CLIMATE CHANGE ASSESSMENT FOR MAPUTO, MOZAMBIQUE: A SUMMARY



CITIES AND CLIMATE CHANGE INITIATIVE

UN HABITAT
FOR A BETTER URBAN FUTURE

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UN HABITAT

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ACRONYMS

ANAMM	Associação Nacional dos Municípios de Moçambique
CCAMUP	Climate Change Adaptation and Mitigation Urban Plan
CCCI	Cities and Climate Change Initiative
CIF	Climate Investment Fund
DRR	Disaster risk reduction
FEMA	Fórum Económico para o Meio Ambiente - Economic Forum for the Environment
INAM	Instituto Nacional de Meteorologia - National Institute of Meteorology
INAHINA	Instituto Nacional de Hidrografia e Navegação – National Institute for Hydrography and Navigation
INE	Instituto Nacional de Estatística - National Institute of Statistics
INGC	Instituto Nacional de Gestão de Calamidades – National Institute for Disaster Management
IIP	Instituto de Investigação Pesqueira – Fisheries Research Institute
JP	Joint Programme
MICOA	Ministério para a Coordenação da Acção Ambiental – Ministry for the Coordination of Environmental Affairs
MMC	Maputo Municipal Council
NAPA	National Adaptation Plan of Action
NPO	National Project Officer
PEUMM	Plano de Estrutura Urbana do Município de Maputo – Urban Master Plan of Maputo Municipality
PPCR	Pilot Programme for Climate Resilience
PRO-MAPUTO	Programa de Desenvolvimento Municipal de Maputo - Maputo Municipal Development Programme
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-HABITAT	United Nations Human Settlements Programme

1.0

INTRODUCTION

1.1 CITIES AND CLIMATE CHANGE

Millions of people around the world are already, or will be, affected by climate change. Urban areas, which typically feature high concentrations of populations and buildings, are particularly vulnerable. Climate change is expected to compound the overall vulnerability of urban areas through rising sea levels, more frequent and stronger weather events, and inland flooding, among other challenges. At the same time, cities are major sources of greenhouse gases, and therefore must stand at the forefront of mitigation efforts. Mitigation and adaptation to the effects of climate change must take into account the vulnerable natural and human systems existing in our urban areas and their surroundings.

In many countries, cities are located in coastal areas, beside rivers, on steep slopes or other risk-prone areas. Infrastructure such as roads, water networks, transmission lines, schools and hospitals providing basic services for urban populations, are vulnerable to extreme climatic events such as floods, storms or landslides. Cities located in tropical coastal areas are particularly vulnerable to cyclones or rising sea levels, the frequency and intensity of which have been on the increase over the past three decades. In addition, salt water intrusion restricts the availability of fresh water in coastal areas, jeopardizing food security as once-fertile land becomes barren due to high salt content. Cities located in the hinterland or along rivers may be vulnerable to flooding. Conversely, areas where climate change is expected to reduce rainfall may be affected by drought, shrinking water tables and food scarcity. In urban areas, the poor are the most vulnerable to the effects of climate change, and particularly slum dwellers in developing countries.

1.2 UN-HABITAT'S CITIES AND CLIMATE CHANGE INITIATIVE

Cities and local authorities have the potential to influence the causes of climate change and to find how to protect themselves from its effects. The Cities and Climate Change Initiative, a key component of UN-HABITAT's Sustainable Urban Development Network (SUD-Net), promotes enhanced climate change mitigation and adaptation in developing-country cities. More specifically, the Initiative supports the development of pro-poor innovative approaches to climate change policies and strategies. This Initiative builds on UN-HABITAT's rich experience in sustainable urban development (through the Environmental Planning and Management approach of the Sustainable Cities Programme and the Localizing Agenda 21 Programme) as well as on well-recognized capacity-building tools. The Initiative develops, adapts and disseminates the methodologies that put city managers and practitioners in a better position to cope with climate change.

The Cities and Climate Change Initiative also promotes collaboration by local authorities and their associations in global, regional and national networks; the triple rationale is (1) to enhance policy dialogue so that climate change is firmly established on the agenda; (2) to support local authorities' efforts to bring about these changes; and (3) to enhance awareness, education and capacity-building in support of climate change strategies. A major outcome of the initiative will be the development of a set of tools for mitigation and adaptation.

This report comes under the Cities and Climate Change Initiative. Four pilot cities were selected in 2009, and one of their first assignments was for each to assess its vulnerability to climate change. In addition to Maputo, the other three cities are Esmeraldas, Ecuador, Kampala, Uganda; and Sorsogon, Philippines. The aim of the assessments is to provide insights on climate

change adaptation and mitigation capacity in cities in developing and least developed countries. The rationale behind this report is to disseminate the early lessons of the Cities and Climate Change Initiative.

1.3 MAPUTO CITY

Mozambique has a land area of 784,090 km^2 which stretches 2,515 km along the coast of South-Eastern Africa. Its boundaries are the Indian Ocean to the East, and inland to the South, West and North lie South Africa, Swaziland, Zimbabwe, Zambia, Malawi and Tanzania. Maputo, the capital city of Mozambique, is located at the extreme South of the country and covers an area of 300 km^2, with a population of about 1.1 million, according to preliminary 2007 census data (INE, 2008). A metropolitan system links Maputo, Matola and Marracuene District, which together are known as Greater Maputo, with a fluctuating population of 2.0 to 2.5 million.

1.4 THE FRAMEWORK FOR CLIMATE RISK ASSESSMENT

This summary of the Maputo city vulnerability assessment is based on the proposed Framework for Urban Climate Risk Assessment developed by the Fifth Urban Research Symposium. The climate risk assessment framework focuses on the way cities are affected by climate change, as opposed to the way they contribute to it, an approach that highlights adaptation rather than mitigation. The framework analyses climate risk from three interconnected perspectives: hazards, vulnerabilities, and adaptive capacities. These perspectives combine physical science with, geographical and socio-economic elements that can be used by municipal authorities to devise and carry out climate change action plans.[1] This summary has been re-written to highlight these three perspectives.

FIGURE 1: Map of Mozambique

Maputo City ©UN-HABITAT/B.Oballa

1.5 ASSESSMENT METHODOLOGY

In Maputo, the preliminary assessment aimed at an overview of climate change issues and challenges in the city. The document highlights current policies and strategies at the national and local levels; on top of this come a general analysis of existing tools and research, on-going and planned activities and initiatives (such as training and capacity- building, mitigation and adaptation projects, etc.) and relevant ongoing information events and networks occurring in Mozambique and in Maputo.

