New controls on coastal development to reduce risks from sea-level rise and storms can threaten existing settlements – as they did after the Indian Ocean Tsunami in 2004, although here, too, there are examples of alternative practices that have made coastal settlements more resilient rather than forcing their inhabitants to move.[71]

The first part of this section reviews lessons from the previous section and presents generic lessons for city governments. This is followed by an assessment of adaptation responses in the various economic sectors. The third part takes a closer look at how to build resilience at the local level, while the fourth part reviews the links between adaptation planning and local governance. The final part of this section presents UN-Habitat's Cities and Climate Change Initiative as an illustration of how international agencies can support climate change adaptation initiatives at the local level.

Generic lessons for city governments

Climate change adaptation needs to develop preparedness goals and actions for each priority planning area

Table 6.5 provides examples – for city governments – of how climate change adaptation needs to develop preparedness goals and actions for each priority planning area. The table addresses this by focusing on three kinds of impacts that will affect many cities: constraints on freshwater supplies; storm and floodwater management; and impacts upon public health, such as extreme heat and higher risks from diseases spread by certain vectors. The diversity of needed actions also highlights how many different departments of city government need to be involved and to be able to work together.

Drawing on the examples provided in this chapter, it is possible to identify certain key components for developing city adaptation strategies:

- *Build commitment among different stakeholders.* This is an essential first stage. There is a need to get an official recognition by and within cities that climate change impacts need to be considered. This has to include building knowledge and commitment within the different departments of local government, many of whom may see climate change adaptation as drawing resources or attention away from their sectors.[72] Without the commitment of a range of individuals, groups and sectors, it is impossible to address the multiple cross-cutting aspects of adaptation. It is also clear from specific examples of cities developing adaptation strategies that particular individuals had important roles in initiating this – for instance, a mayor or a senior civil servant – although, of course, its success depends on others responding positively.
- *Develop or expand the information base on current conditions.* An important part of this is considering the impact of past extreme weather and other disasters in each city or municipality. This should seek as much detail as possible, ensuring the inclusion of 'small disasters' (disasters that do not get included in international disaster databases), and could draw on the DesInventar methodology developed in Latin America and now widely applied elsewhere, which looks more intensively at disasters in any locality and includes 'small disasters'.[73]
- *Initiate risk/vulnerability assessments for the city.* Such assessments should be built up from community and district assessments (and from global and national projections about climate change impacts). In many cities, this can and should include the kinds of community-driven assessments undertaken by the Philippines Homeless People's Federation that were described earlier (see Box 6.3). It may be seen as laborious and time consuming; but engagements with women and men in settlements and districts that are affected most by extreme weather can produce a more detailed and nuanced understanding of risk and vulnerability – and, thus, a better basis to understand what adaptation is needed – as illustrated by the experiences from the urban communities of Mansión del Sapo and Maternillo in Puerto Rico.[74] Such an assessment should include as much geographic detail as possible. Furthermore, it needs to link hazard maps with details of what is currently located within the hazardous zones – including identifying population groups or settlements most at risk and activities that may pose particular risks (e.g. water treatment plants located in areas at risk from flooding). It is also important that city assessment can draw data from global and national projections about climate change impacts. At present, many such projections are insufficient and imprecise, or at times even contradictory, thus impeding local action. It is, for example, difficult for local governments to plan for appropriate future land use if projections of climate change implications are weak or contradictory.[75]
- *Assess sector-specific vulnerability and responses.* Risks from climate change vary greatly between sectors – and the responsibilities for addressing them vary greatly across the different administrative divisions and departments that make up local and extra-local governments. Adapting to climate change does not only depend on all the key sectors and departments seeing the relevance of actions within their jurisdictions and areas of competence. It is also essential that these departments take appropriate action. However, it is difficult to get all key spending and investing sectors and departments to do this – and the department or division with responsibility for directing attention towards climate change adaptation rarely has more than an advisory role and, moreover, usually has a very limited budget of its own for investment. It needs to convince the departments concerned with public works, public health, housing, solid waste management, schools, etc. to engage with adaptation. The adaptation strategies of Durban (South Africa), London (UK) and Melbourne (Australia)[76] sought to make clear how the main climate threats are linked to specific sectoral responsibilities, and this has made the responsibilities for adaptation much clearer. Agencies responsible for disaster preparedness response have particular importance – although these often need to broaden their focus beyond response to disaster preparedness (and disaster prevention) and all that this implies for their engagement with city- and community-level housing and infrastructure investments. The agencies responsible for disaster response will often see the relevance and importance of their engagement in this; but they too often lack influence and resources, especially in relation to the measures that avoid or prevent disasters.[77] Utility companies, different government departments, and the private sector will all have key roles, too, in addressing specific vulnerabilities.

Risk/vulnerability assessments for the city … should be built up from community and district assessments (and from global and national projections about climate change impacts)

- *Develop strategic plans for the city as a whole and its surrounds*.[78] Urban authorities should have the key role in developing strategic plans for the city as a whole; but this needs to be done in association with other stakeholders. These strategic plans are necessary to ensure complementarities and coordination between different activities in the urban area. Several of the most effective strategies described above have included strategic adaptation plans. This has been an important part of the process in both Cape Town and Durban (South Africa) – however, because of the commitment from the municipality's Environmental Planning and Climate Protection Department, the plans have moved closer to implementation in Durban. For many major cities, the strategic plans need to encompass the larger region on whose resources and ecosystem services the city depends. This is more easily done when the area under the jurisdiction of the city government includes this larger region; the added complexities politically and institutionally where this is not so are obvious.

Urban authorities should have the key role in developing strategic plans for the city as a whole; but this needs to be done in association with other stakeholders

- *Support local responses to climate change.* Many of the key adaptations to climate change will require individual and collective action at the community level to build resilience and prevent harmful effects. It is widely accepted that much adaptation will be undertaken

Table 6.6

Examples of specific adaptation interventions by sector

Sector	Adaptation option/ strategy	Underlying policy framework	Key constraints to implementation	Key opportunities to implementation
Water	Expanded rainwater harvesting; water storage and conservation techniques; water reuse; desalination; water-use and irrigation efficiency.	National water policies and integrated water resources management; water-related hazards management.	Financial and human resources; physical barriers.	Integrated water resources management; synergies with other sectors.
Infrastructure and settlements	Relocation; sea walls and storm surge barriers; dune reinforcement; land acquisition and creation of marshlands/wetlands as buffer against sea-level rise and flooding; protection of existing natural barriers.	Standards and regulations that integrate climate change considerations within design; land-use policies; building codes; insurance.	Financial and technological barriers; availability of relocation space.	Integrated policies and management; synergies with sustainable development goals.
Human health	Heat–health action plans; emergency medical services; improved climate-sensitive disease surveillance and control; safe water and improved sanitation.	Public health policies that recognize climate risk; strengthened health services; regional and international cooperation.	Limits to human tolerance (vulnerable groups); knowledge limitations; financial capacity.	Upgraded health services; improved quality of life.
Tourism	Diversification of tourism attractions and revenues; shifting ski slopes to higher altitudes and glaciers; artificial snow-making.	Integrated planning (e.g. carrying capacity; linkages with other sectors); financial incentives (e.g. subsidies and tax credits).	Appeal/marketing of new attractions; financial and logistical challenges; potential adverse impact upon other sectors (e.g. artificial snow-making may increase energy use).	Revenues from 'new' attractions; involvement of wider group of stakeholders.
Transport	Realignment/relocation; design standards and planning for roads, rail and other infrastructure to cope with warming and drainage.	Integrating climate change considerations within national transport policy; investment in research and development for special situations (e.g. permafrost areas).	Financial and technological barriers; availability of less vulnerable routes.	Improved technologies and integration with key sectors (e.g. energy).
Energy	Strengthening of overhead transmission and distribution infrastructure; underground cabling for utilities; energy efficiency; use of renewable sources; reduced dependence on single sources of energy; increased efficiency.	National energy policies, regulations, and fiscal and financial incentives to encourage use of alternative sources; incorporating climate change within design standards.	Access to viable alternatives; financial and technological barriers; acceptance of new technologies.	Stimulation of new technologies; use of local resources.

Source: based on Parry et al, 2007b, Table SPM4

incrementally by individuals and households, and that communities and local organizations also have important roles in this. There are many examples of community-driven 'slum' upgrading that greatly reduced environmental health risks; if served with appropriate information and support, these can include attention to climate change risks (which in the next few decades are mostly increased risk levels from hazards already present). The above examples from the Philippines (see Box 6.3) show that community organizations have the capacity to build resilience and identify appropriate short- and long-term responses to climate events – if they are adequately supported by local authorities. This latter point is an important one; as was noted above, effective climate change strategies require a partnership approach – involving households and communities, but also the various levels of government and other partners, including international organizations.

What is required … is to include climate-proofing of infrastructure for future climate change

Adaptation responses to potential impacts in different economic sectors

It is clear from the discussion above that climate change adaptation action is needed in almost all sectors; Table 6.6, drawn from the IPCC, provides some examples of the kinds of specific adaptation interventions needed by some of the key sectors. Although this table does not highlight this, much of what is listed in the adaptation option/strategy will fall to local government to implement, even if it needs resources and policy and regulation frameworks from higher levels of government.

