

CITIES AND CLIMATE CHANGE INITIATIVE TOOL SERIES



DEVELOPING LOCAL CLIMATE CHANGE PLANS

A GUIDE FOR CITIES IN
DEVELOPING COUNTRIES

DEVELOPING LOCAL CLIMATE CHANGE PLANS

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**Effect of a typhoon along the shore of Sorsogon,
Philippines © UN-Habitat/Joselito Derit**

FOREWORD



Urban challenges in developing countries such as persistent poverty and continuously increasing slum populations, burgeoning inequalities, informality and underemployment, pollution, traffic congestion, loss of urban green spaces, sprawl and the high demand for services and infrastructure can often seem overwhelming for local governments. To add yet another issue such as climate change to the 'to-do list' of local governments may at first glance seem unrealistic. Yet, rapid urbanization and climate change are two of the most prominent challenges of our time, and on closer examination it is clear that these two phenomena are closely intertwined.

First, no city can be placed on a long-term sustainable development path without addressing climate change. Concretely, without taking the impacts of climate change into consideration, today's development gains may be wiped out tomorrow.

Second, to a large extent, the way our cities are planned and operate - as well as the lifestyles of people living in cities - contribute

to the greenhouse gas emissions that cause climate change. The dependency on fossil fuel for transport and electricity for heating, cooling, lighting, etc., increases with ever-more sprawling cities.

In its Global Report on Human Settlements 2011, UN-Habitat demonstrated that well planned and managed cities can address climate change as well as the broader urban development challenges. Cities can maximize economies of agglomeration and scale. A city that prioritizes public transport, walkability, green areas and efficient use of energy, on the one hand and addresses inequity, poverty and social injustice on the other, is on the right path. Climate change vulnerability is a new form of marginalization that intensifies urban poverty. Building resilient cities also requires better planning as well as better urban infrastructure and services.

The aim of this publication is to demonstrate that getting started on climate change is both necessary and possible for any city. The publication provides a simple planning process based on understanding long-term

climate change impacts, urban development challenges and the needs of citizens. It gives guidance so that any city can get started no matter how limited its resources. In particular, it describes “quick win” activities that address both climate and urban issues simultaneously.

Many case studies, to a large extent derived from the now more than 30 cities that participate in UN-Habitat’s Cities and Climate Change Initiative, can provide inspiration to mayors and local governments. Detailed accounts of the climate change response in Esmeraldas (Ecuador), Kampala, Maputo and Sorsogon (the Philippines) provide guidance on how to approach climate change in practice.

Based on a robust methodology and practical examples, this publication should help cities to rally citizens behind action to address climate change and may provide the foundation to attract additional national or international climate funds.



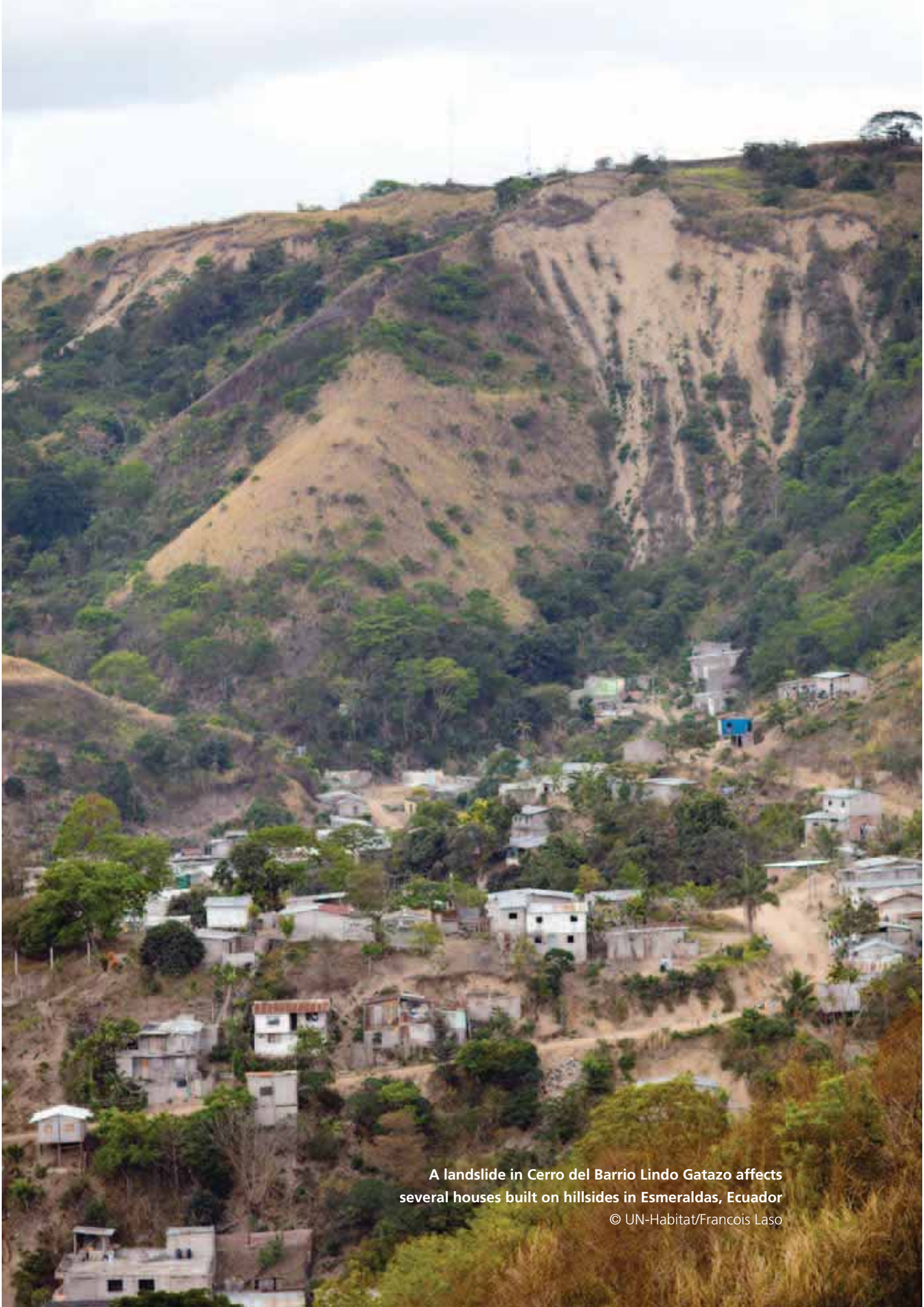
Dr. Joan Clos
Executive Director, UN-Habitat





Street after a typhoon in Sorsogon, Philippines

© UN-Habitat/Joselito Derit



A landslide in Cerro del Barrio Lindo Gatazo affects several houses built on hillsides in Esmeraldas, Ecuador

© UN-Habitat/Francois Laso

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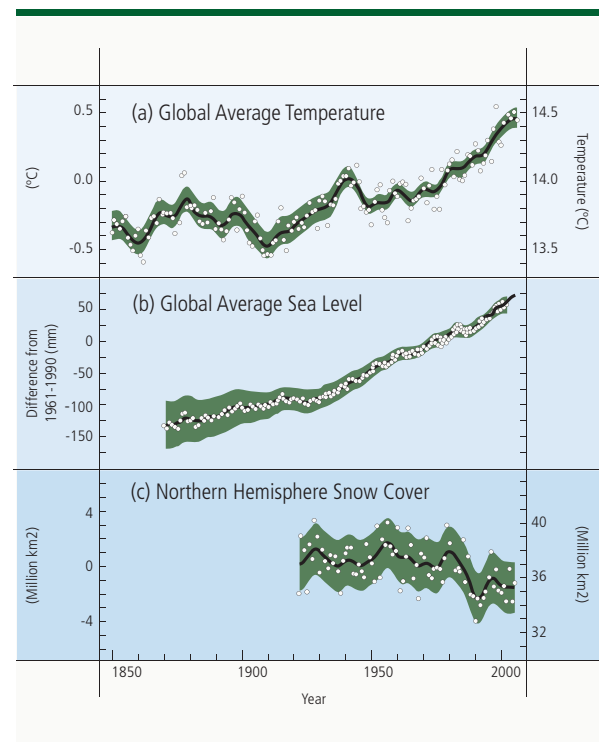
THE LOCAL IMPACTS OF CLIMATE CHANGE

1.1 WHY CITIES SHOULD PLAN FOR CLIMATE CHANGE

Climate on Earth has never been stable. Geological records demonstrate dramatic fluctuations in temperature occurring over thousands and millions of years. However, over the last 100 years, the Earth's climate has been warming as a result of human activities – a process referred to by scientists as 'anthropogenic' climate change (meaning that it results from the influence of human activity rather than natural cycles). Research has abundantly shown that global average temperature has increased, global average sea level has risen, and snow cover in the Northern Hemisphere has declined (Figure 1).

The rises in temperature and sea level are driven by the production of greenhouse gases [see Glossary] emanating from a wide variety of human activities including electricity generation, transportation, manufacturing, waste management, agriculture and deforestation. These changes are expected to continue in the future, with a wide range

Figure 1: **Observed Changes in Temperature, Sea Level and Snow Cover***



* Source: Intergovernmental Panel on Climate Change (IPCC) (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry M, Canziani O, Palutikof J, van der Linden P, Hanson C (eds). Cambridge University Press, C

of impacts on urban areas around the world. Rising temperatures will have a detrimental effect on air quality and public health; changing rainfall patterns will affect water availability and the spread of diseases related to poor sanitation; and extreme weather events will cause widespread damage to infrastructure, as well as loss of life and livelihoods. In addition, urban areas will also see indirect consequences from climate change: movements of people as a result of climate stress; shifts in the distribution of disease vectors; and new regulations for reduced greenhouse gas emissions. Because of this, the lives and livelihoods of hundreds of millions will be affected by what is or is not done in urban centres with regard to climate change over the next decade. Urgent action is required to reduce greenhouse gas emissions if the worst consequences of climate change are to be avoided. Similarly, early interventions are required to ensure that urban societies and economies are able to cope with inevitable changes in climate that will occur even if emissions are sharply curbed now. The effects of climate change are already being felt in many places, and immediate action is required to manage these effectively. In addition, the long-term nature of infrastructure investment means that decisions taken *now* have implications that will last for several decades – and therefore they must allow for a changing climate.

Urban centres are key players both in the generation of greenhouse gases and in strategies to reduce greenhouse gas emissions, especially in reducing dependence on carbon-based fuels. Towns and cities also concentrate large proportions of those most at risk from the effects of climate change – and the enterprises that generate most of the world's production of goods and services. This is why cities and municipal governments must act to reduce not only greenhouse gas emissions, but also the vulnerability of urban residents

to the many direct and indirect impacts of climate change.

Vulnerability refers to the extent to which a system – be it a household, community, city, agricultural system, or ecosystem – is (un)able to cope with the consequences of climate change (see Glossary). *Adaptation* is defined by the Intergovernmental Panel on Climate Change (IPCC) as adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which either moderates detrimental effects or exploits beneficial opportunities (see Glossary). In other words, adaptation refers to preparations for the unavoidable consequences of climate change that are going to be felt in many urban centres.

As is well known, more than half of the world's population now live in urban areas that concentrate national economic power in all its dimensions, including manufacturing, services including banking and finance, trade and consumer demand. Together with rapid demographic and spatial expansion, this means that urban areas have a crucial role to play in the reduction of greenhouse gas emissions. As low- and middle-income countries have become more urbanised, there has been an increasing concentration of low-income urban residents occupying locations that are prone to flooding, landslides and other hazards. Conversely, the planning and building decisions that are taken now will have lasting effects in terms of their consequences for generating climate change; well-managed transportation systems and more efficient buildings will be essential to future reductions in greenhouse gas emissions. At the same time, the planning and urban development decisions made today will either increase or reduce a city's vulnerability to the impacts of climate change.

With cities already facing many challenges, can local governments in developing

countries afford to shift their political focus and inadequate financial resources to climate change? The answer is they *must* and they *can*. If they do not act *now*, the costs for future generations will be extremely difficult to shoulder; the Stern report on the economics of climate change concluded that unabated climate change could cost the world at least five per cent of its total production every year¹. However, the report went on to stress, addressing climate change should not be associated only with high costs, but also with the opportunities which the required adjustments can bring, and the benefits of strong, early action would considerably outweigh the costs. Indeed, many of the steps required to curb greenhouse gas emissions and reduce vulnerability generate significant co-benefits. Improved public transportation networks reduce carbon dioxide emissions from private motor vehicles, but can also help low-income residents move more readily around any given urban area. For example, *TransMilenio*, the bus rapid transit system deployed in Bogotá, Colombia, is meeting the needs of the 80 per cent of the city's population who are dependent on public transportation, including the 53 per cent who are defined as living in poverty². Lower reliance on private motor vehicles can also generate broader health benefits through reduced air pollution and increased physical activity³. An increasing number of innovative practices are emerging in cities to reduce energy consumption in buildings and construction: as most cities rely on fossil fuels for their energy generation, saving energy will reduce greenhouse gas emissions

1 Stern N (2007). *The Economics of Climate Change: the Stern Review*. Cambridge University Press, Cambridge.

2 Héron D (2006) *The TransMilenio Public Transportation System (Bogotá, Colombia)*. UNITAR/VEOLIA Environnement / UN-Habitat. Available online: http://www.sustainable-development.veolia.com/library/en/standalone/others/1767_Transmilenio-Bogota-ANG.pdf [accessed 31/3/09].

3 Bloomberg M, Aggarwala R (2008). 'Think Locally, Act Globally: how curbing global warming emissions can improve local public health' *American Journal of Preventative Medicine* 35(5): 414-423.

along with those energy costs that stand so prominently in municipal budgets.

With regard to climate change adaptation, many of the more important interventions require general improvements to the urban fabric, with associated benefits under the form of slum upgrading and the provision of water, sanitation, waste management,



The benefits of strong, early action would considerably outweigh the costs ... many of the steps required to curb greenhouse gas emissions and reduce vulnerability generate significant co-benefits.



drainage, and transportation. To date, very few climate change adaptation projects have explicitly included these broader social and environmental goals; conversely, very few urban sanitation projects have sought to address climate change.

Still, it is becoming self-evident, for instance, that when urban planning enables low-income communities to settle on land that is not exposed to flooding or landslide hazards, such planning does more than just enhance security of tenure, it also reduces vulnerability to climate risks. Similarly, where improvements to water supply and sanitation take into account increasingly uncertain rainfall patterns, water availability

can be extended to low-income households, with wide-ranging health and social benefits.

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1.2 EXPLAINING THE TOOLKIT

1.2.1 INTEGRATING CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT PLANNING

Planning for climate change involves assessing the risks and impacts from climate change, creating a strategic framework with which to address these, and developing specific interventions to build resilience and reduce vulnerability. While it is important to understand the climate change impacts as described in global, regional, national and in some cases localised models and scenarios, it is at least as important to understand local vulnerabilities based on local knowledge. Successful adaptation to climate change requires local knowledge, local competence, and local capacity within local governments. This highlights the need to involve individuals, households, and community and other non-governmental organisations with the knowledge and capacity to act.

In an urban context, addressing climate change at the local level is intricately associated with planning for sustainable urban development – i.e., an approach

that ensures that today's needs are met without jeopardising those of future generations. In other words, this type of urban development ensures sustainable resource consumption and environmental conservation whilst expanding basic services to all members of a given population. Similarly, planning for climate change should involve both managing greenhouse gas emissions and therefore the future risks at the scale of the planet, and developing adaptation strategies that ensure that more vulnerable members of society, vulnerable sectors and vulnerable eco-systems are not under threat from climate events. No community development can be sustainable if it ignores climate change. The poor are more vulnerable to climate change as they tend to live in hazard-prone areas and are more dependent on the environment for their livelihoods. Consequently, poverty reduction is a major component of enhanced climate resilience, not just of sustainable development. However, sustainability raises further concerns like sanitation, access to clean water, health and diminishing ecological resilience. It is, therefore, vital to explore the linkages between climate change and broader sustainability agendas, as well as to identify the overarching pathways that can build resilient communities through adaptation to climate change.

This tool provides local policy-makers and major stakeholders with a methodology to plan for climate change. These plans must address both mitigation (e.g., reducing the concentration of greenhouse gases in the atmosphere) and adaptation (responding to the impacts of climate change) [see Glossary]. If they are to be effective, local plans for climate change (both adaptation and mitigation) require the involvement of a variety of stakeholders and a specific focus on the most vulnerable groups. Local governments have a vital role to play in this process for two particular reasons: (1)

planning is part of their unique prerogative and mandate, and (2) theirs is a natural, central position when it comes to facilitating action by other local stakeholders and providing for synergies at the regional and national levels.

The planning methodology recommended in this tool is process-based, i.e., it is *vision-* as opposed to *function-*oriented. The objective is to help local stakeholders plan for climate change. More specifically, this report shows how to set out adaptation and mitigation strategies that can meet the needs of the various individuals, households and communities in specific conditions. The process-based toolkit presented in Section 2 focuses on four major stages of a climate change response: **gathering and analysing information; strategic planning; developing adaptation and mitigation projects; and monitoring**

and evaluation (Figure 2). As shown in the flowchart, some functions must be undertaken sequentially, while others can be carried out concurrently. In addition – and as explained in Section 2 – components of this process may already have been undertaken for other purposes. Rather than a rigid structure, the purpose is to provide a broad framework that can be adapted into an appropriate set of responses for a variety of towns and cities. Each of the four main stages requires several specific actions (Table 1), which are explained in Section 2.

1.2.2 MAINSTREAMING OR STAND-ALONE PLANS?

This toolkit assists local governments and local stakeholders in the development of local plans for climate change. What should such plans look like? Depending on local

Figure 2: **Developing Local Climate Change Plans – Flowchart Diagram**

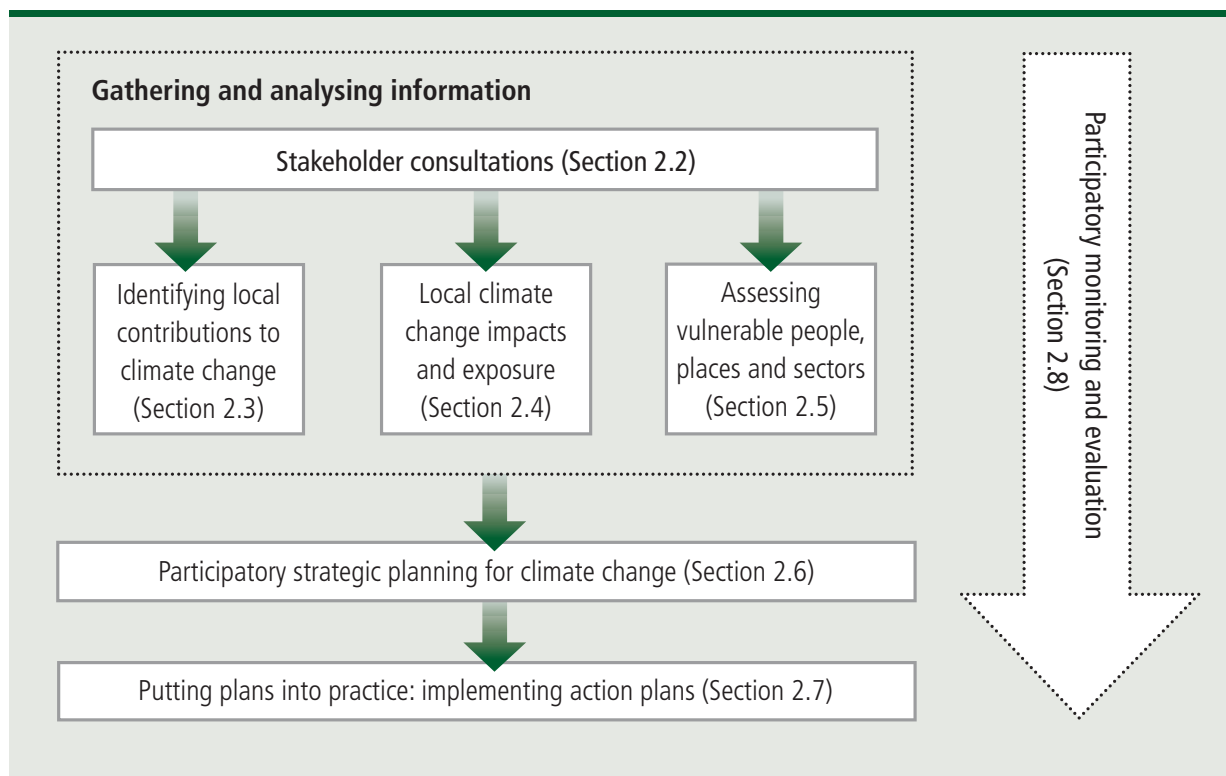


Table 1: Developing Local Climate Change Plans: A Process-Based Methodology

	Specific Functions
Setting the framework for local climate change plans	<ul style="list-style-type: none"> • Setting priorities • Generating support and commitment
Stakeholders, consultations and working groups	<ul style="list-style-type: none"> • City consultations • Formation of working groups
Identifying local contributions to climate change	<ul style="list-style-type: none"> • Measuring greenhouse gas emissions
Local climate change impacts and exposure	<ul style="list-style-type: none"> • Localising climate predictions • Identifying potential impacts
Assessing vulnerable places, people and sectors	<ul style="list-style-type: none"> • Vulnerability assessments for communities and economic sectors
Participatory strategic planning for climate change	<ul style="list-style-type: none"> • Mobilising stakeholders • Developing strategic plans for adaptation
Implementing action plans	<ul style="list-style-type: none"> • Developing implementable activities at different scales
Monitoring plans and projects	<ul style="list-style-type: none"> • An on-going process of monitoring and evaluation that takes changing needs into account

conditions, it can be quite suitable for a municipality to opt for stand-alone climate change plans, programmes, strategies or frameworks (Figure 3, Table 2). Such documents and the underlying processes can help focus collective attention on climate change. Stand-alone climate change plans can give more visibility to climate change issues as well as to responses, which will contribute to rallying citizens, the media, civil society, academia, the private sector and local and national government behind such responses. Stand-alone plans for climate change can also help generate external funding. For all the benefits of stand-alone plans, though, and since any climate change response is intricately linked to sustainable urban/local development, this tool advocates for mainstreaming climate change into existing policies and plans, including urban development and land-use plans.

Figure 3: Options for Local Climate Change Planning

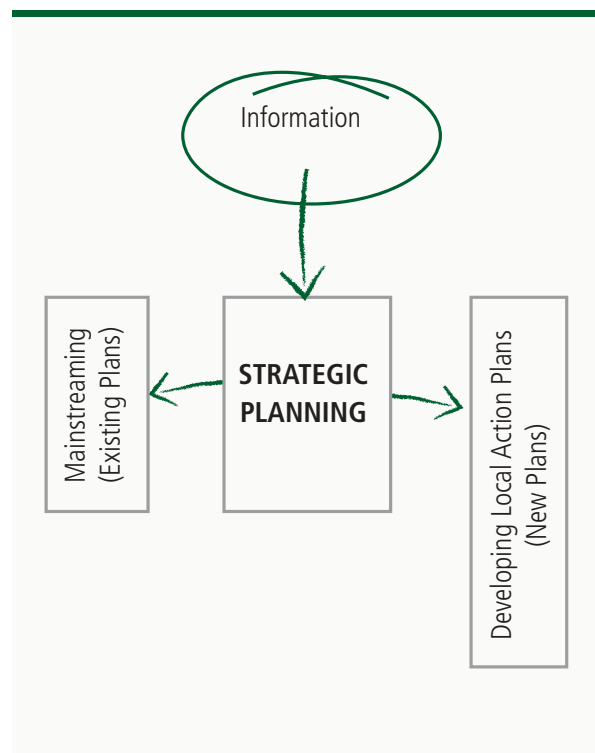


Table 2: **Comparing Stand-Alone and Mainstreaming into Existing Plans**

Reasons for stand-alone plans	Reasons for mainstreaming into existing plans
<ul style="list-style-type: none"> Some countries require local governments to develop local climate change plans 	<ul style="list-style-type: none"> If well executed, mainstreaming climate change objectives will fit in nicely into existing planning cycles, budgets and planning hierarchy
<ul style="list-style-type: none"> Local climate change plans are the logical extension of national plans 	<ul style="list-style-type: none"> Clear/existing responsibilities of plan implementation will be respected and institutionally anchored
<ul style="list-style-type: none"> Climate change adaptation/mitigation plans can provide an opportunity for a more comprehensive approach to sustainable development 	<ul style="list-style-type: none"> There can be a legal requirement for climate change to be integrated in development, land-use and other plans
<ul style="list-style-type: none"> Climate change plans are more flexible as they are not bound by planning cycles. They can also close gaps in existing plans 	<ul style="list-style-type: none"> Can come as a legal requirement or necessary response to sector-specific policies
<ul style="list-style-type: none"> Climate change plans involve the much-needed multi-sector approach 	<ul style="list-style-type: none"> Will ensure that climate change is treated as a cross-sectoral issue and not as an isolated issue – avoids creation of a climate change ‘silo’
<ul style="list-style-type: none"> Climate change plans can increase the visibility of these specific issues and may attract funding 	
<ul style="list-style-type: none"> Plan implementation can be ascribed to a well-trained multi-sector team, fully dedicated to climate change 	
<ul style="list-style-type: none"> Climate change plans can provide for a comprehensive monitoring and evaluation framework 	
<ul style="list-style-type: none"> Climate change plans can improve coordination and avoid maladaptation* 	

* Maladaptation refers to adaptation options that, may (1) increase emissions of greenhouse gases more than alternative options would, (2) burden in particular the most vulnerable, (3) have high opportunity costs, (4) reduce adaptation incentives in the future, and (5) reduce options for future generations (Saffron O’Neill, Jon Barnett, 2010)

The conclusion is that a number of factors weigh in favour either of stand-alone climate change plans (frameworks, programmes, strategies) or of mainstreaming, suggesting there is no conclusive reason to opt for one over the other. In fact, in the short term a climate change action plan may be ideal when it comes to rallying stakeholders. The next stage in the local climate change planning process, therefore, may be careful identification of existing local government plans and evaluation of the degree they are being implemented. Such plans may in fact already be addressing various aspects

of climate change risk – for example, as in the case of disaster management plans, or in areas where changes are required to take climate change risks into account. The methodology in this document focuses primarily on the planning process and only touches on the design of stand-alone plans or how to mainstream. The remainder of this section provides the background to the issues, explaining the concepts of adaptation and mitigation, describing the main risks to cities from climate change and variability, and assessing patterns of vulnerability to these risks.

1.3 LOCAL MITIGATION AND ADAPTATION

1.3.1 MITIGATION

As part of worldwide efforts to identify greenhouse gas emissions and to set targets for reduction, the United Nations Framework Convention on Climate Change (UNFCCC) requires all member states to assess anthropogenic (man-made) emission volumes on a regular basis. For this purpose, the Intergovernmental Panel on Climate Change (IPCC) provides a detailed methodology. The framework takes in the four main sources of emissions: energy; industrial processes and product use; agriculture, forestry and other land uses; and waste. However, there are no specific international frameworks or guidelines requiring measurement of urban emissions. Still, in recent years municipal authorities around the world have begun to commission inventories of this type to measure the overall carbon footprint [see Glossary] of urban activities, promote awareness of the need for climate change mitigation, and provide benchmarks against which reductions in emissions can be measured.

Developing a system that facilitates cross-city comparisons is fraught with difficulties particularly because of boundary issues (related to identifying the precise spatial area covered by any given 'city') and issues of inclusion (for example, related to airports that are used by city-dwellers and residents from surrounding areas). UN-Habitat with the World Bank and UNEP are among the organizations that have developed a standardized approach of measuring greenhouse gases on the city level. Such a standardization allows the development of a Greenhouse Gas Index for inter-city comparisons. If the limitations are taken into account, urban greenhouse gas emissions inventories can be used as a fruitful

benchmark against which future trends can be assessed: indeed, the *Cities for Climate Protection* campaign, coordinated by ICLEI (Local Governments for Sustainability), identifies conducting a baseline emissions inventory and forecast as the first milestone for reducing greenhouse gas emissions.

Decisions made and actions taken in cities can contribute to climate change mitigation in a wide variety of ways. In this respect, it is up to local authorities to take the lead, regulating for more energy-efficient buildings and vehicles, or undertaking detailed audits of their own carbon footprints. The effect can be even wider when urban governments shape the choices and behaviours of a much broader range of stakeholders. Incentives of various kinds can encourage energy-efficiency among households and businesses alike – through insulation, electricity-saving devices and deployment of low-carbon technologies (e.g., solar water-heating). Improvements in public transportation systems can reduce the use of private motor vehicles. These changes in day-to-day functions can also generate co-benefits, such as energy efficiency, reduced air pollution, and the potential for 'green' job creation.

Further information on the role of cities in climate change mitigation can be accessed from:

UNEP, UN-Habitat and the World Bank, 'International Standards for Determining Greenhouse Gas Emissions for Cities': http://www.unep.org/urban_environment/PDFs/InternationalStd-GHG.pdf

ICLEI Cities for Climate Protection Campaign: <http://www.iclei.org/index.php?id=10829>

Carbon Footprint Methodology (for household emission assessment): <http://www.carbonfootprint.com/calculatorfaqs.html>

1.3.2 ADAPTATION

For many cities, particularly those in low- and middle-income countries, adaptation to climate change is a more pressing concern than mitigation (i.e., reducing carbon footprints). These urban areas are hosts to more than a third of the world's total population, nearly three-quarters of the urban population and the bulk of mega-cities. They are also hosts to ever larger proportions of the population and economic sectors most at risk from extreme weather events and sea-level rise.

As far as the need for adaptation is concerned, low-income groups within these cities will be particularly vulnerable for five main reasons: (1) they are affected by a greater exposure to hazards, (2) there is a lack of hazard-reducing infrastructure, (3) there is less adaptive capacity, (4) there is less provision for government assistance in the event of a disaster, and (5) legal and financial protection is weaker. As they live in, or join, undeveloped and increasingly cramped urban areas, low-income urban residents frequently have little alternative but to settle in land sites that are at high risk from climate change and extreme weather events.

They lack the infrastructure and services, including water, sanitation and drainage, which can reduce risks when extreme events occur. Their houses are usually built incrementally on inadequate foundations and rarely comply with formal safety or other standards or regulations. In addition, low-income urban residents are frequently without the knowledge and capacity to take risk reduction measures or to evacuate in the face of an impending threat. Children and the elderly are particularly vulnerable: their specific needs frequently require additional attention, and their morbidity/mortality rates in the wake of disaster events are usually higher than for the population as a whole.

When it comes to meeting the needs for climate change adaptation, cities in the developing world need (1) adequate capital spending on climate change-resilient infrastructure and (2) effective urban governance, with the associated enabling environment for safe shelter and sustainable livelihoods. These efforts put local authorities in a good position to support low-income groups in the face of the challenges of climate change. Where local authorities recognise and address the needs of the poor – for example, by granting access to risk-free land – then low-income groups become much more resilient. In contrast, ignoring this group or treating them as part of “the problem” tends to make things even worse, perpetuating inequality and the vulnerabilities described above.

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) makes four pointed observations regarding local climate change plans⁴. First, the experts express “very high confidence” that the “climate-change vulnerabilities of industry, settlement and society are mainly related to extreme weather events rather than to gradual climate change”. This means that planning for climate change ought to take particular notice of past extreme weather events and the capacities of individuals, households, communities, and cities to deal with these. Of course, climate change cannot but add to uncertainty – still the basic principles for responding to extreme events will remain the same.

Second, IPCC experts are “very highly” confident that that “aside from major extreme events and thresholds, climate

4 Wilbanks T, Romero Lankao P, Bao M, Berkhout F, Cairncross S, Ceron J-P, Kapshe M, Muir-Wood R, Zapata-Marti R (2007). 'Industry, Settlement and Society' in Parry M, Canziani O, Palutikof J, van der Linden P, Hanson C (eds) *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, pp. 357-390.

change is seldom the main factor in considering stresses on the sustainability of industry, settlements and society". With this in mind, planning for climate change must take into account a variety of other sources of social, economic, political and environmental change, building in a keen awareness of any interactions between these distinct factors. Consequently, urban climate change planning must be a comprehensive and forward-looking exercise built on the principles of sustainable development planning. Climate change cannot be addressed in a vacuum, but rather must be considered alongside the multiple social, economic and environmental processes and challenges facing urban areas.

Third, the IPCC is "highly confident" that "vulnerabilities of industry, infrastructures, settlements and society to climate change are generally greater in certain high-risk locations". Therefore, settlements located in these "high-risk" locations call for specific action in response to the likely challenges of climate change.

Fourth, experts are "highly confident" that "poor communities can be especially vulnerable, in particular those concentrated in relatively high-risk areas". Therefore, when developing local climate change plans special emphasis must be placed on the vulnerabilities and capacities of poor communities if the effects of climate change are to be managed effectively.

Rather than addressing mitigation and adaptation separately, however, there is great scope for an integrated planning approach that takes both types of responses into account. As an ever-increasing proportion of the world population lives in the urban areas of low- and middle-income countries, it is important that urban planning and development occur in a climate-friendly manner, rather than

reproducing the unsustainable and carbon-intensive pathways so typical of the highly industrialised countries as they underwent rapid economic growth. Many high-income nations are at the forefront of developing new 'green' or 'climate-friendly' technologies, but these are frequently capital-intensive or technologically complex. However, there are clear opportunities for low- and middle-income nations to position themselves as strategic leaders in low-cost, low-carbon solutions to the world's energy needs.

In addition, responses to climate change can simultaneously address both adaptation and mitigation. For example, a Clean Development Mechanism (CDM) project in Dhaka, Bangladesh uses organic waste to produce compost, thereby reducing methane emissions as organic waste is diverted from landfills (where anaerobic processes generate higher volumes of methane) to a composting plant (where aerobic processes occur). The compost produced is then used in rural Bangladesh to increase the moisture retention and fertility of soil, effectively reducing vulnerability to drought and increasing the carbon sequestration rates of crops. Projects of this type go to show how addressing mitigation and adaptation in tandem can yield greater benefits.