The preliminary assessment is based on a review of literature on climate change issues, including data collection and analysis, existing legislation and strategies, scientific papers, recently implemented and planned initiatives and projects, as well as interviews with central and municipal government officials and specialised professionals.

1 *Mehrotram Shagun et al.,2009.*

2.0

CLIMATE CHANGE HAZARDS

Climate change hazards include "the climate-induced stresses on the city and are identified through observed trends and projections derived from global climate models and regional down-scaling"[2]. These "stresses" take the form of heat waves, droughts, inland floods, accelerated sea-level rise and flooding of coastal cities, and can be tracked through changes in temperatures, precipitation and sea level.

While focusing on the way climate change is bound to affect urban areas, it seems relevant to report the main findings of research carried out by the International Institute for Environment and Development (IIED, 2007), as follows:

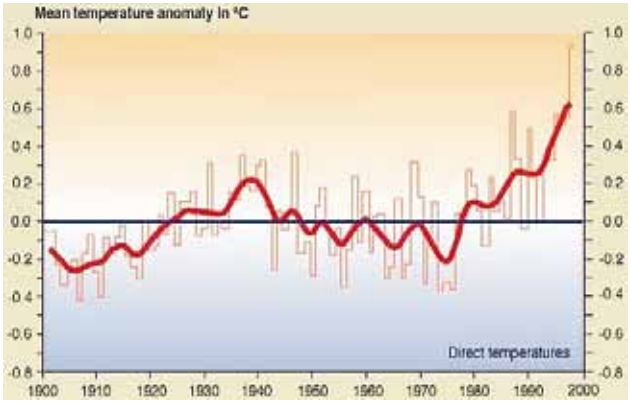
- 10 per cent of the world population live in coastal areas that lie within just 10 metres above sea level;
- Nearly two-thirds of urban settlements with more than five million residents are at least partially in the 0-10 metre zone;
- 21 per cent of the urban populations of least-developed nations are in the zone, compared to only 11 per cent in developed countries.

One of the authors of the IIED research paper, Gordon McGranahan, explains that "urban development in the coastal zone brings multiple risks. It exposes people to seaward hazards such as storms, flooding and cyclones, and it can damage sensitive ecosystems including those such as mangrove forests that protect the coastline". As a coastal city, Maputo is bound to be exposed to the climate change hazards mentioned above.

2.1 RISING TEMPERATURES

When focusing on climate change and related impacts in Southern Africa, recent research strongly suggests that over the coming decades, rising temperatures could change the rainfall regime (Hulme, 1996). As far as the whole continent is concerned, the United Nations Environment Programme (UNEP, 2002) mentions a warming process of about 0.7 °C during the 20th century, based on historical records, i.e., in line with world-wide trends. Research by the Inter-governmental Panel on Climate Change (IPCC, 1990, 1992, 2001 and 2007) confirms these trends. Still according to Hulme (1996), if nothing is done to curb future greenhouse gas emissions, the model delivers a scenario where by 2050 temperatures will rise an average 1.7°C compared with the 1961-90 period. According to the Inter-Governmental Panel's 2007 report, the trend observed in Mozambique is one of rising temperatures.

FIGURE 2: Variations of the Earth's Surface Temperature for the past 100 years in Africa



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2 *Ibid., p 8.*

2.2 HEAVIER RAINFALL, FLOODING AND TROPICAL CYCLONES

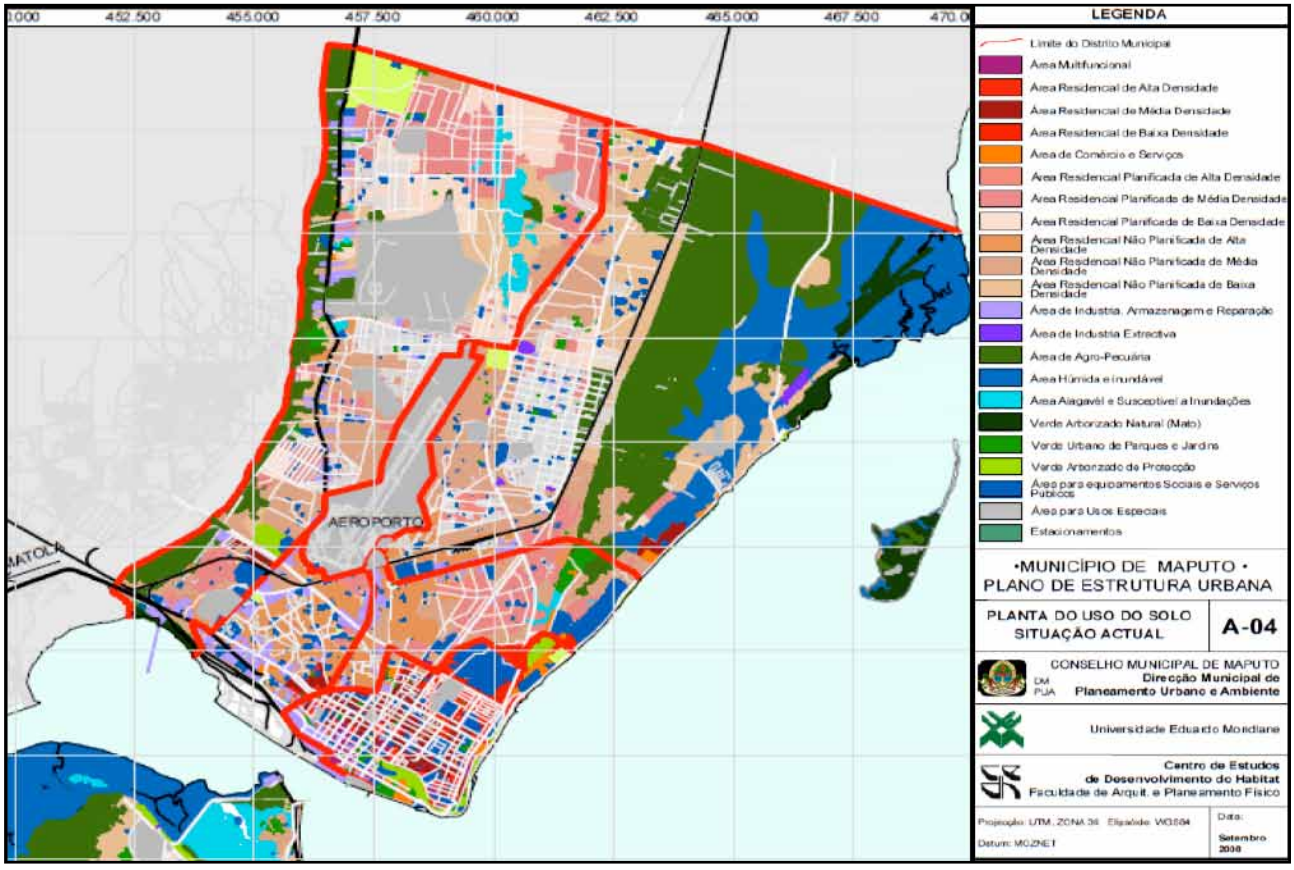
Existing climate change models indicate that in warmer climates, overall average rainfall would increase by about one to two per cent per degree of warming (IPCC, 2007). This is caused by increased evaporation leading to increases in rainfall. A warmer atmosphere as a result of global warming can hold more moisture before becoming saturated (Thow and de Blois, 2008).