With regard to infrastructure, most fields of infrastructure management already incorporate measures to cope with climate variability and extreme events – including water, sanitation, transport and energy management. What is required, in addition, is to include climate-proofing of infrastructure for future climate change.[79] Adaptation to climate change will typically involve increases in reserve margins and other kinds of back-up capacity, and attention to system designs that allow adaptation and modifications without

major redesigns and that can accommodate more extreme conditions for operations.[80] Infrastructural adaptation can take one of several forms: building retrofitting and strengthening; lifeline infrastructure strengthening; and hazard modification.[81] In Georgetown (Guyana), detailed cost-benefit analyses have been used to assess the most important and cost-effective infrastructural responses to climate change. These have been complemented by a more qualitative approach that seeks to identify costs and benefits from a non-monetary perspective.[82]

Infrastructure can be adapted in a variety of ways, not all of which require complicated technological solutions. Planned adaptation to sea-level rise can involve retreat, accommodation or infrastructural solutions (as is illustrated in Figure 6.3). However, in practical terms, there are strong social, political and economic reasons for protecting land that has already been developed in densely settled urban areas.

There are a growing number of examples of urban areas that have adopted infrastructural solutions to address particular aspects of climate change (although it should be noted that some of the examples provided below, such as that of Venice, are related to natural processes that would require attention even without the added risk brought about by climate change):

- *Responses to flooding.* In Venice (Italy), the *Modulo Sperimentale Elettromeccanico* ('Experimental Electromechanical Module') involves the construction of 79 gates at three lagoon inlets: when waters rise 1.1m above 'normal', air will be injected into these hollow gates, causing them to rise and preventing the city from flooding. In many developing countries, few projects have been implemented; although proposed strategies exist for Nam Dinh Province (Viet Nam), including building reservoirs to retain floodwater, strengthening dyke systems to resist higher flood levels, and constructing emergency spillways along dykes for selective filling of flood retention basins.[83]
- *Water conservation.* Singapore has a Four National Taps Strategy to ensure the future supply of water. The first 'tap' is the supply of water from local catchments based on an integrated system of 15 reservoirs and an extensive drainage system to channel water into these; the second is imported water from Johor (Malaysia); the third is high-grade reclaimed water; and the fourth is desalinated water.[84]
- *Reducing urban temperatures.* 'Cool roofs' and 'porous pavements' are being used in Vancouver (Canada) to reduce the urban heat island. These are covered with light-coloured water sealants that reflect and radiate more heat than dark surfaces, thus reducing the need for mechanical cooling systems.[85]

The World Bank and the Asian Development Bank have been developing their capacity to design and deliver infrastructure that will meet the needs of climate change.[86] Investment in infrastructure can support sustainable socio-economic development, and can also facilitate reconstruction and recovery.

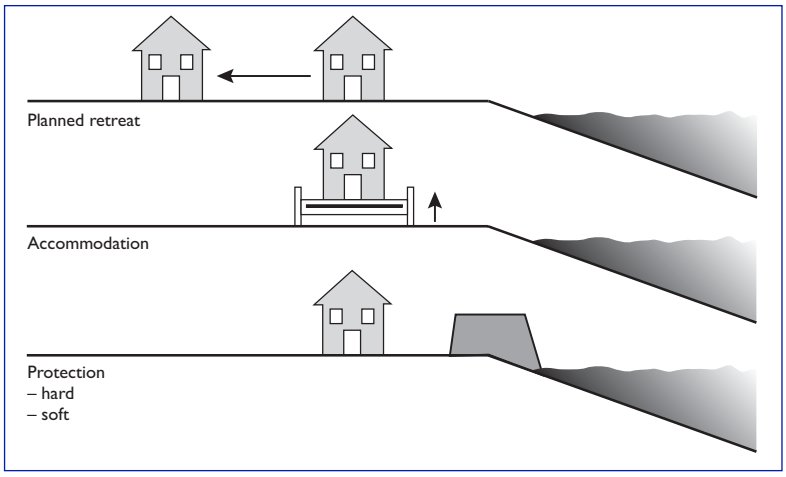

Figure 6.3

Adapting infrastructure to sea-level rise

Source: Parry et al, 2009, p63

However, infrastructural investment is fraught with challenges. Large-scale interventions of this type have frequently failed to take into account the particular social and economic context of the areas in which they are implemented, with negative social consequences, including forced relocations[87] and provision of services in a way that fails to meet the needs of low-income groups.

Building resilience

The many measures by which low-income households and communities try to cope with extreme weather, and their importance in reducing risks, has been discussed at length already. Many of these measures would fit with the definition of resilience given by the IPCC: the 'ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change'.[88] Indeed, the many examples of simple pragmatic ways of coping with floods such as having shelves high up walls above anticipated flood levels, and furniture (often raised on bricks) on which the residents can sit or sleep could be included in this definition.

Planned adaptation to sea-level rise can involve retreat, accommodation or infrastructural solutions

There are important components of resilience beyond 'hard' infrastructure – in part because hard infrastructure will be unable to remove or greatly reduce many risks, especially if the governments of the world do not reach agreement on needed emissions reduction soon.[89] Thus, resilience is also a capacity to live in hazardous, changing and uncertain environments[90] and through assets, social networks and partnerships to have the needed capacity to (in the words of the IPCC) 'absorb disturbances while retaining the same basic structure and ways of functioning'.[91]

The building of resilience should be understood as a way of enabling not only coping with added shocks and stresses, but also addressing the myriad challenges that constrain lives and livelihoods

Perhaps the building of resilience should be understood as a way of enabling not only coping with added shocks and stresses, but also addressing the myriad challenges that constrain lives and livelihoods. Thus, a key part of building resilience is facilitating poverty reduction and more general improvements to the quality of human lives.[92]

Many interventions being undertaken in urban areas around the world – by local, municipal, national and international stakeholders – contribute to building this resilience through improving housing, infrastructure and services, particularly for the urban poor. Addressing the challenges of

climate change adaptation may not be the explicit or primary purpose of these activities; but, in practice, they provide an essential foundation for the process of adaptation. Indeed, for many cities in developing countries, this is likely to be the single most important component of an overall adaptation strategy.

In addition, many of these urban areas already experience an 'adaptation deficit'. The infrastructure is insufficient to cope with present climatic conditions – let alone those that will arise as a result of climate change. Existing storm drains, water supply networks and transport infrastructure may have been developed decades ago to serve a much smaller population – and before these can be 'adapted' to deal with future climate threats, they must first be upgraded to deal with current conditions. In this respect, it is helpful to consider Stern's definition of adaptation: 'development in a more hostile climate'.[93] Many of the adaptation needs for urban areas in developing countries are based on the need for development that takes a changing climate into account.

A wide range of urban improvement programmes and projects around the world can be seen as contributing to reducing the infrastructure deficit and increasing urban resilience to climate change

A wide range of urban improvement programmes and projects around the world can be seen as contributing to reducing the infrastructure deficit and increasing urban resilience to climate change. Global initiatives to improve urban housing (such as UN-Habitat's World Urban Campaign[94] and its predecessor, the Global Campaign for Secure Tenure) and provide appropriate plans for urban development (such as the City Development Strategies[95] promoted by the Cities Alliance) can form the basis for building urban resilience. However, these large-scale responses require careful analysis to ensure that they remain genuinely pro-poor and meet the needs of the most vulnerable urban residents.[96]

For many low-income urban residents, savings schemes form the basis for … resilience

Many communities are already involved in activities that will build the resilience of individuals and households. For many low-income urban residents, savings schemes[97] form the basis for this resilience. The practice of saving regularly with such schemes has both instrumental benefits (the ability to access funds when necessary) and organizational benefits (the relationships of trust built up around small savings groups are central to identifying solutions to larger problems). Small-scale loans repaid over very short time periods provide much needed capital for livelihood activities. They can develop into small-scale loans to help improve or extend housing. Furthermore, organized savings groups have also demonstrated the ability to negotiate for and acquire new land sites that are not vulnerable to climate threats, such as flooding and landslides, upon which to build secure housing and thus provide protection against short- and long-term climatic threats.

Insurance policies for houses, possessions and businesses contribute to resilience where they provide compensation to those whose homes, possessions and businesses have been damaged or destroyed. They could also contribute to building resilience by including financial incentives (such as reduced premiums) for those who have reduced their risks. However, this will not serve those unable to access the formal housing market and/or those who cannot afford insurance. For urban centres in developing countries, this means most of the population and most enterprises. Insurance companies will not offer insurance coverage to cities or to households and businesses on city sites at high risk from climate change because of inappropriate locations or deficits in infrastructure.

Adaptation planning and local governance

Drawing on the descriptions of household, community-based and local government actions for adaptation in previous sections, this section considers the relative roles for community-based adaptation and for adaptation planning and governance. These tend to operate at different scales (although often with cross-scale linkages) and to involve a distinct balance between individual and collective action, and between behavioural and structural (in terms of both housing and infrastructure) responses. Yet, these frameworks should be viewed as complementary rather than as mutually exclusive. As is evident from a wide range of studies on addressing urban environmental challenges more broadly, there is a need to link structural and behavioural responses. For example, individuals and community groups in cities with limited investment capacities may be best placed to devise the most appropriate sanitation solutions for themselves and their neighbourhood – but these are of little use without larger investments at the scale of the town or city to ensure convenient and easily accessed water supplies for personal hygiene and appropriate provision for the removal of human waste.[98] Conversely, large-scale infrastructural developments to improve drainage and reduce flooding require the knowledge and expertise of engineers; but these interventions will have little value if they do not take into account the needs of those in informal settlements and the social and behavioural norms and expectations of urban residents. Drainage systems also have their capacity to protect cities from flooding much reduced if they are not maintained (which may need community support) and protected from encroachment.

