Cities and Climate Change Initiative

ABRIDGED REPORT

Makassar Indonesia

Climate Change Vulnerability Assessment

UNEP

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FOR A BETTER URBAN FUTURE

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Makassar, Indonesia - Climate Change Vulnerability Assessment

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DISCLAIMER

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Introduction

Climate change is already affecting millions of people worldwide. In urban areas, which are typically characterised by significantly higher population density, climate change will exacerbate and compound existing vulnerabilities, especially for the urban poor.

Across Indonesia cities are facing two interlinked challenges, that of rapid population growth and the impacts of climate change. Rapid urbanization offers the benefits of larger economies, increased human resources, and potentially more development opportunities, however, unplanned rapid growth can also strain public services and infrastructure, invite casualization of labour and unsafe informal sector employment, causes pollution and overwhelm ecosystems, and leads to traffic congestion. As a result of climate change, we expect that storm frequency and intensity will increase, flooding will become serious and droughts will affect food production in rural areas, which has damaging knock-on effects in urban areas. Coastal areas are threatened by inundation from sea-level rise, and other urban challenges. Meanwhile, cities are the main drivers of increased greenhouse gas emissions. This means that cities must be the centre of actions both to mitigate the causes of climate change, and to adapt to their anticipated effects.

Makassar is a coastal city, sitting on the far southwestern tip of the island of Sulawesi, in eastern Indonesia. The population has grown from 1.1 million in 2003 to about 1.35 million today, an increase of over 20 per cent in a decade. At the same time, its land area is expanding as reclaimed land extends the city's coastline creating opportunities for new commercial developments. On the periphery of the city new housing estates are being developed with rising demand for homes and public services. The city recently built a new international airport and is expanding its port facilities to boost trading capacity and create jobs. Major infrastructure such as roads, hospitals and water supply networks, as well as basic services such as healthcare, are becoming vulnerable to the negative effects of climate change.

The vulnerability assessment aims to bring together an understanding of urban growth dynamics with that of climate trends and its impacts in Makassar. The vulnerability assessment consists of three components: (i) the climate change vulnerability assessment; (ii) the ecosystem-based adaptation assessment and (iii) the institutional capacity assessment. It is targeted at national and local government officials, policy makers and key members of organizations and institutions working to improve urban systems and living conditions of poor and vulnerable communities as well as community leaders, NGOs and community based organizations, and anyone interested in taking action to decrease climate vulnerability in the city. It is intended to be used as a planning tool as well as an advocacy document to guide decision-making at the metropolitan, city and community levels about effective responses to climate change impacts. The recommendations can be used to identify priority urban systems, places and populations that are being impacted by climate change and to design appropriate policies and programmes that target specific issues, systems and weaknesses.

Amongst the most vulnerable areas and people of Makassar are the urban poor who live along the coast. Climate change threatens their livelihoods and physical safety, and this compounds their existing social vulnerabilities of lacking access to water and low income.

1.1 Cities and Climate Change Initiative

The Cities and Climate Change Initiative was developed by UN-Habitat to promote the mitigation of, and adaptation to, climate change in developing countries. More specifically, the Initiative supports the development of pro-poor innovative approaches to climate change policies and strategies. It builds on UN-Habitat's rich experience of sustainable urban development (through the Environmental Planning and Management approach of the Sustainable Cities and Agenda 21 Programmes) as well as on internationally recognised capacity building tools. The Initiative develops, adapts and disseminates methodologies that put city managers and practitioners in a better position to support adaptation to climate change. The Cities and Climate Change Initiative also promotes collaboration by local authorities and their associations in global, regional and national networks, with the triple rationale of: 1) enhancing policy dialogue so that climate change is firmly established on the agenda; 2) supporting local authorities' efforts to bring about these changes; and 3) enhancing awareness, education and capacity-building in support of climate change strategies.