1.4 MAIN RISKS TO CITIES FROM CLIMATE CHANGE

History has many instances to offer where urban populations, enterprises and governments have adjusted to unfavourable or even extreme environments. This illustrates that adaptive capacities are substantial, as long as the economic, human and knowledge resources are there. However, many urban centres today are at risk from changes in means, in extremes and/or in exposure as a result of anthropogenic

Table 3: The Impacts of Climate Change on Urban Areas*

Change in climate	Potential impact on urban areas
Changes in means (averages)	
Temperature	<ul style="list-style-type: none"> • Increased energy demand for heating/cooling • Worsening of air quality • Urban 'heat islands' will further exaggerate temperatures
Precipitation	<ul style="list-style-type: none"> • Increased risk of flooding • Increased risk of landslides • Distress migration from rural areas as a result of drought or floods • Interruption of food supply networks
Sea-level rise	<ul style="list-style-type: none"> • Coastal flooding • Reduced income from agriculture and tourism • Salinization of water sources
Changes in extremes	
Extreme rainfall / Tropical cyclones	<ul style="list-style-type: none"> • More intense flooding • Higher risk of landslides • Disruption to livelihoods and urban economies • Damage to homes and businesses • Damage to infrastructure
Drought	<ul style="list-style-type: none"> • Water shortages • Higher food prices • Disruption of hydro-electric output • Distress migration from rural areas
Heat- or cold-waves	<ul style="list-style-type: none"> • Short-term increase in energy demands for heating/cooling
Abrupt climate change	<ul style="list-style-type: none"> • Potential and significant impacts from rapid and extreme sea-level rise • Potential and significant impacts from rapid and extreme temperature change
Changes in exposure	
Population movements	<ul style="list-style-type: none"> • Movements from stressed rural and coastal habitats
Biological changes	<ul style="list-style-type: none"> • Extended vector habitats with impacts on health and agriculture • More favourable breeding grounds for pathogens • Loss of biodiversity
<small>* Adapted from Wilbanks T, Romero Lankao P, Bao M, Berkhout F, Cairncross S, Ceron J-P, Kapshe M, Muir-Wood R, Zapata-Marti R (2007). 'Industry, Settlement and Society' in Parry M, Canziani O, Palutikof J, van der Linden P, Hanson C (eds) Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, pages 357-390.</small>	

climate change (Table 3). These centres are hosts to large and growing proportions of the people who are at most risk from climate change, while at the same time facing a

variety of risks associated with sea-level rise, coastal flooding, more irregular and intense precipitation (rain- and snow-fall), riverine flooding, droughts, reduced water

availability from glacial run-off, water-supply disruption, more frequent and more intense extreme weather events, and expansion of the habitats of disease vectors such as those that transmit malaria and dengue.

1.4.1 FLOODING

Climate change has the potential to increase flooding risks in cities in three distinct ways: from the sea (higher sea levels and storm surges); from rainfall (either higher volumes or longer wet seasons); and from increased river flows (for example, due to increased glacial melt). Heavy precipitation events are very likely to increase in frequency and will add to flood risks. This in turn will highlight the growing evidence of increased runoff and earlier spring-peak discharges in many glacier- and snow-fed rivers. In addition to flood hazard, higher average and more extreme rainfall events associated with climate change will also increase the risk of landslides.

Water abstraction and treatment works are frequently located beside rivers and are often the first items of infrastructure to be affected by floods. Electrical switchgear and pump motors are particularly at risk. In severe riverine floods with high flow velocities, pipelines can be damaged⁵. Sanitation can also be affected: flooding often damages pit latrines or septic tanks, and floodwaters may become contaminated by the overflow. During water shortages toilets linked to sewers also become unusable. Right now most urban centres in sub-Saharan Africa and Asia have no sewers – or if they do, these serve only a very small proportion of the population. The importance of sanitation here is that infrastructure (or lack thereof) is a key determinant of urban floodwater contamination, with faecal material carrying

a substantial threat of disease⁶. Every year, diarrhoea kills almost two million children around the world⁷, this number is likely to increase if higher temperatures result in increasing levels of bacteria. Declining water availability reduces standards of sanitation.

Urban areas are always exposed to some risk of flooding when rainfall occurs. Buildings, roads, infrastructure and other paved areas prevent rainfall from filtrating into the soil, which adds to more runoff. Heavy and/or prolonged rainfall produces very large volumes of surface water in any city, which can easily overwhelm drainage systems. In well-planned and well-managed cities, this is rarely a problem because adequate provision for storm and surface drainage (usually a local government responsibility) is built into the urban fabric; on top of this come complementary measures to protect against flooding – for instance, the use of parks and other open space areas to accommodate floodwaters safely from unusually serious storms. In most cities, there is also scope to increase floodwater management capacity through local governments' land-use management and incremental adjustments to drainage systems.

However, things are different in cities where proper governance or public investment capacity are lacking. Most residential areas do not feature any drainage system and instead rely on natural channels that, more often than not, find themselves obstructed by ill-planned buildings or infrastructure. In most of those urban centres significant proportions of the population do not benefit from solid-waste collection services (almost invariably a municipal function), and

5 Wilbanks et al., (2007), op. cit.

6 Ahern M, Kovats S, Wilkinson P, Few R, and Matthies F (2005). 'Global health impacts of floods: epidemiologic evidence' *Epidemiologic Reviews* 27: 36-46.

7 WaterAid (2009). *Fatal neglect: how health systems are failing to comprehensively address child mortality*. Report. Available online: http://www.wateraid.org/documents/plugin_documents/wateraid_fatal_neglect.pdf. Accessed 26 August 2009.

where solid-waste management remains inadequate, garbage can quickly clog drains, leading to localised flooding with even light rainfall. Drainage and flood protection seem to be inadequate in urban centres in Africa, Asia, and Latin America and the Caribbean, and there are an increased numbers of deaths and injuries from flooding in these urban areas.

1.4.2 STORMS, SEA-LEVEL RISE AND COASTAL URBAN POPULATIONS

It is difficult to estimate precisely how many people are at risk from the increased frequency and intensity of extreme-weather events and the sea-level rise that come with climate change. Low-elevation coastal zones – the continuous areas along the coast that sit less than 10 metres above sea level – represent two per cent of the world’s land area but are hosts to 10 per cent of its total population (i.e., over 600 million) and 13 per cent of its urban population (around 360 million). Almost two-thirds of the world’s cities with populations over five million fall in this type of area, at least partly. In low- and lower-middle-income countries, the proportion of the urban population settled in coastal zones is higher than in the richer countries. In least developed countries, coastal zones on average are hosts to nearly twice as many urban residents compared with high-income nations⁸. Obviously, only a proportion of those within those zones are at risk from the sea-level rise that is likely within the next 30–50 years. The IPCC Fourth Assessment report estimated that sea levels could be expected to rise between 18cm to 59cm by the end of

the 21st century; this will certainly add to the number of people flooded by storm surges. One estimate has suggested that at the moment, 10 million people are affected by coastal flooding every year and that the numbers are bound to increase whatever the scenarios for climate change⁹. However, the Fourth Assessment Report did not include the potential effect of the melting of the polar ice-caps, with more recent estimates suggesting that this would contribute significantly more to overall sea-level rise.

There is some evidence that hurricane-force winds are to become more frequent and intense, with possible shifts or expansions in affected areas. Highly urbanised coasts most at risk include Vietnam in Asia; Gujarat and Orissa in India; and much of the Caribbean, as well as Mexico’s Caribbean coast and Central America. High concentrations of populations, especially on the eastern coasts of India and Bangladesh, have led to extremely high vulnerability in this region, with potential for very substantial loss of life and property.

1.4.3 CONSTRAINTS ON WATER SUPPLIES AND OTHER CRUCIAL NATURAL RESOURCES

The IPCC Working Group II noted (with “high confidence”) that, in Africa, “by 2020, between 75 and 250 million people are projected to be exposed to an increase of water stress due to climate change”¹⁰. Any reduction in the availability of freshwater resources caused by climate change would be particularly challenging for those who live in areas already suffering from water

8 McGranahan G, Balk D, Anderson B (2007). ‘The rising tide: assessing the risks of climate change and human settlements in low-elevation coastal zones’ *Environment and Urbanization* 19(1): 17-37.

9 Nicholls R (2004). ‘Coastal flooding and wetland loss in the 21st century: changes under the SRES climate and socio-economic scenarios’ *Global Environmental Change* 14(1): 69–86.

10 IPCC (2007) op.cit.: p8

scarcity or stress – with poorer groups likely to be most affected.

Elsewhere, “freshwater availability in Central, South, East and South-east Asia, particularly in large river basins, is projected to decrease due to climate change which, along with population growth and increasing demands arising from higher standards of living could adversely affect more than a billion people by the 2050s.”

Across Africa, prolonged droughts have resulted in water shortages, and associated hydroelectric generation shortfalls. In Mali, accessing water remains a widespread challenge across the capital city of Bamako; although 90 per cent of households have their own wells, water availability is declining as groundwater levels have fallen. Across the continent in Kenya, protracted drought in 2009 led to frequent and prolonged water cuts, leaving many households without electricity for three days a week – the main victims being low-income residents and small businesses as they cannot afford generators or water tanks. In Zimbabwe, the Kariba hydropower plant serving the capital Harare has been affected by inadequate water supplies, resulting in load-shedding by power utilities. Meanwhile, Lake Victoria – at nearly 69,000 sq km Africa’s largest lake, ringed by Kenya, Tanzania and Uganda – has dropped nearly a metre since 2005, curtailing hydroelectric generation at Nalubaale and Kiira power stations near Kampala, Uganda. Many hydraulic and other structures along the shoreline, including docking facilities at Port Bell near Kampala, now need costly adjustments if they are not to become altogether obsolete.

Many cities and their water catchments are expected to receive less rainfall (and already experience less abundant freshwater sources), a significant challenge for growing

cities as well as the existing large ones. At least 14 African countries are already facing water stress or scarcity and many more are likely to join the list over the next decade or two¹¹. Regardless of incipient or impending climate change, water resources today remain poorly managed in Africa, where around half the urban population already lacks adequate provision, including sanitation, although the situation has far more to do with inadequate governance than absolute scarcity. Africa’s water supply systems are frequently out-dated or poorly maintained, and low-income settlements are poorly served as a result, if at all. As a consequence, the poorest members of society are forced to pay inflated prices to water vendors.

1.4.4 HIGHER TEMPERATURES AND HEAT WAVES

Most cities in Africa, Asia, Latin America and the Caribbean must expect more frequent heat waves in the future. Larger, higher-density cities face the additional problem of urban “heat islands” where temperatures can be several degrees higher than in surrounding areas. The frequency and severity of heat-stress events in cities is bound to increase, affecting the health, labour productivity and leisure activities of urban populations. The precise impacts of heat stress in Africa or Latin America are not well known, but research in North America, Asia and Europe has found that heat waves are associated with marked short-term increases in mortality¹². On top of this come economic effects such as the additional costs of climate-control (air conditioning) in buildings, and environmental effects such as smog, increased concentrations of

11 Muller M (2007). ‘Adapting to climate change: water management for urban resilience’ *Environment and Urbanization* 19(1): 99-113.

12 Confalonieri U et al., op. cit., 391-431.

some air pollutants and the deterioration of green spaces, together with higher volumes of greenhouse gases where additional demand for cooling is met with electricity generated from fossil fuels. This is of particular importance for Asia and Latin America, which host most of the cities with the highest levels of air pollution.

1.4.5 OTHER HEALTH RISKS RELATED TO CLIMATE CHANGE

Climate change is likely to result in a variety of health impacts – particularly for low-income urban residents (Table 4). The greatest concerns have to do with changes

in freshwater resources and food supplies, as well as with more frequent or more severe extreme weather events such as floods and droughts. The more or less indirect effects will include higher incidences of diarrhoea and altered spatial distribution of some infectious disease vectors. For instance, warmer average temperatures permit an expansion of the areas where many “tropical” diseases can occur. Such expansion is likely in the breeding and living areas of mosquitoes carrying malaria, dengue fever and filariasis¹³. On top of this, extreme weather events can also generate new health hazards and cause disruption to public health services, leading to ever-increased disease incidence.

¹³ IPCC (2007), *op. cit.*

Table 4: **The Weather, Climate and Urban Health***

Health outcome	Known effects of weather and climate
Heat stress	<ul style="list-style-type: none"> Deaths from cardio-respiratory disease increase with high and low temperatures heat related illness and death due to heat waves
Air pollution-related mortality and morbidity	<ul style="list-style-type: none"> Weather affects air pollutant concentrations Weather affects distribution, seasonality and production of aeroallergens
Health impacts of weather disasters	<ul style="list-style-type: none"> Floods, landslides and windstorms have direct effects (deaths and injuries) and indirect ones (infectious disease, loss of food supplies, long-term psychological morbidity)
Mosquito- and tick-borne diseases (e.g., malaria, dengue)	<ul style="list-style-type: none"> Higher temperatures reduce the development period of pathogens in vectors and increase potential transmission to humans Vector species require specific climatic conditions (temperature, humidity) to be sufficiently abundant to maintain transmission
Water-/food-borne diseases	<ul style="list-style-type: none"> Survival of major bacterial pathogens is related to temperature Extreme rainfall can affect the transport of disease organisms into the water supply; outbreaks of water-borne disease have been associated with contamination caused by heavy rainfall and flooding in relation with inadequate sanitation More frequent drought conditions may affect water availability and quality (chemical and microbiological load) due to extremely low flows

* Source: Kovats S, Akhtar R (2008). 'Climate, climate change and human health in Asian cities' *Environment and Urbanization* 20(1): 165-175.

1.5 THE DISTRIBUTION OF VULNERABILITY

Vulnerability to climate change is distributed unevenly around the world. According to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change:

Vulnerability to climate change is distributed unevenly not just across but *within* cities as well. In general, vulnerability to most environmental hazards in urban areas (including extreme weather events) is strongly associated with poverty. The basic causal link is a double one: lower-income groups are more physically exposed to hazards, and their capacity to reduce this exposure or cope with the consequences is limited. However, one must never forget that this vulnerability is also directly linked to the quality of local governance: what can dramatically reduce the differentials in environmental risks between low-income and wealthier groups is none other than universal provision of basic infrastructure (piped water, proper sanitation, adequate drainage, safe housing sites) and services (waste collection, health care, education, emergency services).

1.5.1 VULNERABILITY AND URBAN POVERTY

It is well known and well documented that, in most cities, the urban poor live in areas most at risk from extreme weather – for instance, on floodplains or other areas at high risk of flooding, or unstable slopes – and lacking adequate provision of safe water¹⁴. In addition, in most cities difficult relationships prevail between the poor and those very local governments

that are meant to reduce these risks. This is typically the case for two main reasons. First, most of the urban poor live in informal settlements (including many on illegally occupied land) and owe their subsistence to the informal economy (therefore, outside formal rules and regulations). Second, “anti-poor” attitudes and misperceptions tend to persist among government officials and ruling elites. For instance, officials and politicians often assume that those living in informal settlements are unemployed, when in fact they work long hours in the informal economy; or that they are recent migrants, when many have actually been working and living (if not born in the first place) in the urban centre; or that migrants (rural or foreign) would have been better off if they had not moved in, when research shows that migration flows come as logical responses to changing patterns of economic opportunity, which for some are caused by incipient climate change.

Another factor making large segments of the urban poor particularly vulnerable is that public authorities may clear informal settlements on environmental grounds (such as exposure to flooding), with very inadequate if any provision of alternative adequate accommodation. Even those urban authorities among the more responsible and accountable find this a challenge, because low-income groups need central locations for income-earning opportunities, making it difficult to move them from hazardous to appropriate alternative sites.

In general, in any urban area, the people most at risk from climate change are those who are:

- **Least able to avoid the direct or indirect impacts** (e.g. by having good-quality homes and living in settlements with drainage systems that prevent flooding, by moving to places with less risk or by

¹⁴ Hardoy J, Mitlin D, Satterthwaite, D (2001). *Environmental Problems in an Urbanizing World: Finding Solutions for Cities in Africa, Asia and Latin America*. Earthscan, London.



Xikhelene Market, Maputo © UN-Habitat/Acamo Maquinasse

changing jobs if climate-change threatens their livelihoods);

- **Likely to be most affected** (for instance, infants and older persons who are less able to cope with heat waves or floods);
- **Least able to cope** with illness or injury, or with the loss of income, livelihood or assets caused by climate change impacts.

Lower-income groups are hardest hit by this combination of greater exposure to hazards (a high proportion live in makeshift housing on unsafe sites), lack of hazard-removing infrastructure and less capacity to cope (e.g.

lack of assets and insurance), less adaptive capacity, less government support to help them cope, and less legal protection. The poor also have far less scope to move to less dangerous sites; indeed, in the more dynamic cities, the more dangerous sites are often the only places where lower-income groups can either find affordable housing or can build their own homes¹⁵.

Better-off individuals and households are in a better position to reduce risks, with safer housing, a choice of safer jobs or locations to live in, assets that can be called on in

¹⁵ Dodman D, Satterthwaite D (2008). 'Institutional Capacity, Climate Change Adaptation and the Urban Poor' *IDS Bulletin* 39(4): 67-74; Hardoy J, Pandiella G (2009) 'Urban poverty and vulnerability to climate change in Latin America' *Environment and Urbanization* 21(1): 203-224.



Successful adaptation to climate change requires local knowledge, local competence, and local capacity within local governments ... No community development can be sustainable if it ignores climate change.



emergencies and wealth protection through life and property insurance. Good urban governance almost by definition should reduce risk for the whole population, regardless of differences in risk exposure across social segments; however, it is typical of better-off groups not just to wield more influence over public expenditures, but also to reap the bulk of the benefits from government spending on infrastructure and services. Where public authorities fail to provide necessary infrastructure, and at a difference with the poor, those better-off can afford to secure alternatives: developing their own water, sanitation and power supply systems, or moving to private developments that provide these (including gated communities).

1.5.2 VULNERABILITY AND GENDER

Many gender-related factors contribute to vulnerability to climate change. In recent years, it has been recognised that the issue involves more than merely an additional

burden on women (although this is often the case); rather, research has shown that the effects of climate change are felt differentially according to a variety of gender characteristics.

The fact is that poor women do indeed face many gender-specific barriers that limit their ability to cope with, and adapt to, changes in the climate. It is already well-documented that women and girls are more likely to die as a result of extreme events; and future climate change will also affect women in specific ways – for example as a result of health problems generated by the urban heat island and shortages of clean drinking water. This vulnerability arises from several underlying factors. Women and girls make up a disproportionate number of the “poor and marginalised”, and have more limited access to resources than men. As a result, they are finding it more of a challenge to adapt to the existing or predicted impacts of climate change; the reverse aspect of this lack of access is that women and girls are unable to contribute their unique hands-on knowledge and insights to adaptation and mitigation efforts¹⁶. This situation is compounded by social and cultural expectations about the role of women in relation to the division of tasks, livelihoods and decision-making¹⁷. In Bangladesh, for example, research has found that women and girls are less likely to leave their homes during floods, due to cultural constraints on female mobility.

This is not to overlook the fact that men, too, can be exposed to additional risks because of the gender divide. It can be argued that the recent deaths of many young African men trying to reach Europe by boat can be partially attributed to climate

16 Demetriades J, Esplen E (2008). ‘The Gender Dimensions of Poverty and Climate Change Adaptation’ *IDS Bulletin* 39(4): 24-31.

17 Terry G (2009). ‘No climate justice without gender justice: an overview of the issues’ *Gender and Development* 17(1): 5-18.

stress on their livelihoods¹⁸. And following Hurricane Mitch in Central America in 1998, male mortality soared, apparently because traditional male behaviour patterns are more prone to risk-taking. In addition, the consequences of extreme events frequently affect gender relations, as relief, coping and recovery may lead to increased tension between women and men in the household and the community¹⁹.

1.5.3 VULNERABILITY AND AGE

Climate change also stands to have differential impacts across different age groups, particularly the very young and elderly people. Of the many conditions the prevalence of which is expected to rise with climate change – malnutrition, diarrhoea and malaria – mainly affect younger age groups in low- and middle-income countries. A paper published in the medical journal *The Lancet* has concluded that “the total burden of disease due to climate change appears to be borne mainly by children in developing countries”²⁰. The effects of climate change on children will go beyond the physical: the shock and distress of extreme events can be profoundly debilitating, too. In addition, challenges related to climate change could also impair children’s ability to learn and develop emotionally, as a result of both physical impacts and the erosion of social and physical environments²¹.

It has also been observed that elderly people are more severely affected by heat waves – which are expected to become

more frequent and severe as a result of climate change. The European heat wave of 2003 led to substantial excess deaths in France and the United Kingdom. Much of this excess mortality was related to cardiovascular, cerebrovascular and respiratory causes and was concentrated in elderly people²². Therefore, planning for adaptation to climate change must take in the special needs of both the very young and the elderly.

1.6 BUILDING RESILIENCE

Building resilience lies at the core of any climate change adaptation effort. In other words, a local authority preparing for climate change must build the resilience of a city as a whole; this includes infrastructure, the various sectors that are affected by climate change, and, of course that of the more vulnerable locations and residents. The IPCC Fourth Assessment Report defines resilience as “[t]he 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”²³. Resilience is best understood as a process that makes it possible not only to cope with added shock and stress, but also to addressing the myriad challenges that constrain lives and livelihoods, facilitating more general improvements to living conditions. Therefore, in terms of process, resilience must take in the economic, social, psychological, physical and environmental factors that humans need to survive and thrive²⁴.

Many local authorities lack the scientific or financial capacity to conduct detailed analyses of the effects of climate change within their

18 Terry (2009), *op. cit.*

19 Nelson V, Meadows K, Cannon T, Morton J, Martin A (2002). ‘Uncertain predictions, invisible impacts, and the need to mainstream gender in climate change adaptations’ in Masika R (ed) *Gender, development and climate change*. Oxford, Oxfam.

20 Haines A, Kovats R, Campbell-Lendrum D, Corvalan C (2006). ‘Climate change and human health: impacts, vulnerability, and mitigation’ *The Lancet* 367(9528): 2101-2109.

21 Bartlett S (2008) ‘Climate change and urban children: impacts and implications for adaptation in low- and middle-income countries’ *Environment and Urbanization* 20(2): 501-519.

22 (Haines et al. 2006)

23 IPCC (2007), *op. cit.*: p880.

24 Dodman D, Ayers J, Huq S (2009). ‘Building Resilience’ in Worldwatch Institute, *Into a Warming World: State of the World 2009*. New York, Worldwatch Institute, pp 75-77.

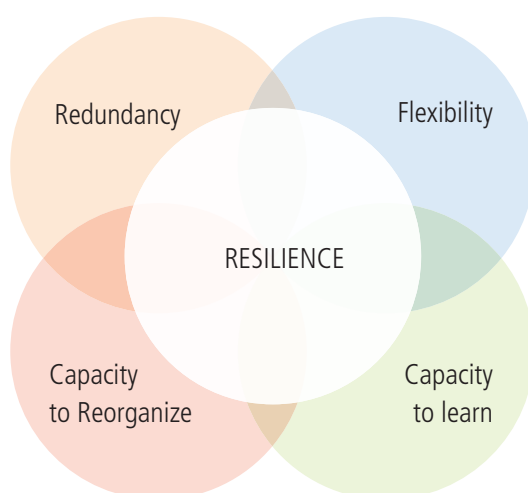
purviews. Even where they are able to do this, they are faced with the substantial degrees of uncertainty associated with lack of knowledge about future greenhouse gas emissions, their prospective effects on the

global climate, and the way this will affect local conditions. This is why it is important to take a broader, integrated approach in the face of climate change, rather than depend on anticipating specific hazards.

Resilience as a Response to Climate Change*

Resilient towns and cities are able to withstand a variety of challenges. Together with improved responses to the challenge of climate change, enhanced resilience generates a wide range of additional advantages. The Resilience Alliance and the Asian Cities Climate Change Resilience Network suggest that urban resilience involves the following four components:

- **Redundancy:** When one system is disrupted, another one can provide similar services. For example, if individuals are trained in basic health and emergency responses, they are able to provide immediate support if transportation and communication systems are disrupted following an extreme event.
- **Flexibility:** The failure of a single system causes a minimal impact on other systems. For example, a city with a diversified economic base will avoid catastrophic failure if a single industry fails due to economic change or environmental disaster.
- **Capacity to reorganise:** Climate change will result in changing conditions – and resilient cities are able to introduce new structures, organisations and land-use measures in response to this.
- **Capacity to learn:** This ensures that future decisions are made on the basis of relevant information and appropriate anticipations.



* Source: Resilience Alliance / Asian Cities Climate Change Resilience Network.



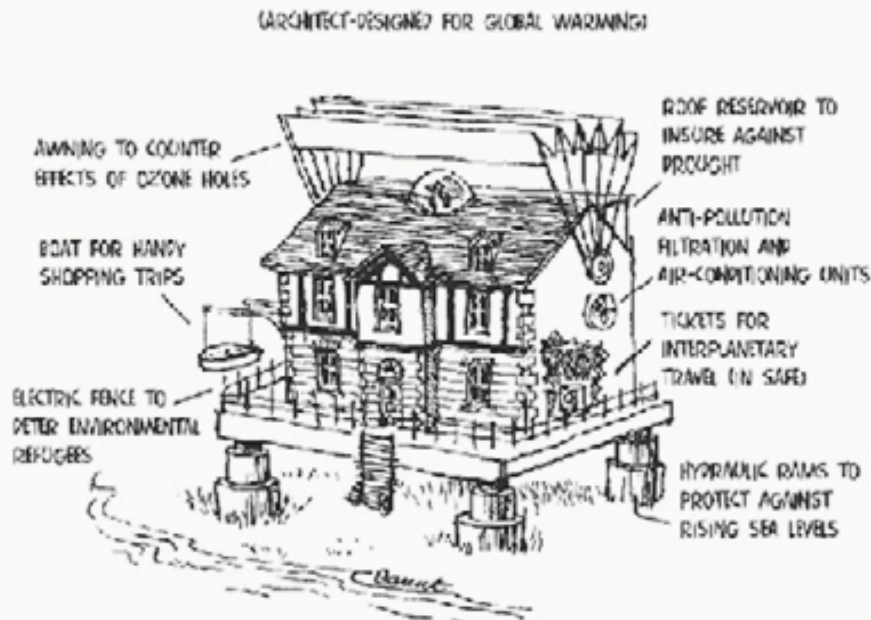
Reconstruction of the coastal area, Maputo © UN-Habitat/Ricardo Rangel

Many aspects of resilience are closely associated with a holistic approach to development. Those households with access to adequate food, clean water, health care and education will inevitably be better prepared to deal with a variety of shocks and stresses, including those caused by climate change. Communities and cities that are served by appropriate infrastructure – particularly water, sanitation and drainage – will also be more resilient to these shocks. Indeed, one of the most

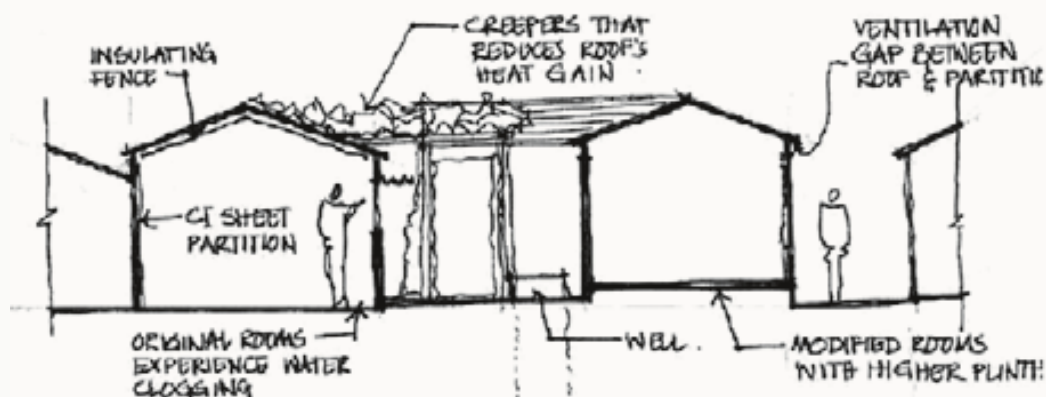
significant reasons that poor people in less developed countries are more at risk from climate change is that they are inadequately served by the basic utilities that are taken for granted in more affluent (i.e., non-slum) locations. This goes to show that building resilience is closely related to broader urban development strategies. However, local climate change plans must specifically consider the additional degrees of stress imposed by climate change.

Figure 4: **Towards Resilient Housing?***

Responses to climate change are often viewed as requiring expensive or complex new technology. The cartoon below is obviously a caricature – yet various official reports have suggested that the cost of adjusting houses in southern England, for instance, to adapt internal temperatures in a warmer climate could cost upwards of USD 23,000 per household.



In contrast, resilient housing in low- and middle-income countries can be developed in response to local conditions, using local knowledge. The second illustration demonstrates how low-income residents in Dhaka, Bangladesh, adapt their homes to make them more resilient to flooding, and more comfortable during the hot season. The method includes several no- and low-cost solutions, including raising rooms on higher plinths, allowing creepers to grow across roofs to reduce heat gain, and ensuring ventilation gaps to allow the circulation of cooler air.



* Source: Tiempo (2006); Jabeen H, Allen A, Johnson C (2009). 'Built-in resilience: learning from grassroots coping strategies'. Paper presented at the 5th Urban Research Symposium, Marseille, June 2009.

Sustainable livelihoods are a significant component of resilience, although they are not usually perceived as such in connection with planning for climate change. Planning for sustainable livelihoods is outside the scope of this document; however, it must be stressed that sustainable livelihoods can make a substantial contribution to both climate change adaptation and mitigation.

A 'sustainable livelihoods' approach takes in the assets, activities and entitlements that enable people to make a living, and assesses these in relation to the risks that can impair this process. Assets include the various resources, skills, abilities and opportunities that individuals and households can mobilise to support themselves. These risks can be of a natural, social, political, human and economic nature. Assets form the basis of people's occupations, they include natural assets (e.g., for fishing or farming) and human assets (such as knowledge or skills)²⁵. As mentioned earlier, climate change poses particular challenges to sustainable livelihoods, as it introduces a new set of risks to be overcome. But climate change can also open up fresh opportunities through the expansion of specific niches of economic activities and opportunities, one example being agriculture in regions previously too cold.

A 'sustainable livelihoods' approach in support of income generation includes four main dimensions:

- It is **people-centred**, as households participate in the choice of priorities and actions.

- It is **holistic**, recognising that people use a variety of strategies to secure livelihoods.
- It is **dynamic**, as these strategies may shift and change over time.
- It promotes **micro-macro linkages**, with local insights informing public policies and institutions.

As mentioned earlier, sustainable livelihoods can contribute to resilience and adaptation to climate change as they put households in a better position not just to respond to shock and stresses produced by climate change, but also to invest in their own adaptation schemes (autonomous adaptation, e.g., improved buildings make residents more resistant to extreme events). Beyond that, sustainable livelihoods can also contribute to broader environmental objectives, including reduced greenhouse gas emissions.

Therefore, when developing local climate change plans one must ensure that households, communities and cities become more resilient and better able to face a range of challenges. In the process, cities will find that building resilience helps them to face a number of other environmental and social challenges, as also shown in this document.

25 Moser C, Stein A (2010). *Implementing Urban Participatory Climate Change Adaptation Appraisals: A Methodological Guideline*. Global Urban Research Centre, University of Manchester. Working Paper 5 (May 2010). Available online: http://www.sed.manchester.ac.uk/research/gurc/documents/GURC_wp5_web.pdf



Windmill in Xai Xai, Maputo

© UN-Habitat/Benzane

02

DEVELOPING LOCAL CLIMATE CHANGE PLANS: A PROCESS-BASED TOOLKIT

2.1 INTRODUCTION

The following sections outline a framework for development of local plans in response to climate change. As explained in Section 1, climate change presents towns and cities with a number of challenges, and planning is essential if these are to be overcome. In many cases, the most effective responses are built into all decisions and functional areas – a process frequently referred to as ‘mainstreaming’. A review of urban planning under its many dimensions is also called for, including land-use, development and disaster preparedness plans. In other cases – as discussed in the previous section – more specific action plans are the most effective strategy. However, the first step to effective planning for climate change is none other than building awareness and gathering knowledge with regard both to adaptation and mitigation.

However, this is not a straightforward or linear process. The overall process of planning takes place at the scale of the community, town, or city, while specific projects take place within

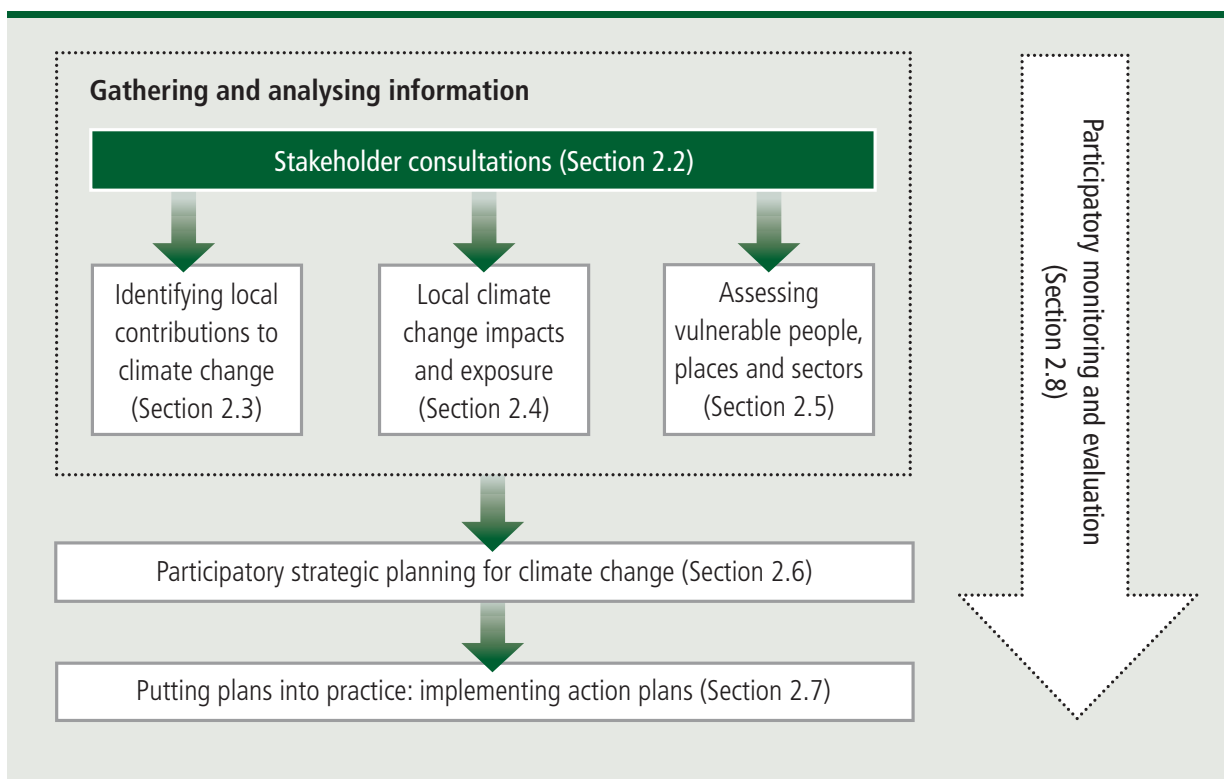
a more sector-specific/functional framework (e.g., housing, urban infrastructure, water, drainage, public health). Any plans must be informed by reliable background information on the local effects of climate change, including vulnerable people, places and sectors (see Sections 2.3 and 2.4). Any response to climate change must be subject to continuous assessment of achievements against agreed objectives (see Section 2.7 on Monitoring and Evaluation). In addition, it may not be necessary to conduct all these stages in every location, as some of this information may already be available, or financial or technical capacities may restrict the scope of this information stage of the planning process.