In urban areas of developed countries, citizens take for granted that a range of local structures and organizations provide protection from environmental hazards and help to create resilience to potential disasters. It is assumed that these will also provide for adaptation to climate change. Here, residents do not need to organize themselves to clear drains and collect solid wastes; these are tasks that local authorities do or organize. These urban areas have infrastructure and services that protect them from environmental hazards (through, for instance, the provision of safe water supplies, sewers and drainage) or help them to cope when illness or injury occurs (e.g. through well-managed healthcare and emergency service systems).[99] In urban areas in developing countries, these facilities and services are frequently absent or they serve only a proportion of the population. Local governments lacking capacity and funding, and with large infrastructure and service deficits need the contributions that community-based organizations can bring. There are also the exceptional local governments that have shown how[100] – even with limited resources – effective governance and planning can work towards facilitating urban adaptation.

Exceptional local governments … have shown how – even with limited resources – effective governance and planning can work towards facilitating urban adaptation

Planning for adaptation can take place at a range of scales. As described in the previous section, some urban areas have developed plans for adaptation at both the city and sectoral levels as a key component of their preparation for climate change. The examples of Cape Town and Durban (South Africa) showed how large urban areas can develop municipal-level plans for adaptation that take into account a range of social and environmental challenges.[101] These provide the framework within which local government departments, the private sector, civil society and individuals can prepare and implement their contributions to strategies for adaptation within development or investment plans. There are other examples where city governments have successfully avoided large-scale settlement by low-income populations on dangerous sites that would be at risk from climate change. In Manizales (Colombia), local authorities, universities, NGOs and communities worked together to develop programmes aimed not only at reducing risks, but also at improving the living standards of the poor and at protecting fragile ecological areas. Households were moved off the most dangerous sites, but rehoused nearby, and most of the former housing sites were converted into eco-parks with strong environmental-education components.[102] In Ilo (Peru), long-term engagement by consecutive democratically elected mayors have improved water supply, sanitation, electricity provision, waste collection and public space. Despite the population increasing fivefold between 1960 and 2000, no land invasion or occupation of risk-prone areas by low-income groups looking for housing has taken place, as local authorities have implemented programmes to accommodate this growth in a sustainable way.[103]

There are also the examples of resident groups in cities that organized to influence the future development of their city along more ecologically sustainable paths. These include some where climate change adaptation has been important – as in the city of Tatabánya (Hungary), some 50km from the capital city of Budapest, which offers an example of how community members can be an important driver and resource in climate adaptation (see Box 6.6).[104] Participatory budgeting has become one of the best known and most widely applied forms of citizen engagement in the plans and priorities of city governments,[105] and in some cities, this engagement has included a strong focus on environmental issues.[106]

In London (UK) (see Box 6.5) and Bangkok (Thailand) (see Table 6.2), the approach to climate change adaptation planning has been to identify particular sectors that are 'at risk' and develop plans to address each of these, and with the delegation of responsibility to appropriate agencies. This requires an effective system of oversight and control, and relies on these agents having sufficient financial and technical capacity to make the appropriate investments and interventions. In London, strategies are being developed to address the three key climate risks affecting the city – flooding, drought and overheating. Bangkok will be vulnerable to a similar set of risks, and the Bangkok Metropolitan Administration has proposed adaptation measures to be taken by the community infrastructure sector, the business and commercial sector, and the general population.

Box 6.6 Citizen-driven city adaptation in Tatabánya, Hungary

Tatabánya is a former mining and industrial town that has approximately 72,000 residents and was known for its high levels of pollution. The residents have formed three groups, each involved in promoting local sustainability:

1. The focus of the 'inhabitants group' is to develop a new vision for the future of the city. They serve in a representative capacity in public decision-making and through their efforts have helped to promote communication between residents and public officials by ensuring that local interests are known.
2. The 'local council of pupils group' is made up of student representatives who engage in a variety of tasks, including participating in local decision-making.
3. The 'local climate group' is comprised of individuals from all walks of life, including students, pensioners, doctors, nurses, teachers, engineers, scientists, public officials, heads of companies and inhabitants. Among their many accomplishments, they have implemented a heat and ultraviolet light alert programme, organized teams to assist in the development of a local climate strategy, initiated a call for tenders on energy-efficient housing, established emissions reduction targets, and implemented educational and information programmes.

What is perhaps most noteworthy of the Tatabánya experience is the commitment of its residents to their city and to addressing both immediate issues and good environmental performance in relation to global systems.

Sources: Moravcsik and Botos, 2007; Carmin and Zhang, 2009

Urban areas on Mexico's Yucatan coast have been involved in a process of social learning for climate-proofing, based on bringing together a range of stakeholders.[107] This involves a three-stage process of consciousness, institutionalization and implementation:

- *Consciousness* is the process of reflection on established norms and practices with the aim of generating new visions.
- *Institutionalization* is the process of changing stakeholders in urban governance to facilitate new norms and practices.
- *Implementation* is the capacity to enact new practices and activities.

There are … examples where city governments have successfully avoided large-scale settlement by low-income populations on dangerous sites that would be at risk from climate change

Social learning by civil society is seen as an essential prerequisite to effective adaptation planning. This is particularly so in a context where the government is constrained by a highly competitive and dynamic political culture, with politicians and officials coming in and out of office frequently and seldom building on past knowledge or initiatives.

Urban adaptation planning is therefore intrinsically linked with local governance. A study of ten Asian cities found that preparation for climate change was strongly linked with climate-resilient urban governance.[108] This includes decentralization and autonomy, accountability and transparency, responsiveness and flexibility, participation and inclusion, and experience and support. Urban governance systems that exhibit these characteristics are better able to build resilience through having more effective financial and technical management capacities in 'climate-sensitive' sectors such as waste, water and disaster management. Responsiveness and flexibility are crucial, given the

Urban adaptation planning is … intrinsically linked with local governance

Table 6.7

Adaptation to extreme weather: The role of city/municipal governments

Role for city/municipal government	Long-term protection	Pre-disaster damage limitation	Immediate post-disaster response	Rebuilding
Built environment				
Building codes	High		High*	High
Land-use regulations and property registration	High	Some		High
Public building construction and maintenance	High	Some		High
Urban planning (including zoning and development controls)	High		High*	High
Infrastructure				
Piped water, including treatment	High	Some	High	High
Sanitation	High	Some	High	High
Drainage	High	High**	High	High
Roads, bridges, pavements	High		High	High
Electricity	High	Some?	High	High
Solid waste disposal facilities	High	Some?		High
Wastewater treatment	High			High
Services				
Fire protection	High	Some	High	Some
Public order/police/early warning	Medium	High	High	Some
Solid waste collection	High	High**	High	High
Schools	Medium	Medium		
Healthcare/public health/environmental health/ambulances	Medium	Medium	High	High
Public transport	Medium	High	High	High
Social welfare (includes provision for childcare and old-age care)	Medium	High	High	High
Disaster response (over and above those listed above)			High	High

Notes: * It is important that these do not inhibit rapid responses.

** Clearing/de-silting of drains and ensuring collection of solid wastes has particular importance just prior to extreme rainfall; many cities face serious flooding from extreme rainfall that is expected (e.g. the monsoon rains) and this is often caused or exacerbated by the failure to keep storm and surface drains in good order.

Source: Satterthwaite et al, 2009c

limited predictability of the consequences of climate change. At the same time, the involvement of the poor and marginalized groups in decision-making, monitoring and evaluation is key to improving the living conditions of these groups. In the context of Mexico, it has been argued that the quality of the governance process is the most important component for enabling climate change adaptation.[109] The need to adapt to climate change and the need to adapt governance systems to be more responsive and effective are therefore closely linked.

The involvement of the poor and marginalized groups in decision-making … is key to improving the living conditions of these groups

Table 6.7 highlights the range of roles that city or municipal governments have in climate change adaptation. It is a reminder of how much adaptation depends on action within many different sectors or parts of local government.[110] This means that adaptation planning needs support not only from public works departments and from development planning and development control, but also from the departments dealing with environmental health, public health, and social and community services (including transport and public space management, and emergency services), as well as those dealing with finance and disaster management.[111] Adaptation to climate change is often taken to mean protection against likely changes (e.g. better drainage systems or coastal defences); but it should also involve three other components listed in Table 6.7: damage limitation measures taken just before an extreme event (that has the potential to cause a disaster), immediate post-extreme event response, and rebuilding. There is also a range of measures that local governments can take that support resilience at the household and community levels. This includes slum and squatter upgrading and schemes that help those with limited incomes to afford to buy, build or rent safer, better served accommodation (although to be effective for adaptation, these need to be guided by climate change risk assessments and appropriate responses). It also includes measures to strengthen or support livelihoods and food security for low-income groups. Urban food security depends on households being able to grow or afford food within other needs that have to be purchased.[112] The extent of food insecurity among low-income households in urban areas is given too little consideration,[113] which also means that their vulnerability to the impacts of climate change on agriculture is probably underestimated.

There is … a range of measures that local governments can take that support resilience at the household and community levels

Measures to support resilience include more effective and accessible healthcare services and emergency response services that are prepared for the scale and nature of climate-related (and other) potential disaster risks. It also includes an early warning system that actually reaches all those in need with appropriate information, combined with knowledge of what to do and where to go – and provision to ensure that all can move to identified safe places, when and where needed. It also means a capacity to respond after disasters – as in the measures listed in Table 6.1 for immediate post-disaster response and rebuilding. Within this, there is a clear need for all measures taken to address gender-specific issues of risk management and adaptation, from shelter management to empowerment, and inclusion of women in decision-making at all scales for stronger emphasis on long-term and risk-averse initiatives.