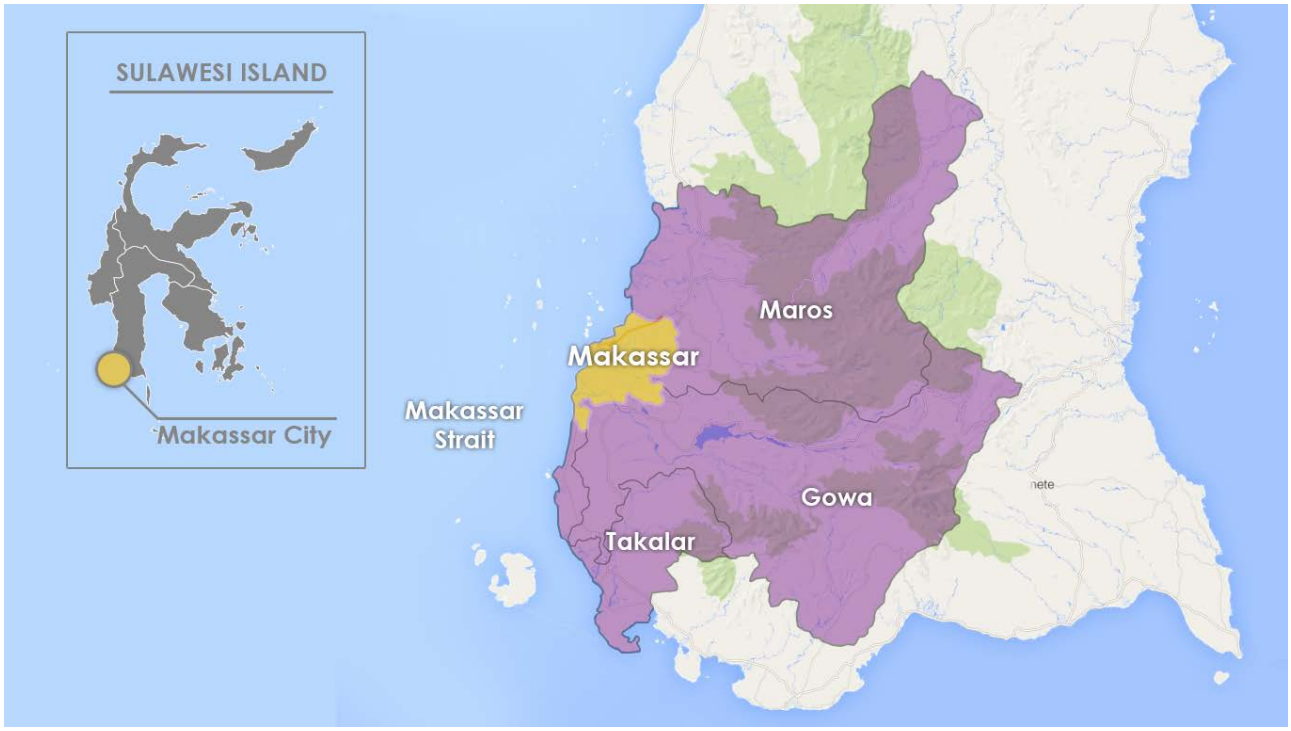
1.2 Methodology

The research team gathered information from available government data and maps, through observation field trips, community meetings, and focus group discussions with civil society organizations, community members and government officials. Analyzed data was structured and aligned by the research team among the different components of vulnerability criteria. The information was used to create a vulnerability map at the sub-district level (Kecamatan) in combination with identified urban trends and predominant urban typologies, and three communities were selected to deepen vulnerability analysis. The results of the analysis were then discussed internally between team members, and then presented for verification to government officials and civil society members.

02

Overview of the City

Figure 1: Location of Makassar on the island of Sulawesi and in relation to the neighbouring districts of Takalar, Gowaand Maros.



Source: Google map redesigned

2.1 Geography

Makassar lies at the base of the vast Jeneberang watershed with two main rivers that flow through the city's territory: the Maros River in the north, which then becomes the Tallo River; and the Jeneberang River in the south. The two river deltas generate ideal conditions for a complex estuarine ecosystem. In particular, the delta created by the Tallo River in the north includes large seasonal and permanent wetlands, which generate a unique biodiversity apart from being essential for water purification, flood control and shoreline stability.

2.2 Ecosystems

The ecosystem in the Makassar Strait is complex and abundant; nearby islands and coastal areas with mangrove forest, mudflats and coral reefs provide optimal conditions for marine biodiversity and coastal livelihoods. Makassar lies on a relatively flat topography with hills to the east of the city which create natural water catchment areas with semi-dense vegetation.