As shown in the flowchart in Section 1 (which is repeated at the start of every subsection), developing local plans for climate change adaptation/mitigation involves seven main tasks, as follows:

- **Engaging stakeholders:** ensuring that all relevant parties are aware of the challenge of climate change and committed to addressing it;

- **Understanding the local climate change impacts:** identifying climate threats to the town or city;
- **Identifying local contributions to climate change:** a first step towards reducing greenhouse gas emissions;
- **Assessing vulnerable areas, people and sectors:** analyse patterns of vulnerability to identify the critical locations and groups in need of enhanced resilience;
- **Participatory strategic planning for climate change:** mobilising stakeholders to create an overall vision;
- **Putting plans into practice:** implementing the plans;
- **Monitoring and evaluation:** ensuring that the desired outcomes are achieved.

2.2 STAKEHOLDERS, CONSULTATIONS AND WORKING GROUPS



2.2.1 INTRODUCTION

Strategic planning requires involvement from a wide range of stakeholders. The first set of stakeholders is a core team who will coordinate and manage the development of local plans for climate change. However, short of effective stakeholder engagement (including

local stakeholders, national environmental pressure groups and foreign/international experts), strategic planning cannot succeed. This section shows how to select and mobilise members of the core team who will conduct strategic planning; the next subsections show how stakeholders can be mobilised through consultations and working groups.

This section on **stakeholder consultation** provides guidance on the following steps:

- Identifying and organising a core team for the planning process;
- Bringing together stakeholder groups;
- Defining the message for the planning process;
- Conducting city-wide consultations;
- Setting up and coordinating working groups.

Further information on this stage of the process can be found in the UN-Habitat *Sustainable Cities Programme Source Book* series, and particularly Volume 2 (*Organising, Conducting and Reporting a City Consultation*) <http://www.unhabitat.org/pmss/listItemDetails.aspx?publicationID=1595> and Volume 3 (*Establishing and Supporting a Working Group Process*) <http://www.unhabitat.org/pmss/listItemDetails.aspx?publicationID=1635>. It is recommended that these materials be consulted in association with this report. The ICLEI/Centre for Science in the Earth System publication, *Preparing for Climate Change*, is another highly relevant source of information.

2.2.2 IDENTIFYING AND ORGANISING THE CORE TEAM

Once a commitment has been made to develop local plans to tackle climate change, the next step is to brief city authorities (including Mayors and other decision-makers) about the process. This will make sure that local leaders better understand the relevance of climate change to the city's sustainable development, and that they agree on the need for participatory strategic planning. In this respect, Section 1 (on the local impacts of climate change) can provide the necessary basic information.

Once political commitment has been secured, a core strategic planning team – the 'climate change team' – can be established. It will bring together 6-8 individuals representing

a well-balanced variety of expertise while securing effective and well-informed decision-making. After this initial stage, there will be ample opportunity to involve a broader group as part of the consultation process. The 'climate change team' would include representatives of the following professional/social groups:

- senior local government officials, to secure legitimacy and political influence;
- local authority technical staff, to contribute knowledge and expertise with regard to formal planning procedures;
- representatives of civil society organisations that are familiar with local (especially low-income) community life and dynamics, including specific gender and youth issues;



The first step to effective planning for climate change is none other than building awareness and gathering knowledge with regard both to adaptation and mitigation.



- representatives from the Chamber of Commerce or other private sector umbrella organisation, who can advise on how best to mobilise the formal business sector;
- scholars and academics specialising in climate change, disaster risk reduction or social vulnerability.

The 'climate change team' will act as the central coordinating body for strategic planning. Members will be committed

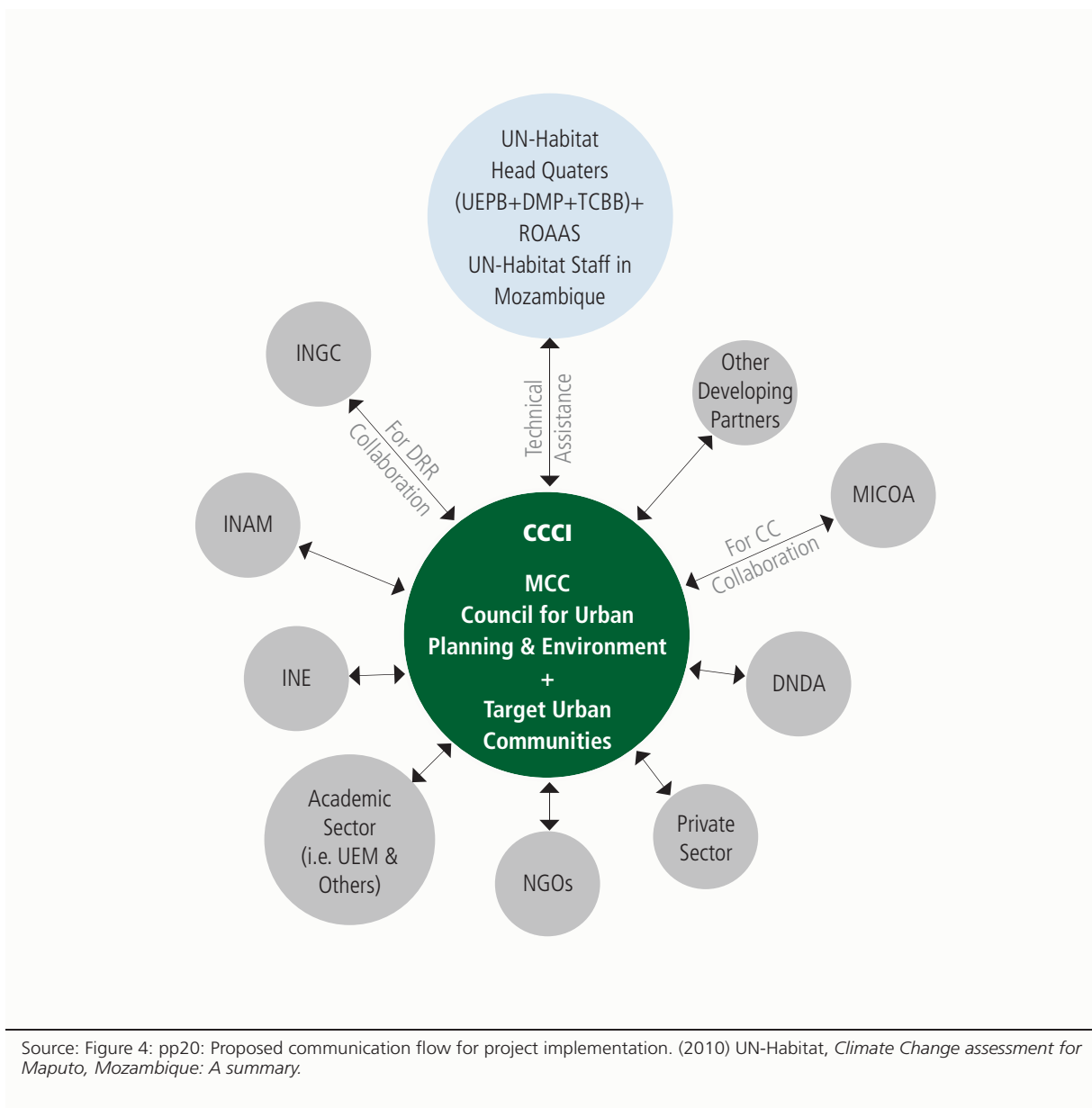
individuals who can dedicate time to the process, can make specific contributions and with the capacity to generate broader momentum behind the process. Above all, members of the 'climate change team' should demonstrate their commitment to the strategic planning process. The team should also be familiar with political, cultural and gender conditions, while at the same time maintaining an open mind and a keen eye for any opportunities, needs and gaps.

Case Study 1: Setting Up a Core Climate Change Team in Maputo

The representative institutions that are part of the core team are the following:

- Maputo Municipal Council – MMC
- MICOA – Ministry for the Coordination of Environmental Affairs
- Department of Physics of the Faculty of Sciences, Eduardo Mondlane University - UEM
- National Meteorological Institute - INAM
- National Disaster Management Institute – INGC
- INAHINA – National Institute of Hydrography and Navigation
- a representative of the private sector
- a representative of the urban community
- a representative of the voluntary sector (Non-governmental organisations).

(For more information on this case study, see Section 3.3)



2.2.3 IDENTIFYING STAKEHOLDERS

The first task of this core team is to raise awareness among a broader group of stakeholders. Several different types of stakeholders can be identified, all of whom must be engaged with local planning for climate change adaptation or mitigation. The five main types of stakeholders are the following:

i. those who are – or who are likely to be – affected;

ii. those with technical expertise;

iii. those with financial resources;

iv. those with the authority for decision-making (at various levels – particularly important in relation to plans that require interventions at different scales);

v. special-purpose institutions (e.g., community and non-government organisations focused on the environment, disaster risk reduction or livelihoods).

Particularly in relation to the first group, several additional aspects must be taken into account. Not all residents of an urban area are equally vulnerable to climate change, and vulnerability is affected by a variety of factors, such as age, gender, and ethnic, national or geographical origin (see Section 1.5). Developing effective adaptation strategies and projects requires engaging with these different stakeholder groups. Engagement of this type leads to a number of practical benefits: individuals and communities often

bring detailed knowledge of their own conditions and surroundings, and people are more likely to be involved in a task when they have taken part in its development and design in the first place.

A wide-ranging stakeholder mapping process is required to ensure that all relevant participants are included in planning. On top of a broader range of knowledge and expertise, this will also instil more ownership and efficiency in any future schemes.

Participatory Stakeholder Mapping*

Participatory stakeholder mapping is a task for the core planning team. Making sure that a wide range of stakeholders and their potential importance in the process are identified requires five steps, as follows:

- i. Create a 'long list' of stakeholders through a brain-storming session;
- ii. Write the name (individual or institution) of each of these stakeholders on a white circular card (approximately 10cm in diameter) and place it on a large table or on the floor;
- iii. Identify the main interests of each stakeholder and organise the cards in clusters of related interests;
- iv. for each cluster, identify the stakeholders that are most influential with regard to climate change;
- v. map the stakes and influence on a scale of high/low stakes and high/low influence (as shown in the matrix below).

* Adapted from *UN-Habitat Participatory Urban Governance Toolkit*

Figure 5: **Mapping Stakes and Influence: A Matrix**

	Low Influence	High Influence
Low Stakes	Least priority	Useful for decision-making and opinion framing
High Stakes	Major stakeholder groups, possibly in need of empowerment	Most critical stakeholder group

Case Study 2: Stakeholder Group Contributions in Ulaanbaatar, Mongolia

Mongolia's capital Ulaanbaatar has expanded dramatically over the past 15 years, with nomadic herders settling down in the periphery in tents ('gers') spread out over the rolling, dusty grasslands of the surrounding valley. Cheap coal is used to warm the gers during the long, harsh winters. As a result, the whole city is wrapped up in smog for months in a row. Services are virtually non-existent in the ger areas. UN-Habitat and the municipality have collaborated since 2005 over community-based strategies for ger area upgrading (including in terms of security). As of 2009, five such pilot investment programmes were underway, with project planning and implementation assigned to Community Development Councils.

Summer flash floods have gradually become a threat to assets and lives in some neighbourhoods. This is why in 2010 UN-Habitat brought together the Unur Community Development Council and city officials around a protection plan. It was evident that the community was familiar enough with local conditions to propose a number of small steps that together could prevent floods from becoming destructive. All those involved in the consultation agreed that these measures would be more immediately useful than the large-scale downstream drainage works planned by the municipality. Participants also agreed that such small 'wins' were not necessarily 'quick wins' as community education and training featured high on the list of local priorities.

2.2.4 DEFINING THE MESSAGE

As part of local planning for climate change, awareness-raising efforts must be adequately geared to the various stakeholder groups. At various stages, it may be appropriate to focus the message to a particular group or groups: elected officials, city management staff, non-government organisations, the private sector, the general public or the media. Different messages are appropriate for different groups, as their understanding, concerns, and roles will not be identical. At the same time, it can be useful to identify 'champions' among stakeholders, i.e., individuals who can provide guidance and leadership. When it comes to defining the message, six questions are in order:

- *What is the message?* Although many people have heard of climate change, it is likely that few understand the is-

ues, and particularly as they relate to a specific location. Once information has been gathered about the likely local impacts of climate change the following questions can help gather and disseminate relevant information, but the answers must be carefully framed if they are to prove both technically accurate and easily understandable for the public at large.

- *What changes have already occurred?* This question can relate both to global changes (using information from, for example, IPCC Reports) and to local changes (as provided by local research and expertise).
- *What changes are expected?* The same sources will help identify likely prospective changes to temperature, precipitation, extreme weather events, sea level and other climate-related effects.

- *How will these changes affect the community?* It is important to translate these 'scientific' predictions into more everyday realities: people will want to know about risks of drought, flooding or other disasters. It is just as important not to exaggerate the threats; making alarming predictions may prompt some people into action, but can also damage the credibility of the process.
- *What actions are required?* Although the challenges can seem daunting, action can be taken that can help both to prepare communities for the consequences of climate change (adaptation) and to contribute to reduced greenhouse gas emissions (mitigation).
- *What are other communities and cities doing?* It is always good to draw on examples from similar communities – either elsewhere in the same country, or as part of the same international networks – to show the kinds of schemes that have been implemented elsewhere.



... Plans must be informed by reliable background information on the local effects of climate change, including vulnerable people, places and sectors.



It is also useful to consider various ways of disseminating the answers to the questions listed above – again, recognising the needs of different groups within the community or city. For local government, non-government organisations or the private sector, seminars and meetings can provide good opportunities for detailed engagement with major issues (e.g., academics presenting overviews of relevant scientific research). For the public at large, the more appropriate channels include websites, newsletters, brochures, public meetings, and a variety of media formats (including newspaper supplements, radio and television programmes).

2.2.5 THE CITY CONSULTATION PROCESS

Various types of consultation can serve as effective channels both to spread the message and to develop strategic plans. In this respect, a city consultation provides a prime opportunity for a variety of stakeholders to be better informed and to agree on issues of concern related to climate change mitigation and adaptation. This effective participatory mechanism encourages the collective development of solutions to this crosscutting issue as well as effective stakeholder participation in decision-making.

Several city consultations should be built into the design of local planning for climate change. An effective initial consultation should produce the following results:

- Identification and prioritisation of the main climate change issues in the city;
- A shared and improved understanding of these issues;
- Securing the commitment and support needed from stakeholders if they are



City consultations in the CCCI pilot city of Esmeraldas, Ecuador. © UN-Habitat

to play a role in the response to climate change.

Subsequent consultations with sub-groups of stakeholders can address specific issues; just as further city consultations can generate broader support for, and engagement with, the participatory planning process.

2.2.6 WORKING GROUPS

The climate change team will not be able to address all the issues – instead, it should be seen as a coordinating body. Much of the detailed planning should be handled by working groups, who can also help those addressing priority issues. Like almost all

other urban environmental issues, climate change is a crosscutting issue that requires action from many different government departments, institutions and disciplines. The working groups referred to here are crosscutting bodies, bringing together representatives from various organisations and groups – with the specific information, ideas and capabilities they can bring – and who are concerned with a particular aspect of climate change. This is why working group members are not appointed in a personal capacity, but rather as representatives of main stakeholder categories with their specific interests and views.

It should be stressed that working groups are not meant to be permanent or to substitute for, or challenge, existing structures of authority and responsibility. Instead, the purpose of these temporary bodies is to facilitate constructive collaboration, pooling

information and ideas, and coordinating action.

Working groups for climate change planning may vary in number and composition, depending on local conditions. In smaller urban centres, it may take just one working group to address greenhouse gas reduction and another for adaptation. Larger or better-resourced urban centres may afford more than two working groups, focusing for example on energy, water supply, disaster management, coastal infrastructure, transportation, etc. Of course, priority areas will not be the same across cities and this should be reflected in the specific focuses of working groups. Typically, the working groups would be set up during the second or third city consultation, that is, once the effects of climate change are established and the main sources of greenhouse gases are identified.

Working Groups: Main Defining Features*

The following list of the defining features of working groups goes to show how they are different from ordinary committees and similar bodies:

- Each working group focuses on a single priority issue.
- Working groups deal specifically with complex cross-cutting issues that are poorly served by traditional governance structures.
- Working groups bring together representatives and participants from a wide range of the public sector, the private sector and civil society groups.
- Working groups are not 'talk shops', but are dedicated to informed discussion and analysis, negotiation and consensus-building over strategies, action plans and subsequent implementation.
- Far from being rigid, the working group approach is adaptable and flexible.

* Adapted from UN-Habitat, *Sustainable Cities Programme Source Book*, volume 3

Case Study 3: Setting Up Stakeholder Working Groups in Kampala, Uganda

Kampala was part of the Lake Victoria City Development Strategy (CDS) initiative for improved urban environment and poverty reduction, a regional programme as implemented between 2002 and 2010 by UN-Habitat with support from SIDA. The initiative brought together local authorities and other stakeholders to develop strategies for grassroots, private and public participation in decision-making.

The CDS Process

In Kampala CDS abided by the process developed by the Cities Alliance (a partnership between UN-Habitat, the World Bank, major international associations of local authorities and donor governments), which provides for stakeholder working groups in charge of issue prioritisation and action planning.

The main stakeholders (including technical staff and politicians from the Kampala City Council, civil society, the private sector and security agencies) attended a citywide sensitisation and consultative meeting. They were introduced to the *Kampala Case Study* highlighting the main local environmental challenges, on-going initiatives and hot spots in need of early action. Hotspots included waste management and improved infrastructure in unplanned settlements.

Following the city consultation, community meetings were held in the areas that been earmarked as requiring slum upgrading and improved infrastructure. Three community-level consultations were held in two divisions of Kampala.

Stakeholder Working Groups

Known as 'Slum Upgrading Committees', working groups were established in Kampala as recommended by the community-level consultations. The committees were able to prioritise one slum dwelling in each division to focus attention on based on established criteria. There were two committees for each of the two administrative divisions of Kampala.

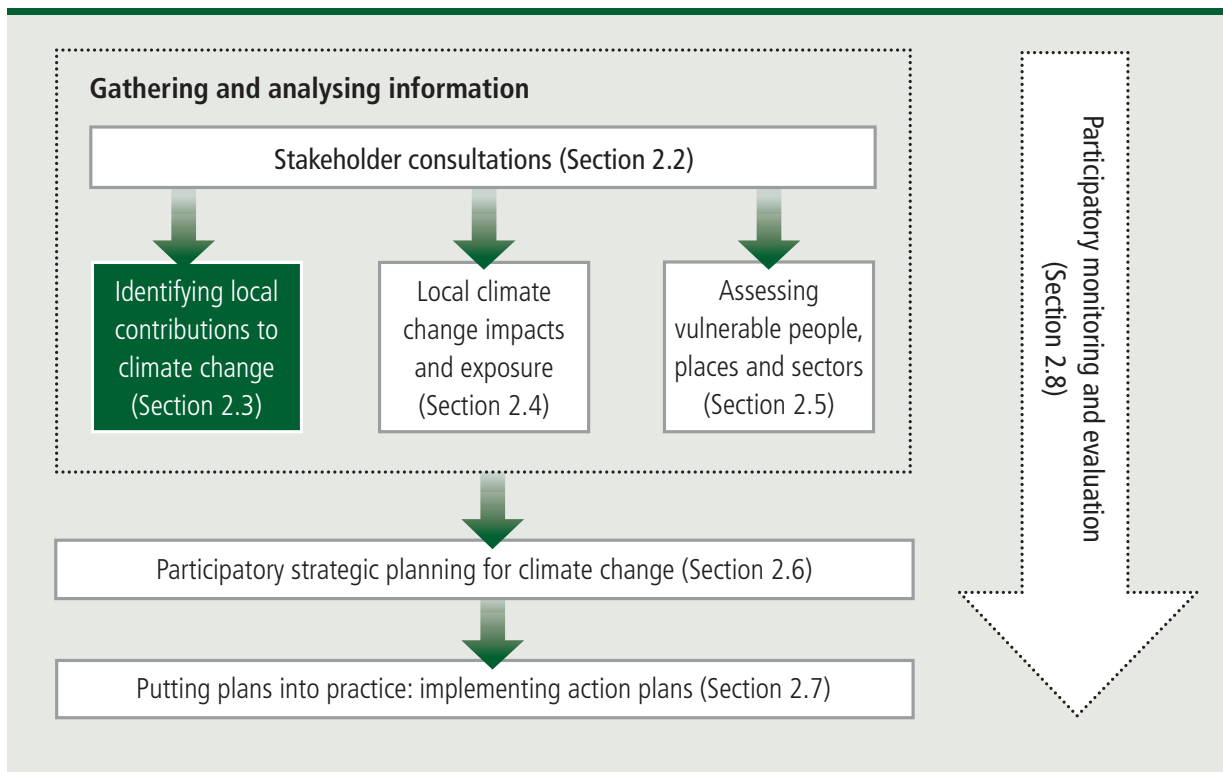
The working groups examined the priority issues and looked into possible action areas, lead participants, and resources (both available and potential) to implement the action plans. The next stage was consultative action planning with the city council taking the lead. The planning was informed by the council budget and work plans, and particularly by on-going local government reforms.

Conclusion

A number of action areas identified in the Kampala CDS document have since been implemented through various initiatives, including the Nakivubo Channel Rehabilitation Programme, expansion of the landfill at Kitezi, an Ecological Sanitation project, the 'Edible Landscapes' project, the Kampala Urban Sanitation Project, and equipment for the Geographical Information System (GIS) unit.

(For more information on this case study, see Section 3.2)

2.3 IDENTIFYING LOCAL CONTRIBUTIONS TO CLIMATE CHANGE



A range of activities that take place within towns and cities result in the production and release of greenhouse gases. Curbing these emissions can help to reduce the extent of global climate change, with the potential to generate efficiency, financial savings and co-benefits, together with revenues from the carbon-trading schemes established under the Kyoto Protocol and confirmed in the Durban Platform. Assessing local greenhouse gas emissions is the first stage in planning for mitigation, and this inventory can also provide a benchmark against which future changes in these emissions can be measured. From a more technical perspective, this on-going measurement process can also act as the baseline for reductions that, after external validation, can be sold as “carbon credits”.

At a national level, inventories are prepared according to a detailed set of criteria developed by the Intergovernmental

Panel on Climate Change (IPCC): the *IPCC Guidelines for National Greenhouse Gas Inventories*²⁶. These inventories take in the full range of greenhouse gases from four main sectors (energy; industrial processes and product use; agriculture, forestry and other land use; and waste), include measuring methods and account for the effect of the various gases on global warming. On top of carbon dioxide methane and nitrous oxide the inventories take in hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride, nitrogen trifluoride, trifluoromethyl sulphur pentafluoride, halogenated ethers and other halocarbons.

National greenhouse gas inventories are based on the assumption that each country

²⁶ Intergovernmental Panel on Climate Change (IPCC) (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan. Available online: <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html>.

is responsible for all emissions produced within its area of jurisdiction. However, industries and enterprises, cities and even individuals have increasingly taken to measuring their own emissions. Urban centres are associated with greenhouse gas emissions in two ways: municipal functions (e.g., owning or leasing buildings,

operating vehicles, purchasing goods, etc.), and through emissions from the broader community (households and businesses operating within a geographically defined area). For each of these broad categories, emissions can be split into several “scopes” based on whether the gases are generated directly or indirectly (Table 5).

Table 5: Emissions Scopes for Local Authorities*

	Definition	Examples
Emissions from government operations		
Scope 1	Direct emission sources owned or operated by the local government	Municipal vehicles powered by petrol or diesel fuel or a municipal generator powered by diesel fuel
Scope 2	Indirect emission sources: electricity, district heating, steam and cooling	Purchased electricity used by the local government, which is associated with the generation of greenhouse gas emissions by power plants
Scope 3	All other indirect or embodied emissions over which the local authority exerts significant control or influence	Emissions resulting from contracted waste hauling services
Community-Scale Emissions		
Scope 1	All direct emission sources located within the boundaries of the municipality	Use of fuels such as heavy fuel oil, natural gas or propane used for heating purposes
Scope 2	Indirect emissions within the relevant jurisdiction (electricity, district heating, steam and cooling)	Electricity used within jurisdiction associated with the generation of greenhouse gases at the power plant outside of the municipal boundaries
Scope 3	All other indirect and embodied emissions that occur as a result of activity within the boundaries of the municipality	Methane emissions from solid waste generated within the community decomposing at landfills either inside or outside the boundary of the municipality
* Compiled from ICLEI Local Governments for Sustainability (2008) International Local Government GHG Emissions Analysis Protocol. Release Version 1.0. Available online: http://www.iclei.org/fileadmin/user_upload/documents/Global/Programs/GHG/LGGHEmissionsProtocol.pdf . Accessed July 29, 2009.		

Various methodologies are available for local greenhouse gas emission inventories, such as the ICLEI *International Local Government GHG Emissions Analysis Protocol*²⁷. This

protocol takes in both the government and the community sectors, using the main categories (derived from the IPCC Protocol) of stationary combustion, mobile combustion, fugitive emissions, product use, other land use and waste. In addition, UNEP, UN-Habitat and the World Bank jointly launched the ‘International Standard for

²⁷ ICLEI Local Governments for Sustainability (2008) *International Local Government GHG Emissions Analysis Protocol*. Release Version 1.0. Available online: http://www.iclei.org/fileadmin/user_upload/documents/Global/Programs/GHG/LGGHEmissionsProtocol.pdf.

Determining Greenhouse Gas Emissions for Cities' at the World Urban Forum in Rio de Janeiro in March 2010. This standard method builds on, and is consistent with, the IPCC protocols for national governments, and its standard format makes it user-friendly for local authorities. Hopes are that as this method becomes widespread, it can serve as the basis for measurable and verifiable emissions reductions that can be turned into revenue-generating carbon credits to be auctioned on the carbon market. The full guidelines for this process are available online (at www.unep.org/urban_environment/PDFs/InternationalStd-GHG.pdf).

A detailed set of instructions for completion of greenhouse gas inventories is outside the scope of this toolkit. At its most basic, though, calculating emissions requires

collecting comprehensive data about the various **functions and operations that generate greenhouse gases** (see Table 6). For each of these functions, a **coefficient for emissions per unit of activity** is applied as specified in specialised documentation. In other words, the approach can be summarised as:

$$\text{GHG Emissions} = \text{Activity Data} \times \text{Emission Factor}$$

Where Activity Data refers to the extent of the greenhouse gas-generating activities taking place, and Emission Factor refers to the amount of emissions per unit of activity

Before following this procedure, however, it would be wise to identify the extent to which the necessary data are available.

Table 6: **Activities Resulting in Greenhouse Gas Emissions**

ENERGY SECTOR
Manufacturing industries and construction [Iron and steel; chemicals; pulp, paper and print; food processing, beverages and tobacco; transport equipment; wood and wood products; textiles and leather; non-specified industry]
Road Transportation [Cars; light duty trucks; heavy duty trucks; motorcycles]
Railways
Other sectors
AGRICULTURE, FORESTRY AND OTHER LAND USE
Livestock [Enteric fermentation (cattle, buffalo, sheep, goats, camels, horses, swine, mules and donkeys); Manure Management (cattle, buffalo, sheep, goats, camels, horses, swine, mules and donkeys)]
Land Use [Land remaining in the same use; land converted to different uses]
WASTE
Solid Waste Disposal [Managed Waste Disposal Sites; Unmanaged Waste Disposal Sites]
Incineration and Open Burning of Waste
Wastewater Treatment and Discharge

Smaller urban centres may find it more straightforward or appropriate to assess greenhouse gas emissions from one or more particular sector(s), such as municipal electricity consumption or municipal vehicle use. Setting a benchmark for emissions from one or more sectors controlled by

local government, and identifying reduction measures, can generate carbon credits for sale on the voluntary carbon market. This procedure is discussed in the UN-Habitat toolkit *Making Carbon Markets Work for Your City*.

Case Study 4: **Compiling a Local Greenhouse Gas Emissions Inventory in Negombo, Sri Lanka**



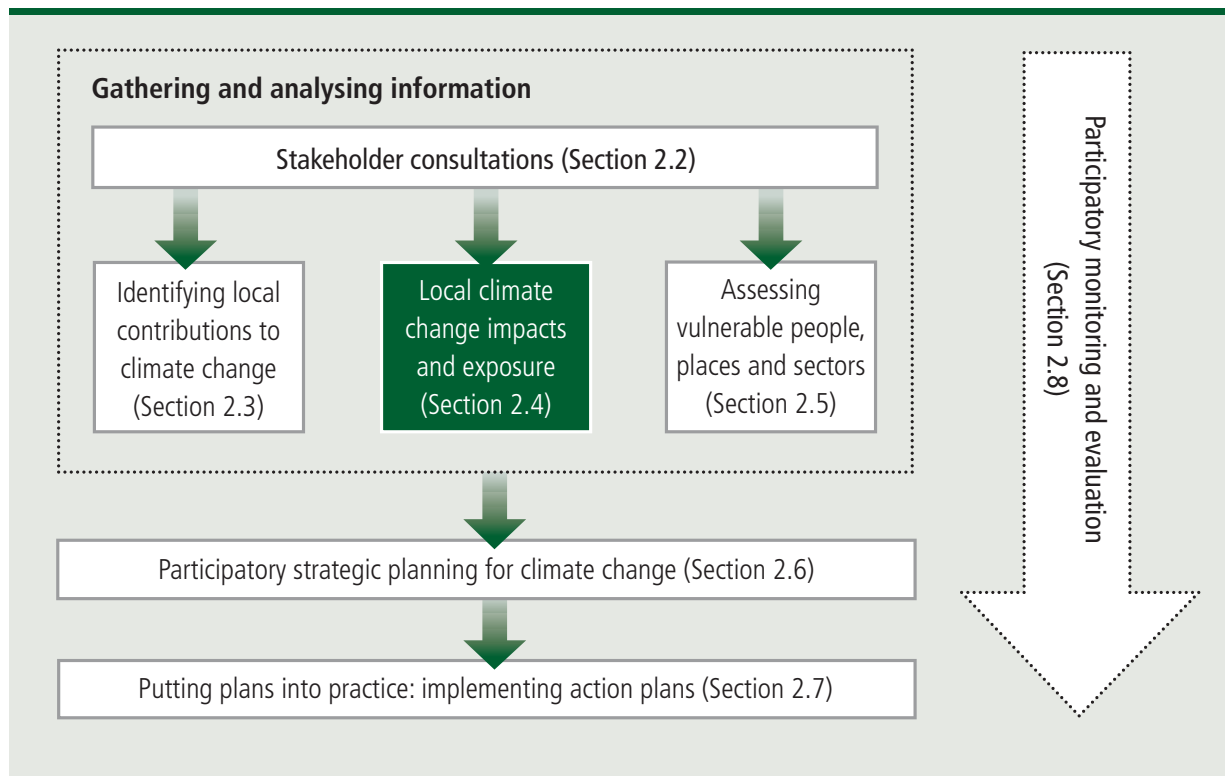
Fishing is the key economic sector in Negombo © UN-Habitat/Bernhard Barth

The Faculty of Architecture at the University of Moratuwa has prepared an inventory of greenhouse gas emissions for the Negombo Municipal Council Area in Sri Lanka. This demonstrates the potential for inventories of this type to be compiled even for relatively small urban centres (Negombo's population is 120,000). The inventory accounted for the emissions from three main sectors: energy; agriculture, forestry and other land use; and waste. Emissions from industrial processes and product use were left out, as manufacturing is insignificant in the area. However, the inventory took in energy use by industries, including bakeries, engineering works, printing and timber.

For commercial sources, energy emissions from electricity and fuel wood were measured. For residential sources, energy emissions from kerosene, fuel wood, liquid petroleum gas (LPG) and electricity were accounted for. In total, energy accounted for an average 45.8 million kilograms of carbon dioxide (CO₂) emissions per year, out of a total of 48 million kilograms. The fisheries sector has a particularly strong impact, as this is a major economic sector in Negombo with more than 1,800 registered boats. As might have been expected, waste was responsible for the majority of methane (CH₄) emissions, accounting for 0.9 million out of a total of 1.1 million kilograms per annum.

* Source: Project Consultancy Unit, Faculty of Architecture, University of Moratuwa. Formulation of a City Development Strategy for Sri Lankan Cities to Response Climate Change.

2.4 CLIMATE CHANGE: LOCAL IMPACTS AND EXPOSURE



2.4.1 INTRODUCTION

Developing local plans for adaptation/mitigation starts with gathering baseline information about the contribution a local area makes to climate change, and about the ways in which the phenomenon is to affect that area. This information can then be disseminated to raise awareness, to mobilise and involve stakeholders as well as to develop strategic plans and specific projects.

The type of information needed to make informed decisions about responding to climate change must focus on six topics: **temperature** changes; future variations in **rainfall** (precipitation); the likelihood of **floods** and **droughts**; the effects of **sea-level rise** (for coastal cities); likely changes in the frequency or intensity of **extreme events**; and the implications of climate change for **human health**. This section of the toolkit identifies the main questions to be asked

about these topics in order to understand exposure to, and impacts of, climate change. The following section (Section 2.5) shows how to assess the vulnerability of particular places, people and sectors.