UN-Habitat's Cities and Climate Change Initiative[114]

The UN-Habitat Cities and Climate Change Initiative

Table 6.8

Proposed and planned activities in the pilot cities of the Cities and Climate Change Initiative

City	Proposed activities
Esmeraldas	• Zoning of riverbanks and preparation of a participatory land-use plan. • Preparation of a risk management plan. • Implementation of an environmental management plan for the Teaone River (including solid waste management and riverside rehabilitation through reforestation).
Kampala	• Establishment of national and city climate change network. • Increasing awareness and capacities of Kampala City Council. • Increasing synergies between national and local climate change policies and programmes.
Maputo	• Strengthening disaster risk preparedness at the community level. • Localizing the national climate change adaptation plan. • Promoting policy dialogue to strengthen the government response capacity to floods. • Education and public awareness campaigns to create climate change awareness. • Capacity-building with local government and a wider range of partners.
Sorsogon	• Development of knowledge products for sharing and cross-fertilization of ideas. • Demonstration of innovative technologies for climate-resilient human settlements, particularly in low-lying urban coastal areas. • Development of the capacity of the city government. • Advocacy, awareness-raising and partnership building on climate change with stakeholders and the general public.

Source: UN-Habitat, 2008a

provides an illustration of how international agencies can support local adaptation action. It aims to strengthen the climate change responses of cities and local governments. The initiative is currently being piloted in four cities – Esmeraldas (Ecuador), Kampala (Uganda), Maputo (Mozambique) and Sorsogon City (the Philippines).[115] This initiative brings together local and national governments, academia, NGOs and international organizations to alert cities to the actions that they can take to respond to climate change. Key programme components that are being encouraged for adaptation to climate change include advocacy and policy change, the development and use of toolkits, and knowledge management and dissemination. An important component in this project is the creation of a global network of cities working on adaptation issues, among whom knowledge can be generated and shared.

The four pilot cities in this initiative face a range of challenges related to climate change. Sorsogon City, Maputo and Esmeraldas are all coastal cities affected by frequent flooding and at risk from sea-level rise. In addition, Sorsogon is at risk from tropical cyclones; Esmeraldas has many households living on hillsides and riverbanks; and the protective mangroves around Maputo are disappearing. Kampala is located inland, but is also affected by flooding and the degradation of fragile hill slopes. In all cases, these challenges are compounded by inappropriate management of natural resources and inadequate urban infrastructure.

Various adaptation responses are being planned and implemented in these cities in association with the Cities and Climate Change Initiative (see Table 6.8). Some of these are associated with broader environmental management projects which will simultaneously improve the resilience of communities and the urban area to climate change: the reconstruction of the National Disaster Management Institute in Mozambique will help to improve disaster risk reduction in Maputo and elsewhere in the country; and the flood prevention programme for the Teaone River in Esmeraldas will help to reduce flooding. Other activities involve building networks and capacity: in Kampala, it is proposed to establish a climate change network of various stakeholders addressing climate change, whereas in Maputo it is proposed to support collaboration between the local government and a range of other partners. Strengthening the capacity of local authorities to address climate change is also a key activity in all four cities – both in terms of awareness of the issues and potential responses to these.

FINANCING ADAPTATION

In terms of financing for climate change adaptation, there are the two main issues that have to be addressed up front:

1 Will funds will be available to cover the cost of adaptation for urban areas?
2 Is there local capacity in place to use such funds in such a manner that the needed adaptation can take place?

Funding for adaptation in developing countries comes … primarily from … the dedicated climate change funds available under the …UNFCCC … and through overseas development assistance

International debates and discussions have tended to focus on the first of these, not the second. Funding for adaptation in developing countries comes (and will come) primarily from two main sources: the dedicated climate change funds available under the United Nations Framework Convention on Climate Change (UNFCCC) (see Box 2.2) and through overseas development assistance. As noted in Chapter 2, the issue of funding has been high on the agenda in international climate negotiations. Ideally, there is wide agreement that international funding for climate change adaptation should be adequate to the task at hand, and should explicitly allocate a fair share of resources to urban settlements. However, in practice, the funds available are, at present, inadequate; furthermore, these funds do not target urban settlements.[116] Moreover, the first consistent approach to identifying adaptation priorities, the NAPAs, generally missed urban priorities. So far, urban priorities also seem to be absent from the funding allocated through the Adaptation Fund.[117]

In practice, the funds available are, at present, inadequate; furthermore, these funds do not target urban settlements

Adaptation to climate change has become an important priority in the international climate change negotiations during recent years. At the latest meeting of the COP (2010, Cancún, Mexico), Parties reiterated the importance of adaptation and agreed that:

> *adaptation is a challenge faced by all Parties, and that enhanced action and international*

> *cooperation on adaptation is urgently required to enable and support the implementation of adaptation actions aimed at reducing vulnerability and building resilience in developing country Parties, taking into account the urgent and immediate needs of those developing countries that are particularly vulnerable.*[118]

The Cancún Agreements further reaffirm the commitment made by developed countries to expand the scale of funding available for adaptation during COP-15, including through the US$100 billion which is to be mobilized by 2020 to support action in developing countries. However, the ambiguity on where the increased funding will actually come from remains unresolved. Furthermore, the Cancún Adaptation Framework was established to further enhance action on adaptation.

The Cancún Agreements … reaffirm the commitment made by developed countries to expand the scale of funding available for adaptation during COP-15

As noted in Box 2.2, international funding for adaptation through the UNFCCC includes the Special Climate Change Fund, the Least Developed Countries Fund and the Adaptation Fund. The Adaptation Fund was established to finance adaptation projects and programmes in developing countries, with particular attention to those countries that are particularly at risk from the adverse effects of climate change. It is likely to have particular importance because part of its funding comes from a levy on the project activities of the Clean Development Mechanism, and this should give it a considerable and guaranteed source of funding. Thus, unlike the other funds, it is not reliant on negotiating funding from donor agencies. It also has a governance structure in which developing countries have more influence; its independent board has representation from each of the major regions, as well as special seats for the least developed countries and the small island developing states.[119]

The large climate change adaptation deficit in most developing countries is also a development deficit

A review of financing arrangements for adaptation[120] suggested that there is an opportunity for complementarity between this Adaptation Fund and overseas development assistance. For example, the review suggested that overseas development assistance can help to focus on the drivers of vulnerability that are associated with weak institutional capacity, while the Adaptation Fund supports developing countries' broader climate risk management strategies. It also suggested that the bilateral and multilateral donor agencies can help to build the necessary local and national institutional capacity to receive and make good use of support from the Adaptation Fund. However, this also presupposes a capacity among such agencies to work with civil society and local governments, which is often not present.

If the costs of remedying … infrastructure deficits are considered as part of climate change adaptation, the costs of adaptation increase very considerably

This mix of funding might also overcome the contentious issue of the boundary between climate change adaptation and development. Development should certainly include 'adaptation' to all disaster and environmental health risks, including those to which climate change does not contribute or only partially contributes. The large climate change adaptation deficit in most developing countries is also a development deficit. This raises the questions of whether funding for climate change adaptation should include funding for removing this development deficit (which also proves to be an adaptation deficit) or not. In theory, the governments of developed countries that contribute funding to adaptation will want this to be separated from aid budgets and focus specifically on climate change adaptation. Yet, how can a city adapt to climate change if half of its population live in informal settlements that lack the most rudimentary infrastructure and services? And how can funding for adaptation be managed if there is one funding stream and set of agencies for putting in place needed infrastructure and another for adapting this infrastructure?

Attention should also be paid to the relative costs of mitigation and adaptation. The estimates for the costs of mitigation (achieving the needed reductions in global GHG emissions) appear very high. Many estimates for the costs of adaptation – including those produced by the UNFCCC (see Table 6.9) – are much lower. Based on this, it could be argued that mitigation costs can be reduced by funding for adaptation that allows a less rapid reduction in global GHG emissions. However, if the estimates for the costs of adaptation are far too low and consideration is given to the difficulties in overcoming the lack of adaptive capacity within local governments, it changes the balance. A more realistic assessment of the incapacity and unwillingness of most national, city and municipal governments within developing countries to actually implement needed adaptation measures means that mitigation should receive a much higher priority. In the end, the discussion boils down to the willingness of governments in developed countries (and some industrialized developing countries) to reduce the carbon-intensive consumption patterns of their citizens[121] to benefit others – especially future generations and those who are most at risk and most vulnerable to climate change (most of whom live in developing countries).

This section focuses on the costs of adapting infrastructure to the potential future impacts of climate change. It also includes a discussion of the very large costs involved in remedying the large deficits in infrastructure in urban areas in most developing countries – for instance, the lack of storm and surface drains, paved roads and footpaths, and reliable piped water supplies. Remedying these deficits may not be considered as climate change adaptation; but without remedying these deficits, it is not possible to build resilience to most climate change impacts. Also, if the costs of remedying these infrastructure deficits are considered as part of climate change adaptation, the costs of adaptation increase very considerably.

It is, however, important to note that the discussion below does not include a discussion of many institutional and social adaptation costs. Nor does the discussion touch on the issue of residual damage: the cost incurred in an increasing number of locations that become permanently beyond adaptation – because adaptation is considered too expensive or technically unfeasible. Some such challenges are addressed in the next section.[122]

The costs of adaptation

The basis for accurate national and global estimates for the costs of adaptation does not exist. The costs of adaptation

are so local, so specific to location and to existing levels of housing and infrastructure quality and governance capacity – and there are few examples of locally determined adaptation costs upon which to base national or global estimates. Cost estimates are also greatly influenced by the form that adaptation takes – for instance, what safety margins are built into new infrastructure and what balance is achieved between protection and accommodation.