2.3 Climate Change Issues

Geographically exposed, the coastal city of Makassar is sensitive to a series of climate change hazards. According to climate change models prepared in 2012 by the Australian based Commonwealth Scientific and Industrial Research Organization, rainfall levels in Makassar will remain constant in the coming years but precipitation will be concentrated over a shorter period of time. In other words, the dry season will be prolonged, but average rainfall patterns are expected to remain unchanged. An expected and constant increase in temperatures will simultaneously have an impact on evaporation levels and sea level rise. Tidal floods and storm surges also pose a threat to coastal communities as well as seawater intrusion in coastal aquifers. Flooding is another key concern for the city government regarding climate change impacts. Every year, during January and February there are an increasing number of reported inland and coastal floods, according to the local disaster prevention agency (BPBD). Floods rarely last more than 48 hours, but the increasing number of communities that are impacted by floods has constantly exceeded the capacity of BPBD to respond.

2.4 Urban Economy

Makassar's role as a gateway city to the rest of eastern Indonesia for both maritime and aircraft traffic has created a boom for the city as demand increases for commodities. Makassar's gross domestic product (GDP) has increased from 11,341,848 million Rupiah in 2006 (USD1,104,905,647) to 16,252,451 million Rupiah in 2010 (USD1,583,289,151). During this period the economic growth rate rose from 8.09 per cent in 2006 to 9.83 per cent in 2010. As the city continues to grow it is likely that the economy will diversify further, adding more commercial and industrial activities and putting more pressure on the environment.

2.5 Governance System

Indonesian cities such as Makassar are governed through a series of local government departments and agencies, supported by a five-year budget plan called the Rencana Pembangunan Jangka Menengah Daerah (RPJMD), or regional medium-term development plan. The RPJMD sets out a vision for the city through the allocation of funds to the different departments, these then have to be approved on an annual basis. Examples of key agencies are public works, responsible for infrastructure projects such as roads, bridges and installing water systems, the municipal water company or Perusahaan Daerah Air Minum (PDAM) responsible for managing water supplies, and Badan Perencana Pembangunan Daerah (BAPPEDA) the regional body for planning and development. Beneath the level of individual departments are the district and local level governments that provide services for residents and act as the first contact that citizens have with government officials. Despite the reliance on the local budget for projects and infrastructure improvements, large civil works projects that can create an impact at the city level require national government funds, these are called ministerial projects. Thus there is often a discrepancy between what vision can be achieved relying solely upon the city's budget, and what aspirations can be achieved while accessing additional funding from both national government and private investors.

2.6 Urban Trends

The following trends are occurring in Makassar as a result of rapid urbanization. Coupled with the risks of climate change they present a growing concern regarding the city's sustainability.

1. Urban expansion: Over the last ten years, the periphery region of Makassar, and the border areas of Maros, Gowa and Takalar municipalities have grown much faster than the population of the city centre. Over this period the five outer districts have grown at a rate of 3.01 per cent while the nine districts of the center of the city have a negative growth rate of -0.2 per cent. This indicates that not only are the outer districts outpacing those of the centre, but those of the centre are decreasing in population. Migrants come to the city to seek jobs and many of them

end up settling on the periphery. Often migrants in these areas go without many services, as public providers and local government struggle to keep up with demand for water, sanitation and electricity. Social services (education and health care facilities) are often also deficient. Peripheral land conversion also limits communities' capacity to produce food as former farmland is occupied as new urban space.

2. Land reclamation and changing coastlines: Makassar is currently undertaking an ambitious plan to create developable lots of land through land reclamation. The new coastline will present economic development opportunities and, for investors, the added incentive of flat, empty land. However, it is affecting natural ecosystems, local cultures and economies. New coastal developments threaten these predominantly poor communities by blocking their access to the sea, altering their livelihoods and potentially transforming their way of life.