Over the past 25 years, Mozambique has suffered from an uninterrupted succession of droughts and floods, with damaging consequences for social and economic development. The most severe drought periods were recorded in 1981-1984, 1991-1992 and 1994-1995; while floods were observed in 1977-1978, 1985, 1988, 1999-2000 and more recently in 2007-2008.

Floods are often exacerbated by cyclones. Since 1970, Mozambique has been hit by 34 significant cyclones or tropical depressions and four major flood events (2000, 2001, 2007 and 2008). In particular, the number of recorded cyclones during the 1999-2000 wet seasons was extraordinarily high and flooding had terrible consequences. In February and March 2000, a combination of torrential rains and tropical cyclones caused the most devastating floods in the history of Mozambique, killing 700 and causing US$600 million worth in damages (McBean and Henstra, 2003; Kundzewicz et al., 2001).

Figure 3 shows the current pattern of land use in Maputo. Wetlands and areas subject to flooding are highlighted in light and dark blue. It can be observed that these areas coincide with the coastal strip and with some long-standing slum neighbourhoods scattered in the city centre, such as Mafalala, Luis Cabral, Chamanculo and Xipamanine.

FIGURE 3: Current land use map of Maputo city



Source: Adapted from the Maputo's Municipality Urban Master Plan (Plano de Estrutura Urbana do Município de Maputo, PEUMM), 2008

2.3 RISING SEA LEVELS

The Inter-governmental Panel on Climate Change (IPCC, 2007) warned that sea levels could rise by tens of centimetres this century, making coastal populations more vulnerable to flooding and storm surges. The Panel also predicted more intense tropical cyclones. "The IPCC is aware that there are high population densities in coastal areas, but it has not yet recognised the links to urbanisation, and the implications for adaptation to climate change", wrote co-author Deborah Balk. "It is too late to rely solely on a reduction in greenhouse gas emissions to mitigate climate change, although this is clearly an imperative", according to McGranahan. "Migration away from the zone at risk will be necessary but costly and hard to implement, so coastal settlements will also need to be modified to protect residents".

Rising sea levels as derived from global warming would flood the lowest-lying areas of Maputo, which happen to be the most populated. This forecast is supported by Mozambique's National Adaptation Plan of Action to Climate Change (NAPA, 2007). Recent research on the changes in Maputo Bay over the length of the Holocene era highlighted the effects of rising sea levels since 8,000 years BC (Mussa et al., 2003). The average sea level in Maputo may be influenced by the total rainfall/runoff pattern of the catchments areas of the Incomati, Maputo and Matola river basins (INAHINA and IIP, 2002).

According to recent research by the National Institute of Disaster Management (Instituto Nacional de Gestão de Calamidades), "If not protected by new coastal defences, a sea level rise of 5m by 2100 would flood the entire area of the Marginal. In addition, the port and its rail links will need to be gradually relocated as the water rises. The new coastline will be dominated by steep cliffs, which will make the development of new coastal infrastructure difficult and expensive. However, the city itself will remain safe on its high ground".[3]

Erosion along the Maputo coastline
©UN-HABITAT/B.Oballa

Flooding in Maputo city in January 2010
©UN-HABITAT/Silva Magaia

3 *INGC. 2009.*

3.0

VULNERABILITY TO CLIMATE CHANGE

According to the Framework for City Climate Risk Assessment (FCCRA), vulnerability refers to the "physical attributes of the city and its socio-economic composition that determine the degree of its susceptibility. The variables affecting vulnerability include flood-proneness (proximity to coast or river), land area, elevation, population density, percentage of poor, and quality of infrastructure."[4]

3.1 GEOGRAPHIC LOCATION

Given its geographic location, Mozambique is highly vulnerable to natural disasters, in particular those of a hydro-meteorological nature (such as floods, drought and cyclones). The IPCC defines 'vulnerability' as "the degree to which a system is susceptible to, or unable to cope with adverse effects of climate change, including climate variability and extremes. In this respect vulnerability is seen as the function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity" (IPCC, 2001). The terrain of the country is mostly coastal lowland, with a vast network of rivers and tributaries emptying into the Indian Ocean. The coastline is highly susceptible to cyclones and tropical storms.

Maputo is also highly vulnerable to the effects of climate change since it faces the Indian Ocean and is the most densely populated urban area in Mozambique. A rising sea level has resulted in salty intrusion, causing damages to agriculture and contributing to urban poverty. Any further sea-level rises would flood the lowest-lying areas (which are the most populated), with serious consequences for the urban poor whose capacity to adapt to climate change is rather limited. Shrinkage of sand strips on the beaches results in serious coastal erosion with negative consequences for economic activity.

4 *FCCRA, p 9*

FIGURE 4: Marginal Avenue: Areas at risk of erosion from rising sea levels

Figure 4 shows the impact on Maputo's infrastructure of an extreme event linked to climate change,- and more specifically the current effect of rising sea levels on Marginal Avenue, which runs along shore of the Indian Ocean. Although Avenida da Marginal has been recently rehabilitated, no adequate protection barriers have been built yet. Moreover, the city's three islands, located a few kilometres, off the coast, show clear evidence of climate change effects; these include the disappearance of mangroves, degradation of well-water quality, desertification and exposure of sand dunes, worsening wind erosion, loss of coastline and lack of arable land for domestic agriculture.