Not all residents of an urban area are equally vulnerable to climate change, and vulnerability is affected by a variety of factors, such as age, gender, and ethnic, national or geographical origin.



This section on **understanding the local climate change impacts** provides guidance on the following steps:

- The way in which climate predictions are made by scientists, together with the strengths and weaknesses of this process;
- Asking the right questions of experts and identifying appropriate sources of information;
- Understanding the effects these changes will have at the local scale.

All these issues must be handled with specific knowledge and expertise. This is why urban authorities must secure strong links with various institutional stakeholders who can lead this information stage, gathering and interpreting the data. Understanding the local climate change impacts is just the first step in the process, after which stakeholders must turn to exploring how specific impacts (or just exposure to climate change) give rise to distinct patterns of vulnerability as influenced by geographical and social variables.

2.4.2 PREDICTING CHANGES IN THE CLIMATE

Climate models and climate scenarios are part of a suite of tools that can be used to determine likely changes in climate patterns for a given region. While *weather* refers to current atmospheric conditions in a particular location (for example, the temperature and whether it is raining), *climate* is a broader-ranging, longer-term phenomenon, including all weather events occurring over a period of years in a given place. Climate models are computer programmes that predict the climate system's future behaviour based on the fundamental laws of physics. They are the best available representation of our planet's atmosphere but remain a simplified version of climatic processes. It is important to remember that while modelling can be an effective tool when assessing the future impacts of climate change, it can only offer simplified versions of reality and cannot remove all

uncertainty from the planning process. It is also worth stressing that an absence of detailed models does not stand in the way of anyone in charge of local planning for climate change, particularly where the objective is to build resilience to a number of shocks and stresses.

Climate models require two main sets of inputs: the drivers of climate change and an assessment of the ways that these affect the climate. Neither of these can be accurately known: future political and socio-economic decisions will affect the quantity of greenhouse gases emitted, while the way in which these emissions affect overall climate over a number of decades cannot be known with certainty. Additional uncertainty results when predictions about global temperature and rainfall patterns are 'downscaled' to local or regional scales – meaning that accurate predictions at the level of the town or city cannot be confidently made.

Case Study 5: **Gathering Information in Esmeraldas, Ecuador**

As part of the *Cities and Climate Change Initiative*, the city of Esmeraldas, Ecuador has undertaken an analysis of future climate change scenarios. In the process, the municipality has drawn on past records from weather stations in Ecuador as well as the outcomes of five climate models and nine emissions scenarios. Records show rises in temperatures over the past 50 years, while the various models predict that surface air temperature is to rise by 2.2 to 4.4°C by 2100. However, precipitation is expected to increase or fall, depending on individual models. Combined with past observations, these findings suggest a scenario where more intense rainfall is associated with longer dry spells.

The uncertainties around these predictions should not be used as an excuse for inaction. In the first instance, there is clearly a need for further research to narrow down these uncertainties. Second, many adaptation schemes will generate a range of additional benefits, including more secure livelihoods and better urban services. Finally, this uncertainty emphasises the importance of a resilience-based approach to adaptation, with a broader, integrated scope in the face of climate change, rather than trying to anticipate specific hazards.

(For more information on this case study, see Section 3.1)

2.4.3 SOURCES OF INFORMATION

Generating fresh information about the precise climate risks faced by a particular location is outside the scope of this toolkit, and beyond the technical capacities of most municipal authorities. Rather than conducting fresh research, it is more important to be aware of the relevant sources of information and the right types of questions to ask. It is also important to consider the extent of detail required: decisions about substantial spending on infrastructure or land-use planning may require particularly detailed information. Just as questions about environmental impact are routinely asked during the development phase (through the implementation of Environmental Impact Assessments), climate vulnerability assessments should be applied to the various areas of concern, and particularly for major projects.

The major sources of information include the Intergovernmental Panel on Climate Change (IPCC), scientific publications, and the World Wide Web. Respective benefits and drawbacks are summarised in Table 7.

THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

The IPCC is the scientific body in charge of assessing the causes and consequences of climate change caused by human activities. The Panel produces periodic Assessment Reports (complete with technical summaries for policy-makers) detailing the state of knowledge on major issues. The Fourth Assessment Report (2007) was coordinated by three 'working groups', each of which produced a substantial sub report: 'The Physical Science Basis' (Working Group I), 'Impacts, Adaptation and Vulnerability'

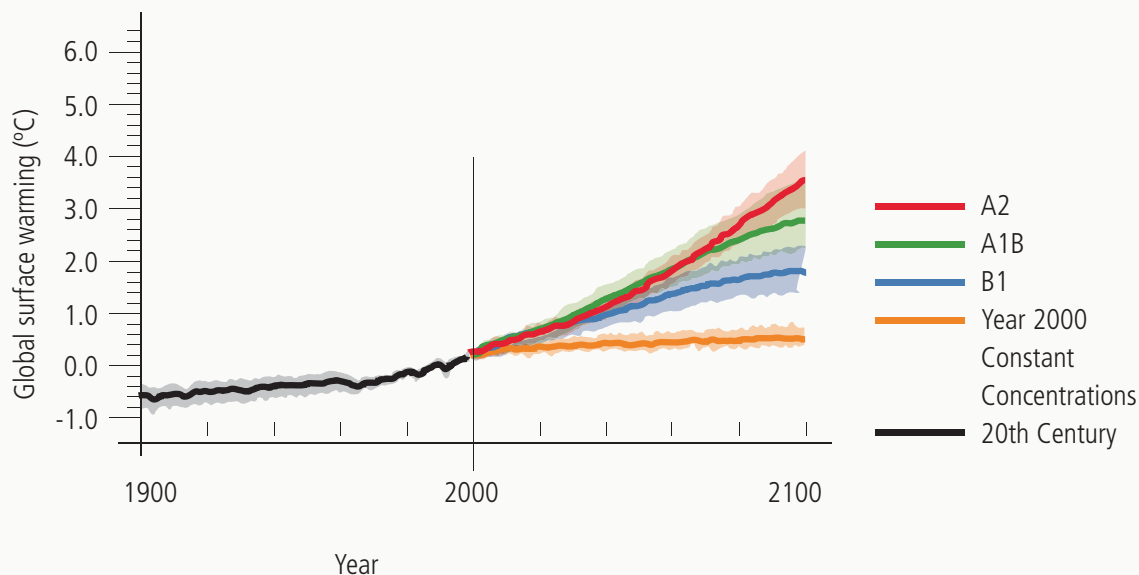
(Working Group II), and 'Mitigation of Climate Change' (Working Group III). The report of Working Group II reviewed effects, adaptation and vulnerability in all five continents and beyond (Africa, Asia, Australia and New Zealand, Europe, Latin America, North America, the Polar Regions (Arctic and Antarctic), and Small Islands).

The IPCC also produces occasional special reports and technical papers on particular issues or sectors. All of these are freely available on the IPCC website, www.ipcc.ch. The next assessment report will be published in 2014, but 'special reports' addressing specific issues may be published in the meantime.

Case Study 6: Climate Predictions Under the IPCC*

The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment report used a variety of simulations to outline potential future climate scenarios. These were based on assessments of likely trends in greenhouse gas emissions and the effect on climate systems around the world (particularly in relation to changes in temperature and precipitation). These scenarios took in economic growth, population, changes in economic structures, and relative level of emphasis on sustainability.

The figure below shows the anticipated changes in mean global temperatures under the B1, A1B, and A2 scenarios. The B1 scenario features rapid changes in economic structures toward a service and information economy with the introduction of 'clean' and resource-efficient technology. Scenario A1B is based on very rapid economic growth and a balance between fossil and non-fossil fuels as the main source of energy. As for scenario A2, it assumes that the world population remains on the increase, with regionally oriented economic growth.



© IPCC 2007: WG1-AR4

* Source: Intergovernmental Panel on Climate Change (IPCC) (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry M, Canziani O, Palutikof J, van der Linden P, Hanson C (eds). Cambridge University Press, Cambridge, Figure 10.4.



Community level input is crucial for understanding local climate change impacts

© UN-Habitat/Analyn Demdam

SCIENTIFIC PUBLICATIONS

The IPCC does not conduct ‘first-hand’ scientific research, but rather summarises and assesses past research. More specific and more recent information can be gathered from current scientific literature. Universities often have access to a wide range of information, including journals that may include articles on specific issues of relevance to particular locations.

ACADEMIA

Various academic disciplines routinely gather information about past, present, and future climates. Departments of Biology, Ecology, Geography, and Geology

can use records of past weather and climate conditions, while Departments of Geography and Physics may be involved in modelling of future conditions. Even if first-hand research is not available from local academic institutions, some faculty members may often be able to help gather and interpret secondary information. In some cases, schools may have also collected weather and climate data.

THE WORLD WIDE WEB

Large amounts of information about climate change are available online. Some of the material may be highly reputable – many scientists post findings online as well as publishing in traditional paper format.

Many international organisations also post their own material online. However, it is important to remember that there is no way of guaranteeing the quality of online data. In general, this information should be used as background and treated very carefully, unless it is clearly identifiable as being from a reputable source (such as the IPCC, above).

GOVERNMENT DEPARTMENTS

Gathering information on weather and climate often falls within the purview of some government department/agency or another: ministries for the Environment or Natural Resources, or meteorological or disaster-preparedness agencies. In addition, climate data may be collected by seaport and airport authorities.

Table 7: Sources of Climate Change Information

Source	Benefits	Drawbacks
Intergovernmental Panel on Climate Change (IPCC)	<ul style="list-style-type: none"> the most authoritative and comprehensive assessment of climate change on a global scale easy access 	<ul style="list-style-type: none"> limited information on specific locations less up-to-date
Scientific publications	<ul style="list-style-type: none"> the most authoritative source of scientific information 	<ul style="list-style-type: none"> patchy coverage (may not be available for some locations) difficult access (only available to subscribers) may be difficult to understand (technical language)
The World Wide Web	<ul style="list-style-type: none"> very easy access 	<ul style="list-style-type: none"> very limited 'quality control'
Local sources (e.g., local schools, universities, government departments, airports, ports, etc.)	<ul style="list-style-type: none"> easy access provide locally relevant information 	<ul style="list-style-type: none"> may not be comprehensive or detailed

In some countries, National Adaptation Programmes of Action (NAPAs) provide a useful source of information about potential climate change impacts. Funding for the Least Developed Countries to prepare NAPAs is available through agreements under the United Nations Framework Convention on Climate Change (UNFCCC) – and so far (November 2011) 46 NAPAs have been completed (see Information Box). The steps for the preparation of a NAPA include synthesis of available

information, participatory assessment of vulnerability to current climate variability and extreme events and of areas where risks would increase due to climate change, identification of key adaptation measures as well as criteria for prioritising activities, and selection of a prioritised short list of activities. The NAPA process gives priority to community-level input as an important source of information, recognising that grassroots communities are often the main stakeholders.

Countries that Have Completed the NAPA Process

Afghanistan (September 2009); Bangladesh (November 2005); Benin (January 2008); Bhutan (May 2006); Burkina Faso (December 2007); Burundi (February 2007); Cambodia (March 2007); Cape Verde (December 2007); Central African Republic (June 2008); Chad (February 2010); Comoros (November 2006); Democratic Republic of Congo (September 2006); Djibouti (October 2006); Eritrea (May 2007); Ethiopia (June 2008); Gambia (January 2008); Guinea (July 2007); Guinea-Bissau (February 2008); Haiti (December 2006); Kiribati (January 2007); Lao People's Democratic Republic (May 2009); Lesotho (June 2007); Liberia (July 2007); Madagascar (December 2006); Malawi (March 2006); Maldives (March 2008); Mali (December 2007); Mauritania (November 2004); Mozambique (July 2008); Nepal (November 2010); Niger (July 2006); Rwanda (May 2007); Samoa (December 2005); Saõ Tome and Principe (November 2007); Senegal (November 2006); Sierra Leone (June 2008); Solomon Islands (December 2008); Sudan (June 2007); Tanzania (September 2007); Timor-Leste (September 2011), Togo (September 2009), Tuvalu (May 2007); Uganda (December 2007); Vanuatu (December 2007); Yemen (April 2009); Zambia (October 2007).

Additional sources for information are the National Communications (National Communiqués) on Climate Change*, which are updated in on a regular basis.

* The National Communications are available on the UNFCCC website (http://unfccc.int/national_reports/non-annex_i_natcom/items/2979.php)

2.4.4 IDENTIFYING POTENTIAL IMPACTS

The impacts of climate change extend to natural and human systems alike. The IPCC has summarised the main likely impacts on industry, settlements and society at large (Table 8).

It must be stressed again, however, that any predictions of climate patterns remain tainted with a fair amount of uncertainty, particularly at the scale of an individual city. Such predictions can only serve as indications of what may take place. Even where relatively in-depth scientific surveys have been conducted for individual cities – for example, Esmeraldas, Ecuador – they fall short of supporting detailed planning. Urban managers should instead use these predictions as potential conditions against which they need to build resilience. Most importantly, patterns of

vulnerability – which can be assessed based on the current situation – can identify areas for targeted interventions, and this is the focus of the next section.

The exposure of a particular location, including anticipation of the impacts of climate change, can be assessed based on the following parameters:

- Changes in **temperatures**;
- Future variations in **rainfall** (precipitation);
- The likelihood of **floods** and **droughts**;
- The effects of **sea-level rise** (for coastal cities);
- Likely changes in the frequency or intensity of **extreme events**;

Table 8: The Impacts of Climate Change on Industry, Settlements and Society*

Phenomenon and direction of trend	Likelihood of future trends	Major impacts
Over most land areas, warmer and fewer cold days and nights, warmer and more frequent hot days and nights	Virtually certain	Reduced energy demand for heating; increased demand for cooling; declining air quality in cities; reduced disruption to transport due to snow, ice; effects on winter tourism.
Increased frequency of warm spells / heat waves over most land areas	Very likely	Reduction in quality of life in warm areas without appropriate housing; impacts on the elderly, very young and poor.
Increased frequency of heavy precipitation events over most areas	Very likely	Floods disrupt settlements, commerce, transportation and communities; pressures on urban and rural infrastructures; loss of property.
Droughts affect more areas	Likely	Water shortage for settlements, industry and communities; reduced hydropower generation potential; potential for population migration.
More frequent intense tropical cyclones	Likely	Disruption by floods and high winds; withdrawal of risk coverage in vulnerable areas by private insurers; potential for population migrations; loss of property.
Increased incidence of extreme high sea level (excluding tsunamis)	Likely	Costs of coastal protection v. costs of land-use relocation; potential for movement of populations and infrastructure.

* Source: Intergovernmental Panel on Climate Change (IPCC) (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry M, Canziani O, Palutikof J, van der Linden P, Hanson C (eds). Cambridge University Press, Cambridge: Table 3.2.



Flooding in the Guerra Popular Avenue, Maputo © UN-Habitat/Ricardo Rangel

- The implications of climate change for **human health**.

Each of these issues raises a number of questions for experts when trying to identify the most likely future climate scenarios for

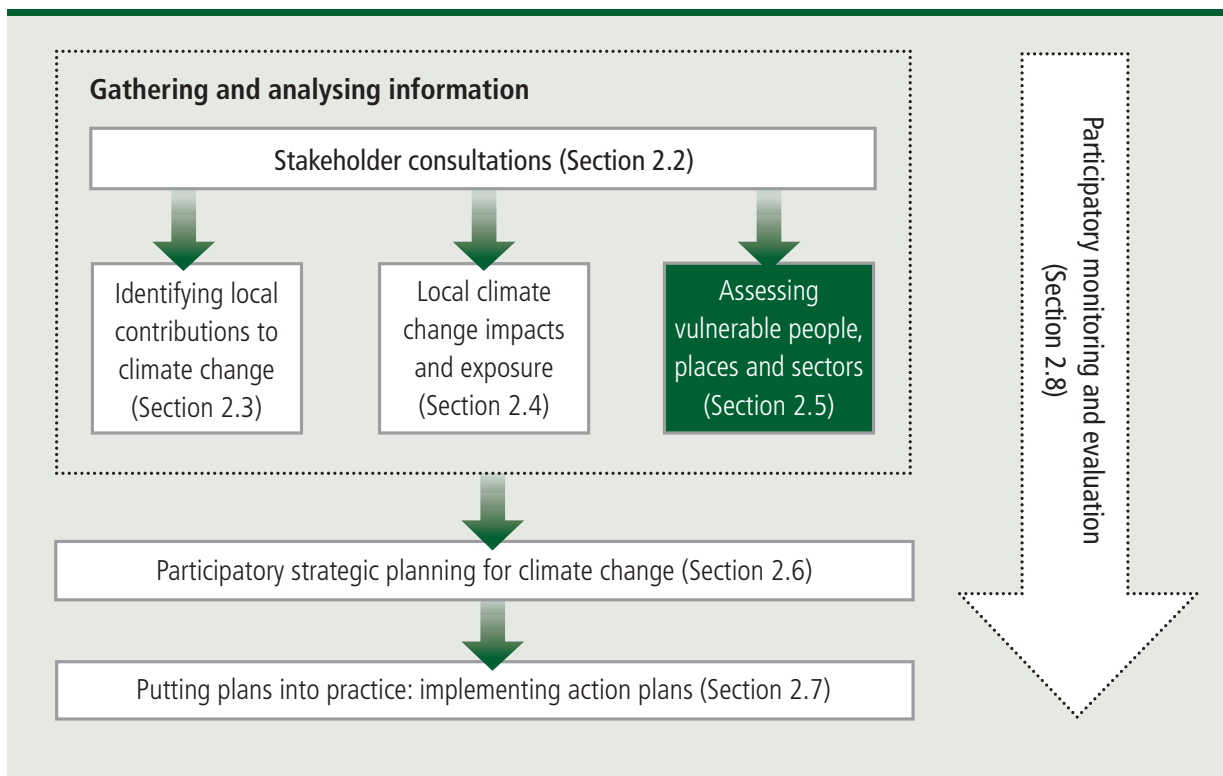
a given location. Based on the answers, the vulnerability of various places and people can be assessed for planning. The matrix below (Table 9) lists the main questions to be asked of experts.

Table 9: **Assessing the Effects of Climate Change: A Matrix***

Changes in climate	Effects on location
Temperature: observed trends and future projections	<ul style="list-style-type: none"> • How has past temperature changed in this location? • How good are the records, and can any particular recent trends be identified? • Are trends already showing warming? • What are the likely future changes in temperature in this location? • How are temperature changes likely to be distributed throughout the seasons? • How is the urban 'heat island' effect likely to change, and what is the likelihood of future heat waves?
Precipitation: observed trends and future projections	<ul style="list-style-type: none"> • How has past precipitation (rainfall) changed in this location? • How good are the records, and can any particular recent trends be identified? • Is the absolute amount of rainfall already changing? • Is the distribution of rainfall already changing (e.g., is it falling at different times of year, or at different levels of intensity)? • What are the likely future changes in precipitation in this location? • How is the distribution of rainfall likely to change in coming decades? • How are precipitation changes likely to be distributed throughout the seasons?
Flooding and droughts	<ul style="list-style-type: none"> • What are the likely future patterns of floods and droughts? • Are they likely to become more frequent or more intense? • Which locations will be particularly affected?
Sea level rise (for coastal cities)	<ul style="list-style-type: none"> • What are the likely local changes in sea level? • Does this take into account local issues, such as tidal conditions and subsidence / uplift of the land? • Will sea level rise affect groundwater resources?
Extreme events	<ul style="list-style-type: none"> • What extreme events already affect the city? • How is the frequency and severity of these expected to change in the coming years and decades?
Human health	<ul style="list-style-type: none"> • How will changes in temperature and precipitation affect the spread of disease? • How will future changes in the frequency of floods and droughts affect the spread of disease? • Which groups in society face particular health risks?

* Adapted and expanded from Mehrotra S, Natenzon C, Omojola A, Folorunsho R, Gilbride J, Rosenzweig C (2009). *Framework for City Climate Risk Assessment*. World Bank Commissioned Research: Fifth Urban Research Symposium Cities and Climate Change.

2.5 ASSESSING VULNERABLE PEOPLE, PLACES AND SECTORS



2.5.1 INTRODUCTION

The way the overall effects of climate change are to materialise for cities, communities and households will vary according to specific circumstances. The effects of climate events of various kinds are not uniform across the board: some places and people are far more vulnerable, that is, they lack the ability to cope effectively with shocks and stress. If local climate change plans are to be effective at all, these patterns of vulnerability must be assessed so that the most appropriate interventions can be made. Vulnerability is the degree to

which a system is susceptible to, and unable to cope with, any adverse effects of climate change, including variability and extremes. In other words, vulnerability is a function of the character, magnitude, and variation to which a system is exposed, its sensitivity and its adaptive capacity. When planning for climate change, identifying vulnerabilities is the first step. It is also important to keep in mind that climate change will exacerbate current vulnerability through more frequent stresses and more extreme shocks. This section suggests a variety of ways in which vulnerability can be identified and assessed using a variety of participatory strategies.

This section on **vulnerability to climate change** provides guidance on the following steps:

- Linking impacts and exposure to vulnerability;
- Assessing vulnerability at the scale of the city;
- Assessing vulnerability in communities;
- Assessing vulnerable sectors and infrastructure;
- Assessing adaptive capacity and ability to respond.

2.5.2 LINKING IMPACTS AND EXPOSURE TO VULNERABILITY

In general, vulnerability to climate change can be seen as a function of **exposure**, **sensitivity** and **adaptive capacity**. Section 2.4 provided an assessment framework for *exposure*. This section shows how to identify the *sensitivity* of a system (i.e., the extent to which it is to be affected by climate change) and to assess *adaptive capacity* (i.e., the ability of the system to respond, and to change in response to climate impacts). For instance, an area may be **exposed** to increased intensity of rainfall, may be **sensitive** because of an inadequate drainage system that results in more frequent flooding, and may lack the **adaptive capacity**, such as financial or technical resources, to improve drainage or amend land use plans to reduce the consequences.

Again, the changes in climate assessed in the previous section are bound to affect different places and different people in different ways. Table 10 shows how to link impacts and exposure with vulnerability to climate change.



Residents of Bwaise, Kampala cross a flooded road © UN-Habitat/Nicholas Kajoba

Table 10: **Assessing Climate Change Impacts and Vulnerability: A Matrix***

Changes in climate	Effects on location	Identifying vulnerability
<p>Temperature: observed trends and future projections</p>	<ul style="list-style-type: none"> • How has past temperature changed in this location? • How good are the records, and can any particular recent trends be identified? • Are trends already showing warming? • What are the likely future changes in temperature in this location? • How are temperature changes likely to be distributed throughout the seasons? • How is the urban 'heat island' effect likely to change, and what is the likelihood of future heat waves? 	<p>Overall city vulnerability (Section 2.5.3) How will these changes affect the town / city as a whole, and various locations within the urban area?</p> <p>Vulnerable sectors (Section 2.5.4) How might these changes affect various urban services and sectors (e.g. energy, housing, transportation, water and sanitation)? What are the likely implications for economic activities?</p> <p>Vulnerability of communities (Section 2.5.5) How will the effects vary between different groups of people in the city? How will these changes affect social and cultural life?</p>
<p>Precipitation: observed trends and future projections</p>	<ul style="list-style-type: none"> • How has past precipitation (rainfall) changed in this location? • How good are the records, and can any particular recent trends be identified? • Is the absolute amount of rainfall already changing? • Is the distribution of rainfall already changing (e.g. is it falling at different times of year, or at different levels of intensity)? • What are the likely future changes in precipitation in this location? • How is the distribution of rainfall likely to change in coming decades? • How are precipitation changes likely to be distributed throughout the seasons? 	
<p>Flooding and droughts</p>	<ul style="list-style-type: none"> • What are the likely future patterns of floods and droughts? • Are they likely to become more frequent or more intense? • Which locations will be particularly affected? 	
<p>Sea level rise (for coastal cities)</p>	<ul style="list-style-type: none"> • What are the likely local changes in sea level? • Does this take into account local issues, such as tidal conditions and subsidence / uplift of the land? • Will sea level rise affect groundwater resources? 	
<p>Extreme events</p>	<ul style="list-style-type: none"> • What extreme events already affect the city? • How are the frequency and severity of these expected to change in coming years and decades? 	
<p>Human health</p>	<ul style="list-style-type: none"> • How will changes in temperature and precipitation affect the spread of disease? • How will future changes in the frequency of floods and droughts affect the spread of disease? • Which groups in society face particular health risks? 	

* Adapted and expanded from Mehrotra S, Natenzon C, Omojola A, Folorunsho R, Gilbride J, Rosenzweig C (2009). *Framework for City Climate Risk Assessment*. World Bank Commissioned Research: Fifth Urban Research Symposium Cities and Climate Change.

Case Study 7: Mapping Vulnerability with Focus on Location, People and Sectors in Pekalongan, Indonesia



Small enterprises may be compromised by the effects of climate change © Ian Pratomo

The coastal city of Pekalongan, Indonesia is small, but its reputation as a leading batik producing centre is considerable. However, seashore abrasion, salt water intrusion and decaying drainage systems combined with overcrowding turn the workshops producing the colourful fabrics into a cluster economy under threat. UN-Habitat has undertaken a variety of surveys and mapping tasks to chart out the risks: these included mini-atlases of neighbourhoods where batik production is the main source of subsistence; a value-chain analysis was done to see where environmental hazards pose the largest threats; and action plans were discussed both at the neighbourhood and the city levels to gauge communities' and city officials' respective perceptions of the threats and preferred responses. The spatial review of this cluster economy was useful, charting out where livelihoods, (including those of the poorest batik workers producing the cheaper bottom-of-the-range fabric) are under threat from regular flooding. Admittedly, neighbourhood mini-atlases are somewhat unconventional but on this occasion they complemented conventional government statistics. Perhaps even more importantly, mini-atlases empower communities, putting them in a better position to discuss programming and budgeting priorities. This is a welcome development against the more general background of on-going decentralisation in Indonesia, where such engagement is possible but where tools to support community prioritisation are often lacking. Still, mini-atlases were found to foster clarity and transparency when mapping vulnerability of specific locations, including residents and economic functions.

2.5.3 OVERALL CITY VULNERABILITY

Various methods have been proposed and used to assess the main risks or vulnerabilities that cities are to face as a result of climate change. Most involve consulting a broad range of stakeholders to identify potential threats, prior to assessing their relative importance with a view to prioritising interventions.

In order to assess the overall degree of vulnerability of a given urban centre, it is necessary to consider seven main factors, as follows:

- **Population.** Although absolute population does not directly influence vulnerability, it does provide an indication of the necessary scale of response. Large cities with large numbers of people living in 'at risk' locations require more detailed and sophisticated planning for adaptation to climate change.
- **Population density.** Again, high population densities do not necessarily imply high degrees of vulnerability. Dense populations in high-quality buildings can be very resistant to climate impacts, and this can allow for cost-efficient provision of effective infrastructure. However, dense populations in low-quality buildings can be particularly at risk.
- **The percentage of the population who are poor or live in slums.** This is a strong indicator of vulnerability, as low-income urban residents lack the financial capacity to make individual improvements to their homes or to respond to additional shock or stress.
- **The percentage of urban land area susceptible to particular events.** These might include slope failure, river-bank erosion, coastal flooding, etc.

- **The state of existing urban infrastructure** must be assessed, including protective structures (e.g., seawalls), bridges, roads (as they are affected by extreme events and play an important role in disaster recovery), schools, power supply, etc.
- **The state of institutions,** including the availability or otherwise of disaster preparedness plans, the state of urban planning and of emergency response systems, etc.
- **The role of the city in the national economy.** Cities that play a central role in the national economy are particularly vulnerable, as climate change may result in extensive 'knock-on' effects. This also means that extreme weather events can severely impair those very institutions expected to help respond to them.

Where available, detailed and up-to-date city land-use plans can make significant contributions to vulnerability assessments by identifying vulnerable locations, particularly where several aspects of vulnerability (physical, social, etc.) intersect. On top of this, vulnerability mapping can inform future land-use plans that take in the need for climate change adaptation.

The city consultation process provides an ideal opportunity to assess overall urban vulnerability. The points above can be discussed by the all participants (or by smaller sub-groups) for a double purpose:

- (1) determining how the specific physical and social features of a given urban centre are to interact with likely changes in the climate and generate vulnerability; and
- (2) to identify the critical issues to be addressed. The matrix in Table 11 will help stakeholders in this double function. The

boxes on 'exposure' and 'sensitivity' can be completed with a description of the situation, or by allocating scores (e.g., from 1 to 10 for least to most exposed/

sensitive). Far from being an end in itself, this matrix is meant to encourage focused discussion on the main climate change issues at hand.

Table 11: Analysing City Vulnerability

This matrix should be completed for all the likely impacts of climate change in the urban area: temperature, precipitation, flooding and droughts, sea level rise, extreme events human health.

Who / what will be affected?	Exposure (probability or likelihood of impact)	Sensitivity (potential adverse consequences)
People location socio-economic status age and gender		
Areas residential commercial industrial recreational agricultural forested		
Economic sectors infrastructure systems (energy, transportation, water and sanitation, etc.) tourism agriculture commerce and industry small-scale / livelihoods		



In general, vulnerability to climate change can be seen as a function of exposure, sensitivity and adaptive capacity.



Example: The World Bank's "Hotspot" Methodology*

The World Bank has developed another method to assess city-scale risks. This so-called "Hotspot" Methodology involves several types of matrices:

- *Typology and risk characterisation matrix*: city profile, size and other defining features of the city, governance structure with regard to disaster risk management, municipal management of climate change and disaster risk issues, financial resources, the built environment, political effect of disasters, economic effect of disasters, threat of natural hazards, disaster response system and effects of climate change;
- *Vulnerability assessment* focusing on the various implications of climate change in urban areas;
- *Preparedness and response* to different natural hazards in various urban sectors (manufacturing, services, finance, tourism and hospitality);
- *Recommended indicators* for preparedness.

The full methodology can be downloaded from www.worldbank.org/eap/climatecities.

* Source: World Bank (2008). *Climate Resilient Cities: 2008 Primer*. World Bank / Global Facility for Disaster Reduction and Recovery / International Strategy for Disaster Reduction. Available for download from www.worldbank.org/eap/climatecities.

2.5.4 VULNERABLE SECTORS AND INFRASTRUCTURE

Any vulnerable sector must be included in the development of local climate change plans. This must start with an assessment of critical socio-economic sectors as part of the city consultation process, with expert working groups stepping in in the next stage for detailed sector-by-sector scrutiny.

Critical sectors are bound to vary from place to place and are for the city consultation to identify. Similarly, the sectors and infrastructure that are 'at risk' from climate change will also be a function of local conditions. However, some sectors are likely to be particularly important for any urban centre:

- **Electricity generation.** This is an essential urban service, without which households face many challenges and industries and businesses cannot operate. Electricity generation and distribution facilities may be affected by changes in climate, particularly more intense extreme events.
- **Water and sanitation.** This is central for households and businesses, and essential for public health. Many water treatment facilities are located close to rivers and therefore may be affected by changing run-off patterns. Similarly, sewage treatment plants can also be located close to the coast where they may be affected by sea-level rise.

- **Solid waste management.** This is also of critical importance to public health. In times of heavy rain and flooding, waste cannot be collected and piles up outside houses and business facilities. Waste at unmanaged disposal sites is swept into rivers, the sea and drainage systems (same applies to waste disposal sites near areas exposed to sea-level rise, which further exacerbates flooding problems). On top of this, changes in temperatures affect the biological processes at work in waste treatment facilities.
 - **Transportation.** Roads, railways, sea-ports and airports are critical components of urban economies, but their locations may be exposed to various climatic threats, including sea level rise.
 - **Coastal protection.** For many coastal cities, well-maintained sea walls, or adequate ecosystem-based protection (e.g., mangroves) act as essential lines of defence for urban infrastructure against storm surges and sea-level rise.
 - **Public health.** Climate change is bound to put public health under fresh stress, therefore it is important to ensure that public health infrastructure (including clinics and hospitals) are sufficiently resilient to changes in climate.
 - **Education.** Educational institutions are a critical component of urban systems. In addition, school buildings are often used as emergency shelters and therefore require particular attention to ensure that they are able to deal with climatic hazards.
 - **Housing.** Resilient housing is essential to protect lives and property from extreme weather events and climate change.
- Other sectors may be relevant depending on specific local conditions. However, the matrix below (Table 12) can be used in city consultations to assess the most vulnerable infrastructure and sectors, and to identify potential avenues for adaptation.



Where available, detailed and up-to-date city land-use plans can make significant contributions to vulnerability assessments by identifying vulnerable locations, particularly where several aspects of vulnerability (physical, social, etc.) intersect.



Table 12: Assessment of Vulnerable Infrastructure and Sectors

Sector	Vulnerable components	Triggers of vulnerability	Options for adaptation
[These are all provided as examples only: the matrix should be completed based on local experiences]			
Electricity generation	<ul style="list-style-type: none"> • generation facilities located in flood-prone areas • network can be affected by extreme storms 	temperature precipitation flooding or droughts sea level rise extreme events (see Table 11)	<ul style="list-style-type: none"> • improve power lines • assess location of new generation facilities • bury new cables • diversify energy sources
Water and sanitation	<ul style="list-style-type: none"> • water and sewage treatment facilities located close to rivers or coast 		<ul style="list-style-type: none"> • expand and diversify water supply (new groundwater sources and reservoirs) • reduce demand and improve efficiency • assess location of new treatment facilities
Solid waste management	<ul style="list-style-type: none"> • unmanaged waste disposal facilities located close to rivers or coast • disruption to waste collection system • alteration in waste decomposition rates (biological processes) 		<ul style="list-style-type: none"> • relocate waste disposal sites • reduce amount of waste produced and taken to final disposal site • ensure that waste can be collected from flood-prone areas
Transportation	<ul style="list-style-type: none"> • roads • railways • seaports • airports 		<ul style="list-style-type: none"> • relocating critical transport infrastructure • amending design standards • transportation systems must facilitate rapid emergency responses
Coastal protection	<ul style="list-style-type: none"> • sea walls • protective ecosystems (e.g., mangroves) 		<ul style="list-style-type: none"> • sea wall upgrading and expansion • designating protected areas for ecosystems
Public health	<ul style="list-style-type: none"> • hospitals and clinics 		<ul style="list-style-type: none"> • improving building standards and maintenance • better management of extreme heat events • use of shade trees to manage the urban 'heat island' effect
Education	<ul style="list-style-type: none"> • schools 		<ul style="list-style-type: none"> • improving building standards and maintenance
Housing	<ul style="list-style-type: none"> • homes that are not resilient to extreme weather 		<ul style="list-style-type: none"> • building standards must be adapted to climate scenarios and made more affordable for the poor

2.5.5 VULNERABILITY IN COMMUNITIES

Vulnerability is a complex phenomenon where a wide range of physical and social factors are bound to interact. Within cities and communities, it is important to ask a variety of questions to assess which individuals and groups are most likely to be affected by climate change in order to develop plans and projects that meet their needs. Various techniques are available to assess particular aspects of vulnerability at the community scale with residents. Yet even within communities, not everybody will be affected in the same way. To address this issue, it can be helpful to ask six basic questions, as follows²⁸:

- Who lives or works in the locations most exposed to hazards related to the direct

²⁸ Source: Hardoy J, Pandiella G (2009) 'Urban poverty and vulnerability to climate change in Latin America' *Environment and Urbanization* 21(1): 203-224.