3. Water management and supply: The principal water sources for the municipal water company (PDAM) are the two rivers that flow down to the city: the Jeneberang River and the Maros River (that later becomes the Tallo River). After a massive landslide in 2007 river water from the Jeneberang River became too muddy to use without significant filtration and treatment. The Maros River is cleaner, but the watershed can only provide a limited amount of water and may not be sufficient for the rapidly expanding northern and eastern regions of the city. In addition, the district of Maros has decided to use it themselves rather than continue to provide for Makassar.

2.7 Makassar's City Vision

The two city visions set forth by the Makassar government capture the essence of the city's imagined future and put forward its strategy for development. The first city vision is of a 'world city' or 'gateway to eastern Indonesia' which is ambitious and intended to mobilize the aspirations of citizens and generate the interest of potential investors. It is focused on the city's port and industrial expansion plans, as well as the creation of reclaimed and vacant land along the coastline. The second vision is a more pragmatic approach to city development and relates to short-term projects. It provides direction to government agencies about how to improve services and keep up with growth.

2.8 The Medium-Term Budget Funding Profile

Makassar's medium-term development plan (RPJMD) has a five-year development budget that allocates resources to government agencies from national government transfers on an annual basis. The RPJMD is relevant to the climate change vulnerability assessment because it is the most reliable means of data on public investments. Given that it is discussed and approved every five years and guides the direction of investments, it can help produce vulnerability reduction impacts in the short-term. The RPJMD allocates financial resources to local government departments, rather than the type of large development projects in the 'world city' vision, which access funding from national-level government institutions and private investors.

03

Climate Change Vulnerability Assessment

3.1 Methodology and Definitions

According to the Intergovernmental Panel on Climate Change, vulnerability is defined 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 order to understand Makassar's vulnerability to climate change it is essential to assess three main components:

1. Exposure: the degree of climate stress upon a particular unit of analysis (i.e. community, sector), and may be characterized by long-term change in climate conditions, or changes in climatic variability including the magnitude and frequency of extreme events in the urban context.

2. Sensitivity is defined as the degree to which a system is affected by the bio-physical impact of climate change. It considers the socio-economic context of the system being assessed, as well as other non-climate stressors that may affect the city's vulnerability, such as its economy, development plans, administrative arrangements and ecosystems.

3. Adaptive capacity: the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequence.

3.2 Climate Change Exposure

The vulnerability assessment identified the climate hazards that Makassar is most exposed to as: sea-level rise, floods, droughts, high winds and erosion, and increased in temperatures.