3.2 URBAN DYNAMICS

3.2.1 URBAN GROWTH AND POVERTY IN MAPUTO

According to statistics and projections from the United Nations Department of Economic and Social Affairs (UNDESA, 2007), the urban population of Mozambique will be greater than the average in sub-Saharan Africa by the next decade. As in other

African countries, rural-urban migration is a defining demographic feature of Mozambique, and Maputo in particular. In 1997, with a density of 3,700/km^2, Maputo was host to 45 per cent of the total urban population in Mozambique, 50 per cent of which was considered to be living below the poverty line. Recent data reflects increased rural-urban migration, contributing to higher poverty and vulnerability. Climate change is liable to compound the combined effect of high urban population density (especially in the peri-urban slum areas of Maputo) with season-related factors with cool seasons associated with drought and warm seasons d with wet events. Table 1 is derived from 2007 census data showing the patterns of demographic growth in the capital city over a decade.

3.2.2 PROLIFERATING UNPLANNED SETTLEMENTS

Vulnerability to floods has increased in peri-urban areas in Mozambique, where during the last three decades unplanned human settlements have been proliferating, gradually expanding to lowlands and marshy areas with high flood risks (Spaliviero, 2006).

Unplanned settlement in Maputo
©UN-HABITAT/B.Oballa

The following is a testimony of a slum dweller in one of the oldest and most dilapidated neighbourhoods of Maputo: "Our houses are built in low areas. We have no shelter when the flood starts. The house owners do not help us to drain out water from our homes. People use buckets to remove water themselves. Once water has gone, the real disaster has just begun. That is

TABLE 1: Distribution of Maputo's population (by municipal districts)

Municipal District	1997 Population Census	2007 Population Census (Preliminary Data)	Difference 1997-2007
Municipal District Nº 1	154,28	108,353	-45,931
Municipal District Nº 2	162,750	155,264	-7,486
Municipal District Nº 3	210,551	224,181	+13,630
Municipal District Nº 4	228,244	289,864	+61,620
Municipal District Nº 5	211,008	293,716	+82,708
Municipal District Nº 6 (Catembe)	15,853	19,605	+3,752
Municipal District Nº 7 (Inhaca Island)	4,672	3,956	-716
Total	**987,362**	**1,094,939**	**+107,577**

Source: 2007 Census, National Institute for Statistics (Instituto Nacional de Estadísticas - INE, 2008)

diseases." (Extract from an interview with a resident of Mafalala in Maputo (ActionAid, 2006)). Consequently, the risk of serious consequences for the urban poor will increase, especially considering their incapacity to improve their dwellings or move to safer areas.

Generally speaking, the incidence of extreme events linked to climate change will have destructive consequences on cities, damaging their water, sewerage, energy supply and transportation systems, as well as buildings, trees and public areas. This can lead to illness and death. Table 2 illustrates the impacts of climate change on various areas and sectors in Maputo.

Inadequate storm water management
©UN-HABITAT/B. Oballa

TABLE 2: Sectors and areas of Maputo city vulnerable to extreme events related to climate change

Sector or area	Climate change related-event	Impact or consequences
Coastal zone and ecosystems	Tropical cyclones	Damage to coastal infrastructure, dunes, beaches and other natural features
	Rising sea level and storm flow	Increased erosion or damage to coastal infrastructure, dunes, beaches, and other natural features
		Loss of coastal wetlands, mangroves and other coastal habitats
		Higher costs for maintenance and expansion of coastal erosion controls (natural or man-made)
		Saltwater intrusion into coastal aquifers
		Higher risk of pollution from coastal hazardous waste sites
		Reduced effectiveness of sea walls
Transportation systems	Variations in temperature and heavy rainfall	Increased damage to road surface sand bridges
		Increased maintenance requirements for roadside/pavement
Wetlands and urban agriculture	Heavy precipitation	Increased risk of flooding
	Dry season	Crop failures, water scarcity, drying of water reservoirs, and stronger demand for irrigation
		Increased risk of habitat loss (mangroves), and salt intrusion
Human settlements and infrastructure	Tropical cyclones	Damage to housing and infrastructure
	Heavy rainfall	Damage to housing and infrastructure
		Need for new or upgraded flood and erosion control structures
		Landslides, road washouts and flooding
		Increased demands on storm water management systems and sewer overflows
	Rising sea levels	Reduced effectiveness of sea walls
		Damage to housing and infrastructure
Health, food and waste management	Heavy rainfall	Increase in vector-borne diseases (malaria, cholera, etc.)
		Need for new waste collection, management and treatment systems

4.0

ADAPTIVE CAPACITY

The adaptive capacity of a city refers to the "institutional attributes of the city and its actors that determine the degree of its capability to respond to potential climate change impacts"5. It measures the willingness and ability to cope and respond positively to the stresses of climate change.

4.1 NATIONAL POLICIES AND PLANS

Of the key national policies, strategies and plans as well as strategic plans and programmes that have come under review, the following directly address climate change:

1. **National Adaptation Plan of Action to Climate Change (NAPA)** Programa de Acção Nacional para a Adaptação às Mudanças Climáticas (approved in 2007). The Plan of Action identifies the country's more urgent needs with regard to climate change through a participative assessment process. The overall purpose is to improve the country's capacity to deal with the effects of climate change. More specifically, the Plan of Action pursues four objectives, as follows: (1) strengthening the warning system for natural disaster prevention; (2) capacity-building and awareness-raising for farmers to deal with the effects of climate change; (3) reducing these effects in coastal areas; and (4) improving water resources management. The National Adaptation Plan of Action addresses climate change issues on a country-wide scale, without any specific attention for urban areas.
2. **The Environmental Strategy for Sustainable Development of Mozambique** Estratégia Ambiental para oDesenvolvimento Sustentável de Moçambique (approved in 2007). This Strategy provides an integrated vision for sustainable environmental management in Mozambique, and comes complete with guidelines for stakeholders involved in development programmes. The Strategy includes four elements, as follows: (1) capacity-building for implementation, and setting national and local objectives for integrated management and preservation of natural resources and ecosystems; (2) setting up institutions with the technical capacities required for urban planning, development of infrastructure, waste management, and water and sanitation services; (3) providing the technical and financial support required to strengthen the country's capacity to measure, curb and evaluate environmental pollution (including any impacts on health and climate change issues); and (4) keeping demographic growth within the limits of socio-economic and sustainable development objectives. This Environmental Strategy addresses climate change issues in a direct way, but then mainly from the perspective of atmospheric (greenhouse gas) pollution, specifying a range of steps to be taken to meet the terms of the United Nations Framework Convention on Climate Change. On top of this, the Strategy refers to the urban environment and includes a slum upgrading strategy, but does not specifically address the impact of climate change on cities.