Most global estimates of the cost of adaptation are based on the costs of climate-related disasters; but these are known to form a very inadequate basis for this. One reason for this is that the cost estimates of climate-related disasters do not include most disasters because they have a very high threshold for a damaging event to be included in their considerations.[123] Where careful local or national reviews of disaster events and their impacts have been carried out, these highlight the very large underestimates, especially with regard to deaths and serious injuries.[124] There is also the problem of assigning costs to disasters based on the value of the properties destroyed – so a disaster that destroys the homes and possessions of hundreds or thousands of households does not appear 'serious' because the monetary value of their homes in informal settlements is low and they had no insurance. It is odd, indeed, to base any estimates for adaptation costs on what insurance companies have had to pay out for extreme weather disasters if almost all those affected by these disasters do not have insurance.

Most estimates for the costs of adaptation that are relevant to urban areas are based on the costs of adapting infrastructure, and thus include roads (of all sizes, from highways to streets and lanes) and bridges, railways, airports, ports, electric power systems, telecommunications, water, sewerage, and drainage/wastewater management systems. The definition of infrastructure is sometimes broadened to include services which make economic and social activities possible – so it would include services such as public transport, healthcare, education and emergency services (which collectively are sometimes termed social infrastructure). A proportion of such infrastructure is outside urban boundaries, although almost all of it is important to the functioning of urban economies. There is also all the ambiguity in what gets included under infrastructure – including housing (sometimes included, sometimes excluded) and the institutions that operate and manage infrastructure.

The UNFCCC secretariat has made estimates for the costs of adapting infrastructure (see Table 6.9); but it does not specify what is included in the term. It is also unclear as to whether housing and the institutions needed to operate and manage infrastructure are included in its estimates.[125] It might be assumed that estimates for the costs of extreme events that draw on records from insurance companies would include housing; but only a very small proportion of households in developing countries have disaster insurance (and thus have their costs included in 'costs' based on insurance claims). The destruction of, or damage to, housing is one of the most common and most serious impacts of many extreme weather events, especially in many developing countries. The damage to, or loss of, housing is usually concentrated among low-income groups and this often also includes loss of possessions. Only a very small proportion of the population in developing countries have insurance for this. Assessing the impacts of such events in terms of the value of property damaged or destroyed can be misleading; an event that is devastating to the lives of very large numbers of people (in deaths, injuries and loss of property) may have low economic impacts because of the low value assigned to the housing damaged or destroyed.[126]

Table 6.9

Annual investment needs by 2030 to cover climate change adaptation costs (estimates)

Sector	Global costs (US$ billion)	Developed countries (US$ billion)	Developing countries (US$ billion)
Agriculture	14	7	7
Water	11	2	9
Human health	5	Not estimated	5
Coastal zones	11	7	4
Infrastructure	8–130	6–88	2–41
Total	49–171	22–105	27–66

Note: All values are in US$ at present day values. The only 'sector' that includes the cost of 'residual damage' in the above estimates comprises the 'coastal zones'.

Source: UNFCCC, 2007, cited in Parry et al, 2009

For infrastructure, adaptation costs should include the costs of limiting the impacts (as well as preventing them). For many extreme weather events in urban areas with large infrastructure deficits and poor-quality housing, good early warning systems, measures taken just before the extreme event (e.g. reducing the impact of flooding by supporting populations in moving temporarily to high ground or safe sites) and rapid and effective post-event responses (temporary accommodation, restoring access to services, supporting rapid return to settlements damaged and supporting rebuilding) greatly reduce the impacts upon populations and their assets. Yet, these measures might be considered as inadequate or invalid for adaptation funding in that they are not limiting the damage done to infrastructure. The costs of building and maintaining this capacity to reduce the impacts of extreme weather events is not included in figures for infrastructure investments, and these costs are thus not considered in the UNFCCC estimates.

The destruction of, or damage to, housing is one of the most common and most serious impacts of many extreme weather events

There is also the issue of infrastructural damage that cannot be prevented by adaptation – the so-called 'residual damage' – stemming both from conscious choice (locations/facilities/structures for which full protection is judged to be too costly, or where adaptation is technically not feasible) or from incapacity on the part of those who are at risk and those institutions which have responsibility for reducing this risk (local government, national governments, etc.) (see Figure 6.4). Thus, the UNFCCC estimates for the costs of adapting infrastructure include consideration of a limited part of 'infrastructure' that does not include social infrastructure, disaster-response infrastructure, housing and the institutional infrastructure needed to build, maintain and adapt infrastructure. Thus:

The UNFCCC estimates for the costs of adapting infrastructure … does not include social infrastructure, disaster-response infrastructure, housing and the institutional infrastructure needed to build, maintain and adapt infrastructure

> *The UNFCCC estimate of investment needs is probably an under-estimate by a factor of between 2 and 3 for the included sectors. It could be much more if other sectors are considered... For infrastructure it may be several times higher, at the lower end of the cost range.*[127]

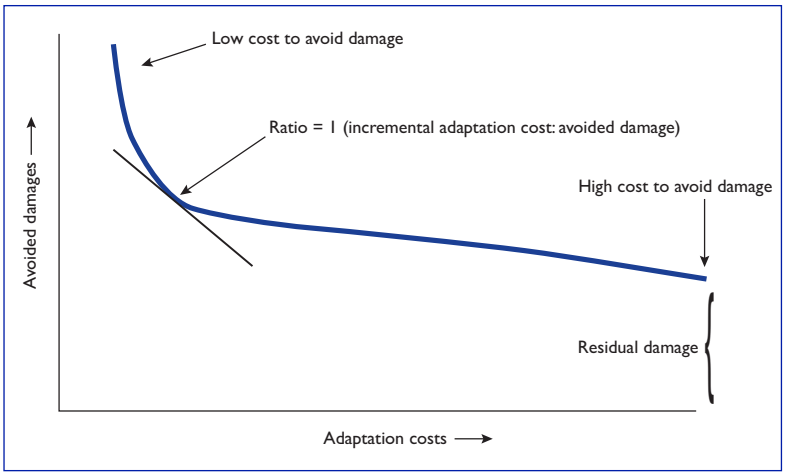

Figure 6.4

Adaptation costs, avoided damages and residual damage

Source: Parry et al, 2009, p12

The infrastructure deficit

The fact that most developing countries have very large deficiencies in provision for infrastructure has been discussed in detail already. A high proportion of the urban population in Africa and Asia and a significant proportion in Latin America and the Caribbean live in homes and settlements with little or no infrastructure (i.e. no all-weather roads, no drains, no piped water supplies and no provision for electricity). Most urban centres in developing countries have no sewers, including many with several million inhabitants.[128] During the period from 2000 to 2010, the number of slum dwellers in developing countries has increased from 767 million to 828 million, and 'short of drastic action to curb current trend, the slum population worldwide is likely to ... reach a total of 889 million by 2020'.[129] A large proportion of these slums are characterized by inadequate or no provision of basic infrastructure. The lack of provision or inadequacies in the provision of protective infrastructure is perhaps the main reason for the very rapid increase in the number of flood and windstorm 'disasters' since the 1950s.

Most of the investment needed for climate change adaptation in terms of infrastructure is required in developed countries, rather than in developing countries

Reviewing data on disasters also gives some indications of the kinds of impacts that extreme weather events can have upon infrastructure – within the larger costs in terms of death, injury and economic disruption – and loss of livelihood for large numbers of people. Reviewing the 'disasters' registered on an international database[130] between 1996 and 2005 shows not only thousands of people killed and tens of millions affected by floods and windstorms, but also hundreds of billions of dollars worth of damage. For instance, in Asia, floods and windstorms between 1996 and 2005 caused over 70,000 deaths and around US$191 billion worth of economic loss. A large part of these deaths and the economic losses could be attributed to infrastructure deficiencies. UNFCCC notes the following:

> *Evidence for the existence and size of the adaptation deficit can be seen in the mounting losses from extreme weather events such as floods, droughts, tropical cyclones, and other storms. These losses have been mounting at a very rapid rate over the last 50 years. This increase is likely to be mostly due to the expansion of human populations, socio-economic activities, real property, and infrastructure of all kinds into zones of high risk. Moreover, much of this property is built at a substandard level and does not conform even to minimal building codes and standards. This widespread failure to build enough weather resistance into existing and expanding human settlements is the main reason for the existence of an adaptation deficit. Real property and socio-economic activities are just not as climate-proof as they could and arguably should be. The evidence suggests strongly that the adaptation deficit continues to increase because losses from extreme events continue to increase. In other words, societies are becoming less well adapted to current climate.*[131]

However, while this recognizes that there is a very large climate change adaptation deficit, much of which is an infrastructure and institutional infrastructure deficit, the UNFCCC report does not consider it appropriate to consider this in estimating adaptation costs for infrastructure.[132]

A review of the basis used by the UNFCCC for estimating the costs of adapting infrastructure[133] suggested that this was based on an incorrect premise – that this can be costed by applying a small increment to existing investment flows into infrastructure that is climate sensitive, with no account taken of the very large infrastructure deficits. This leads to the conclusion that most of the investment needed for climate change adaptation in terms of infrastructure is required in developed countries, rather than in developing countries. It also ends up showing very small sums needed for Africa and other places where there are very low/inadequate investment flows into infrastructure and where many of the countries most at risk from climate change are located. This same review also noted three other assumptions that need to be questioned:[134]

1. The availability of funding from international agencies is the 'solution' for adaptation. In much of Africa and Asia and parts of Latin America and the Caribbean, local governments are weak, ineffective and unaccountable to local populations, so their capacity to design and implement appropriate adaptation strategies that serve those who are most at risk from climate change must be in doubt. This is most obvious in the countries that are often termed 'failed states'; but it is also evident in many other countries. External funding agencies have not proved very effective in addressing this – or even in knowing how to address this.
2. 'Adaptation' and 'development' can be kept separate. On the ground, climate change impacts are exacerbating non-climate change impacts and addressing both is inhibited by institutional/governance failures. It is difficult, if not impossible, to separate what proportion of extreme weather damage or water shortages in any locality are caused by climate change. So much of the adaptation deficit for housing and infrastructure is also a development deficit.