Within cities and communities, it is important to ask a variety of questions to assess which individuals and groups are most likely to be affected by climate change in order to develop plans and projects that meet their needs.



or indirect impacts of climate change (e.g., on sites at risk of flooding or landslides)?

- Who lives or works in locations where there is no proper risk-reducing infrastructure (e.g., in the absence of drainage flooding poses a serious threat to settlements)?
- Who lacks the knowledge, capacity or opportunities to take immediate short-term measures to keep any effects under check (e.g., move family members and assets before a flood hits)?
- Whose homes and neighbourhoods face greatest risks when impacts occur (e.g., poorer-quality homes leave residents and their possessions/physical assets more exposed to serious injury, death and loss)?
- Who is least able to cope with impacts (i.e., illness, injury, death, loss of property, loss of income, lack of insurance or relation to government to get compensation, etc.)?
- Who is least able to adapt to or avoid impacts (e.g., by building better homes, getting government to provide infrastructure and disaster preparedness as needed, or moving to a safer place)?

These questions are apt to stimulate discussion at city consultations or within working groups, and can pinpoint areas for priority intervention. For example, climate change responses may need to be targeted at particular age, gender, or social groups. Techniques are available to identify vulnerable communities, and patterns of vulnerability within these. Two such methodologies are outlined below: community hazard mapping and participatory vulnerability assessments.

Community Hazard Mapping

Mapping exercises are a very helpful way of identifying vulnerability in communities. These serve a range of different objectives:

- Ensuring broader participation of citizens when developing responses to climate change;
- Using local knowledge, skills and experience to respond to climate change;
- Identifying particular locations that are at risk from the effects of climate change;
- Encouraging information sharing about the consequences of climate change;
- Promoting discussion within communities about the likely impacts of climate change.

Community hazard mapping starts with a base map which is drawn plotting the main features (roads, wells, etc.) and which can be displayed at a large scale on a wall or table. Community members are then asked to highlight any areas and houses which have previously been affected by climate-related hazards, and which they think are at risk from future changes in climate. On top of identifying priority areas for action, this preliminary mapping exercise can stimulate discussion and encourage community members to articulate their understanding and ideas.

Figure 6: **Community Hazard Mapping in Barangay Cambulaga, Sorsogon, the Philippines***



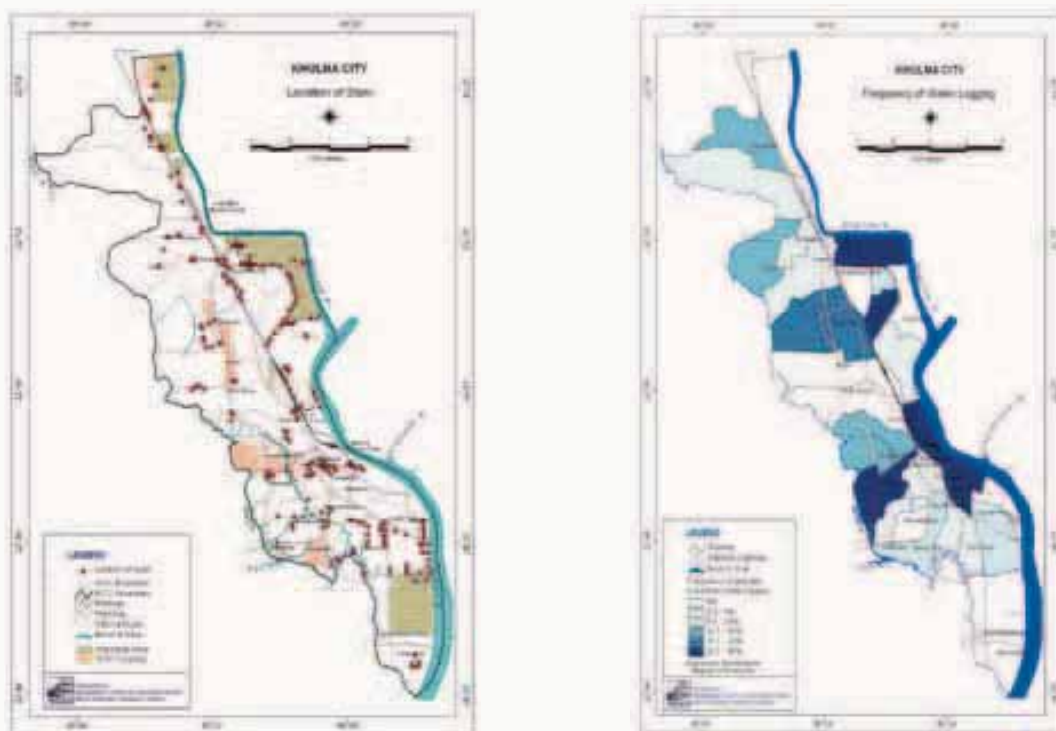
* Source: CCCI team in Sorsogon

Case Study 8: Mapping Climate Vulnerability in Bangladesh and Kenya

In less-developed countries until recently, extreme weather events and other effects of climate change had rarely been considered in urban planning or infrastructural design. Highlighting the links between climate change and urban expansion provides an effective approach to vulnerability mapping, as demonstrated in Bangladesh and Kenya by an international group of experts known as Capacity Strengthening of Least Developed Countries to Adapt to Climate Change (CLACC). The group supports sustainable development through capacity-building and assistance to local initiatives in 15 particularly vulnerable countries (12 in Africa and three in South Asia)

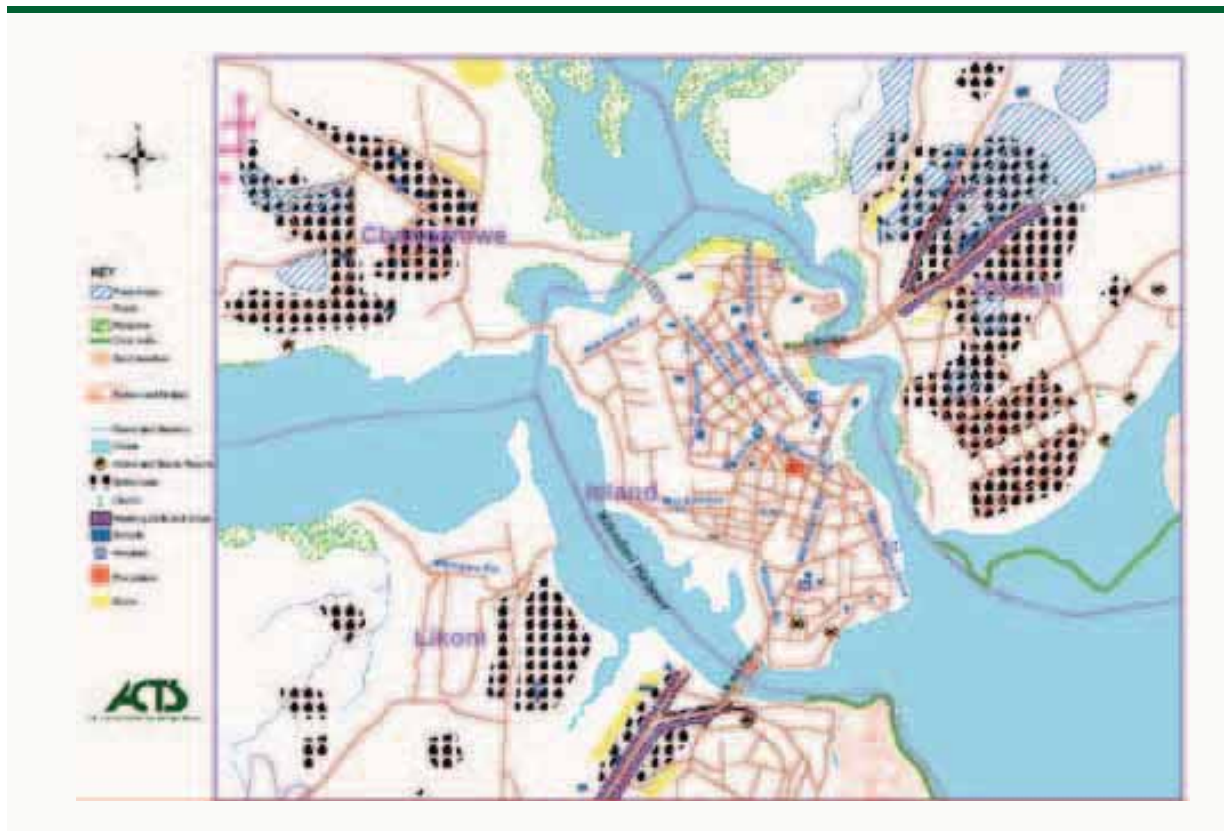
In Khulna, Bangladesh (Figure 7), the Bangladesh Centre for Advanced Studies and CARITAS Bangladesh have carried out a mapping process to assess vulnerability under its various aspects and the effects on the urban poor. As the figures show, slum settlements are often located in areas that are frequently subjected to waterlogging. A comparable exercise in Mombasa, Kenya (Figure 8), performed by the African Centre for Technology Studies, showed that many slum settlements are located in low-lying areas that will become increasingly susceptible to flooding as a result of sea-level rise. These are vivid examples of the benefits of social and technical expertise when identifying groups that are particularly vulnerable to climate change.

Figure 7: **Slums and Vulnerability in Khulna, Bangladesh***



* Source: Bangladesh Centre for Advanced Studies

Figure 8: **Slums and Vulnerability in Mombasa, Kenya***



* Source: African Centre for Technology Studies

Participatory Vulnerability Assessments: Brainstorming and Spider Diagrams*

A number of participatory techniques enable communities to identify and categorise climate threats before assessing any relationships and inter-connections between them.

A brainstorming procedure can identify relevant issues, topics and questions, each of which is written down on a piece of card or paper or a 'post-it' note. Once the cards are posted on a wall, participants split them into a number of main themes. For the purposes of local planning for climate change, this exercise can focus on perceived vulnerabilities or proposed responses.

Spider diagrams can function in a similar way, identifying linked ideas. A central issue, topic, or question is proposed – for example, related to the effects of climate variability on a particular location. This is the opportunity for all participants to come up with associated issues, topics and questions that can be written down (probably on a flipchart) and to specify the connections between them.

* Adapted from Pretty J, Guijt I, Scoones I, Thompson J (1995). *A Trainer's Guide for Participatory Learning and Action*. IIED Participatory Methodology Series, International Institute for Environment and Development.

2.5.6 ASSESSING ADAPTIVE CAPACITY – THE ABILITY TO RESPOND

Adaptive capacity is the ability or willingness of stakeholders to respond to the impacts of climate change by reducing potential damages, taking advantage of opportunities, or coping with the consequences. This ability is a function of awareness, capacity and willingness to act. Cities, sectors and communities can show different degrees of adaptive capacity.

At city scale, adaptive capacity can entail the preparation of a detailed climate risk-assessment together with able and committed staff. Other stakeholders can also shape a city's adaptive capacity, provided they are well organised and effective (community groups, non-governmental organisations and business). Table 13 below shows how institutions, governance and engagement of city leaders can combine with availability of information and financial resources to strengthen the adaptive capacity of urban authorities.

Table 13: **Adaptive Capacity Matrix for Cities**

Element of adaptive capacity	Potential indicators
Institutions and governance structures	<ul style="list-style-type: none"> • Dedicated administrative departments or positions within city and national government • Overall transparency and efficiency of governance structures (e.g., as measured by UN-Habitat's Urban Governance Index)
Determined city leadership	<ul style="list-style-type: none"> • Endorsement by Mayor and/or senior officials • Climate-relevant laws and bye-laws • Attendance of relevant international workshops and meetings • Membership of international networks for climate change response (e.g. Cities for Climate Protection, C40 Climate Leadership Group)
Availability of relevant information and resources	<ul style="list-style-type: none"> • Local and national research programmes on climate impacts • Relevant research from local academic community
Financial resources	<ul style="list-style-type: none"> • Dedicated budget for disaster risk reduction and climate change adaptation • Per capita GDP (indication of household/community adaptive capacity) – but it is important to remember that this is an average figure, and may not be distributed evenly across the population

Adaptive capacity can be found within specific sectors, too, and can also have been built already in infrastructure systems. In this respect, some networks are better able to adapt than others. For example, a water supply system relying on multiple sources is better able to cope when one of these is disrupted than one that relies on a single major source. Similarly, an electricity

network that can boost production from one generation system to make up shortfalls in another also features higher adaptive capacity. Some options for adaptation – which by themselves already assume some degree of adaptive capacity – are shown in Table 13. However, the adaptive capacity of these critical sectors and infrastructure can best be assessed by expert working

groups that are aware of the specific technical issues affecting these. Individuals and communities also feature various degrees of adaptive capacity, which can be

assessed with the matrix below (Table 14). This methodology will highlight the assets –technical, financial, or social – that are already available.

Table 14: Capacity for Adaptation: A Matrix for Communities*

Topic for discussion	Discussion output
What resources are available to the community (services, technology, skills, etc.)?	List of community assets that could be used for adaptation
What would community members miss if a resource was taken away?	List of community values and focused priorities for adaptation
What assets do/could the community use to respond to climate-related disasters?	Assessment of current adaptive capacity

* Source: CCCI team in Sorsogon

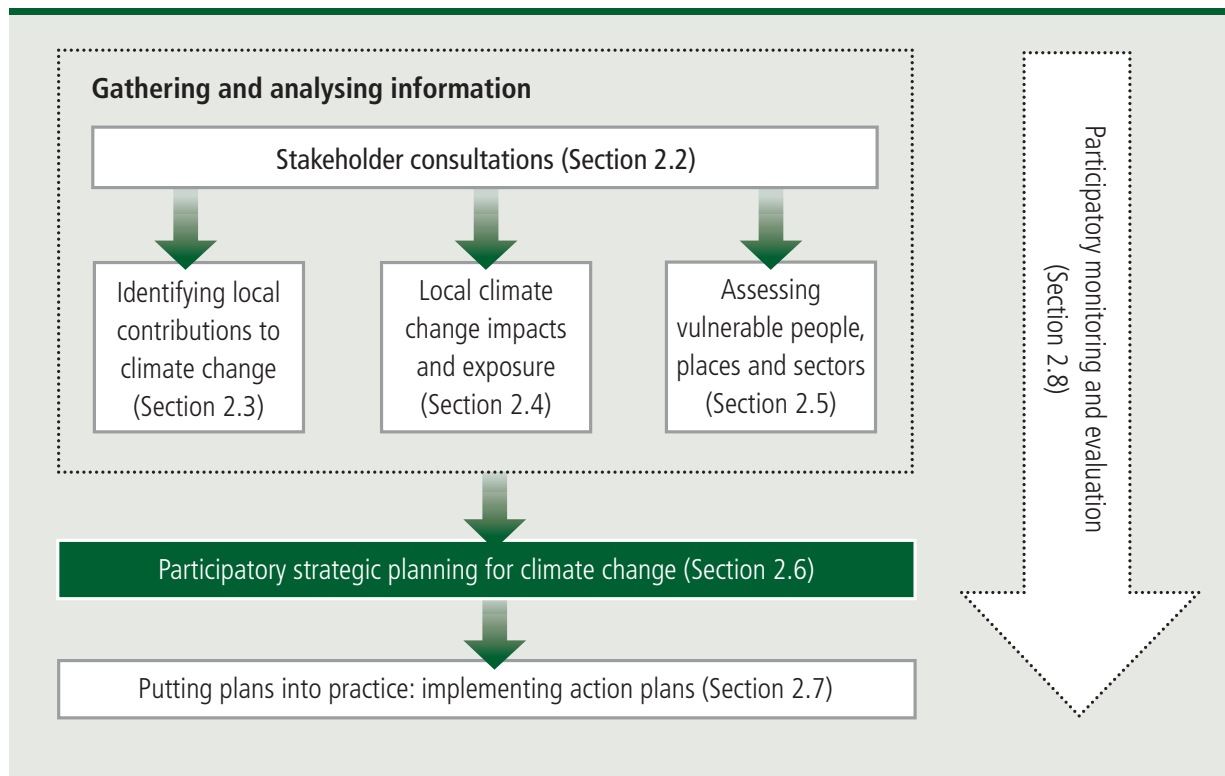
Assessment of adaptive capacity has two main roles: identifying which cities, sectors and communities are most vulnerable to climate change; and highlighting what potential resources are available to address

climate variability and change. Such assessment can also point to particular areas in need of strengthening when planning for climate change, as described in the following sections.



Children playing on the bank of Teaone River in Esmeraldas, Ecuador © UN-Habitat/Francois Laso

2.6 PARTICIPATORY STRATEGIC PLANNING FOR CLIMATE CHANGE



Many aspects of strategic planning for climate change share significant common elements with good practice in more general planning for sustainability.



2.6.1 INTRODUCTION

The first stage when responding to the challenges posed by climate change is the development of a vision for the future, i.e., a clear statement of what the desired outcome is to be. This section outlines some of the main components of strategic planning that can serve as the basis for the development of specific projects and tasks. As discussed earlier in this document, the starting point for strategic planning will differ across locations and countries. The process presented here is intended to be sufficiently flexible to be inserted into local and national strategies and accommodate any such differences.

This section on **strategic planning for climate change** provides guidance on the following five steps:

- The process of strategic planning;
- Strategic planning for climate change adaptation and mitigation;
- Supporting adaptation efforts by households, community organisations, Non Governmental Organisations and the private sector;
- Mainstreaming climate change into existing urban plans;
- Developing stand-alone climate change plans.

Strategic planning is the process of defining a particular direction in which an organisation or institution wishes to go, which serves as the basis for decisions on more specific interventions. Traditionally, strategic planning involves an analysis of the current situation, defining goals and objectives, and identifying the best possible pathway to achieving them. Many aspects of strategic planning for climate change share significant common elements with good practice in more general planning for sustainability. However, responding to climate change requires an additional stage: assessing future conditions that may be very different from those prevailing today. This section describes the broad process of strategic planning and how it can be made relevant to climate change adaptation and mitigation. Next comes a review of how urban authorities can support efforts by other stakeholders (including households, community organisations, NGOs and the private sector) to respond to climate change. The final sections weigh up the respective merits of mainstreaming climate change into existing urban plans, or of producing other types of stand-alone plans (including local climate change action plans,

local comprehensive climate change plans, sector-based climate plans, community-based climate plans, and the use of major interventions as entry points) that can meet specific climate change objectives.

2.6.2 THE PROCESS OF STRATEGIC PLANNING

Development of a strategic plan for climate change adaptation or mitigation involves the same general principles as for any other strategic plan. One typical pathway involves the following stages:

- **Prevailing conditions:** assess the current situation and how it came about;
- **Target:** define the intended outcomes of the plan;
- **Path:** map out a route to achieve these outcomes.

An alternative approach is known as 'draw-see-think'. Participants are encouraged to take a thorough look at various issues based on four more specific questions:

- **Draw:** what is the desired outcome?
- **See:** what is the current situation (and, in the case of climate change, the likely future situation)?
- **Think:** what actions are required to move from the current to the desired situation?
- **Plan:** what actions and resources are required to achieve this?

Planning can often be enhanced through a SWOT analysis, taking in both internal and external factors, as follows:

- **Strengths:** the internal attributes that will contribute to the desired outcomes;
- **Weaknesses:** the internal attributes that work against the desired outcomes;
- **Opportunities:** the external attributes that will contribute to the desired outcomes;
- **Threats:** the external attributes that work against the desired outcomes.

It is important to identify these strengths, weaknesses, opportunities and threats as they will become part of subsequent plans and projects. It is just as important to consider

how strengths and opportunities can be used to their fullest and how weaknesses and threats can be smoothed out.

The strategic planning process should involve the stakeholders identified in Section 2.2. It should build on the assessments of local contributions to climate change, local climate change impacts, and vulnerability to climate change in order to address the main issues that have been identified. This can be supplemented by a series of questions about methods, actions, and interventions. Based on the outcomes of city consultations, working groups and the group in charge of adaptation policies could reflect on the following questions:

- Of all the community's development priorities, what are the main ones for adaptation and mitigation in the short and the longer terms?
- How will these priorities contribute to a resilient community?
- What planning and design challenges are associated with these priorities?
- What challenges will climate change present in relation to attaining these goals?

Devising Strategies: The SCP Process*

UN-Habitat's Sustainable Cities Programme (SCP) provides clear guidelines for the development of strategies for urban sustainability. Even though these are presented in a particular order, it is recognised that the complex nature of environmental issues – including climate change – requires an iterative process with back and forth movements, feedback and adjustments.

* Source: UN-Habitat SCP Source Book v4

The SCP strategic process went through four steps:

1. Defining Goals and Objectives

Goals set out the desired future state. They can be broad and general – for example, ‘achieving sustainability’ – but fall short of providing strategic guidance. ‘Good’ objectives are realistic enough to be understood readily, but ambitious enough to be challenging and to bring significant improvements with them.

2. Assessing and Negotiating Strategies

This refers to the direct involvement of stakeholders in strategy development. Instead of the technical approach of conventional strategic planning, it takes a broader selection of participants to envisage sustainability (and climate change), and this represents a methodological shift. Assessing strategies can call on a variety of techniques, including SWOT and Force Field analyses.

3. Considering Resources and Options for Implementation

Strategy development calls for consideration of a variety of issues, the three most important being as follows: the efficacy of implementation instruments (can new regulations be enforced?); availability of resources (one should never opt for a strategy before wondering whether the resources to back it up are available); and absorption capacity (implementation capacity may not be sufficient even if resources are available).

4. Agreeing on Strategies and Mobilising Support

Effective strategies require firm and lasting commitments at the policy decision-making level. Strategies are best devised through a participatory process, frequently involving working groups (see Section 2.3.3). However, strategies should still be discussed further in mini-consultations or review workshops, with four main benefits: eliciting reactions and inputs from additional sources; clarifying strategies and how they relate to other plans, securing wider support, and publicising strategies more directly.

2.6.3 STRATEGIC PLANNING FOR CLIMATE CHANGE ADAPTATION AND MITIGATION

Strategic plans for adaptation

Strategic plans can play a significant role in adaptation to climate change in urban areas. This requires developing, organising and refining actions and strategies to build resilience. The preceding sections have shown how to identify the specific challenges

that a given location is facing. This section highlights a number of major questions that can shape appropriate responses. These questions can be broadly grouped into three main categories: identifying adaptation actions, implementing adaptation interventions, and support and resources (Table 15).

Table 15: **Critical Questions to Shape Adaptation Strategies**

<p>Identifying adaptation actions. These specific actions can be taken to reduce climate change-induced risks</p>	<ul style="list-style-type: none"> • Which anticipated impacts will require adaptation? • What can contribute to adaptation in the overall development context? • What are the social, environmental and economic benefits of adaptation plans?
<p>Implementing adaptation schemes. These longer-term actions fit into the broader urban development framework</p>	<ul style="list-style-type: none"> • What are the preferred options combining development priorities and adaptation needs? • Can ‘win-win’ or ‘high-value’ interventions be identified? • What is needed in the short-, medium- and long term to implement these act interventions? • What capacities and resources are required for effective implementation? • Who will be in charge of overseeing the overall process? • How will progress be measured and evaluated? • How will lessons learned be incorporated into future planning?
<p>Support and resources. These are the pre-requisites for implementing adaptation actions and interventions.</p>	<ul style="list-style-type: none"> • How will implementation be funded? • Who is in charge of implementation at the government department level? • Is project implementation supported at all levels? • Are adequate capacities and resources available? • Are education, outreach and communications strategies required? • Does implementation require support or involvement from other agencies?

Case Study 9: **When Local Authorities Take the Lead: Lami, Fiji**

In Fiji, the municipality of Lami has devised plans for climate change risk and disaster preparedness through a fully consultative approach. A coastal town on Viti Levu Island, Lami is particularly exposed to cyclones, flooding, coastal and river bank erosion and landslides.

In consultation with the Ministry of Local Government, Urban Development, Housing and Environment (MLGUDHE) and the Disaster Management Committee, the municipal council has identified synergies with the national framework for risk management. This exercise also clarified the roles and responsibilities of national and local governments and improved their relationship, as well as the emergency response.

At the same time, the council worked on preparedness: mapping risk-prone areas, raising awareness on vulnerability and developing community plans. In the process,

the council also became more familiar with the various aspects of climate change vulnerability as experienced by the population, and enhanced the communities' understanding of the role (and capacity) of the council in the face of climate-induced disasters. The effective partnership between the Lami council and the community has also been showcased for the benefit of the national government, showing that local authorities can do more than act just as information centres, indeed taking an active role in risk management and resilience-building.

Strategic plans for mitigation

Local planning can make a significant contribution to reducing global greenhouse gas emissions. In this respect, four main channels are available to local authorities, as follows:

- **Curbing any direct emissions from their own functions/operations:** Local authorities own or lease buildings, use energy for lighting, cooling or heating, use water, operate fossil fuel-powered vehicles, and generate waste. Decisions made in all of these areas can directly reduce greenhouse gas emissions.
- **Well-devised regulations, taxation and incentives** (where applicable) can discourage activities that release greenhouse gases and encourage those that reduce such emissions by households and industry within the municipal boundary. This can include setting limits on some actions, imposing direct taxes on higher emitting activities, providing tax breaks for 'green industries', or developing standards for 'green' buildings.
- **Land-use planning.** Where local authorities are in charge of land-use planning, 'smart' urban design that encourages relatively high densities and the use of public transportation can reduce the need for private transportation. This

must come hand in hand with the provision of green spaces that can absorb carbon dioxide.

- Through the **provision of an enabling framework** to encourage individuals and companies to reduce emissions. Where local authorities take the lead in greenhouse gas reduction, individuals and companies are likely to follow.

These actions can affect a number of sectors, such as the following:

- **Energy.** What incentives can be provided to reduce energy consumption by local government, households and industries, and to promote the use of renewable energy?
- **Transportation.** How can price mechanisms, taxation, urban planning, and the development of infrastructure result in more climate-friendly transportation systems?
- **Waste Management.** How can the amount of waste generated be reduced? How can waste disposal sites be managed – for example through landfill gas capture – to reduce carbon emissions?

2.6.4 STAKEHOLDER INVOLVEMENT IN CLIMATE CHANGE PLANNING

In many urban centres in low- and middle-income countries, local authorities wield less influence through what they can afford to build or invest in than through what they can encourage, in terms of behaviour, action or capital spending, among households, community organisations, civil society and business. This means that with regard to climate change adaptation, local government must, first of all, be sure to disseminate appropriate and easy-to-understand information among all stakeholders. On top of that, existing planning and regulatory powers can impose effective land-use planning whereby (1) new developments are kept away from high-risk areas (which also means ensuring low-income groups can find land-for-housing that they can afford and on non-dangerous sites) and (2) buildings and infrastructure are adapted to climate-change risks (focusing on affordable options).

Any urban authority opting to support bottom-up approaches should have the capacity to support large numbers of risk-reduction initiatives that emanate from local communities and are managed by them. Many such initiatives may not be costly and may see local authority funds mobilising household/community contributions. This supporting capacity is typical of many cities that have instituted participatory budgeting, i.e., where residents collectively determine which improvements for their neighbourhood they want to be included in the municipal budget. For instance, a settlement at risk from landslides can have municipal funds allocated to slope stabilisation. Of course, this works particularly well where local authorities have the capacity to provide citywide supporting infrastructure or services – for instance,

the trunk drains into which community-managed local drains feed.

2.6.5 MAINSTREAMING CLIMATE CHANGE INTO EXISTING PLANS

Apart from stand-alone plans, mainstreaming is the other major option for local planning for climate change. An integrated approach to climate change risk may require changes to a wide range of existing urban plans (including land-use or development plans and sector strategies). This is a good way of making sure that all aspects of urban functions are protected from the worst impacts of climate change. This approach requires considerable knowledge and commitment from a wide range of municipal/urban functions.

Cities concentrate people and production, together with all the inputs/goods they use and the wastes they generate. In the process cities also concentrate a variety of hazards. Any well-conceived urban development plan or strategy is inevitably seeking to reduce three types of environmental hazard: biological pathogens (disease-causing agents), chemical pollutants and physical hazards. Indeed, most forms of infrastructure (e.g., provision of water, sanitation and drainage) and most regulations on the workplace, buildings and planning find their roots in the reduction of environmental risk, even if the form they take or the way they are implemented no longer serve this purpose. Many regulations, services or forms of infrastructure are not designed to be specific to particular hazards, but rather to provide general protection. For instance, sewers and drains reduce the risks of water-related diseases and of flooding. Health care systems are intended as responses to all illnesses and injuries, regardless of whether these arise from pathogens, pollutants or physical hazards. Insurance – for property, possessions, workplace equipment, or

life – is also intended for a ‘multi-hazard’ environment. Building regulations similarly reduce risks to a variety of environmental hazards. Infrastructure standards, building regulations, land-use controls and the way services are organised should all also include defences against the effects of extreme weather events and their prospective higher intensity or frequency.

If climate change is to be mainstreamed into existing or amended urban plans, the following three priorities should be addressed:

- **Prevent:** What can be done to prevent climate impacts in the particular sector at hand?
- **Prepare:** For impacts that cannot be prevented, how best to anticipate and make sure that any damage is not extensive?
- **Respond:** How can local authorities, civil society and business address the consequences of a climate event?

Examples of Plans that Require Climate Change Mainstreaming

Local authorities are in charge of a variety of plans, many of which require amendments if they are to take in the challenges of climate change. Among these plans are the following:

- Medium/long-term urban/municipal development and strategic plans, including master plans;
- Strategic land-use plans;
- Development orders;
- Strategies and plans for water management;
- Strategies and plans for waste management;
- Strategies and plans for energy supplies;
- Management plans for coastal zones.

2.6.6 DEVELOPING STRATEGIC, STAND-ALONE CLIMATE CHANGE PLANS

Apart from mainstreaming into existing frameworks, local planning for climate change can use a number of other approaches. These are summarised in

the table below (Table 16). They are all based on a combination of stakeholder engagement, an analysis of the effects of climate change, and an assessment of vulnerability. Differences lie in the ways in which responses are developed, and those who take the main responsibility for implementation.

Table 16: **Local Planning for Climate Change: Six Approaches**

Approach (not mutually exclusive)	Appropriate Situation (when to use this approach)	Major needs (legislative, technical, financial, etc.)	Potential strengths	Potential weaknesses	Examples
Mainstreaming into Existing Plans	Existing and regularly updated urban plans (land- use plans, development orders, sector strategies). Existing plans are funded and implemented. National legislation mandates integration of climate change issues into existing plans.	Political support for process. Legal and institutional scope for mainstreaming. Legal requirements.	Strongest potential for resulting in systemic changes that take in climate change.	Risk of overlooking the needs of the more vulnerable groups	
Local Climate (Action) Plan	Can support / drive mainstreaming into existing planning framework. Can attract funding and support. Can address gaps in existing plans.	Political support for process.	Easy starting point / achievable without external support. Flexible.	Initially not comprehensive. Implementation may include mainstreaming, making it a more complex process. Short or medium term.	

Local Comprehensive Climate Change Plans (stand-alone plan)	<p>Political support for this approach.</p> <p>Statutory plans are non-existent, out-dated, poorly implemented and/or not funded.</p> <p>Legal requirement for explicit climate change plan.</p>	<p>Political support for process.</p> <p>Financial and technical support to develop plan.</p>	<p>May facilitate coordination between stakeholders.</p> <p>Potentially more effective to attract funding.</p>	<p>Effective achievement of systemic change.</p>	
Sector-Based Climate Plans	<p>Lack of political commitment for city-wide planning.</p> <p>Driven by national ministry or relevant authority.</p>	<p>Relatively strong utilities (e.g., electricity, water).</p>	<p>Focused and specific.</p>	<p>Inadequate focus on social dimensions of vulnerability.</p> <p>Local government may not have any authority over certain sectors.</p>	<p>Local government provides incentives for privately owned utility to develop climate plan.</p>
Community-Based Climate Plans	<p>Lack of political commitment for citywide planning.</p> <p>Strong localised risks.</p>	<p>Strong civil society organisations.</p>	<p>Likely to address needs of the more vulnerable groups.</p>	<p>Limited capacity to address infrastructural needs.</p>	
Major Interventions as Entry Points	<p>Major urban interventions are on-going.</p>	<p>Support from donor/ implementing agencies.</p>	<p>Focused and specific.</p>	<p>Does not address broader issues of vulnerability.</p>	<p>Slum upgrading, water and sanitation, drainage systems</p>

Often known as ‘Municipal Climate Plans’, stand-alone climate change plans can, in fact, be fairly comprehensive, and can exist alongside a mainstreaming process. They can also come in handy where urban governance is split between several distinct authorities. A comprehensive climate change plan can incorporate a number of different strategies. For example, in

Chicago, USA, the local Climate Action Plan includes a diversity of components such as energy-efficient buildings; clean and renewable energy sources; improved transportation options; reduced waste and industrial pollution; and adaptation²⁹.