In addition, several nationwide initiatives that address the effects of climate change have recently been, or are soon to be, launched in Mozambique. The following three are of interest to the Cities and Climate Change Initiative:

3. **The UN Joint Programme for Disaster Risk Reduction (DRR) and Emergency Preparedness** is led by the UN Development Programme (UNDP) with UN-HABITAT participation. This programme aims at: (i) mainstreaming disaster risk and vulnerability reduction in national development plans and programmes, including development of policy and norms; (ii) strengthening government and civil society capacities for disaster risk

5 *FCCRA, p.9*

reduction at central, provincial and local levels; (iii) setting up a National Information System including early warning, and cross-sector information sharing and knowledge management for disaster risk reduction. Several methods and tools are being developed under this Joint Programme, some of which could well fit the purpose of the Cities and Climate Change Initiative.

4. **The UN Joint Programme for Environmental Mainstreaming and Adaptation to Climate Change**, led by the Food and Agriculture Organisation (FAO) with UN-HABITAT as participating agency. The programme supports the Government of Mozambique's efforts towards sustainable development through (i) mainstreaming of environment and climate change policies, and (ii) adaptation of human activities to climate change. The Programme is currently implemented in Chicualacuala District, a remote and arid rural area of Gaza Province 500 km north-west of Maputo. The Cities and Climate Change Initiative will be able to take advantage of the policy and normative work under this Programme.
5. **The Pilot Programme for Climate Resilience (PPCR),** to be funded by a US$500 million contribution from the World Bank in the next two to three years. A preliminary step in this Pilot Programme – an in-depth assessment on the potential climate change impacts in Mozambique for the next 50 years – is currently under preparation. This Programme is part of the Climate Investment Fund (CIF), recently approved by the Word Bank, and represents a potential funding source for follow-up investment under the Cities and Climate Change Initiative.

Many of the policies, strategies and plans that have come under analysis included strategic recommendations and proposed actions which should contribute to the formulation and deployment of climate change adaptation and mitigation measures. However, lack of integration between these different instruments does not make it possible to do so in a comprehensive and systematic manner, and the urban dimension of the problem does not come under any particular focus. In particular, it appears that the negative effects of climate change and Disaster Risk Reduction in general do not yet feature on municipal agendas. Moreover, to the knowledge of the authors, no specific methods or tools have been developed or adopted yet. These are major shortfalls which must be addressed urgently.

4.2 CITY-LEVEL POLICIES AND PLANS

At the city level, only one instrument was found that specifically addressed climate change issues. This is the Urban Master Plan of Maputo Municipality – Plano de Estrutura Urbana do Municipio de Maputo (PEUMM) – which was approved in 2008. As the main urban planning instrument for the city, its five-fold objective is to:

- define the spatial vision and strategic planning priorities of the city;
- identify priority areas for public capital investment;
- establish municipal principles for urban planning;
- provide clear guidelines for private capital investment and/or initiatives;
- establish a simple data collection system, and one which can be permanently updated

When it comes to climate change, the Master Plan identifies sensitive areas of Maputo that are vulnerable to extreme events related to climate change, as well as any effects that can be anticipated, and proceeds to detail guidelines for future urban development operations. The strategic projects in the Master Plan include, among others: (1) slum upgrading; (2) land requalification for development of social/public services and infrastructures; (3) land provision for urban expansion; (4) promotion of urban diversification of activities and functions, in a bid to prevent peri-urban slums and spatial segregation of poor communities; and (5) reduce social segmentation through provision of infrastructure, services and amenities in slum areas.

Another local initiative addresses the effects of climate change, viz., the Maputo Municipal Development Programme (Pro-Maputo), a three-year, US$40 million initiative also funded by the World Bank. Although the programme does not specifically address issues related to climate change its urban planning dimension and proposed physical interventions should have mitigation effects in that area. Furthermore, as mentioned already, Pro-Maputo can act as a potential source of funding for a follow-up investment phase of the Cities and Climate Change Initiative in the city, especially if the Initiative is well embedded in the municipal agenda.

4.3 STAKEHOLDER ENGAGEMENT

The capacity to adapt to climate change reflects the ability of a community to reduce its vulnerability; therefore, stronger adaptive capacity should focus on the most vulnerable groups and territories. There is a general agreement on the need to move away from top-down implementation approaches and centralised planning, and instead look to build adaptive capacity and resilience at grassroots level. This calls for enhanced mitigation and recovery capacities among local stakeholders and communities.

A stakeholder analysis has been carried out as part of the City Vulnerability Assessment. The main finding was a need to broaden stakeholder participation in order to enhance the adaptive capacity of the nation, and Maputo in particular. The following stakeholders were identified for the purposes of the Cities and Climate Change Initiative in Mozambique:

At central government level, six departments and agencies:

i. The Ministry for the Coordination of Environmental Affairs as the focal point for coordinating matters related to climate change, with departments dealing with urban planning, environmental promotion and solid waste management, among other areas.

ii. The Ministry of Public Works and Housing (Ministério das Obras Públicas e Habitação – MOPH) which is involved with building codes, housing development strategies and capital investment in water and sanitation.

iii. The Ministry of State Administration (Minstério da Administração Estatal – MAE) includes two well-placed institutions for this initiative: (a) the National Institute of Disaster Management (INGC); and (b) the National Directorate for Municipal Development (Direcção Nacional de Desenvolvimento Autárquico – DNDA).

iv. The Ministry of Science and Technology (Ministério da Ciência e Tecnologias – MCT), which tests innovative and sustainable solutions/technologies for mitigating/adapting to climate change-related effects.

v. The National Institute for Hydrography and Navigation (INAHINA) which is responsible for the deployment and maintenance of tide-gauge stations, as well as for the acquisition, processing, archiving and dissemination of sea-level data; and

vi. The National Institute of Meteorology (INAM).

Sea wall along Maputo coastline
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At municipal level: The Maputo Municipal Council (MMC) is the main municipal focal point for (i) urban plans for climate change adaptation; (ii) coordinating the planning and execution of pilot interventions; (iii) training and capacity-building programmes; and (iv) serving as intermediary to access the final beneficiaries (vulnerable populations at neighbourhood level, slum dwellers and community-based or other local associations.

The academic sector: The Eduardo Mondlane University (Universidade Eduardo Mondlane - UEM) in Maputo will be involved in the development and testing of climate change adaptation/mitigation tools and methods, especially through the Faculties of Architecture and Physical Planning, Engineering and Sciences.