3 NAPAs give us an idea of adaptation costs. The focus of most of the NAPAs is a very small part of what these countries will need for adaptation. NAPAs are thus not a good basis for costing adaptation costs.

The cost of addressing the infrastructure deficit

Detailed cost estimates were undertaken in selected countries to estimate the investments needed to meet the Millennium Development Goals between 2005 and 2015 and these came to US$993 to $1047 per person.[135] Around half of this was for infrastructure (including water and sanitation, energy and roads). Yet, these estimates do not address the elimination of all infrastructure (and other development) deficits. Many of the Millennium Development Goals are only for reducing the problem – for instance, halving the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015. Similarly, the goal for improving the lives of slum dwellers was to reach 100 million slum dwellers by 2020, which would represent only around 13 per cent of the slum population in 2000 (and a much smaller percentage of the likely slum population in 2020). Thus, the total cost to remove the infrastructure deficit is likely to be much higher.

One recent estimate suggested that the cost of removing the housing and infrastructure deficit in developing countries by 2030 would be some US$6.3 trillion – and this would include US$700 billion for expanding housing and infrastructure for expanding urban populations.[136] These estimates are broadly in line with estimates in the 2009 report of the International Strategy for Disaster Response[137] for the investments needed to reduce the deficit in disaster risk avoidance and risk reduction. This suggests that several hundred billion dollars a year are required to address the underlying risk factors for disasters (including those relating to climate change).

However, as was noted in the introduction to this section, the availability of funding is only a part of the solution, as solutions also depend on national and local governments having the competence, capacity and accountability to make the needed investments. It is important to stress that adaptation will require very large capital sums invested in developing countries, but also to recognize that, at the moment, there are no reliable methodologies for estimating these costs accurately. What is more urgent and important is to get serious consideration given to climate change adaptation plans and programmes for particular localities (including cities), and to what resources can be generated for these locally or supported by higher levels of government. Furthermore, there is a need to consider how these plans and programmes can be pro-poor and supportive of general development initiatives. Based on such considerations, it might be possible for the international community to arrive at a more accurate and specific understanding of the international funding mechanisms which are required to support such plans and programmes.

Thus, there is a need for detailed case studies of what adaptation would involve in particular locations and what component would have to be allocated to infrastructure deficits. The studies described earlier in this chapter are moving in this direction, although most are from cities in developed countries. Such studies need to consider the infrastructure deficit and the needed institutional/governance underpinning for addressing the infrastructure deficit and climate-proofing all new and existing infrastructure and urban developments. From this can come a better idea of the kind of funding needed for adapting infrastructure to climate change risks, and from this, some thoughtful discussion of what these imply for adaptation costs and adaptation funding, in general. It would only take a few such studies of major cities that are particularly at risk from climate change and have large infrastructure deficits to show that the UNFCCC estimates for Africa and for most cities in Asia are far too low. It is also likely that studies of major cities in Latin America at high risk from climate change would also show the UNFCCC estimates for these regions to be far too low.

The UNFCCC notes[138] that even with a growing number of location-based estimates for costs, it will be difficult to extrapolate these to figures for whole regions because of:

- *Very large differences in contexts* (risks and vulnerability), including the scale of the infrastructure deficits and the extent of the local governance failures. In most of the locations with the largest infrastructure deficits and governance failures, much of the data needed to assess such costs are simply not there.
- *Very large differences in costs.* The estimate in London's adaptation plan that it can cost UK£15,000 to make a single dwelling in London cooler in summer could build 15 houses in many Asian and African urban centres.
- *The 'moving target' of urbanization.* United Nations projections suggest that almost all growth in the world's population in the next few decades is expected to be in urban areas in developing countries.[139]
- *Public costs versus private costs.* Many of the costs in adapting cities – particularly in upgrading housing stock – will be borne by private individuals and are even more difficult to account for. Estimates that are based only on the costs of adapting infrastructure are thus certainly not the 'total costs of adaptation'.[140]

One recent estimate suggested that the cost of removing the housing and infrastructure deficit in developing countries by 2030 would be some US$6.3 trillion

The UNFCCC estimates for Africa and for most cities in Asia are far too low

CHALLENGES TO ADAPTATION

Most of the world's urban population and most of its largest cities are now in developing countries. Furthermore, and as noted in the introduction to this chapter, most of the growth in the world's population over the next few decades is likely to occur in the urban centres of developing countries. At the same time, most of the urban centres most at risk from climate change are in developing countries. And it is in urban areas in developing countries that the deficits in infrastructure and services needed to protect populations from climate change are most evident. Yet, most governments and many international agencies still give little or no attention to

urban adaptation. Many disaster response agencies are also better equipped to deal with rural disasters than urban disasters.[141]

Perhaps the most pressing challenge for climate change adaptation in urban areas in developing countries is to get it seen and understood as a central dimension of development – and, thus, also a central dimension of economic strength and poverty reduction, including meeting the Millennium Development Goals. If the Millennium Development Goals were met in urban areas, it would certainly increase their resilience to climate change. However, this raises a second challenge of how to get far more effective local action on the ground for development that includes the needed attention to adaptation. A city's economic success may be important for its adaptive capacity – but there are many cities with successful economies where large sections of their population still live in informal settlements that lack the infrastructure and services that reduce climate-related (and many other) risks.

Perhaps the most pressing challenge for climate change adaptation in urban areas in developing countries is to get it seen and understood as a central dimension of development

It will also be difficult to balance present and future needs. The adjustment of building and infrastructure standards and designs to address likely increases in extreme weather or water constraints – that may not become evident for 20 or more years in the future – is important as it will be more expensive to rebuild or adjust these in 10 to 20 years. With investment capacity so constrained in most urban centres in developing countries, however, the extra costs of building resilience to future risks will be contested by those who claim that there are more pressing priorities. In this context, it will especially be difficult to get the needed priority to risk reduction for lower-income groups, as wealthier and more powerful interests (residents and businesses) want their risks, vulnerabilities and adaptation needs to be addressed first. City governments that have long ignored the needs and priorities of those living in informal settlements are not likely to become committed to address these deficits.

City and municipal governments need to consider how to reduce climate-related risks within their plans and investments in infrastructure and land-use management

Effective action on adaptation on the ground also depends on a willingness to act by local governments. The generic lessons that can be drawn from the experiences of cities that have already developed adaptation plans were discussed above.[142] These include building a commitment to act among the different stakeholders, developing the information base on current conditions (and risks), and developing city-wide risk/vulnerability assessments that draw on community and district assessments. City and municipal governments need to consider how to reduce climate-related risks within their plans and investments in infrastructure and land-use management. This usually depends on, or is much enhanced by, civil society organizations, especially those that represent and work with those who are most at risk. An earlier section also discussed the key roles for local governments and for civil society groups of building or supporting the building of resilience to climate-related stresses and shocks.[143] Here, too, there are many co-benefits with development (and poverty reduction).

The failure to mitigate sufficiently in developed countries will create ever more adaptation failures, mostly in developing countries, including many countries with insignificant … contributions to climate change

However, within each country and urban centre, different stakeholders may be working according to very different worldviews of adaptation. This may hamper efforts at creating coherent and holistic adaptation responses that take into consideration the different vulnerabilities highlighted earlier in this Global Report.[144] There is also the growing influence of those who insist that climate change is not happening or that it will bring few costs; a web-based consultation on London's adaptation programme[145] that asked for comments and suggestions produced many remarks to this effect that also showed little or no understanding of climate science.

In addition, little attention is given to urban adaptation by most international agencies, even as they discuss and develop policies on adaptation.[146] Where international funding is available for adaptation, it will be difficult to get the needed attention for addressing the (often very large) deficits in infrastructure and services (the lack of provision for piped water, storm and surface drains, all-weather roads, emergency services, etc.) that arise from governance failures and limitations because these are not seen as climate change related. Getting international support available in a form that allows it to support effective urban adaptation which is integrated within local development (and build local adaptation capacity) is thus a challenge. There are also all the constraints faced by international agencies from their lack of capacity to support local engagement, as they have shifted their support to sector support and basket funding.[147] Channelling funding through recipient governments and supporting their priorities serves development when these governments are competent, representative and accountable; but this is often not the case. This raises issues about the structures and effectiveness of international agencies in supporting needed local action on climate change in the thousands of urban areas where this is required.