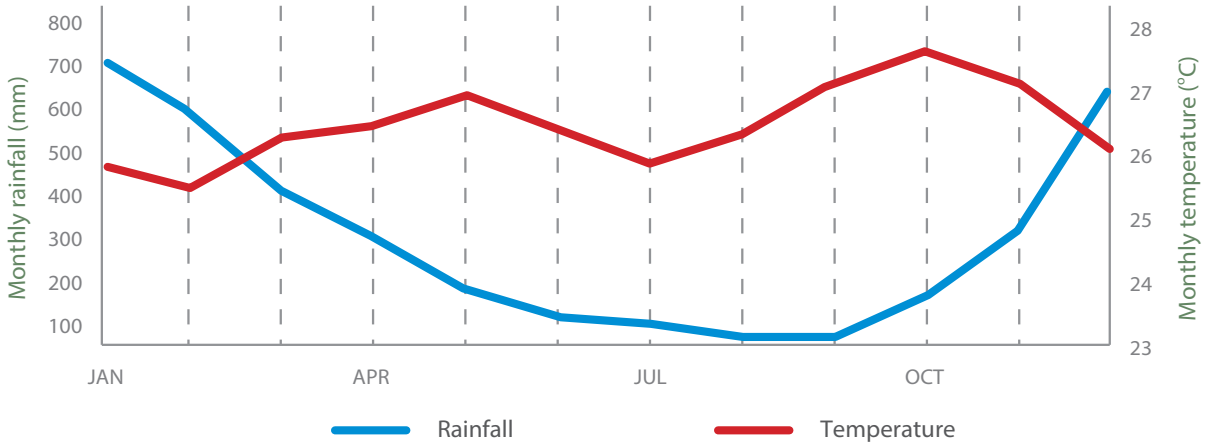
3.2.1 Climate Trends in Makassar

Makassar enjoys a warm and tropical climate with a distinct wet season from November to May and a dry season from June to October and is characterized by high humidity and an average temperature at around 27.8 °c. There is very little temperature variation throughout the year, ranging from 24°c and 32°c minimum and maximum temperatures. Global meteorological phenomena, such as "el niño" and "la niña" strongly influence climate patterns and impact marine biodiversity. According to the Bureau of Meteorology and Climatology (BMKG), during El Niño years the wet season onset in Makassar is generally delayed by about 10 days and its length is shortened by about 10-30 days. In the meantime, the dry season rainfall is reduced by 51–80 per cent. Historical records over the last fourteen years indicate that flooding and strong winds have damaged the city. From 1999–2013 there were 26 recorded cases of flooding, in which a total 324 houses were damaged and 6,476 people were affected.

3.2.2 Climate Hazards in Makassar

The predictive and historical information indicate that the most likely climate change hazards that the city will face in the future are: heavy rainfall during a shortened rainy season, increased temperatures during a prolonged dry season with possible droughts, sea-level rise, and high winds and waves. These climate hazards will affect different areas of the city in different ways given the geography of the city, with some urban areas more exposed than others. The Australian National Science Agency developed climate models in 2012 and their projections for Makassar are as follows:

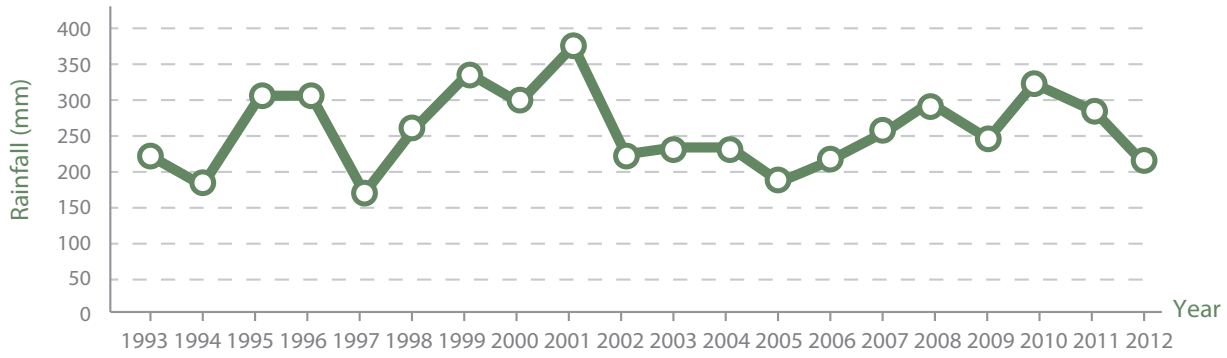
Figure 2 shows the mean rainfall and temperature over the long term in Makassar.



Source: UN-Habitat

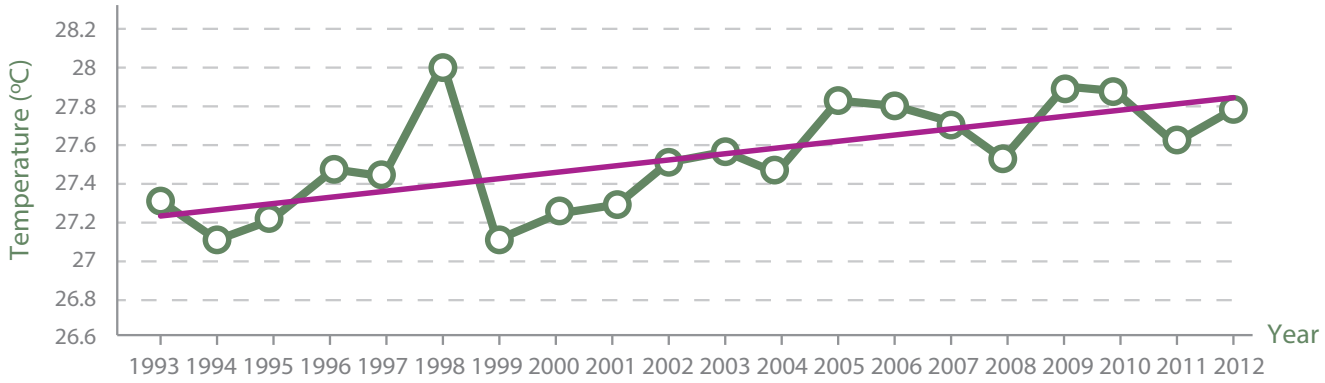
The maritime meteorological station in Paotore presented the longitudinal climate data in figure 3 and 4 in 2013.