Civil society and the private sector: These are essential sectors. Other than the Economic Forum for the Environment (Fórum Económico para o Meio Ambiente – FEMA), additional major stakeholders have not yet been clearly identified. The potential they can offer is of a double nature: enhancing climate change awareness and advocacy, and providing capital investment for pilot adaptation and/or mitigation schemes.

Before engaging in the design of a climate change adaptation strategy for the city of Maputo, it is important to begin by carrying out a systematic assessment of the possible effects; this would examine not only how climate change is likely to affect the natural environment and physical infrastructure of a given urban region, but also to trace any potential economic effects on municipal operations and on the city's economy, as well as the social impact on the vulnerable population (Clean Air Partnership, 2007).

5.0

CONCLUSIONS AND RECOMMENDATIONS

5. 1 PRIORITY URBAN SECTORS FOR CLIMATE CHANGE INTERVENTION

After the consultations carried out at both municipal and central government levels, a list of key priority sectors were identified in which climate change adaptation and mitigation measures could be tested in urban and, particularly, informal areas of Maputo municipality with a potential relevant impact in the short to medium term. These sectors are detailed in Table 3.

5.2 ELEMENTS OF AN EFFECTIVE ADAPTATION PROCESS

For the city of Maputo, the Climate Vulnerability Assessment has identified four key elements that should be endorsed if the adaptation process is to be effective:

1. *Awareness and engagement of stakeholders.* The consultations and interviews carried out within the framework of this study confirmed a strong degree of engagement and interest in the need to address climate change as well as in the Cities and Climate Change Initiative. However, a more comprehensive and consistent consultation process is needed in order to assess the degree of awareness among the various stakeholders.
2. *Climate change impacts and assessment*. As follow-up to this report, additional data and further investigation are needed in order more accurately to identify and assess the potential effects of climate change in Maputo. For this purpose, the following four actions must be undertaken: (i) review and analysis of historical climatic and hydrological records, including the hydro-morphological dynamics of Maputo Bay; (ii) identification of potential threats and effects on Maputo of various climate change scenarios; (iii) in-depth assessment of specific vulnerable areas of Maputo (e.g., coastal strip, flood-prone peri-urban slums, etc.) and sensitive sectors (water supply, drainage, energy, transportation, building codes, green and wetland areas, solid waste management, health, etc.); and (iv) assessment of potential socio-economic and

TABLE 3: Proposed key sectors for climate change adaptation and mitigation measures in Maputo

Key sectors	Type of mitigation and/or adaptation measures
Urban infrastructure and planning	• Improved drainage/storm water system • Building coastline protection dikes • Development and implementation of adaptation/mitigation urban plans
Housing and building codes	• Building environmentally sustainable social housing • Development and enforcement of building codes that provide for resistance to natural disasters
Water, sanitation and health	• Sustainable use and supply of water resources • Provision of basic services to the urban poor • Health education and promotion
Urban environmental quality and green areas	• Improved solid waste management • Support of urban agriculture development • Preservation of green areas, wetlands and coastal mangroves • Installation of ecological water treatment systems

Improved drainage in Mafalala, Maputo ©UN-HABITAT/B.Oballa

infrastructure costs of climate impacts at city level.

3. *Planning for effective adaptation*. An analysis of current policies, strategies and plans at national level, and of strategic instruments at municipal level, shows that climate change issues are indeed recognised in Mozambique. However, these legal/policy/strategic instruments do not address climate change either in an integrated and consistent way (there are a number of gaps), or with any clear focus on urban areas (where population densities, hence risks, are higher), especially those located in vulnerable areas such as along the coastline, as is the case with Maputo. Consequently, the Cities and Climate Change Initiative in Mozambique has a strategic role to play in the development of adequate policy, strategic and planning tools based on the outcomes of the previous two steps (i.e., engagement/awareness and detailed assessments), in order to provide policy- and decision-makers with a range of adaptive options for cities. These tools must be simple as well as easy to understandable and to implement; they must also come as part, of an overall strategic framework for sustainable urban development in Mozambique. Currently, some innovative plans and strategies are being developed for adaptation and mitigation of climate change-related impacts on a nationwide scale, especially under the leadership of the National Institute for Disaster Management (INGC). However, these instruments are not yet fully adopted or systematically deployed, and they do not specifically focus on urban areas.

4. *Taking adaptive action.* Proper institutional mechanisms to guide the adaptation process must, in the first place, be established at both national and municipal levels. As mentioned earlier, the Ministry for the Coordination of Environmental Affairs is the focal point for the coordination of climate change schemes and policies in Mozambique; however its capacity needs to be strengthened. The Maputo Municipal Council still lacks a dedicated unit or department to deal with climate change and related disaster risk reduction issues. Therefore, the Cities and Climate Change

Initiative represents a most welcome opportunity to building an institutional set-up within the municipality, with proper linkages to government/policy-making functions.

In terms of existing policies, several gaps must be filled in. It is highly desirable for the Cities and Climate Change Initiative to serve as a major demonstration and catalytic scheme, with a significant impact at both institutional and ground levels.

Finally, climate change adaptation must be mainstreamed and highlighted in on-going or prospective programmes or initiatives. This is why deployment of demonstration/adaptation projects or interventions is so important. It will be essential to establish proper coordination and create synergies with on-going programmes.

5.3 A CLIMATE CHANGE IMPLEMENTATION STRATEGY

The assessment proposes an implementation strategy for the Cities and Climate Change Initiative to be carried out within a two-year time frame. The objective is to build the institutional capacities that are required to develop appropriate policies, strategies, tools and methods for climate change adaptation and/or mitigation measures in urban areas. More specifically, the threefold objective is the following:

1. To establish effective management and implementation capacities within Maputo Municipal Council for dealing with climate change impacts in urban areas, with clear institutional roles and communication channels, including mechanisms for policy dialogue.
2. To carry out a fully-fledged and multi-dimensional assessment of the impacts of climate change on Maputo and to develop strategies, tools and methods for climate change adaptation or /mitigation in urban areas
3. To manage and disseminate awareness of the effects of climate change on urban areas, and to deploy demonstrative schemes for adaptation-mitigation in Maputo, including awareness-raising.

Maputo Municipal Council ©UN-HABITAT/B.Oballa

The following recommendations will support the proposed intervention strategy for implementing the Cities and Climate Change Initiative in Mozambique:

1. Secure stronger involvement from major stakeholders and set up efficient institutional and communication mechanisms to reach consensus on the proposed intervention strategy.