Furthermore, official development assistance was not, in the first place, set up to support local governments and civil society groups with regard to adaptation efforts. There is little clarity as yet on how international funding for adaptation (hopefully integrated within development) can work with and serve local governments and civil society groups within each urban centre. The key roles of local government and civil society as designers and implementers of climate change adaptation in urban areas may be better appreciated; but the means by which they can influence climate change negotiations and institutional responses and hold international funders of adaptation to account is not yet clear.

It is important to note that the failure to mitigate sufficiently in developed countries will create ever more adaptation failures, mostly in developing countries, including many countries with insignificant historic and current contributions to climate change. It is also difficult to see any agreement reached on needed mitigation strategies by the governments of developing countries unless the governments in developed countries demonstrate their commitment to mitigation by taking responsibility for their (very high) contribution to global climate change. For (local and national) governments in countries with minimal per capita GHG emissions, it is very difficult to justify to their electorates expenditures on climate change mitigation if they are already unable to provide their populations with basic infrastructure and services.

Most of the urban populations and places at greatest risk from climate change are not those with large historic or current contributions to GHGs. As noted in Table 1.4, the average African (excluding South Africa) individual emits only 54 per cent of the CO_2 emitted by the average Indian, only 16 per cent of that emitted by the average Chinese, and only 4 to 8 per cent of that emitted by the average citizen of the major developed countries. And, in terms of total figures, if CO_2 emissions from all African countries (except South Africa) were cut in half, this would only imply a 1.2 per cent reduction in global emissions. In contrast, a similar global emissions reduction could be achieved by the US through a national reduction of CO_2 emissions of only 6 per cent. Such issues of *environmental justice* are playing an important part in the increasing focus being given to climate change adaptation in developing countries.

There is also the larger issue for urban adaptation of *population displacement* at a national scale and its influence on migration, including that to urban centres. If cities become the destination of very large flows of rural migrants driven from their homes and livelihoods by, for instance, the damage brought by climate change to agriculture, it will add further to the infrastructure deficit and probably to the scale of settlement on hazardous sites. There are predictions that by 2050, some 200 million people may be forced to leave their homes due to environmental degradation and water shortages caused by climate change.[148] Yet, studies of migration show how population movements are generally rational, well-informed responses by individuals and households to changing circumstances. Thus, they are, in fact, a key part of individual and household adaptation. Land degradation or decreases in rainfall do not inevitably result in migration. Or where they do, most movement is short term, as in response to extreme weather disasters, and short distance, as in migrant responses to drought and land degradation.[149]

Where there are slow-onset impacts from climate change (e.g. rising temperatures and declining rainfall), this can bring negative impacts upon agriculture; but income diversification and short-distance circular migration are likely to be common responses.[150] Where climate change is causing environmental stress for rural livelihoods, it will be one among a number of factors in determining migration. In addition, support for agriculture – including agricultural adaptation initiatives – does not necessarily reduce rural–urban migration. Indeed, successful rural development often supports rapid urban development locally as it generates demand for goods and services from farmers and rural households.[151] Yet, a failure by governments and international agencies to reduce global GHG emissions and to support rural and urban populations to adapt will bring crisis-driven population movements that make those forced to move very vulnerable. Here, migration is no longer planned movement helped by knowledge and contacts in the destination area. The pressures on crisis-driven population movements will also be much increased if developed countries fail to agree on implementing the large reductions in GHG emissions that are needed to avoid dangerous climate change.

So far, there is debate as to whether climate change has yet led to *forced migration* from any location.[152] Yet, there is growing concern about how to address the issue of migrants who are forced to leave their homes due to future climate change. This aspect of 'residual damage', people whose lives and homes cannot be adapted *in situ*, falls outside the scope of most national and international legislation. Under current international law, strictly speaking, those fleeing from environmental pressures are not considered as refugees – this term is reserved for those 'being persecuted for reasons of race, religion, nationality, membership of a particular social group, or political opinion'. Furthermore, the term 'refugee' refers only to people who are 'outside the country of [their] nationality'.[153] In international law, people who are displaced within their own country are referred to as 'internally displaced persons'. Thus:

> *… there is a broad consensus among lawyers considering the issue of climate change migration that current protections at international law do not adequately provide for a number of the categories of person likely to be displaced by climate change.*[154]

There are major consequences of this inadequate protection in human rights law – namely, who will be responsible for assisting this group? If international climate migrants were to be considered refugees, this would imply a responsibility of countries to offer them the same protection as they offer to political refugees. So far, not one country has been willing to accept such a definition.[155] At the same time, the international agency with the primary responsibility for dealing with refugees, and which has been taking on the task of addressing the concerns of internally displaced persons as well – the Office of the High Commissioner for Refugees – is 'already overstretched and … unable to cope with their current "stock" of refugees'.[156] Thus:

> *Given the nature and magnitude of the problem which climate change displacement presents,* ad hoc *measures based on existing domestic regimes are likely to lead to inconsistency, confusion and conflict.*[157]

There are thus increasing calls for the development of new international legislation to address the concerns of 'climate migrants' – perhaps in the form of an international convention for persons displaced by climate change.[158]

CONCLUDING REMARKS AND LESSONS FOR POLICY

What needs to be done to support the adaptation of urban areas to climate change has become clearer during the last ten years, in large part because of innovations by civil society groups and local governments, some of which have been described in this chapter. What is much less clear is how to

If cities become the destination of very large flows of rural migrants driven from their homes … by … climate change …, it will add further to the infrastructure deficit and probably to the scale of settlement on hazardous sites

The pressures on crisis-driven population movements will … [increased] if developed countries fail to agree on implementing … large reductions in GHG emissions

There are … increasing calls for … new international legislation to address the concerns of 'climate migrants' – perhaps in the form of an international convention

translate 'what needs to be done' into 'how to do it', especially in countries and urban areas with weak local governments or local governments unwilling to work with the low-income groups within their jurisdiction.

Clearly, one important way forward is to work with and learn from the innovators – in grassroots organizations, in local governments, in national governments and in international agencies. Another is to encourage the engagement of all key stakeholders in cities (which in the end means almost everyone). This includes far more attention to the needs and capacities of those who are most at risk from climate change. Here, consultations on the ground and risk assessments are not focused on 'climate change', but on all the risks and vulnerabilities that they face – some, most or all of which are likely to be exacerbated by climate change. This can be the basis for risk and vulnerability assessments that inform a 'climate change aware' development agenda. This has to build resilience both to the specific threats identified as certain or likely from climate change and, more generally, to all the stresses and shocks that threaten the well-being and livelihoods of low-income groups. Another important issue here is how to make the adaptation measures provided or financed by the private sector that serve better-off households and businesses extend their range so that they also serve smaller businesses and lower-income households.

A focus on community-based adaptation, local assessments or the international transfer of funds only is unlikely to be a successful recipe for climate change adaptation at the city level

Yet, it has to be kept in mind that a focus on community-based adaptation, local assessments or the international transfer of funds only is unlikely to be a successful recipe for climate change adaptation at the city level. Successful adaptation also has to take into account the following major issues:

- Concerted action at the household, community, local government, national government and international levels are required.
- Global and national projections about climate change impacts have to be improved in order to better support measures at the local level. At present, projections are insufficiently precise or, at times, contradictory, which impedes local action.
- The issue of social and environmental justice needs to get appropriate attention, both within cities and countries, but also internationally. As is acknowledged by the UNFCCC, the bulk of funding for climate change adaptation has to come from those countries that are responsible for global climate change. Also, there is a need to consider who is to pay for the homes and properties lost from the impacts of climate change that cannot be adapted to: the so-called 'residual damage'.
- The emerging international funding for climate change adaptation has to be adequate to the task at hand, and should explicitly allocate a fair share of resources to urban settlements. At present, resources are inadequate and do not target urban settlements.

It is … important that the emerging knowledge about climate change adaptation in urban areas is synthesized and included in the Fifth Assessment Report of the IPCC

It is also important that the emerging knowledge about climate change adaptation in urban areas is synthesized and included in the Fifth Assessment Report of the IPCC that will be developed between 2010 and 2014. The work undertaken in preparing this Global Report, as well as other UN-Habitat activities, is already feeding into that process. The Fourth Assessment Report of the IPCC, published in 2007, focused on reviewing and summarizing the evidence for human-induced climate change and presenting the case for the importance of action both on adaptation and mitigation. The Fifth Assessment Report needs to go much further in summarizing and synthesizing what is known about how to achieve adaptation (and mitigation). The initial work for IPCC's Fifth Assessment recognizes the need for more attention to human settlements; in the plans for the Fifth Assessment Report, the Working Group II on 'impacts, adaptation and vulnerability' includes three chapters on 'human settlements, industry and infrastructure', compared to only one in the Fourth Assessment. This includes a chapter on urban areas, another on rural settlements and a third on networked infrastructure that serves all human settlements (including transport, energy and water).[159] There are also measures under way to have closer links between the various working groups on the role of cities and other settlements in considering both adaptation and mitigation; here the interest is in the co-benefits between adaptation and mitigation. It is also being planned that the Fifth Assessment Report should have more detailed coverage on human health, security and livelihoods, and poverty. The ongoing work of the IPCC will thus serve to get the attention of national governments and international agencies to all the measures needed to address climate change adaptation in urban areas discussed in this chapter.