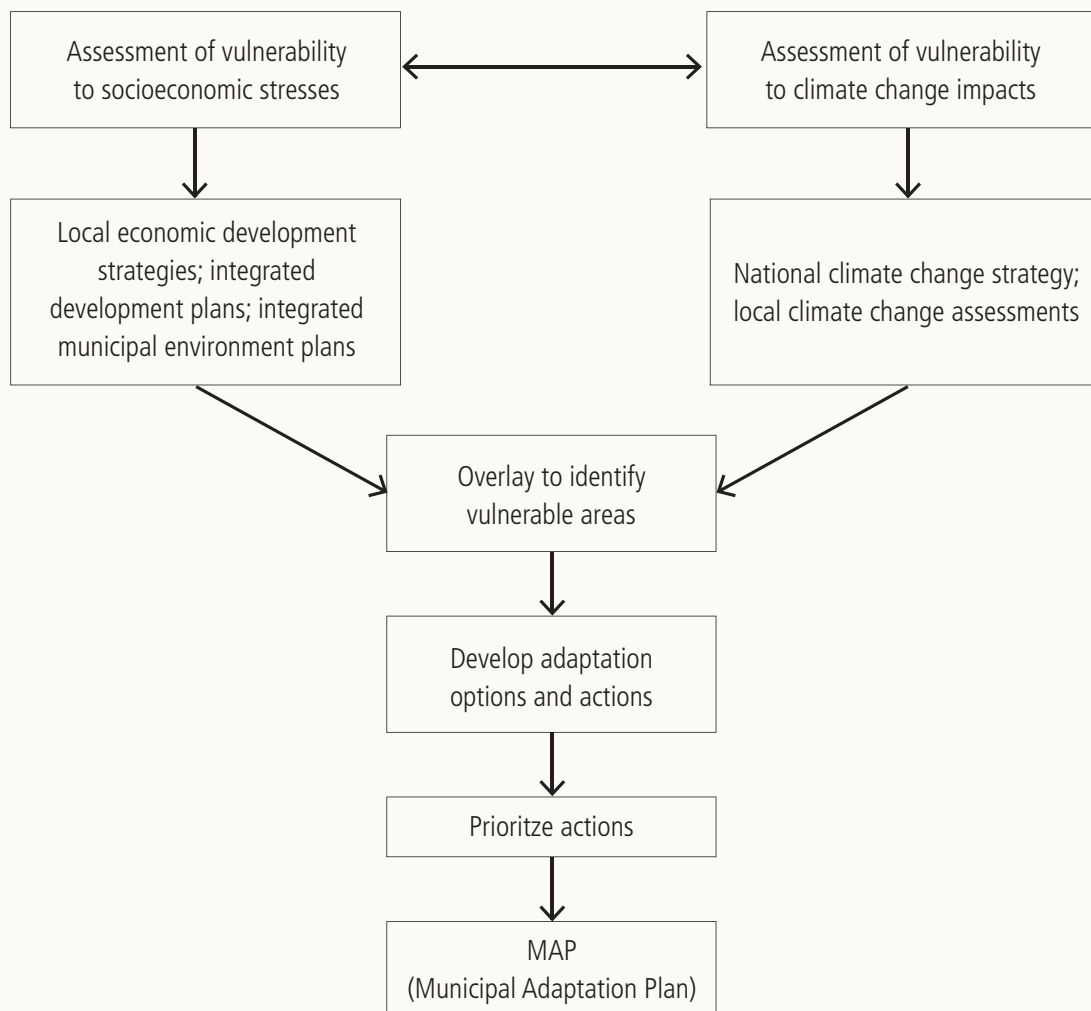
²⁹ Chicago Climate Action Plan: www.chicagoclimateaction.org

In other circumstances, it may be more appropriate for communities or sectors to develop their own climate plans. Communities are familiar with current local risks and how to tackle them. Where community-based and non-government organisations are well-established and

capable, they can develop local responses to climate change together with municipal authorities. Similarly, professionals operating in major urban sectors – including water, sanitation and electricity generation – are often best placed to identify what they can do to respond to climate change.

Case Study 10: Developing a Municipal Adaptation Plan in Cape Town*

Cities in South Africa have started planning for climate change. In Cape Town, South Africa, the process for developing a Municipal Adaptation Plan recognizes that this cannot simply be a linear process, but requires a variety of simultaneous and interlocking activities (see below). At every stage, these steps are complemented by two crosscutting processes: stakeholder engagement and adaptive capacity assessment.



* Source: Mukheibir P, Ziervogel G (2007) 'Developing a Municipal Action Plan (MAP) for Climate Change: the city of Cape Town' *Environment and Urbanization* 19(1): 143-158.

Case Study 11: Strategic Planning in Durban, South Africa

Borrowed from Debra Roberts (2010), 'Prioritising climate change adaptation and local level resilience', *Environment and Urbanisation* Vol. 22 No. 2 October 2010.

The eThekweni Municipality is the local government in charge of managing and planning the city of Durban. Since 2004 the Municipality has been working on the implementation of a Municipal Climate Protection Programme (MCCPP). This programme is largely climate change adaptation based – quite unique for a municipal climate change plan at the time when mitigation often featured more prominently – looking at impacts of climate change to the city and developing suitable local responses. The reason for this approach was that the municipality felt that by following adaptation strategies there would be a complimentary balance to on-going development and poverty alleviation work, especially to show gains in post-apartheid development.

The road map to institutionalizing adaptation within eThekweni Municipality has not been smooth but one in which lessons learnt have constantly being reflected upon and internalized to produce more appropriate strategies. In 2006 the Headline Climate Change Adaptation Strategy (HCCAS) was developed from the adaptation work stream of the MCCPP and the initial assessment on climate change impacts for the city. The HCCAS focused on the key municipal sectors that would be most affected by climate change and highlighted adaptation options that these sectors could follow. However, the institutional ability of these sectors varied considerably: some sectors such as the water sector were already implementing adaptation measures, albeit under a different heading, and others due to their lack of awareness, capacity or institutional mandate were prohibited from taking action. One such sector was the Disaster Management Unit whose mandate was primarily a reactive one to disasters and not a proactive one to preventing these disasters from happening in the first place. This finding, relating to the Disaster Management Unit, was one of the major findings of the HCCAS that identified the need for the Unit to work with other sectors to develop an early warning system, ensure resilience is in-built into infrastructure and improve urban planning to reduce the vulnerability of new developments.

The HCCAS laid a good foundation for the need for engaging different municipal sectors and the importance of a central and functional disaster management system. However it did not stimulate any new adaptation action and the main reasons attributed to this were identified as:

- The high level and generic nature of the strategy;
- Excessive existing workloads;
- Urgent development challenges/pressures that resulted in issues perceived as less urgent being ignored;
- The perception of climate change as a distant and unlikely threat; and
- A shortage of skills and funds.

To correct this, the municipality decided to pilot adaptation planning into two sectors only, the health and water sector. The planning process involved developing more sector

specific adaptation plans but which were aligned to existing sectoral business plans, development objectives and which could be executed within the available budget and human resources. During the development process of these plans it became evident that in adapting to climate change both these sectors would also have to have an element of emergency response and disaster risk reduction but on a strategic planning level. It was therefore decided that in parallel a third municipal adaptation plan would be prepared for the disaster management sector. This third adaptation plan would in the end form the umbrella under which a large part of eThekweni municipality's adaptation measures would be implemented. The plan consists of:

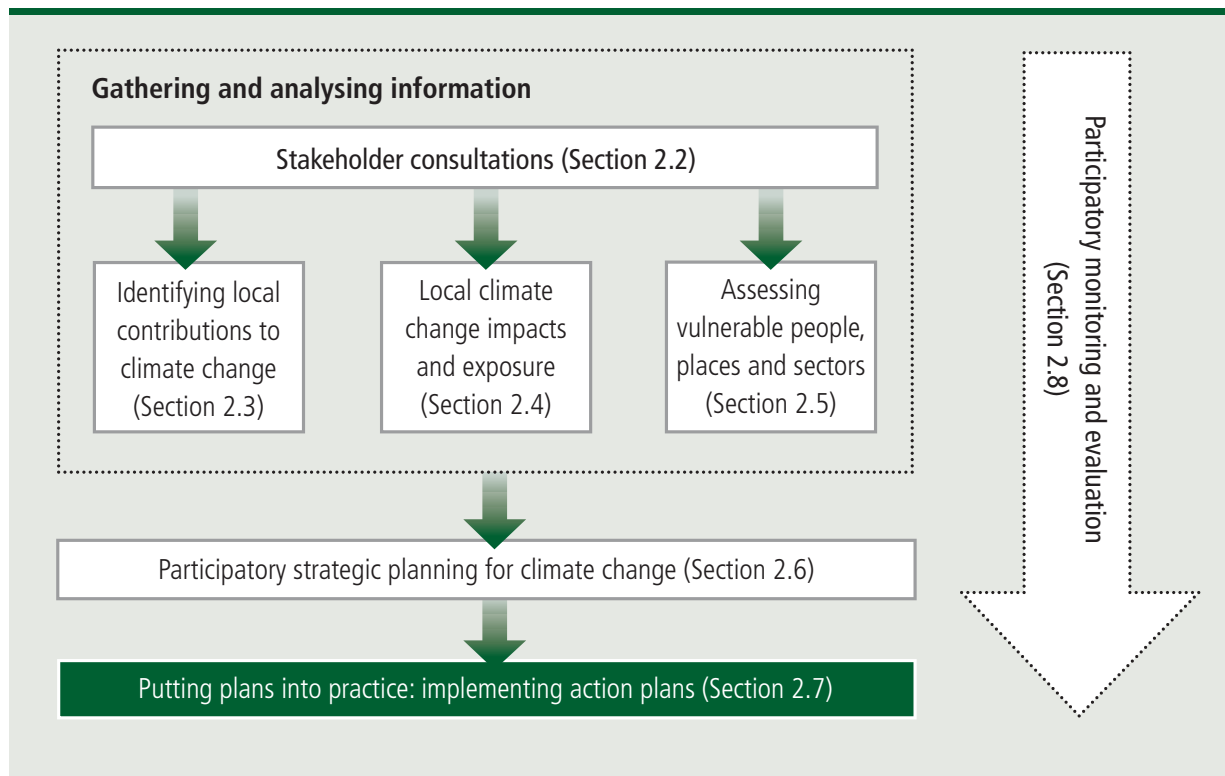
- Implementation of the disaster risk management framework (approved in 2009);
- Comprehensive citywide risk assessment;
- Securing additional human resources for the Disaster Management Unit;
- Revision of the contingency plans for key risk areas;
- Hosting a disaster risk management summit.

To date the following projects have been included under this plan:

- Climate Smart Communities pilot projects, involving community-based adaptation planning; food security and implementation of micro scale agricultural water management technologies;
- Use of community theatre in community adaptation planning as a means to communicating the threats to climate change;
- Community reforestation project;
- Green roof pilot project;
- Sea-level rise modelling;
- 2010 FIFA world Cup, Durban was the only city which committed to being climate neutral for the event by planting trees but also produce a Green Guideline Series on issues such as water and energy efficiency;
- The Durban Climate Change Partnership.

The planning process in eThekweni Municipality shows the lengthy process involved in institutionalizing adaptation measures in municipalities by following a sectoral approach and then scaling it down to a few sectors. It also shows the dominance of a Disaster Management Unit not merely as a responsive unit but a proactive unit. The institutional structure has a large bearing on the successful integration of adaptation related work into a municipality's daily functions. Lastly local governments cannot be engaged in adaptation on their own and there is a strong consensus that key stakeholders and other institutions need to be on-board.

2.7 IMPLEMENTING ACTION PLANS



2.7.1 INTRODUCTION

Responses to climate change can take various forms (Table 17) and involve various stakeholders including households, communities, business as well as local and national governments. Once strategic plans have been developed, they give rise to specific projects aimed at various aspects of climate resilience. This section of the toolkit

focuses on the ways in which action plans can be implemented. Their role is to link the strategic planning process (described in Section 2.6) to more specific projects. They are short-term responses that take place over a clearly defined and managed period of time. Action plans need specific budgets, independent of the funding source such as specific project funds or from the regular municipal budget.

This section on **developing specific projects** provides guidance on the following steps:

- Developing projects at the scale of the city;
- Developing adaptation projects for various sectors;
- Developing community-based adaptation projects;

- Climate change responses to meet multiple needs;
- Financing mechanisms for climate change projects.

Specific projects can involve either building adaptive capacity, or implementing adaptation on the ground*. To build adaptive capacity, a municipality can collect additional information, establish more supportive social structures, or improve governance. Adaptation measures include offsetting losses (by spreading or sharing risks or losses), preventing effects or reducing risks, or accepting impacts and bearing losses. These actions can be developed through city consultations and expert analysis; they can also arise as a result of coordinated action within communities to identify the more appropriate solutions.

* UK Climate Impacts Programme (UKCIP) (2008). *The UKCIP Adaptation Wizard v2.0*. UKCIP, Oxford. Available for download: www.ukcip.org.uk/wizard.

Table 17: Types of Response to Climate Change*

	Autonomous (households, communities, firms)	Policy-driven
Short term	Adjustments can include reduced water use, or spreading risk of loss through insurance	Greater understanding of climate risks and vulnerabilities; improved emergency response
Long term	Investing in climate resilience – encouraged highly desirable option where future effects are relatively well understood and benefits are easy to capture for households, community organisations or firms	Invest in new or well-adapted infrastructure (e.g., larger reservoir storage, increased drainage capacity, higher sea walls); avoiding negative impacts (e.g., land-use planning to restrict developments in floodplains and exposed coastal sites)

* Stern N (2007). *The Economics of Climate Change: the Stern Review*. Cambridge University Press, Cambridge.

2.7.2 CITY-BASED ADAPTATION PROJECTS

Some cities have begun to implement action plans as part of the UN-Habitat *Climate Change Initiative*. In Esmeraldas, Ecuador, the municipality's adaptation strategy includes both investment in infrastructure and institutional approaches. Structural changes include construction of upstream water storage and flood control systems (e.g., dams and reservoirs), levees, and

expansion of drinking water and sewage networks. Institutional instruments include changes in zoning systems and improved governance. In Maputo, Mozambique, some institutional mechanisms have been deployed on top of new or amended policies, together with mainstreaming adaptation in all projects, some of which are outlined in Table 18 below.

Table 18: **Specific Adaptation Responses: Maputo, Mozambique***

Major areas of vulnerability	Specific adaptation responses
Urban infrastructure and planning	Improved drainage/storm water system Strengthening coastline protection dikes Development and implementation of urban plans
Housing and building standards	Construction of environmentally sustainable social housing Mainstreaming natural disaster resilience into building standards
Water, sanitation and health	Sustainable use and supply of water Provision of basic services to the urban poor Health education and promotion
Urban environmental quality and 'green' areas	Improved management of solid waste Support to urban agriculture Protection of 'green' areas and wetlands Deployment of environment-friendly water treatment systems

* Developed by CCCI team in Maputo

2.7.3 SECTOR-SPECIFIC ADAPTATION PROJECTS

Many of the practical responses to the challenges of climate change must be deployed within specific sectors. Sectors such

as water supply, storm-water management, energy and public health all need to develop their own responses, and these are bound to be different across different locations. Table 19 provides some examples.



Kampala City Authority workers clear drainage along the Mulago-Kalerwe Road

© UN-Habitat/Nicholas Kajoba

Table 19: **Preparedness: Goals and Actions for Specific Sectors***

Priority Planning Area	Preparedness Goal	Preparedness Actions
Water supply	Expand and diversify water supply	Develop new groundwater sources Construct new surface water reservoirs Enhance existing groundwater supplies through aquifer storage and recovery Develop advanced wastewater treatment capacity for water re-use Develop strategies for recharging of groundwater (addresses both flood control and drought preparedness objectives)
	Reduce demand / improve efficiency	Increase billing rates for water Change building rules in favour of low-flow plumbing fixtures Provide incentives (e.g., tax breaks, rebates) for switching to more water-efficient processes
	Increase drought preparedness	Update drought management plans to recognise changing conditions
	Increase public awareness of impacts on water supplies	Provide information (on the effects of climate change on water supplies and how residents can reduce water use) through various channels (utility newsletters, Websites, local newspapers, etc.)
Storm- and flood-water management	Increase capacity to manage storm-water	Increase capacity of storm-water collection systems Change urban landscaping requirements to reduce storm-water runoff Preserve ecological buffer zones (e.g., wetlands)
	Reduce property damage from flooding	Move or abandon infrastructure in hazardous areas Change zoning to discourage developments in flood-exposed areas Update building codes to require more flood-resistant structures in floodplains
	Improve information to municipal departments on storm and flood events	Make more use of climate and weather information when managing risk and events Update flood maps to reflect the risks associated with climate change
Public health	Reduce impacts of extreme heat events	Improve early warning systems for extreme heat events Make additional cooling centres available during extreme heat events Increase use of shade trees to reduce urban temperatures
	Improve disease surveillance and protection	Increase monitoring of known diseases and potential diseases moving into the area Increase public education to pre-empt increases in climate-related vector-borne illnesses

* Adapted from ICLEI (2007) and IPCC (2007) Table SPM4

Energy	Ensure consistency of energy supplies while expanding to low-income groups	Strengthen overhead transmission and distribution infrastructure Install underground cabling for utilities Reduce dependence on single sources of energy
	Reduce greenhouse gas emissions associated with energy use	Increase energy efficiency Use more renewable sources
Transportation	A transportation network that functions despite changes in temperature and precipitation	Realign or relocate transport infrastructure Improve design standards and planning for roads, rail and other infrastructure
	A transportation system that facilitates rapid emergency responses	Develop effective emergency plans for evacuations by public transport, etc.

When the time comes to implement the proposed actions, this process can be expanded into a task-stakeholder matrix. Table 20 shows how the first preparedness goal from Table 19 can be implemented. It is important to remember that this is only a guideline – in reality, the more detailed the matrix, the more effective it will be. Each stakeholder should commit or confirm that they have the funding needed to carry out the functions assigned to them, and should focus on integrating these tasks into their own work programmes and budgets. In addition, the matrix should not just show which stakeholder is in charge of a particular action, but also identify clearly what that action is.



Cities concentrate people and production, together with all the inputs/goods they use and the wastes they generate. In the process cities also concentrate a variety of hazards.



Table 20: **Water Supply: Task-stakeholder Matrix for Priority Planning***

	City Authorities	National Government	Water Authority	Civil Society / NGOs	Private Sector	Media
Develop new groundwater sources		✓	✓			
Construct new surface water reservoirs		✓	✓			
Enhance existing groundwater supplies through aquifer storage and recovery		✓	✓			
Develop advanced wastewater treatment capacity for water re-use	✓	✓	✓		✓	
Increase billing rates for water	✓	✓	✓			
Change building standards to require low-flow plumbing fixtures	✓	✓				
Provide incentives (e.g., tax breaks, rebates) for switching to more water-efficient processes	✓	✓	✓		✓	
Update drought management plans to recognise changing conditions	✓	✓				
Through various formats and media, provide information on climate change impacts to water supplies and how residents can reduce water use				✓		✓

* Adapted from UN-Habitat SCP toolkit volume 4

Case Study 12: Addressing Climate Change in Sorsogon, the Philippines

In Sorsogon, the Philippines, the Cities and Climate Change Initiative is addressing various climate change issues through several projects. These have been identified by action-planning Working Groups on four main issues facing the city: environmental management; livelihoods; disaster risk reduction; and shelter and basic infrastructure.

Issue No 1: Environmental Management

Demonstration project on carbon reduction; conversion to compact fluorescent lights and LEDs - The purpose is to reduce carbon emissions through conversion of lighting fixtures in public buildings (including health centres, schools and government offices). This is a low-cost intervention that carries three major benefits: energy savings, cost savings, and reduced greenhouse gas emission.

Issue No 2: Shelter and basic infrastructure

Construction and upgrading of climate change-resilient housing units - In some areas, almost half of households live in unsafe homes. Shelter conditions must be upgraded to become disaster-resilient. This project has developed and tested prototype housing units.

Issue No 3: Livelihoods

Enhanced skills for fishermen's disaster-resilience - Many households in Sorsogon City rely on fishing for subsistence. This project trains fishermen in basic building techniques – both as an additional source of livelihood and to enhance post-disaster recovery capacities in the community.

Issue No 4: Disaster Risk Reduction

Schools: mitigation, adaptation and response to risks and threats - Schools in Sorsogon are often used as evacuation centres following disasters. This project will enhance emergency facilities at schools, also ensuring that students can resume classes as soon as possible afterwards.

(For more information on this case study, see Section 3.4)

2.7.4 COMMUNITY-BASED ADAPTATION PROJECTS

Households and communities have important roles to play in climate change response. Local people are more familiar with the particular issues affecting their own lives and livelihoods, and therefore in a better position to develop appropriate solutions. Particularly in low- and middle-income nations, many of the general solutions proposed for adaptation are hardly relevant to local conditions. This section outlines several processes and methods that can support communities when developing their own local plans for climate change.

The LOCATE methodology (for *Local Options for Communities to Adapt and Technologies to Enhance Capacity*) focuses on community-based adaptation projects³⁰. It involves four successive phases: identification, design, implementation and monitoring/evaluation. Although it is primarily applied in rural areas, some changes can make it relevant to urban communities keen on appropriate responses to climate change. LOCATE combines top-down and bottom-up approaches to identify physical vulnerabilities. In the next step, the extent to which they bear on various

³⁰ Alam M, Mqadi L, Huq S, Rahman A (2008). 'Local Options for Communities to Adapt and Technologies to Enhance Capacity'. Unpublished paper: Bangladesh Centre for Advanced Studies / International Institute for Environment and Development.

aspects of community life is analysed and coded through a matrix ranking. This can apply both to livelihoods (both formal and informal) and to broader issues affecting wellbeing (food security, health, etc.).

The coding and ranking matrix (Table 21) identifies the main areas of vulnerability, in the process pinpointing existing and new coping ways of reducing any effects on livelihoods, wellbeing, etc.

Table 21: **Climate, Assets, Incomes and Wellbeing: The Locate Matrix**

	Temperature	Precipitation	Flooding or droughts	Sea-Level Rise	Extreme events
Formal employment					
Informal employment					
Home-based livelihoods					
Urban agriculture					
Food security					
Health					
Water					
Other					
[Impact rating: 0 = none 1 = small 2 = moderate 3 = severe]					

Various responses to climate change can be developed at the community level, but the actual number of such projects to date remains relatively small. In the absence of significant experience to learn from, it is best to start with relatively small-scale demonstration schemes, which can fall into several categories:

- *Knowledge-Sharing Projects.* Few communities today are familiar with climate change and its implications. This must be changed if they are to respond to the phenomenon.
- *Behavioural Change.* Changes in behaviour can contribute significantly to responses to climate change; for instance, altered patterns of energy use can reduce greenhouse gas emissions. More efficient use of water can contribute to

adaptation to long-term trends like more frequent droughts. Extreme weather events – which are likely to become more frequent and more severe – call for adaptation through improved information sharing and better preparedness.

- *Support for Autonomous Adaptation.* Households can play a significant role in contributing to climate change adaptation. It may take only small steps, such as building stronger walls or roofs, to make households noticeably more resilient to climate change. Community-led responses can create an enabling framework for households to make these positive changes.
- *Small-scale Infrastructural Projects.* Adaptation at the community level must take advantage of local knowledge

about local processes. Support for small-scale infrastructural projects is a good way of turning grassroots expertise into adaptation schemes in areas such as water, sanitation, drainage or flood control. Steps toward adaptation can be identified, implemented (labour) and preserved by the community.

2.7.5 SPECIFIC PROJECTS FOR MITIGATION

Reducing greenhouse gas emissions requires different types of action from one location to another. It is important to remember that many such actions can also generate side-benefits. For example, changing to more efficient lighting in public buildings will require initial capital spending, but subsequent reductions in energy consumption and greenhouse gas emissions will result in an overall reduction in costs. Similarly, projects that reduce the need for private motor vehicle use will promote alternative transport, improving local air quality and human health. Specific, small-scale mitigation projects have been developed in many towns and cities, as in Sorsogon, the Philippines, with the switch to compact fluorescent lights.

2.7.6 CLIMATE CHANGE RESPONSES CAN MEET MULTIPLE NEEDS

Many responses to climate change can also contribute to other social and environmental objectives in urban communities. Both mitigation and adaptation can come with various co-benefits. Reducing greenhouse gas emissions from manufacturing or motor vehicles will contribute to the broader environmental objective of improved air quality. In addition, a study in New York City concluded that carbon-reduction efforts can have a significant impact on public health:

“Most local-source air pollution comes from the burning of fossil fuels—and local air pollution is directly linked to mortality, cardiovascular diseases, and respiratory illnesses, including asthma among young children. Promoting walking and bicycling instead of driving reduces not only automobile emissions but also obesity—and obesity is linked to chronic conditions such as heart disease and diabetes. Promoting dense, transit-oriented urban environments that get people out of their cars also reduces the traffic fatalities that are a major cause of death in many parts of the world among otherwise healthy adults and young people.”³¹

Similarly, a variety of ecosystem services can enhance climate adaptation. In particular, more general environmental improvements such as the rehabilitation of wetlands and rivers, preserving woodlands, and planting trees can reduce flood risk, offset the urban ‘heat island’ effect, and reduce energy demands.

Perhaps most importantly, adaptation in urban settlements has many overlaps with improved infrastructural provision for low-income households and communities. Many low-income urban settlements are poorly served by water, sanitation and drainage provision, all of which can contribute to poor resilience to the shocks and stresses that will be exacerbated as a result of climate change. Climate change will bring more frequent and extreme rainfall, and proper drainage can alleviate this issue. There is also growing evidence that rising temperatures will lead to the increased spread of water-borne and water-washed diseases – and proper water and sanitation will help to prevent this. These are prime examples of convergence, where meeting broader development goals

31 Bloomberg M, Aggarwala R (2008). ‘Think Locally, Act Globally: how curbing global warming emissions can improve local public health’ *American Journal of Preventative Medicine* 35(5): 414-423: p414.

and meeting climate change adaptation needs come together. More generally, areas of convergence/overlap include the following:

- *Provision of quality infrastructure for all areas* (which should reduce risks of flooding for the whole city area, not just the wealthier neighbourhoods) and land-use management (to restrict settlements in high-risk areas, or make them more resilient);
- *Quality disaster-preparedness* (including warnings, damage-control and, if needed, assistance to people in need of urgent relocation);
- *Quality planning and coordination for disaster response* (for instance, rescue and appropriate emergency and health care services) and reconstruction (to help those who have lost their homes and livelihoods) which should aim to improve resilience, but seldom achieves this;
- *The extent to which the poor can buy, build or rent "safe" housing in "safe" sites;*
- *The extent to which local government create an enabling environment for local civil-society action* to contribute towards the practical aims listed above.

2.7.7 FINANCING CLIMATE CHANGE PROJECTS

As explained above, any strategic action in response to climate change should, as far as possible, be mainstreamed and internalised within already existing agencies, departments and programmes. However, it will often be necessary to identify and access sources of funding for particular projects to prepare for climate change. Many such sources are similar to those already available for broader environmental goals. Others are

more explicitly oriented towards climate change (as detailed in a companion toolkit on the Clean Development Mechanism and Voluntary Emissions Reductions by UN-Habitat, "Making Carbon Markets Work for your City").

The first stage is to quantify the funds required and to identify funding sources to implement particular projects. This task should be included at several phases in project planning:

- (i) *Strategic planning*: a rough estimation of costs and available resources early in the process;
- (ii) *Action planning*: a more detailed scrutiny of financial and other resource requirements, with separate estimates for major tasks and stakeholders;
- (iii) *Project formulation*: detailed cost estimates and specific sources of resources.

Conventional sources of finance

These sources are detailed in *SCP Sourcebook Volume 4* (Section B6). Five main sources of funding are available, as follows:

- Government (local, regional, national);
- The private sector (both formal and informal);
- Households and communities;
- Local NGOs, voluntary organisations, charities, etc.;
- International organisations.

A variety of strategies can be adopted to involve these stakeholders and mobilise resource commitments, as follows:

- Improving the revenue base of municipalities and their capacity for capital spending;
- Incorporating action plans and projects into government capital spending budgets and public works programmes;
- Enhancing the role of private sector finance;
- Strengthening the role of communities in financial and resource support;
- Involving donors at an early stage;
- Linking new and on-going initiatives.

External funding for mitigation projects

The need to reduce global greenhouse gas emissions has opened up several dedicated sources of funding for relevant projects. The most significant of these is the **Clean Development Mechanism** (CDM), which the United Nations Framework Convention for Climate Change (UNFCCC) developed as part of its mandate to reduce global greenhouse gas emissions. The mechanism enables emission reduction (or emission-removal) projects in developing countries to earn certified emission reduction credits that can be traded and sold to industrialised countries as part of their emission reduction targets under the Kyoto Protocol.

More than 1500 CDM projects have been approved around the world. In urban areas, many of these address issues such as electricity generation from landfill emissions; thereby helping to meet both energy security and greenhouse gas emissions needs. Full information about the CDM – and all the projects that have been submitted and approved to date – can be found on the UNFCCC website (<http://cdm.unfccc.int>).

Carbon credits under the CDM are certified under international agreements on greenhouse gas emissions reductions. There is also a ‘voluntary’ carbon market based on the generation of **voluntary emission reductions** (VERs, e.g., to offset the carbon imprint of air and other travel) through which individuals or companies make financial contributions to emissions reductions elsewhere.

This goes to show that local climate change plans can be associated with either CDM or voluntary emission reduction projects. These schemes can play two major roles in climate change policies: (1) they contribute to the global aim of reducing greenhouse gas emissions, and in the process restrict the extent of climate change; and (2) projects under either scheme can generate funds that can contribute towards the costs of adaptation to climate change.

For a guide to CDM project development, refer to UN-Habitat’s Publication, *‘Making carbon markets work for your city’*.

External funding for climate change adaptation

Further substantial developments have also occurred in recent years with regard to funding for climate change adaptation. However, so far they have not been particularly aimed at the local level³², although this is where adaptation policies and projects are expected to prove most effective. External funding for climate change adaptation/mitigation is available from two distinct sources: multilateral and bilateral.

Firstly, funding for adaptation has been developed under the auspices of the UNFCCC. At their Conference in Marrakech,

³² For a more detailed discussion of these issues, see Ayers J (2009) ‘International funding to support urban adaptation to climate change’ *Environment and Urbanization* 21(1): 225-240.

Morocco in 2001, UNFCCC signatory countries agreed that funding should be made available for “pilot or demonstration projects to show how adaptation planning and assessment can be practically translated into projects that will provide real benefits”. Three specific funds have been created to address these needs: the Least Developed Countries Fund, the Special Climate Change Fund, and the Kyoto Protocol Adaptation Fund. The Least Developed Countries Fund supports the design of National Adaptation Programmes of Action (NAPAs). The Special Climate Change Fund supports a limited number of mitigation, technology transfer, and adaptation projects. The Kyoto Protocol Adaptation Fund is explicitly designed to support adaptation projects in low- and middle-income countries and is funded directly by a levy on the Clean Development Mechanism. The Adaptation Fund is governed by an independent board and relies on revenues from the CDM levy initially expected to amount to USD160- 190 million per year. However, the Fund can only take applications from national governments, rather than local authorities or civil society. Various other proposals have been made for adaptation financing under the UNFCCC, including a levy on international air travel or maritime bunker fuels – as yet, these are only in the discussion phase. At the conference of the UNFCCC in Durban, countries agreed to the broad design of a global Green Climate Fund, however, how this mechanism will be funded remains unclear.

Donor funding for local climate change projects: Dedicated multilateral and bilateral funds for adaptation include the World Bank’s Pilot Programme on Climate Resilience. Donor agencies have also added climate change adaptation to their agendas, and the international consensus is that it must come in addition to existing aid commitments, instead of substituting for them.

Additional information on climate change funding is provided in two UN-Habitat policy papers³³.

2.7.8 OUTCOMES AND SUMMARY

As demonstrated throughout this section, local planning for climate change results in workable operational projects for which funding is available and which address various aspects of climate change in a manner appropriate to local conditions. These projects speak to the priorities identified through the process of strategic planning and specifically focus on the needs of the most vulnerable groups in society, including the very young, the elderly and women. They may include community-based adaptation projects, although if this is the case there should also be adequate support for larger-scale interventions that provide the framework within which communities can operate effectively.

2.7.9 FURTHER INFORMATION

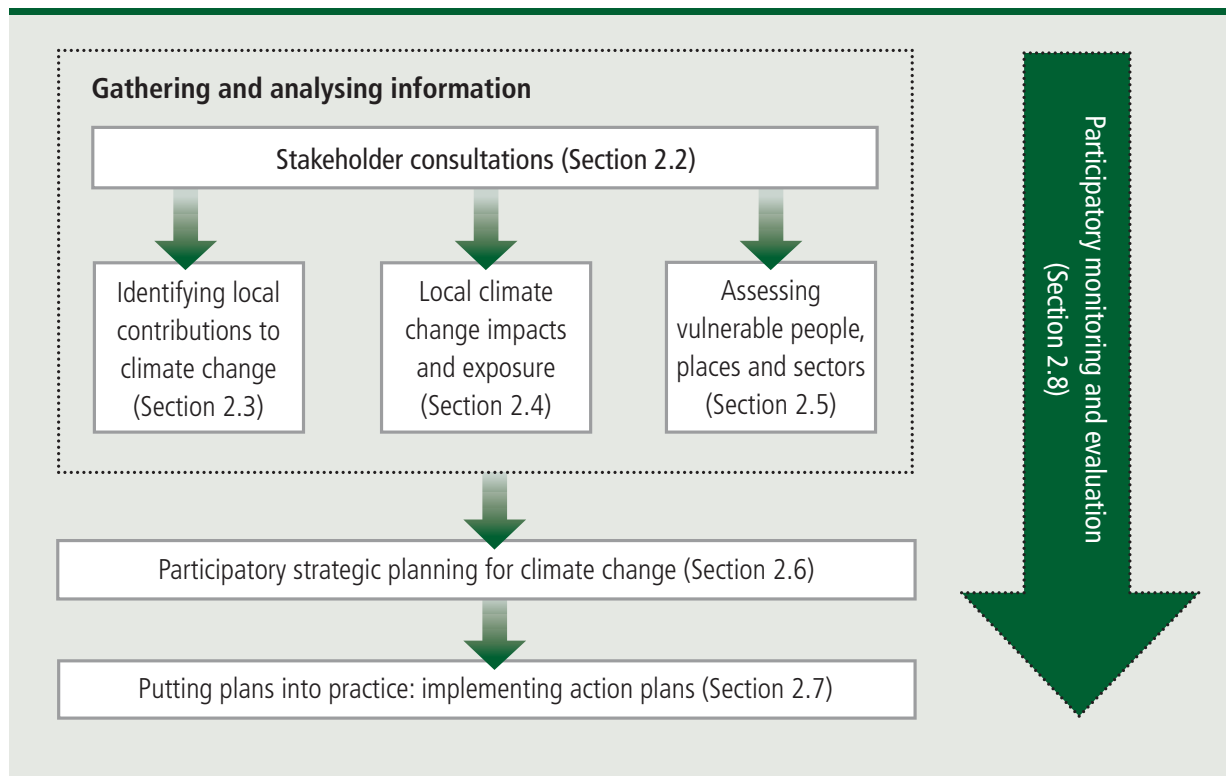
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USAID. *Adapting to Climate Variability and Change: a guidance manual for development planning*.

http://www.usaid.gov/our_work/environment/climate/docs/reports/cc_vamannual.pdf

³³ UN-Habitat (2011) Policy Note 1, Adaptation Finance: Are Cities in Developing Countries, Slipping Through the Cracks? (<http://www.unhabitat.org/pmss/listItemDetails.aspx?publicationID=3238>) and UN-Habitat (2011) Policy Note2, Mitigation Finance: Do Cities in Developing Countries Have Sufficient Access? (<http://www.unhabitat.org/pmss/listItemDetails.aspx?publicationID=3239>)

2.8 PARTICIPATORY MONITORING AND EVALUATION



2.8.1 WHY MONITOR?

The momentum associated with plan and project design should not draw attention away from the significant role of monitoring and evaluation. When put in place from the very start of the process, a monitoring strategy can meet several important needs. Monitoring and evaluation had given rise to a variety of methods, but this toolkit focuses on 'Participatory Monitoring and Evaluation' (PME), a methodology that can meet a broad range of objectives. PME draws on a number of participatory research traditions, involves a wide variety of stakeholders, and focuses on local, specific ways of measuring the achievements of particular actions on the ground.