Following a comprehensive and consistent consultation process among all stakeholders, it will be important actively to involve key institutions such as the Ministry for the Coordination of Environmental Affairs and the National Institute of Disaster Management (INGC) at central level, and the Maputo Municipal Council at local level.

As a result of these consultations, consensus on a functional and efficient institutional set-up of the whole initiative should be reached; this consensus will determine the roles and responsibilities of the various parties involved (i.e., central government, municipal authorities, target communities and development partners, including UN-HABITAT) and establish clear communication channels. The consensus must also include participation and transparency mechanisms at all stages of implementation, from decision-making to planning to actual execution.

Generally speaking, stronger involvement is expected from the academic sector (for research and urban planning), civil society (for advocacy and awareness-raising) and the private sector

(for setting up sustainable investment schemes in the long term). Potential bi- or multi-lateral development partners must be identified in order to coordinate with on-going projects and create synergies at a very early stage of the Cities and Climate Change Initiative, including the identification of potential sources for funding the follow-up investment phase. For this purpose, liaising with key discussion/ coordination fora such as the Working Groups for Municipal Development and for Environment will be very useful.

Importantly, the proposed implementation strategy will have to be discussed and revised until full consensus is reached by all parties involved.

2. Establish effective management and implementation capacities in order to fulfil the various functions deriving from the Cities and Climate Change Initiative from the very beginning.

A full-time National Project Officer (NPO) attached to the Maputo Municipal Council must be recruited in order to facilitate project implementation as per the outcomes of the consultative process specified above.

If the Initiative is to succeed, it is strongly recommended that climate change-related impacts and Disaster Risk Reduction issues be mainstreamed within the Department of Environmental Management (Municipal Directorate for Urban Planning and Environment) of the Maputo Municipal Council. At a later stage, the functions and status of this Department must be gradually expanded and enhanced, as the Department comes fully to integrate the various functions, decision-making mechanisms and projects of the municipality.

3. Prepare a fully-fledged and multi-dimensional assessment of the impacts of climate change on Maputo in order to determine the adaptation-mitigation measures to be deployed and any steps or schemes to be implemented as a matter of priority.

This assessment must take in the following elements, at the very least:

Inadequate solid waste management
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A detailed review of the degree of awareness of the effects of climate change on Maputo, to be followed by a statistical analysis of the results as well as a set of practical recommendations, as a prerequisite for awareness-raising campaigns;

An extensive policy/strategy review of existing instruments dealing with climate change, with more specific and elaborated recommendations on any gaps to be filled in;

A review and analysis of existing/historical climatic and hydrological records of the Maputo micro-region, including hydro-morphological dynamics of the bay; this review should give rise to specific recommendations whether to include Greater Maputo in the target area for climate change adaptation/mitigation;

Identification of potential threats and effects on Maputo city (or Greater Maputo, as the case may be) under various climate change scenarios, with a special focus on flooding (associated with heavy rainfall), rising sea levels and cyclones;

In-depth assessment of specific vulnerable urban areas of Maputo (e.g., coastal strip, flood-prone peri-urban slums, etc.) and sensitive sectors (water supply, drainage system, energy, transportation, building codes, green and wetland areas, solid waste management, health, etc.), including an estimation of any potential socio-economic and infrastructure costs of the effects of climate on the city;

Any physical climate change adaptation/ mitigation measures in Maputo must be ranked by priority over the short, medium and long terms, with a special focus on the following four sectors: (i) urban infrastructure and planning; (ii) housing and building codes; (iii) water, sanitation and health; (iv) urban environmental quality and green areas (see Table 5); also to be included is an economic and cross-sector analysis of the various adaptation/mitigation measures/options.

4. Develop proper climate change adaptation/ mitigation strategies, tools and methods for urban areas in Mozambique to be tested in Maputo city

Training is required urgently for the benefit of government and municipal staff to be involved in the Cities and Climate Change Initiative, if they are to be in a position to develop climate change adaptation/mitigation strategies, tools and methods that are well-adapted to the urban situation in Mozambique. These are entirely missing at the moment. The need is for simple, instruments that are easy both to understand and implement as part of an overall strategic framework for sustainable urban development in Mozambique

In this respect, a major step under the Cities and Climate Change Initiative shall be the development of a Local Climate Change Adaptation and Mitigation Plan (LCCAMP) for Maputo City. This plan must be consistent with the recently approved Urban Master Plan of Maputo Municipality (PEUMM); in particular, it must provide a range of adaptation/mitigation measures/options targeting policy and decision-makers to be applied in the short, medium and long terms. The Local Climate Change Adaptation and Mitigation Plan must be prepared and coordinated through the Unit to

Adapting to climate change. Improved storm water drainage in Maputo ©UN-HABITAT/B. Oballa

be set up within the Maputo Municipal Council by the project. The plan will be part of a set of tools and methods to be disseminated and applied in other Mozambican cities.

Moreover, the municipality's Department of Environmental Management should develop a database in order to systematically record existing knowledge and data regarding events related with climate change which pose a threat to the city. Such database will make it possible to update and adjust the Local Climate Change Adaptation and Mitigation Plan.

5. Implement demonstrative climate change adaptation/mitigation projects or interventions in Maputo, and secure funding sources for follow-up investment

As part of the Local Climate Change Adaptation and Mitigation Plan to be developed for Maputo, a pilot scheme should be carried out, taking advantage of the experience and know-how developed by UN-HABITAT in Mozambique. Such a pilot scheme can have a catalytic role, with a potentially positive effect, at both institutional and ground levels, demonstrating how best to tackle climate change in the country's urban areas.

The scheme, if properly carried out, can then serve as best practice and stimulate the formulation of an improved policy framework; this will put public authorities in a better position to deal with climate change-related issues against a background of accelerated urbanisation in Mozambique. Together with the development of adequate capacity and planning tools, a pilot adaptation/mitigation scheme can also help secure funding for follow-up investment, for example under the World Bank's Maputo Municipal Development Programme (Pro-Maputo) and Pilot Programme for Climate Resilience.

6. Set up dissemination mechanisms regarding climate change-related issues in urban areas, and launch awareness campaigns.