NOTES

1 Satterthwaite, 2007.
2 UN, 2010. See also Chapter 1.
3 The definitions used in this section are based on Parry et al (2007b). See also Box 1.1.
4 See Chapter 1 and also UN-Habitat (2007) for an in-depth discussion of resilience with respect to natural and human-made disasters.
5 See also discussion of vulnerability in Chapter 4.
6 See Chapter 5.
7 See Chapter 1.
8 Mitlin, 2008.
9 See section on 'Household and community responses to the impacts of climate change'.
10 Bicknell et al, 2009.
11 See Chapter 4.
12 See Wisner et al, 2004.
13 See Chapter 4 for a more in-depth discussion of vulnerability.
14 Stephens et al, 1996.
15 Mrs Fatu Turay, Kroo Bay Community, Freetown, Sierra Leone. ActionAid International, 2006, p6.
16 Douglas et al, 2008.
17 ActionAid International, 2006, p4.
18 Dodman et al, 2010b.
19 Jones and Rahman, 2007.
20 Mitlin and Dodman, forthcoming.
21 Boonyabancha, 2005, 2009.
22 Hasan, 2006, 2010.
23 This example is drawn from López-Marrero and Tschakert, forthcoming.
24 Similar differences in perception of risks and impacts have been noted in Delhi, India (Diana Reckien, pers comm, 2010).
25 Wamsler, 2007.
26 Mitlin and Dodman, forthcoming; see also Banks, 2008.
27 Sabates-Wheeler et al, 2008.
28 Prowse and Scott, 2008.
29 Dodman and Satterthwaite, 2008.
30 Moser and Satterthwaite, 2008.
31 See Roberts, 2008.
32 Karol and Suarez, 2007; Roberts, 2010a; .
33 Stern, 2006; Satterthwaite et al, 2007a.
34 Satterthwaite et al, 2007a.
35 See Chapter 2.

36 Satterthwaite et al, 2009a.
37 Dalal-Clayton, 2003.
38 Satterthwaite et al, 2007a; Satterthwaite et al, 2009a.
39 Huq et al, 2003.
40 The City of Durban has been a pioneer within Africa in developing a coherent inter-sectoral adaptation strategy. See Roberts (2008, 2010a) for an account of the difficulties in getting buy-in from within different sectors in government. See also the section below on 'Moving from risk assessments to adaptation strategies'.
41 This section draws on Hintz, 2009.
42 Pelling, 1997.
43 This section draws on Bangkok Metropolitan Administration, 2009.
44 Roy, 2009.
45 It should be noted that many of the actions implemented in Bangladesh, particularly during the early years, were addressing natural disaster risks, rather than climate change adaptation *per se*.
46 Alam and Rabbani, 2007.
47 The section on Durban draws on Roberts (2008, 2010a, 2010b); the section on Cape Town draws on Mukheibir and Ziervogel (2007).
48 Roberts, 2008, 2010a.
49 UN, 2010.
50 Roberts and Diederichs, 2002a, 2002b.
51 The discussion on Durban draws on Roberts, 2008, 2010a; and Debra Roberts, eThekwini Municipality, Durban, South Africa, pers comm, September 2009.
52 Roberts, 2010a.
53 See www.durban.gov.za/durban/services/epcpd/about/branches/climate-protection-branch.
54 Roberts, 2010b.
55 Roberts, 2010b.
56 City of Cape Town, undated.
57 Departments such as roads and storm water, disaster risk management and housing (City of Cape Town, 2010).
58 In practical terms, this may be better understood as the second step, as it first needs the decision by the city government to think about climate change adaptation, and then to commission the work needed to advance such thinking.
59 Nickson, 2010.
60 This draws on City of Melbourne, 2009.
61 This draws on City of Rotterdam, 2009 and undated.
62 This draws on IFRC, 2010, especially Chapter 7.
63 See, for instance, UN, 2009; IFRC, 2010.
64 Lungo, 2007.
65 Gavidia, 2006.
66 Adger et al, 2007.
67 Note the literature on the early adopters. See, for instance, Carmin et al (2009).
68 Satterthwaite et al, 2007a.
69 Boonyabancha, 2005; Usavagovitwong and Posriprasert, 2006; Some et al, 2009; see also Hasan, 2006.
70 van Horen, 2001; Torres et al, 2007.
71 Syukrizal et al, 2009.
72 See Roberts, 2008, 2010a.
73 UN, 2009.
74 See the above section on 'Community responses'.
75 Osbahr and Roberts, 2007; Kehew, 2009.
76 See discussion earlier in this chapter.
77 See Roberts, 2010a, for a discussion of this in relation to Durban, South Africa.
78 For a more elaborate discussion on urban planning, see UN-Habitat, 2009a.
79 See ADB, 2005.
80 Satterthwaite et al, 2007a.
81 Revi, 2008.
82 See Hintz, 2009, and the above section on 'Local government responses to the impacts of climate change'.
83 World Bank, 2008.
84 World Bank, 2008.
85 Bizikova et al, 2008.
86 World Bank, 2008.
87 See the section below on 'Challenges to adaptation'
88 Parry et al, 2007b, p880. See also Box 1.1 and the discussion of resilience in UN-Habitat, 2007.
89 See Chapter 2.
90 See discussion in López-Marrero and Tschakert, forthcoming.
91 Parry et al, 2007b, p880.
92 Dodman et al, 2009.
93 Stern, 2009.
94 See www.unhabitat.org/categories.asp?catid=634, last accessed 14 October 2010.
95 See www.citiesalliance.org/ca/cds, last accessed 14 October 2010. It should be noted that the City Development Strategies approach does not yet clearly address climate change *per se*.
96 Pieterse, 2008.
97 See discussion in the section on 'Household and community responses to the impacts of climate change' above.
98 Hasan, 2010.
99 Satterthwaite et al, 2007a.
100 Such as Durban (South Africa) and Manizales (Colombia).
101 See section on 'Local government responses in developing countries' above.
102 Velasquez, 1998.
103 Díaz Palacios and Miranda, 2005.
104 Carmin and Zhang, 2009.
105 See Cabannes, 2004.
106 See, for instance, Menegat, 2002.
107 Pelling et al, 2008.
108 Tanner et al, 2009.
109 Manuel-Navarrete et al, 2008.
110 Satterthwaite et al, 2009a.
111 See also Roberts, 2010a.
112 Cohen and Garrett, 2010.
113 See Maxwell et al, 1998; Cohen and Garrett, 2010; Tolossa, 2010.
114 This section draws on UN-Habitat, 2008a, and the Cities and Climate Change Initiative's website at www.unhabitat.org/content.asp?typeid=19&catid=570&cid=6003, last accessed 14 October 2010.
115 Additional cities are joining the initiative in Africa, Asia and Latin America.
116 See the section on 'The potential of the international climate change framework for local action' in Chapter 2.
117 It should be noted that the Adaptation Fund became operational in 2010; see Box 2.2.
118 UNFCCC, 2010.
119 Ayers, 2009.
120 Ayers, 2009.
121 As can be seen from Table 1.4, developed countries and the top nine GHG-emitting developing countries are responsible for 83 per cent of all GHG emissions (in 2005) and 87 per cent of all CO_2 emission (in 2007).
122 See section on 'Challenges to adaptation' below.
123 See UN, 2009; IFRC, 2010.
124 UN, 2009.
125 Dodman and Satterthwaite, 2009.
126 For more details, see IFRC, 2010.
127 Parry et al, 2009.
128 Hardoy et al, 2001.
129 UN-Habitat, 2010, p42.
130 Disasters included in the Emergency Events Database, CRED, Louvain, Belgium (www.emdat.be).
131 UNFCCC, 2007, para 371, p90.
132 This having been said, however, it is easy to argue that many parts of the infrastructure deficit are only marginally related to the adaptive capacity of a community. The adaptive capacity of New Orleans during Hurricane Katrina in 2005, for example, would not have been much different if, say, 20 or 80 per cent of the population had access to sewerage services or piped water. Yet, in terms of urban governance, it is hard for local governments, particularly in developing countries, to justify investments in 'pure' climate change adaptation measures if a large proportion of the population do not have access to basic infrastructure and/or services.
133 Dodman and Satterthwaite, 2009.
134 Parry et al, 2009.
135 UN Millennium Project, 2005.
136 Parry et al, 2009.
137 UN, 2009.
138 Dodman and Satterthwaite, 2009.
139 UN, 2010.
140 Dodman and Satterthwaite, 2009.
141 Suarez et al, 2008; IFRC, 2010.
142 See the section on 'Generic lessons for city governments' above.
143 See the section on 'Building resilience' above.
144 See Chapter 4.
145 See www.london.gov.uk/climatechange, last accessed 14 October 2010.
146 See, for instance, the lack of attention to this in the recent *Human Development Report* on the topic of climate change (UNDP, 2007).
147 Crespin, 2006. 'Basket funding is the joint funding by a number of donors of a set of activities through a common account, which keeps the basket resources separate from all other resources intended for the same purpose' (Ministry of Foreign Affairs of Denmark, 2006, p2).
148 See note 257 in Chapter 4.
149 See Henry et al, 2004; Massey et al, 2007; Tacoli, 2009.
150 Tacoli, 2009.
151 See Beauchemin and Bocquier, 2004; Henry et al, 2004; Massey et al, 2007.
152 See, for example, Brown, 2007.
153 Convention relating to the Status of Refugees, Article 1, http://www2.ohchr.org/english/law/pdf/refugees.pdf, last accessed 13 October 2010.
154 Hodgkinson et al, undated.
155 Brown, 2007.
156 Brown, 2007, p8.
157 See www.ccdpconvention.com/documents/CCDPConventionFAQs.pdf, p3, last accessed 13 October 2010.
158 See www.ccdpconvention.com, last accessed 13 October 2010.
159 See www.ipcc.ch/activities/activities.htm for more details, last accessed 18 October 2010.