Monitoring and evaluating the outcomes of climate change planning pursues two main purposes. One is to ensure that the planning process itself meets its desired

objectives, and that the plans are coherent and effective. The second main purpose of monitoring and evaluation is to ensure that adaptation actions meet the intended goal of reduced vulnerability to climate change. Because adaptation involves tackling unknown changes over decades or longer periods of time, it can be very difficult to assess whether the plans have been carried out effectively. Section 2.7.4 explores some of these issues and pinpoints some mechanisms that can be used to evaluate whether adaptation interventions have been successful.

Given the variety of methods available for project monitoring and evaluation, the information provided here is intended solely as a summary outline (more information can be found in the dedicated guide published by UN-Habitat as part of the Sustainable Cities Programme).

Participatory monitoring and evaluation fulfils six main functions:

- *Assess the impact of plans and projects.* This is probably the most straightforward function of PME, and involves comparing the stated objectives of a project with actual achievements on the ground.
- *Develop further plans and manage projects more effectively.* The information deriving from project monitoring and evaluation can be useful for future project planning and implementation.
- *Strengthen organisations and facilitate institutional learning.* The learning process associated with participatory monitoring and evaluation can contribute to the sustainability, replicability and effectiveness of environmental tasks and functions, including planning for climate change.
- *Understand and negotiate the perspectives, perceptions and interests of the various stakeholders,* since PME enables a variety of stakeholders to contribute to the evaluation process.
- *Ensure public accountability.* Monitoring and evaluation has traditionally played a role in accountability to donor agencies or governments. *Participatory* monitoring and evaluation broadens this process to ensure that projects meet the needs of the intended beneficiaries.
- *Inform policy-making.* Involvement of a broader range of stakeholders in the process of monitoring and evaluation enables them to articulate local needs more clearly and compare these more

directly to stated development and climate change priorities³⁴.

2.8.2 WHY PARTICIPATORY MONITORING AND EVALUATION?

The main distinguishing feature of participatory monitoring and evaluation is that it emphasises the inclusion of a broader range of stakeholders in the process. It is based on a belief that the stakeholders involved in planning and implementation should also help determine the subsequent degree of success. Conventional monitoring and evaluation has relied on external 'experts' to measure performance against pre-set indicators, using standardised procedures and tools. In contrast, PME engages project stakeholders in a more active way to reflect on, and assess, the progress and achievements of a particular project. To summarise, participatory monitoring and evaluation is based on four main principles, as follows:

- The active participation of primary stakeholders;
- Building the capacity of local people to analyse, reflect, and take action;
- A shared process of learning between stakeholders at various levels;
- Greater commitment to taking corrective action.

Of course, participatory monitoring and evaluation must also be sufficiently

³⁴ Adapted from Estrella M, Gaventa J (1998). *Who Counts Reality? Participatory Monitoring and Evaluation: a literature review*. Institute for Development Studies, Working Paper 70 and Estrella M (2000). 'An Introduction' in Estrella M (ed) *Learning from Change: issues and experiences in participatory monitoring and evaluation*. London, ITDG Publishing. Pages 1-14.

rigorous – particularly with regard to financial accountability. However, the built-in flexibility of PME ensures that projects are accountable in a broader sense. The process is planned and managed by a variety of stakeholders (often supported by a facilitator), who design, adapt and implement the monitoring methodology in a participatory manner. Any indicators can therefore be defined specifically for individual plans and projects in order to better take account of the local circumstances.

2.8.3 STEPS IN PARTICIPATORY MONITORING AND EVALUATION

Step 1: Planning the Process

Monitoring and evaluation should be considered from the very start of plan formation and programme design. This should begin with stakeholder mobilisation (see Section 2.2), when these groups come together for the first time. At this point, stakeholders develop shared objectives of what they want the outcomes of the climate change planning process to be. This is the basis on which indicators are selected to assess the extent to which the objectives are met. It can be helpful to think about indicators as being SMART, that is:

- S**pecific
- M**easurable
- A**ction-oriented
- R**elevant
- T**ime-bound

In order to assess impact, a monitoring and evaluation system needs to track progress in relation to targets, identifying what would represent ‘success’ or ‘failure’. At this stage, the scope and purpose of the monitoring and evaluation system should be established, the main indicators and monitoring mechanisms selected, and a budget line provided to support the process. Effective monitoring and evaluation may also require training for staff in charge.

A monitoring and evaluation matrix (Table 22) can help in this planning process. If anything, it will ensure that any information gathered is well-targeted: one of the most frequent problems with monitoring and evaluation is that too much information is gathered without regard for the way it can answer the particular questions being asked.

Table 22: **A Monitoring and Evaluation Matrix***

Indicator	Baseline information requirement and responsibilities	Data-gathering methods and responsibilities	Analysis, reporting and feedback methods and responsibilities
Indicator 1			
Indicator 2			

* Adapted from IFAD (2002). Managing for Impact in Rural Development: a guide for project M & E. International Fund for Agricultural Development, Rome.

Step 2: Gathering and Analysing Data

Once agreed upon, the indicators will define the type of data to be collected to support each. They may be of a quantitative nature – for example, counting the number of households that are protected by new flood protection measures, or they may be qualitative – such as a community or household’s ability to respond to floods. The main point to remember is that stakeholder groups can be involved throughout the gathering and analysis of data, giving them an opportunity to reflect on successes and challenges, and identifying potential next steps. In other words, the information gathered during the monitoring stage can be used to inform future decisions and actions.

At this stage, questions about performance, together with indicators and monitoring mechanisms, should be revised. At the start of the implementation phase, baseline studies should be initiated so that progress can be measured. All the relevant stakeholders must be reminded of the importance of the process to ensure that they facilitate the gathering and sharing of information.

Step 3: Documenting and Sharing Information

The participatory monitoring and evaluation process is only valuable if the findings are reported and shared to relevant groups. In conventional monitoring and evaluation, reports have been intended primarily for funding agencies, and have seldom been seen by the intended beneficiaries. In participatory monitoring and evaluation, local stakeholders secure ‘ownership’ of the information and use this to build their own knowledge base.

At this stage, the best information-sharing channels must be chosen and implemented. These may include written documents, but may also involve workshops and consultations under various forms.

2.8.4 ASSESSING THE BENEFITS OF ADAPTATION ACTIONS

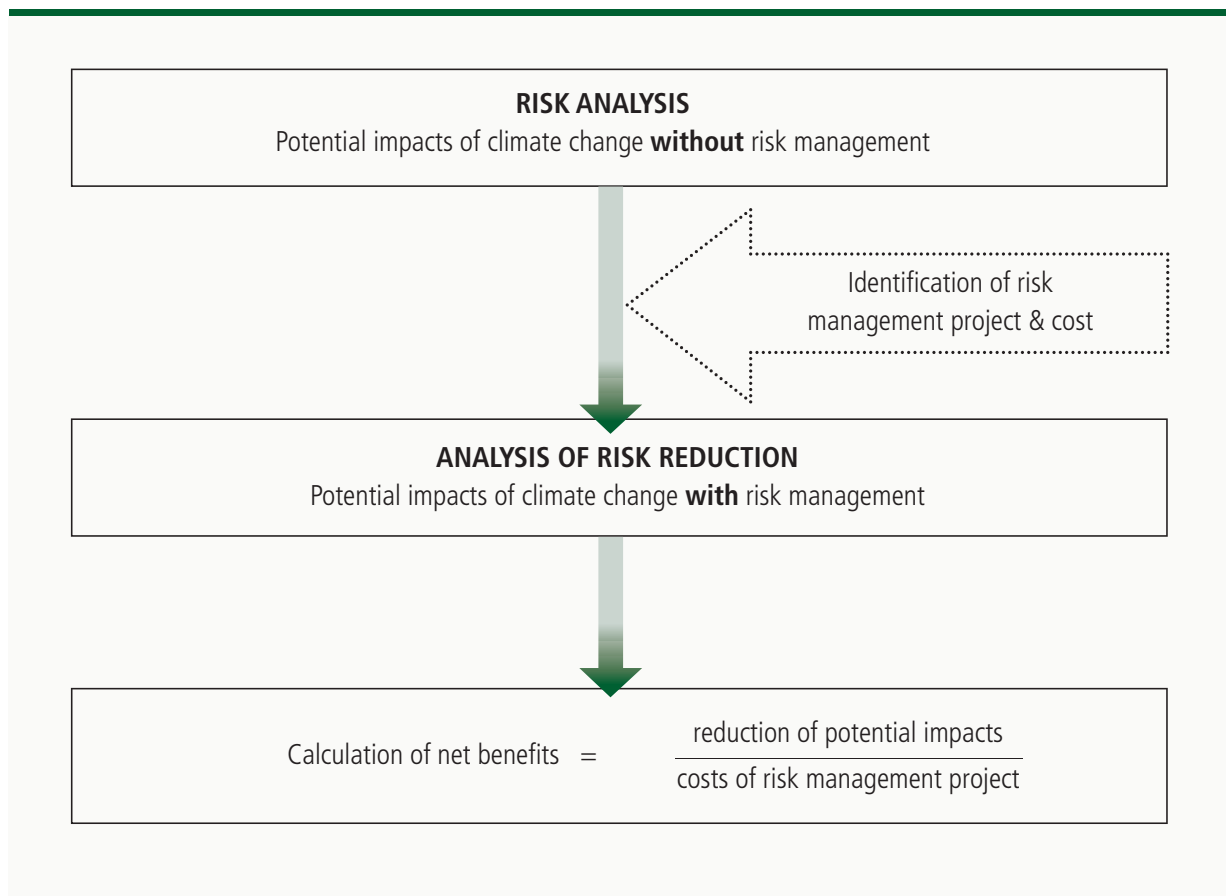
Over the course of a city’s planning process for climate change, it is important to evaluate whether the decisions made –for mitigation or adaptation alike – are the most relevant to local conditions. This process can involve a variety of methods and can be complex – for instance, many benefits may not become tangible for several years in the future, or may be very difficult to measure.

Among the evaluation methods for adaptation schemes, two are outlined below: the Cost/Benefit Analysis (CBA) and the Multiple Criteria Analysis (MCA)³⁵.

Cost/Benefit Analysis for climate change adaptation projects involves the sequence of steps outlined in Figure 9. This method is most effective where costs and benefits can be measured in pecuniary terms, allowing net financial costs or benefits to be identified. The basic process involves calculating the costs that will arise if adaptation actions are *not* taken, against the costs of taking these actions. If the costs of action are lower than those of inaction, then this can be seen as a justification for action.

35 These outlines are based on presentations by Fawad Khan (Institute for Social and Environmental Transition) and Stelios Grafakos (Institute for Housing and Urban Development Studies).

Figure 9: **Cost/Benefit Analysis for Adaptation Actions**



It will not come as a surprise that cost/benefit analysis fails to quantify many aspects of adaptation. For example, what is the financial value of preserving a particular ecosystem as used for leisure by urban residents?

Multiple Criteria Analysis (MCA) is based on a relative weighting of the importance of distinct criteria for specific actions, and can be carried out in a participatory manner. The method recognises that many of the costs and benefits of specific schemes/projects cannot be measured solely in financial terms, and is open to both objective and subjective information.

In a multi-criteria analysis, several different options are available, and the relative strengths of each are assessed according to several previously selected criteria. These criteria may not all be as important as each other – some may be seen as essential, and others as only desirable. An example of a matrix for multiple criteria analysis is shown in Table 23, displaying a range of actions to reduce vulnerability to sea level rise in a coastal city. Actions can be assessed against various criteria either through some form of objective measurement, or through participatory debate involving a number of stakeholders.

Table 23: **Multiple Criteria Analysis: Assessing Responses to Sea Level Rise**

Adaptation option	Economic	Social	Environmental	Overall Assessment
Construct sea wall	High economic cost	Enables activities to continue as before	May harm coastal ecosystems	
Enhance coastal ecosystem (e.g. mangroves)	Relatively low cost, possible economic benefits from improved fisheries	Possible benefits for recreation	Very good for environment	
Relocate coastal population	Relatively high.	Serious social implications	Limited environmental consequences	
Increase building standards	Moderately high	May affect low-income groups	Limited environmental consequences	

As can be seen from this matrix, the benefits and drawbacks cannot be precisely quantified. However, awareness of the benefits and drawbacks of various options, according to different sets of criteria, can result in better-informed decisions that meet the requirements of a variety of stakeholders.

2.8.5 EVALUATING ADAPTATION OUTCOMES³⁶

How to define adaptation, and how to measure it *ex post*, has recently come under active debate. In many ways, the measure of effective adaptation reflects the extent to which the detrimental effects of climate change have been avoided and it is notoriously difficult to measure things that have not yet taken place. Because of this uncertainty, the principles of participatory monitoring and evaluation are particularly important if one wants to make sure that monitoring and evaluation indicators are developed with the intended beneficiaries,

and that the effects of adaptation projects on a wide range of stakeholders are captured accurately.

It is important to ensure that any actions that are taken do not result in **maladaptation**. This refers to actions that are taken ostensibly to avoid or reduce vulnerability to climate change, but that have an adverse impact on other systems, sectors, or social groups³⁷. Decisions about which adaptation actions to take, and evaluation of whether these actions have been successful, ought to ensure that these do not:

- Increase greenhouse gas emissions;
- Impose a disproportionate burden on the most vulnerable (for example, minority groups or low-income households);
- Impose high economic, social or environmental costs relative to alternatives;
- Reduce the incentive to adapt (for example, if improving water supply schemes

³⁶ For further information, see Hedger M, Mitchell T, Leavy J, Greeley M, Horrocks L (2008). *Evaluating Climate Change Adaptation from a Development Perspective*. IDS Research Summary, Institute for Development Studies.

³⁷ Barnett J, O'Neill S (2010). 'Maladaptation' *Global Environmental Change* 20: 211-213. These authors suggest that assessing different "types of maladaptation can be used as a criteria for evaluating decisions about adaptation" (p211).

causes households to stop making efforts to reduce water consumption);

- Result in “path dependency” (expensive engineering solutions may reduce the range of future adaptation options that are available).

In addition, there are two other areas which monitoring and evaluation of adaptation projects needs to take particularly into account: reassessment of time-frames for impacts, and re-assessment of baseline scenarios.

Time Frames. The effects of climate adaptation must last long beyond the time frame of the initial project. The most serious effects will be felt in subsequent decades, and adaptation schemes that fail to provide resilience to these future uncertainties will not have met their intended objectives. This is a challenge to traditional monitoring and evaluation frameworks that tend to focus on the time frame of the project, and lack mechanisms to capture this future value. Evaluation of physical infrastructure projects must take these future impacts into

account; whereas evaluation of projects that seek to build adaptive capacity must make sure that this capacity is embedded in individual, community and institutional memory so that it can deal with these future challenges.

Baseline Scenarios. Because effective adaptation is about avoiding future impacts, it is important to organise for effective baseline monitoring at the start of projects. Because of the complexities of climate change, the relationship between the project and its impact may not be straightforward, as long-term climatic trends can be interrupted by seasonal and annual fluctuations. For example, measuring the efficacy of a project intended to reduce household flooding requires knowing how many homes in a given area are currently flooded as a result of seasonal rainfall. These baseline data must be retained, and used as the basis for current and on-going monitoring.

Monitoring and evaluating actions for climate change adaptation can be carried out through the matrix in Table 24.

Table 24: **Evaluating Adaptation Activities**

Pre-Implementation	
Economic costs	How do the costs compare with other possible interventions?
Social aspects	Will the action reduce inequality, and promote gender equity?
Environmental aspects	How will the action affect the long-term functioning of ecosystems?
Avoiding maladaptation	Are there likely to be any negative consequences as a result of the action?
Generating co-benefits	Does the proposed activity generate other benefits for urban residents?
Post-Implementation	
Measurement against baselines	Ensure that baseline data are collected and recorded.
Initial assessment	Identify mechanisms to assess impact (for example, through simulations)
On-going assessment	Keep records so that lessons can be learned for future projects.

2.8.6 OUTCOMES AND SUMMARY

With the comprehensive monitoring and evaluation plan outlined above, urban authorities will find themselves in a better position to make sure that objectives are reached, while highlighting specific challenges early on. Involving households and communities in the participatory monitoring and evaluation process will result in greater accountability and awareness, ensuring that the benefits of effective climate change plans are reaped by the social segments they are intended to benefit.

2.8.7 SOURCES OF FURTHER INFORMATION

The material in this chapter provides only a summary overview of the Participatory Monitoring and Evaluation process. Further information is available as follows:

IFAD Participatory Planning Monitoring and Evaluation Website:

<http://portals.wi.wur.nl/ppme>

UN-Habitat Sustainable Cities Programme: Sourcebook Volume 9

Measuring progress in improving urban management decision-making processes

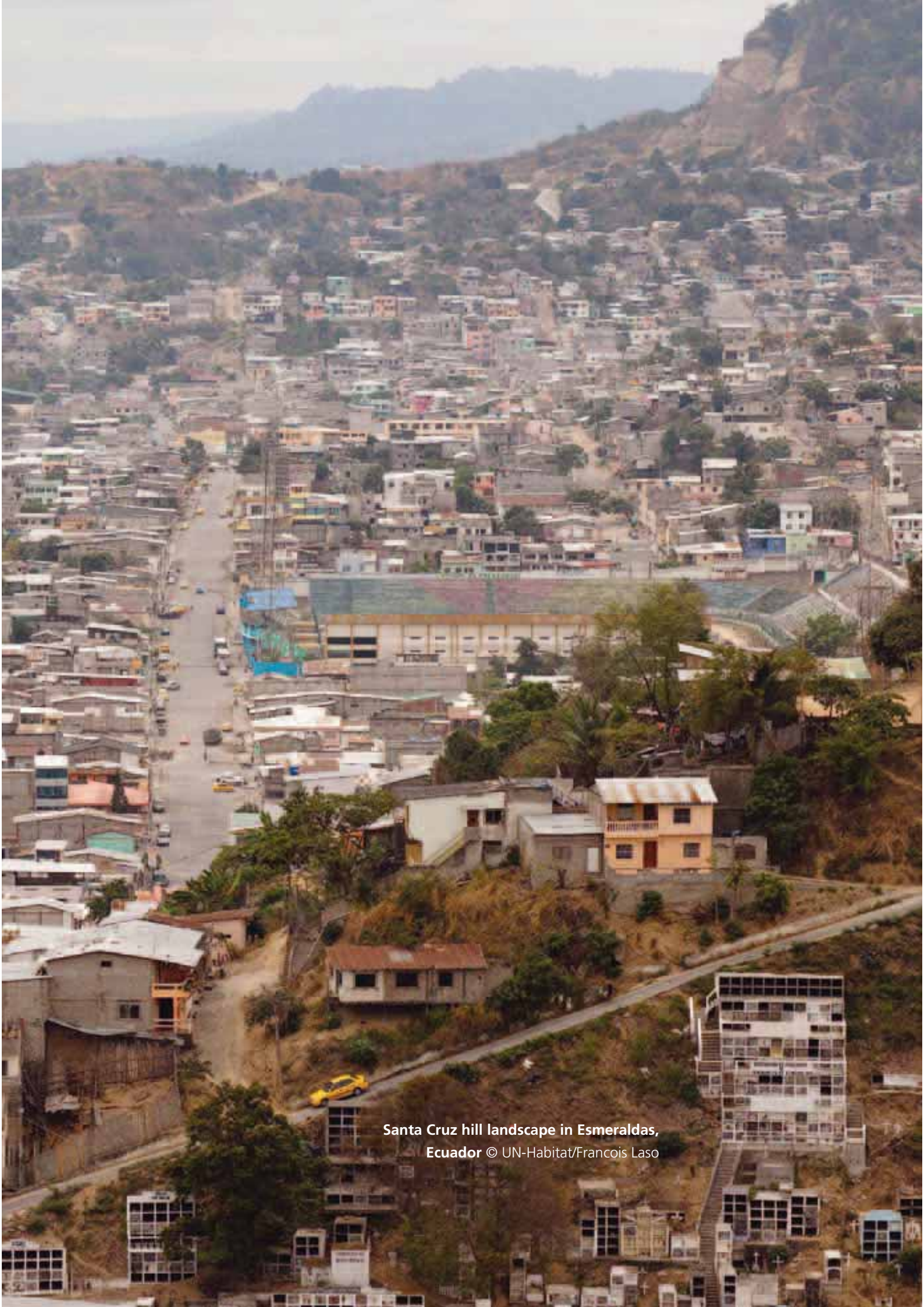
World Bank Participatory Monitoring and Evaluation Website:

<http://go.worldbank.org/G966Z73P30>



Provincial centre of administration, education and commerce in Sorsogon, Philippines

© UN-Habitat/Joselito Derit



Santa Cruz hill landscape in Esmeraldas,
Ecuador © UN-Habitat/Francois Laso

03

IN-DEPTH CASE STUDIES

3.1 ESMERALDAS, ECUADOR

3.1.1 BACKGROUND

Esmeraldas is a medium-sized coastal city in north-western Ecuador. It is part of the Chocó bio-geographical region, which features one of the highest rates of biodiversity in the world. Esmeraldas covers a land area of 16,155.97 km² with an estimated population of 124,538 (2010). As in most cities in Ecuador, expansion has mostly been associated with illegal occupation of land in peri-urban areas. In 2009, close to 60 per cent of homes had no building permits, located as they were in areas most exposed to natural disasters.

With support from UN-Habitat, the local authority participated in the *Localising Agenda 21 Programme*. This involved strengthening institutional capacities and developing participation in environmental planning and management. An "Environment Urban Diagnostic" was developed and the Planning and Environmental Management Unit enhanced its own profile. Right from the beginning of the partnership with UN-

Habitat, the Esmeraldas municipality was keen to develop climate-change related risk management schemes. However, being a medium-sized city with limited resources, Esmeraldas found it difficult to include climate change criteria into the planning process, although significant information was available to decision-makers.

An assessment of climate change challenges and opportunities was carried out in late 2008, with special emphasis on the extent to which the institutional and governance frameworks were supportive of effective adaptation schemes. The assessment was to come up with a number of practical proposals in favour of climate-aware economic, social and environmental agendas. The likely effects of climate change were identified for each of three scenarios, but these were for Ecuador as a whole, not just Esmeraldas. In the city, the effects of climate change are a function of higher land surface temperatures, sea-level rise and uncertain factors such as changes in rain, cloud cover and wind patterns. These in turn will have indirect effects such as increased rural-urban migration,



Children playing in polluted water from the Teaone River in Esmeraldas, Ecuador

© UN-Habitat/Francois Laso

reduced food production and changes in the ecological stock and processes.

3.1.2 LOCAL CONSULTATIONS ON CLIMATE CHANGE

In order better to understand local concerns and priorities, the Climate Change team conducted two workshops with the municipality and local partners. The challenges and opportunities of climate change were identified and discussed from a citywide perspective. Two problems were repeatedly highlighted by participants: (1) the water supply and distribution system, and (2) the illegal homes located on landslide-prone sites and in flooding areas. The main objective is to include mitigation and adaptation actions in the local urban planning system, and to strengthen local awareness of climate change. Workshop participants agreed on four objectives, as follows:

1. Collect data on climate change to support decision-makers;

2. Develop and implement mitigation and adaptation actions;

3. Enhance awareness among the local population and promote educational programmes;

4. Promote technology transfers for the benefit of local industries.



Active participants in thematic working groups at the change mitigation workshop at the Catholic University of Esmeraldas, Ecuador

© UN-Habitat/Francois Laso

Subsequently, a mixed group of academics, professionals, women's groups and youth representatives, parish leaders and local associations participated in a two-day workshop. As in previous meetings, water supply problems and the risk of landslides were highlighted as the two main impacts and areas of concern.

At the same time, the local citizenry remained well aware of three specific issues:

1. The greenhouse gas emissions associated with the local oil refinery;
2. The need better to familiarise the population with climate change issues and 'green' practices;
3. Severe pollution of water supplies.

3.1.3 DEVELOPING A LOCAL CLIMATE CHANGE RESPONSE

UN-Habitat's *Cities and Climate Change Initiative* has supported data collection by the Esmeraldas Municipality to improve information and the decision-making process with regard to landslide and flood prevention, making it easier to identify any urban settlements located in high-risk areas. Software is also under development to support risk management. The programme includes specific risk prevention information about social infrastructure, including hospitals and schools; main evacuation paths, as well as the populations under risk. Finally, the city developed a property registry focusing on new settlement areas located in flood zones, mainly on the southern part of the city along the Esmeraldas River.

As mentioned earlier, most of the poorest settlements in Esmeraldas are illegally occupying urban land located in risk areas, with limited access, where any, to public



A climate change strategy developed in Esmeraldas, Ecuador with UN Habitat.
www.unhabitat.org/cci

services. Ecuador's nationwide *Cities and Climate Change Initiative* is responding with an expansion scheme for urban agriculture; this includes permaculture systems to minimise waste and increased urban land productivity, while restoring the urban environment with a particular emphasis on slope stabilisation. Several families have built dry toilets (*baños secos*) and taken to fertilise vegetable gardens with human waste. The Municipality has given plots to the residents of Las Acacias as part of a permaculture demonstration scheme run by beneficiaries. These have received appropriate training from UN-Habitat and Cuba's *Fundación Núñez Jiménez*.

The Esmeraldas Adaptation and Mitigation Strategy was launched in October 2011. This document summarises the currently available technical information (such as the initial assessment report: "Adaptation to Climate Change in Ecuador and the City of Esmeraldas: an assessment of challenges and opportunities"). Together with highlighting residents' main concerns and expectations, the report makes recommendations for

partnerships and projects in connection with local adaptation to climate change.

With regard to mitigation, the strategy in Esmeraldas includes four main functions:

- Reforestation
- Transport control



A safety zone established in case of a tsunami or flood in Cerro el Panecillo, Esmeraldas, Ecuador

© UN-Habitat/Francois Laso

- Waste management, and
- Greenhouse gas emissions reduction (thanks to 'green' technologies).

The main adaptation actions will focus on the following:

- Capacity-building and educational programmes for water use;
- Educational programmes on climate change;
- Improvement of the water supply and distribution systems, as well as sewerage;
- Construction of upstream water storage, flood control systems and levees;
- Consultations and agreed settlements relocation away from vulnerable areas, changes to the zoning system, and participatory urban planning for enhanced resilience to climate change.



Composite construction, cement and wood are a relatively inexpensive solution to the problems of self-owned houses in Esmeraldas, Ecuador

© UN-Habitat/Francois Laso

3.1.4 NATIONAL CONSULTATIONS

In Esmeraldas, climate change-related projects were implemented in close partnership with the Municipality of Quito. Since over the past several years the Ecuadorean capital has been mainstreaming climate change into urban planning, cooperation with Esmeraldas provided a unique opportunity to learn from one another.

Including climate change concerns into urban planning is the rationale behind the *Climate Change Initiative* in Esmeraldas but national-level partnerships still need strengthening if they are to have any effect on public policies and climate change guidelines.

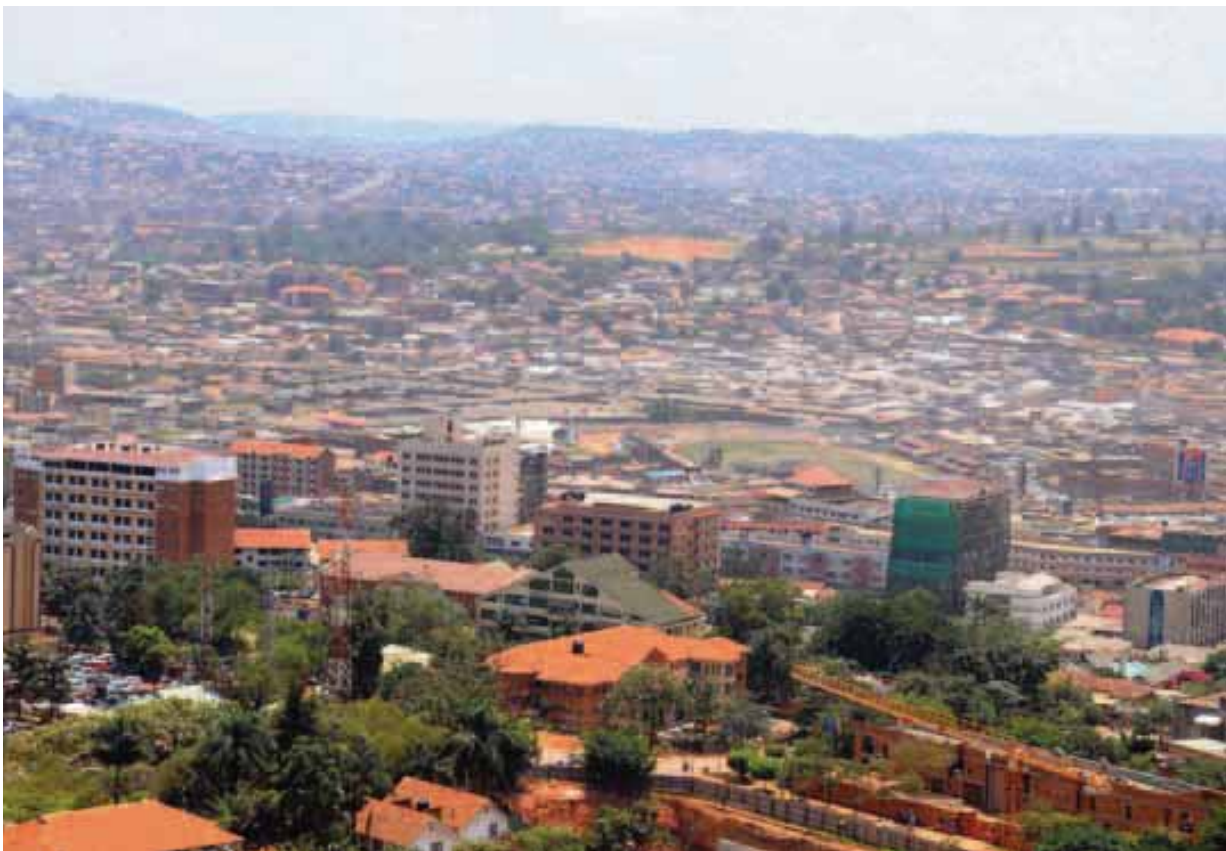
The experiences in Esmeraldas and Quito will be used to develop a handbook for climate-change strategy design for all urban centres in Ecuador.

Ecuador's Ministry of Housing and Architects' Association have jointly organised a competition to develop prototypes of affordable housing that incorporate 'green' building and alternative construction technologies. This initiative is part of a national social housing project known as "*Socio Vivienda*".

3.2 KAMPALA, UGANDA

3.2.1 BACKGROUND

Uganda's capital Kampala sits on the northern shores of Lake Victoria. Covering an area of 195 sq. km across 24 low-lying, flat-topped hills (average altitude: 1,120 m) and surrounded by wetland valleys. The city has a typically tropical climate with wet and dry months.



Aerial view showing Kampala from Nakasero Hill © UN-Habitat/Nicholas Kajoba

Kampala has a population of 1.6 million, a number that nearly doubles in daytime with an influx of people from neighbouring regions. The annual population growth rate is an estimated 3.7 per cent, the highest of all Uganda. Between 2010 and 2020, Kampala's population is projected to grow 50 to 56.7 per cent (UN-Habitat, *State of African Cities 2010*). Like many other urban centres across Africa, basic infrastructure, housing and social amenities in Kampala are lagging way behind the robust increase in population numbers.

In 2002, Kampala was one of eight cities in the Lake Victoria Region that benefited from a UN-Habitat initiative in favour of 'City Development Strategies' combining improved urban conditions and poverty reduction. The Strategy was developed with the local authority and major stakeholders. The municipal planning department coordinated a city profile which pinpointed a number of needs: sanitation and drainage; waste management; income generation; and shelter. The profile also highlighted flooding and its effects on the four selected areas of intervention.

The City Development Strategy was perceived as a good way of mainstreaming climate change into municipal mandates and functions. Consultative meetings familiarised municipal technical staff and policy-makers with the various issues and a list of pilot schemes was adopted. The *Cities and Climate Change Initiative* subsequently built on this process, promoting collaboration, policy dialogue and enhanced awareness among local authorities, government departments and other local/regional networks.

3.2.2 ASSESSING CLIMATE CHANGE

In Kampala, the in-depth citywide vulnerability assessment was combined with a similar nationwide exercise. Part of the city assessment was also focused on interfacing the action plans developed under the City Development Strategy with the city's climate change mitigation and adaptation measures.