Last but not least, it will be very important to systematise all collected information on climate change-related issues in urban areas for the duration of the Initiative. Central government institutions such as the Ministry for Coordination of Environmental Affairs and National Institute of Disaster Management (INGC) will have major roles to play in this respect. In particular, the following should be undertaken:

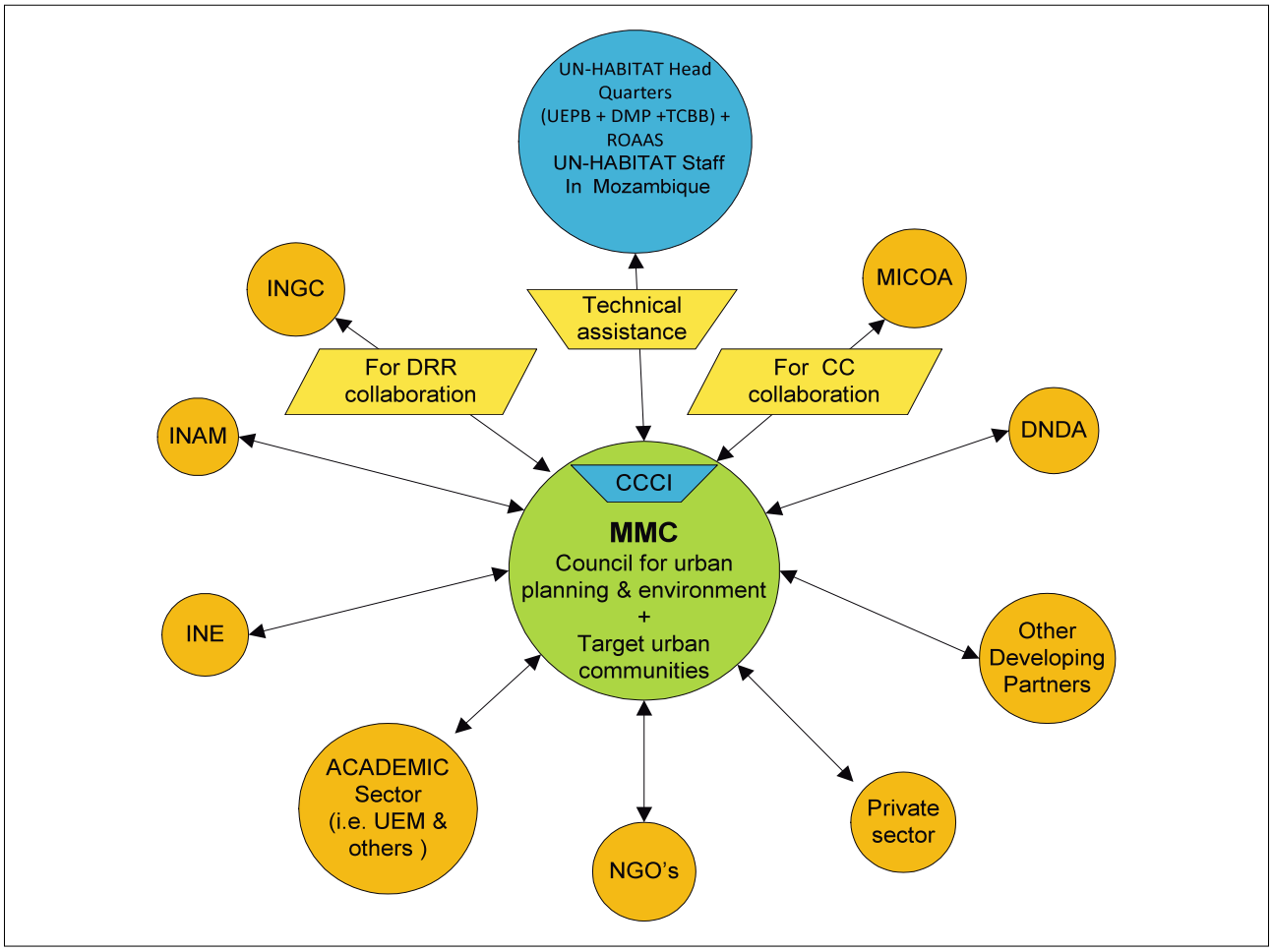
i. Proper policy dialogue mechanisms should be established through workshops that promote/improved policies/strategies dealing with climate change, in order to mainstream the urban dimension of this phenomenon.

ii. All strategies, tools, methods and plans shall be devised and disseminated across interested parties through a knowledge management set-up.

iii. Efficient dissemination mechanisms should be established, with brochures, advocacy material and best practice reports prepared and, distributed to municipalities through seminars and ad-hoc training sessions. The Associação Nacional dos Municípios de Moçambique (ANAMM) could also help in this purpose.

iv. Since the assessment identifies the potential effects of climate change in urban areas, each of these should provide the theme for an awareness campaign.

FIGURE 4: PROPOSED COMMUNICATION FLOW FOR PROJECT IMPLEMENTATION



LEGEND:

CC:	Climate Change
DMP:	Disaster Management Programme
DRR:	Disaster Risk Reduction
INGC:	Instituto Nacional de Gestão de Calamidades/National Institute for Disaster Management
MICOA:	Ministério para a Coordenação da Acção Ambiental/ Ministry for Coordination of Environmental Affairs
MMC:	Maputo Municipal Council
CCCI:	Cities & Climate Change Initiative
ROAAS:	Regional Office for Africa and the Arab States
TCBB:	Training and Capacity Building Branch
UEPB:	Urban Environment Planning Branch
UN-HABITAT:	United Nations Human Settlements Programme
INAM:	Instituto Nacional de Meteorologia/National Institute for Meteorology
DNDA:	Direcção Nacional de Desenvolvimento Autárquico/National Directorate for Local Authority Development
INE:	Instituto Nacional de Estatística/National Institute for Statistics
UEM:	Universidade/University Eduardo Mondlane

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UN-HABITAT's Cities and Climate Change Initiative promotes enhanced climate change mitigation and adaptation in developing country cities. Maputo is a pilot city of the Initiative, and this document is an initial output of the city's Cities and Climate Change Initiative activities. This summary on climate change assessment for Maputo is based on the report titled "Climate Change Impacts in Urban Areas of Mozambique, a Pilot Initiative in Maputo City: Preliminary Assessment and Proposed Implementation Strategy".

Starting with a brief background on the city, the report addresses Maputo's climate change situation from a climate risk perspective that focuses on hazards, vulnerabilities and the adaptive capacities of the city. Following the insights gained from clarifying the climate change challenges, the report proposes the key sectors for climate change adaptation and mitigation measures in Maputo. It finally recommends a Climate Change Implementation Strategy for the city to be carried out under the Cities and Climate Change Initiative.

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