Geospatial analysis identified and assessed Kampala's vulnerable population combined



Residents of Kisenyi slum draw water during the rainy season in Kampala © UN-Habitat



Flooding in Kalerwe, Kampala © UN-Habitat/Nicholas Kajoba

with demographic, health and environmental data. The assessment resulted in a 'gridding' approach at city, regional and national scale, extracting information on the dynamics driving development in Kampala.

SWOT (strengths, weaknesses, opportunities, threats) analysis provided a more in-depth perspective and assessment of the institutional framework, human capacity and existing tools. Through interviews and literature reviews, institutional mapping further highlighted the extent to which the Kampala Capital City Authority (KCCA) and Uganda's Ministry of Lands, Housing and Urban Development are prepared in the face of climate change. A consultative workshop with senior policy-makers reviewed the information collected over the course of the institutional mapping exercise.

In May 2011, a stakeholders' workshop familiarised policy-makers, municipal technical staff, government officials, business, academics and NGO representatives with the findings of the Assessment Report, which were endorsed by participants.

Kampala's Vulnerability to Climate Change: Main Findings

- Flooding is the most significant impact of climate change on Kampala; some 45 per cent of the buildings are located in flood-prone areas, and after heavy rainfall some neighbourhoods become isolated due to overflowing rivers. Increased runoff has turned flooding into the most serious threat to life, livelihoods, urban systems and the economy. On top of this, changes in temperature have affected urban livelihoods and food security.
- The urban poor and slum dwellers are most vulnerable, with settlements located in high-risk areas such as river banks. Loss of life and property as well as increases in waterborne diseases have become routine occurrences during floods. Sanitation facilities (pit latrines) become inaccessible (some flood over for lack of depth), with the problem only made worse by solid waste blocking drains.



Traffic congestion on Namirembe Road in Kampala © UN-Habitat/Nicholas Kajoba

- The natural environment is under threat from both climate change and the fast-paced geographical expansion of the city. Changing land-use and the associated increase in built-up areas combine to threaten wetlands, forests, water resources and the natural landscape.
- Uganda's high rate of urbanisation and associated challenges have become highly visible. Today, these problems are also extending to secondary urban centres, which lack the institutional frameworks and capacities required to face the impacts of a changing climate.

City and Country-Wide Assessment – Main Findings (By Sector):

(a) **Energy** – Kampala relies on renewable energy (hydroelectric power) and fossil fuels. However, as climate change reduces water levels in Lake Victoria, the hydroelectric power plant cannot operate at full capacity and use of diesel-powered generators has increased to meet the shortfall. Households are the largest energy

consumers in Uganda, using a combination of electricity, wood, fuel, charcoal and petroleum products. As many as 75 per cent of households rely on wood and charcoal, with significant implications on carbon emissions (including through deforestation) and for health (particularly for women and children, as they spend more than a fair amount of time indoors).

(b) **Transportation** – emissions by motor vehicles are the major source of pollution in Uganda. To make things worse, un-leaded petrol is not available and diesel fuel is very high on sulphur oxides (SO_x). Combined with high population growth rates and urban sprawl, poorly planned transport does not serve new residential/settlement areas, leaving personal motor vehicles as the major alternative. In the process, the economies of scale which an urban area can offer in terms of reduced environmental impacts from transport are diminished.

- (c) **Waste** – in Kampala only 40 per cent of the waste produced by 1.6 million residents is collected and disposed of at the one and only landfill site. Lack of on-site treatment results in significant carbon dioxide and methane emissions as well as leachate into the ground. Waste has been identified as a sector that could obtain financing from the Clean Development Mechanism (CDM) – provided, that is, that the private waste management sector and local authorities engage in a fair amount of capacity-building in the first place.



Man sorts garbage at Nakawa, Kampala
© UN-Habitat/Nicholas Kajoba

3.2.3 PLANNING FOR CLIMATE CHANGE

A stakeholder workshop in May 2011 agreed on seven action plans that will eventually form the basis of a local climate change strategy for Kampala:

- (a) **Youth Sensitisation.** This tried and tested programme worked with 40 youths, of which 24 were trained on adaptation and 16 on mitigation issues and measures. It is expected that these young people will then spread the knowledge to peers and neighbourhoods, and also liaise with the municipality on issues arising from a changing climate.
- (b) **Gender Mainstreaming** into a climate change assessment report. A gender mainstreaming checklist was developed and a pilot audit carried out (in May 2011) in two low-income neighbourhoods. A community walk and focused group discussions highlighted men and women's respective roles in society and different functions, showing how various segments are more vulnerable than others to climate change. At the same time, the Kampala municipality



A woman prepares tea using biogas energy in Kansanga, Kampala © UN-Habitat/Nicholas Kajoba

was developing a Gender Policy, and has since mainstreamed the results of the community audit into the new Gender Policy.

- (c) **Integrated Flood Risk Management.** For the sake of a holistic and effective handling of the multi-dimensional nature of flooding, an integrated approach has been adopted, acknowledging the linkages between floods, development and poverty. The action plan will involve a comprehensive citywide assessment of the risks of flooding. These will be assessed in more detail in a representative 'hotspot' neighbourhood, paving the way for a proposed policy for improved and integrated flood management.

- (d) **A Local Urban Knowledge Arena (LUKA).** This concept will improve information networks, tools and advocacy, which so far have proved well short of requirements, hopefully stimulating action and changes in attitudes at the neighbourhood, city and national scales. An agreement has been reached between UN-Habitat, the municipality and Makerere University, which will host a dedicated online 'knowledge platform'. The Website will be accessible by all, including residents, enabling them to share information/knowledge on urban issues related to climate change. Two public events will be held every year, and they will feed into the National Urban Forum.
- (e) **A Greenhouse Gas Audit.** A city-wide audit of greenhouse gas emissions from energy use, industrial processes, agriculture, forestry, land use and waste will use the 'International Standard for determining greenhouse gas emissions for cities' jointly developed by UN-Habitat, the World Bank and the UN Environment Programme (UNEP). One major feature of this particular scheme is that, for the very first time, the audit will take in Kampala's far from negligible informal sector and low-income population.
- (f) **Raising Awareness in Schools.** This scheme will be launched in as many of Kampala's 110 primary schools (ages 6 to 9) as possible. The main plank will be a cartoon on climate change known as 'The Change', complete with discussions and poster-drawing sessions.
- (g) **The Kampala Metropolitan Physical Plan** – discussions have been held with the consultants currently developing the Metropolitan plan and, as a result, the climate change issues raised in

the assessment report and through implementation of the Cities and Climate Change Initiative have been mainstreamed into this Plan.

3.2.4 NATIONAL CONSULTATIONS

The Kampala municipality has spearheaded the Cities and Climate Change and over the past few years, the issue of climate change has slowly begun to emerge in national and local agendas, although Uganda still lacks a specific policy on climate change. The newly created Climate Change Unit in the meteorological department of the Ministry of Water and Environment signals a favourable shift at national level. Still, Kampala's proposed demonstration projects under the *Cities and Climate Change Initiative* will hopefully familiarise other urban centres with the various relevant issues. In this respect, it is also worthwhile noting that the recent initial steps towards a dedicated institutional framework for climate change adaptation and mitigation have also benefited from guidance and support from Uganda's Poverty Eradication Action Plan (PEAP) and the subsequent National Development Plan (NDP) currently under preparation.

It is envisaged that the experiences in Kampala will serve as a basis for a methodological manual for the development of climate change strategies in smaller urban centres in Uganda.

3.3 MAPUTO, MOZAMBIQUE

3.3.1 BACKGROUND

Maputo's geographic location makes it highly vulnerable to the impacts of climate change. The capital city is the most densely populated (1.1 million in 2007 (INE, 2008))



Aerial view of the city, Maputo © UN-Habitat/Jesper Milner

urban area in Mozambique. The population of the metropolitan area (Maputo-Matola-Marracuene) fluctuates between 2.5 and 3 million. More than 70 per cent of the total population live in informal, unplanned areas prone to floods, soil erosion and other environmental hazards. These areas are hosts to low-income communities without access to basic services (sanitation, drainage system, potable water or electricity).

Maputo Municipality's engagement in UN-Habitat's *Cities and Climate Change Initiative* started with bilateral consultation meetings with the main institutions dealing with climate change and natural disaster management in Mozambique. The meetings brought together representatives from national and local government institutions such as the Ministry for the Coordination of Environmental Affairs (MICOA), the National Disaster Management Institute (INGC) and the National Metrologic Institute (INAM), as well as academic institutions, civil society and the Municipal

Council of Maputo. The discussions were complemented by field visits, enabling participants to take a visual, physical measure of Maputo's urban development efforts and challenges, pertaining to climate change. Two subsequent workshops came in consolidation of the start-up activities. The first one, in May 2009, formally launched the *Cities and Climate Change Initiative*, providing stakeholders with an opportunity to comment on the findings of the preliminary climate change assessment. The second workshop, in November 2009, was restricted to main stakeholders, with development partners and the media also in attendance. The Mayor of Maputo expressed his commitment to the Initiative and to proper implementation of the Strategic Action Plan as presented to participants. However, the initial stages of anchoring the process were significantly delayed by the political environment in Maputo following municipal elections and change of mayor.

3.3.2 ASSESSING CLIMATE CHANGE

A preliminary climate change assessment highlighted that cities located along the coastline, such as Maputo, are particularly vulnerable to extreme weather events. Maputo is particularly affected by floods, cyclones, sea-level rise and temperature increases. The assessment identified the main stakeholders (central and municipal government, academia, business and civil society) whose participation in any climate-change response was expected. The assessment also identified the more vulnerable communities and sectors, and went on to review existing national- and

local-level policy instruments and their relevance to climate change adaptation and mitigation efforts. The report highlighted any gaps as well as the need to enhance awareness across sectors and at all levels.

The preliminary assessment brought out some significant findings, but also recognised the need for in-depth assessment of climate change impacts in order to determine and prioritise specific adaptation and mitigation measures. As recommended under the *Climate Change Initiative*, the report also called for improvements in policy dialogue, knowledge management and dissemination channels.



Wildfire, Bazaruto Island, Maputo © UN-Habitat/CDFF



Flooding in the city of Maputo
© UN-Habitat/Martinho Fernando



Soil erosion, Maputo
© UN-Habitat/Jesper Milner

The in-depth assessment consisted of three dedicated research reports, as follows:

1: Awareness assessment of the effects of climate change

The Maputo Municipal Council used its internal procedures and staff's local experience to collect relevant data and information, with assistance from UN-Habitat for survey and checklist development.

2: In-depth assessment of the effects of climate change in Maputo, including:

- Climate and hydrology,
- Identification of climate change scenarios and potential effects
- Identification and description of vulnerable areas/sectors
- Analysis of the socio-economic effects in risk-prone areas (including infrastructure costs and prioritising risk-prone areas according socio-economic issues)
- Prioritisation of adaptation and mitigation measures in the short, medium and long terms.

An integrated analysis of population and climate dynamics highlighted which communities are particularly affected by climate change.

3: An ecological zoning study of the mangrove pilot site of Costa do Sol along the coast.

This research will pave the way for improved spatial, social and economic development of the *Costa del Sol* neighbourhood, with special regard for urban infrastructure and natural preservation and tourism.

For the purposes of community engagement and participation in Costa del Sol, consultative

workshops were held with all district leaders. On top of securing local participation, this was an opportunity for community leaders to air their views and concerns for inclusion in the Ecological Zoning Study Plan.

In this phase of the project, the significant contribution of the municipality of Maputo highlighted its commitment to work on climate change issues, which by now are formally under the responsibility of the department of urban development and environment. Although the response to all these efforts has been appreciable, the subsequent overextended procurement process came as a major challenge. UN-Habitat has sought to make sure that any future procedures in this and other aided projects are fast-tracked.

3.3.3 PLANNING FOR CLIMATE CHANGE

The Initial Assessment Study produced a strategic action plan as a first step towards comprehensive climate change mitigation and adaptation. The broad objective is as follows:

To build institutional capacities in Mozambique for the development of appropriate policies, strategies, tools and methods with the aim of carrying out climate change adaptation and/or mitigation measures in urban areas

The plan pursues three specific objectives:

1. To establish an effective management and implementation capacity, enabling both the relevant government department (MICOA) and the Maputo municipality to deal with the effects of climate change, with clear institutional roles and communication channels, including for policy dialogue.

2. To carry out a full-fledged, multi-dimensional assessment of the effects of climate change on Maputo City and to develop adaptation/mitigation strategies, tools and methods.
3. To organise management and dissemination of knowledge on the effects of climate change, and deploy demonstrative adaptation-mitigation schemes, including for awareness raising.

Development of a Local Climate Change Adaptation and Mitigation Plan (LCCAMP) for Maputo Municipal Council was launched in July 2011. The plan is to be based on the above-mentioned in-depth assessments.

The plan includes a number of adaptation/mitigation measures and options to be implemented in the short, medium and long terms and in coordination with other, ongoing schemes such as the Urban Master Plan (PEUMM), the Five-Year Municipal Governing Programme (PQCMM) and the Maputo Development Programme (ProMaputo).

3.3.4 NATIONAL CONSULTATIONS

From the beginning, the *Cities and Climate Change Initiative* in Maputo has been working in close coordination with many stakeholders, including some representing various tiers of central and local government. The major events bringing together national stakeholders included the following:

1. In May 2009, a national consultative workshop jointly called for by UN-Habitat and the Maputo Municipal Council presented the findings of the preliminary assessment report and discussed a proposed action plan.
2. In November 2009, another consultation was convened by the

Maputo Municipal Council and the strategic action plan was discussed at length. The roles and contributions of various participants also came under review, together with expected funding from UN-Habitat and formal agreements for project execution.

The January 2011 rainy season caused flash floods in Maputo and emergency shelter was provided by the Municipality together with the Disaster Management Institute (INGC), the relevant government department (MICOA), the National Operational Centre for Emergencies (CENOE) and the Mozambique Red Cross. This coordination and collaboration came as an instructive experience for all those involved, and now must be institutionalised through a comprehensive policy framework.

Policy dialogue regarding the effects of climate change on Mozambique's urban areas is maintained through a 'project communication flow plan' and a Project Steering Committee. This body brings together a variety of stakeholders, including the Maputo Municipal Council, urban communities, central and local government, academics, business, civil society, UN-Habitat and other relevant partners. This aspect is to be embedded in planned and on-going consultations where in-depth studies are to come under review, focusing on policy instruments and, of course the Local Climate Change Adaptation and Mitigation Plan.

3.3.5 SIX MAIN LESSONS

Six main lessons can already be learned from Maputo's early experience with the *Cities and Climate Change Initiative*:

- Political will and buy-in can take time but

cannot be dispensed with if any project is to be established on sustainable foundations and institutionalised.

- Institutionalisation is a delicate process. The municipal Department of Environment Management (Directorate of Urban Planning and Environment) is now in charge of climate change issues. It is crucial that a broad and transparent decision making process identifies the most appropriate institution to anchor the climate change planning process.
- It is necessary to undertake an in-depth climate change vulnerability assessment following initial scoping studies that should be fully 'owned' by major local partners.
- One must keep an eye on the political calendar: is an election coming up around the time the project is to start?
- National–local policy dialogue is a major challenge as these two tiers of government do not often relate, let alone on climate change.

- Language can be a barrier to proper knowledge management, as most documents are in English that is not widely understood in the municipality.

3.4 SORSOGON CITY, THE PHILIPPINES

3.4.1 BACKGROUND

Sorsogon City lies at the southernmost tip of Luzon, the largest of the 7,100 islands in the Philippine archipelago, between the Pacific Ocean (through the Albay Gulf) and the China Sea (through Sorsogon Bay). The city is the administrative, commercial and educational centre of Sorsogon Province. The population (151,000 in 2007) grows an average 1.78 per cent every year and is split across 64 barangays (of which 37 are coastal) over 31,292 ha.

Research by the Manila Observatory and the Department of Environment and Natural Resource has placed Sorsogon Province in the 'Very High Risk' category with regard to combined climate-related disasters. Over



Street view in the centre of Sorsogon, Philippines © UN-Habitat/John Palma

the past few years, extreme weather events have caused massive destruction in Sorsogon City. In late 2006, 'super typhoons' Milenyo (Xangsane) and Reming (Durian) affected over 27,000 families and all but destroyed 10,070 houses. After the first five hours of typhoon Milenyo, damages to municipal infrastructure already amounted to an estimated USD 4.3 million.

This is the background against which the Sorsogon municipality became interested in the UN-Habitat Cities and Climate Change Initiative. As an "emergent" coastal city, Sorsogon is keen to test innovative approaches to cope with, or forestall, existing and future climate related threats. The city government sees this as an important step towards "no-regrets" action - that is climate change action that makes sense even without a changing climate - in favour of improved resilience and long-term urban sustainability.

3.4.2 ASSESSING CLIMATE CHANGE

As a first step, the municipality secured the support of major local stakeholders. The city further entered into dialogue with national government departments and agencies operating at the provincial level, with a view to facilitate the local climate change response. The next step saw the formation of a climate change team with multi-disciplinary backgrounds, directly reporting to the mayor.

The review of national government assessments further established that local/city level vulnerability and adaptation assessments (V&AA) were necessary as information required for local action was lacking. However, documents and data suggested that climate change would add to current pressures on the urban environment. Issues like sustainable land use, infrastructure, access to potable water and health services and waste management,



Local government staff discuss the land use plan with community members.

© UN-Habitat

among others, featured prominently and were recognised as highly relevant to Philippine cities' sustainable development.

Early on in the process the municipality was faced with a sore lack of projections for the local climate and the prospective changes on which specific adaptation/mitigation plans could be developed for Sorsogon. The city had kept limited weather records, most of which were destroyed in the 2006 typhoons. Therefore the assessment had to rely on local experience-based information, adding nationwide projections for good measure. Citywide and community-based consultations enabled the municipality to narrow the scope, and found that prospects were dominated by changes in extremes (i.e., tropical cyclones, storm surges and extreme rainfall/flooding) and to some extent by changes in means (i.e., higher temperatures and higher rainfall, saline intrusion and sea-level rise). More than one year into the project, assistance from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) provided the municipality with more location-specific projections for changes in precipitation and temperature.

The next step was to identify 'climate change hotspots' in Sorsogon, based on the area's exposure to the multiple prospective hazards and risks, with help from the actual risk/hazard maps produced by the city disaster coordinating council (based on previous disaster events and assessments). As a result, 12 barangays were identified as 'hotspots' in view of their exposure to multiple climate hazards (i.e., tropical cyclone/storm surge, sea-level rise, flooding, and landslides). Of these 12 hotspots, eight are 'urban barangays', one is urbanising, and the last three are categorised as 'rural'.

Buildings (residential, and community facilities like health centres) are exposed

to tidal flooding and have been damaged in the past; sea walls have been in disrepair since the super typhoons of 2006 destroyed them; coastlines are eroded or inundated; settlements are not planned for climate hazards (lack of flood drains); livelihoods are derived from weather-sensitive activities such as fishing and the selling of fish as well as tourism; job-providing commercial facilities are at risk of flooding and sea-level rise; public infrastructures (schools, bridges and roads) were not engineered to withstand extreme events, as evidenced by previous disaster reports.

The main factor of climate change vulnerability in urban hotspots is none other than poverty, which leaves residents particularly susceptible to the impacts of extreme weather events as well as changes in temperatures, precipitation and sea-level rise. At the same time most people have little capacity to cope with the projected impacts of climate change.

All these findings have been substantiated by municipal data and information collected during local focus group discussions.

As far as governance is concerned, the City Government is well aware that Sorsogon's general vulnerability is due to the fact that the City Comprehensive Land Use Plan (CLUP) has not taken into account the prospective effects of climate change. The built-up areas, as planned in that plan, have been found to be exposed to the seaward risks associated with climate change (e.g., sea-level rise and storm surges). Spatial planning capacity is limited by lack of a Geographic Information System. Vulnerability tends to be higher since the disaster risk management framework as it stands is more aligned with reactive or responsive actions (relief and rescue) than preparedness (disaster mitigation and anticipatory planning).

Based on the vulnerability and adaptation assessments (V&AA), the municipality called on a multi-stakeholder meeting to validate the findings and agree on a 'long list' of issues and priorities. The next step for the municipality was to put these into technical perspective and ask questions such as: "who will be heavily burdened?", "Who/what needs immediate action?" "What city resources are available?" In this process an additional chapter was added to the vulnerability assessment focusing on neighbourhood and household level vulnerability (27 indicators were developed for this) in recognition that the barangays in the climate change hotspots were very heterogeneous. The answers led the city to define a shortlist of priorities. As part of the same process, proposition papers were developed in order to further analyse and highlight the issues, including the major "strategy options" selected at the validation meeting, the municipal technical review, and the vulnerability assessments. The papers were then discussed in a multi-stakeholder city consultation and ultimately led to an agreement on priority actions as well as on the formation of Issue-specific Working Groups.

3.4.3 PLANNING FOR CLIMATE CHANGE

Sorsogon's climate change action plan is derived from consultations, working groups and research focused on four main areas: **Housing and Basic Services** (improved housing for the poor; water and sanitation; development of a plan for climate change-responsive shelter); **Livelihoods and Economic Development** (developing a baseline for livelihoods; skills development for people with climate sensitive livelihoods; local economic development in a climate change perspective); **Environmental Management** (forest and mangrove rehabilitation and afforestation; lowering greenhouse gas emissions (in particular in local transportation and energy savings in public buildings); and **Mainstreaming Climate/Disaster Risk Reduction** (development of local policies as well as preparedness and response mechanisms which were to be articulated in a community-based Disaster Risk Reduction and Management plan (CBDRRM)).

These priority actions were chosen over others as they are the type of initiatives over



Mangrove rehabilitation efforts strengthen resilience and protect biodiversity on the coast of Sorsogon, Philippines © UN-Habitat/Joselito Derit



Community volunteers clearing solid waste from the coastline to mitigate the effects of future disaster events in Sorsogon, Philippines © UN-Habitat/Joselito Derit



Impact of a 2006 typhoon in Sorsogon, Philippines © UN-Habitat/Joselito Derit



Climate change-induced flooding and erosion have devastated farms and threatened food security in Sorsogon, Philippines

© UN-Habitat/Joselito Derit

which the municipality and local partners can have a fair degree of control, and are considered as achievable and realistic. 'Quick wins' were then derived from the above-mentioned priority actions. 'Quick wins' refers to initiatives/actions which

the municipality is confident it can carry out over a short time horizon but with a more significant effect in terms of "climate change resilience and responsiveness", while at the same time bringing about 'sustainable urbanisation'.

In Sorsogon, adaptation 'quick wins' focus on the poor, who are expected to bear the brunt of climate change effects, as well as on any policy gaps, in order to launch and sustain action on the ground.

At the same time, the Sorsogon City Mitigation Plan focuses on energy and transport initiatives. Here the government decided to take the lead and retrofit lighting in public buildings with energy saving LEDs rather than the standard energy saving compact fluorescent lamps (CFL). Whilst the retrofitting with LEDs is more expensive, they are more energy efficient and there are fewer concerns about their safe disposal. A key concern in terms of local air and noise pollution are the omnipresent "three-wheeler" taxis, most of which run on two-stroke engines. The city has ambitious plans to replace these with electric "three wheelers" which have been tried and tested in other cities of the Philippines. The city decided



The main factor of climate change vulnerability in urban hotspots is none other than poverty, which leaves residents particularly susceptible to the impacts of extreme weather events.



to take the lead and showcase energy efficiency measures and only in a second phase identify options on how to encourage households to follow suit.

Having agreed on the above-mentioned quick wins, the municipality together with the multi-sector working groups conducted 'core issue' assessments through problem and objective 'tree' analyses, leading to the selection of demonstration projects. The demonstration projects (listed below) now under implementation are expected to showcase innovative activities, processes and systems, both locally and beyond, in favour of climate change resilience and responsiveness. The demonstration projects are as follows:

Adaptation: 'Quick wins' Housing

1. Development of local minimum standards for climate change-resilient building for the social housing sector;
2. Development of a template for community-based structural assessments, using the above-mentioned local minimum standards;
3. Retrofitting vulnerable structures inhabited by poor families;

Livelihoods

1. Given the effects of climate change on seasonal production/productivity, setting a baseline for livelihoods in the community;
2. Vocational training in construction trades and other income-earning skills ('non-climate sensitive livelihood support') in particular for fisher folk;



Climate-proof shelter development is a key element of resilience strengthening in Sorsogon, Philippines © UN-Habitat/Bernhard Barth



Installation of a solar-powered street light along Diversion Road in Sorsogon, Philippines
© UN-Habitat/Joselito Derit



Site planning activity in a community action planning workshop in Barangay Cabid-an, Sorsogon, Philippines © UN-Habitat/John Palma

Strengthening Community-Based Disaster Risk Reduction and Management (CBDRRM) for climate change

1. Retrofitting of a school used as evacuation centre, using climate change-resilient building technologies;
2. Art programmes at the community level to build awareness for disaster risk reduction and management.

Mitigation: 'Quick wins'

Environmental management

1. Conversion of public buildings to efficient lighting fixtures and systems;
- 2.. Conversion of tricycles to four-stroke engines and procurement of electric tricycles.

Medium- to long-term climate change action

In addition to the 'quick wins' the city also set in place a number of medium- to long-term measures. Improved land-use and sector-specific plans that mainstream climate and disaster risk reduction are about to be finalised. The enhanced land-use plan will be implemented through a climate change-oriented zoning ordinance that fully takes in risks and hazards. A plan for climate change-sensitive shelter development includes a "rights-based resettlement guide" for people living in recognised high-risk areas.

Assessments of the water, sanitation and drainage infrastructure and of the approach to coastal zone management with emphasis on eco-systems, protective infrastructure where necessary and settlements have been prepared. The implementation of the recommendations will however take time and will require additional funding.

3.4.4 NATIONAL CONSULTATIONS

As part of the Cities and Climate Change Initiative, a national scoping study was commissioned to establish urban climate change vulnerabilities beyond Sorsogon City, to provide an overview of the stakeholders and their roles with regard to an urban climate change response. The report clearly indicated that cities/urban areas hosting a combined 64 per cent of the total Filipino population ought to play a critical responsive role. The study showed that cities and urban areas in general are faced with greater pressures in relation to settlements and livelihoods (especially with regard to agriculture, food security, health, access to ground water, and inundation). National stakeholder forums showcased Sorsogon City experience the upshot of which was the "Philippine Urban Stakeholder Action Agenda on Climate Change" that was adopted by the Philippine Urban Forum. The Climate Change Act of 2009 and the National Urban Development and Housing Framework (2009-2016) act as policy platforms that were informed and are continuously inspired by the Sorsogon City experience. This experience has also given rise to the vulnerability assessment toolkit, which is now mainstreamed into the national government's planning guide for local governments. Despite the momentum on national level, capacitating local governments to take a front line role in climate change adaptation and mitigation planning (as embodied in the Climate Change Act) remains a challenge. Capacity building is particularly needed when it comes to bridging the local sphere with national policy frameworks closer and based on scientific evidence. Knowledge management and information sharing across local governments sectors and areas of knowledge are crucial if sustainable adaptation and development are to be

effective. Innovations and practicable, affordable new technologies must be considered, given the inadequate financial resources of both local governments and, most importantly, of the vulnerable poor who would be the end-users of any adaptation technologies.

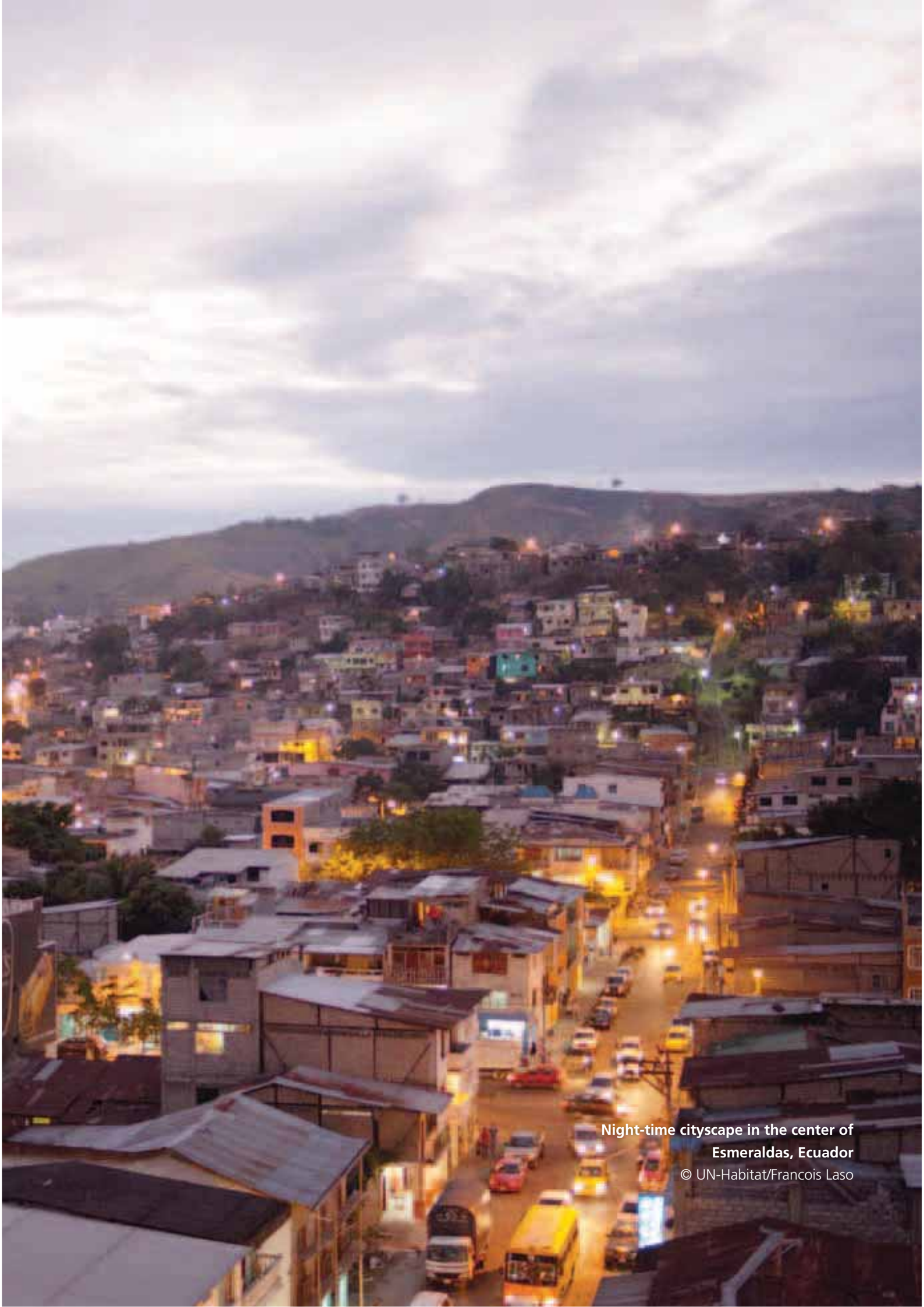
On a more positive note, sharing its own experience of the Cities and Climate Change Initiative puts Sorsogon City in a position to help other cities in the country and in the Asia-Pacific region to address local climate change issues in a proactive manner. The mayor and senior municipal officers have participated in a number of regional events. Closer to home, Sorsogon City has organised and funded a climate change forum in Bicol, one of the country's 17 regions. The event resulted in the so-called "Bicol Region Cities and Municipalities Declaration on Climate Change," committing to knowledge sharing, advocacy and capacity building

for local authorities to enhance resilience to the effects of climate change impacts. Moreover, besides the national online urban knowledge forum hosted by the UN-Habitat Philippines Website, Sorsogon City is about to launch another one focusing on local issues, in an effort to further disseminate experiences and knowledge. Finally, on World Habitat Day 2011 (3 October 2011), a national forum was held on the theme "Philippine Cities and Climate Change 2011: Towards a Roadmap for an Urban Agenda." The event provided a platform for a cross-sector discussion on urban development and climate change, which helped strengthen the urban perspective in the development of the Philippines' National Climate Change Action Plan.

Many documents related to this case study can be found on the UN-Habitat Philippines Website: www.unhabitat.org.ph/climate-change



A number of climate change adaptation actions of Sorsogon City have been documented in some detail (www.unhabitat.org.ph).



Night-time cityscape in the center of
Esmeraldas, Ecuador
© UN-Habitat/Francois Laso

04

SOURCES OF FURTHER INFORMATION

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4.4 GLOSSARY³⁸

Adaptation. Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates the more detrimental and/or takes advantage of the more beneficial. Adaptation can take place before the effects of climate change are observed, can be planned as a result of a deliberate policy decision, or can be spontaneous or unplanned.

Carbon footprint. This concept is derived from the 'ecological footprint', which measures the area of land required to support human activities and absorb human waste. The carbon footprint attempts to measure the entire greenhouse gas emissions resulting from all aspects of an individual's, organisation's, city's, or country's activities. These can be direct emissions (associated with activities taking place within a specified geographical area) or indirect emissions (associated with the production of goods and services elsewhere).

Greenhouse effect. The process by which the absorption of radiation by the atmosphere warms the Earth. This occurs naturally, but is enhanced by the release of greenhouse gases as a result of human activities.

Greenhouse gases. These are gases that absorb and emit radiation that cause warming to the Earth's atmosphere. The most significant gases produced by human activity that contribute to this process are carbon dioxide (CO₂) and methane (CH₄).

Mitigation. An intervention to lessen the effects of climate change by reducing greenhouse gas emissions.

Resilience. The ability of a social or ecological system to absorb disturbances and to continue functioning after being exposed to shocks or stresses.

Vulnerability. The degree to which a system is susceptible or unable to cope with the adverse effects of climate change. It is a function of the extent of climate change, the sensitivity of the system and its capacity to adapt.

38 Source: Adapted from Parry M, *et al.*

“Developing local Climate Change Plans – A Guide for Cities in Developing Countries” is part of UN-Habitat’s Cities and Climate Change Initiative tool series for local government officials and urban professionals in developing countries who have to deal with the growing problems of climate change. This publication provides a simple planning process based on understanding long-term climate change impacts, urban development challenges and the needs of citizens. It gives guidance that any city can use to get started no matter how limited its resources, describing “quick win” activities that address both climate and urban issues simultaneously.



Other publications in this series are:

- *Local Leadership for Climate Action*
- *Making Carbon Markets Work for Your City: A Guide for Cities in Developing Countries*
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