Figure 3. Makassar Rainfall Intensity.



Source: Maritime Meteorology Paotore Station, 2013

Figure 4. Makassar Average Temperature 1993 - 2012.



Source: Maritime Meteorology Paotore Station, 2013

Annual rainfall in Makassar is expected to rise only slightly, but the intensity of rain will be more intense during a shortened rainy season. The majority of models predict that the wet season onset will remain unaltered but will retreat earlier by 12 days, suggesting a concentration of the intensity of rainfall during the rainy season. The dry season will experience a decrease in mean rainfall of around 36 per cent. Over the period 1993 - 2002, sea level rise in the Makassar Strait rose 7.5 cm and based on simulations it has been estimated that the sea level rise in Makassar will reach 88.16 cm by 2025, 1.14 m by 2050, and 1.44m by 2100 (BPPT, 2008). High winds along the coast can reach up to 50-60 km/hr.

High winds in poor coastal areas have increasingly become a common climate-related hazard for the Tallo River community, damaging inadequate housing and knocking down large trees.

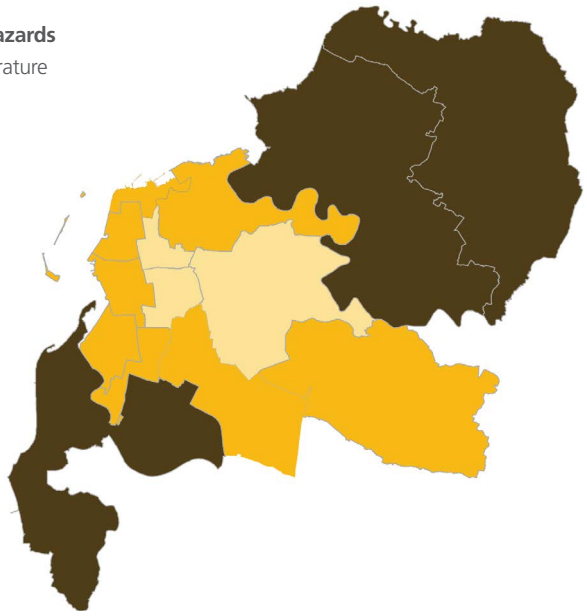
More intense rainfall will cause flooding. The areas of the city that are most exposed are those that lie alongthe the three rivers that run through the city, the Jeneberang River, Tallo River, Maros River. Communities in recently urbanised and peri-urban areas that have poor drainage systems, or are not connected to existing drainage networks, are particularly exposed.Those areas most exposed to rising sea-levels are low-lying areas along the coastline, as well as the island communities off the coast and include the districts of Tallo, Biringkanaya, Mariso, Tamalanrea, and Wajo.

Figure 5. Exposure rating by district in Makassar. The very high indicates the districts that are exposed to all four climate related hazards: increased temperature, rainfall, droughts and sea-level rise. Some of the districts along the coast and in the periphery are exposed to all four hazards.

Kecamatan	Exposure
Mariso	√ √ √
Mamajang	√ √
Tamalate	√ √ √ √
Rappocini	√ √ √
Makassar	√ √
Ujung Pandang	√ √ √
Wajo	√ √ √
Bontoala	√ √
Ujung Tanah	√ √ √
Tallo	√ √ √
Pamakkukang	√ √
Manggala	√ √ √
Biringkanaya	√ √ √ √
Tamalanrea	√ √ √ √

4 Climate related hazards

- √ Increase temperature
- √ Increase rainfall
- √ Droughts
- √ Sea level rise



Exposure rating Low Medium High Very high

Source: UN-Habitat

Adaptation to climate change is particularly important for the large number of small fisherman in the city of Makassar, a traditional livelihood among Bugis-Makassar people that is under pressure due to rising climate-related hazards.

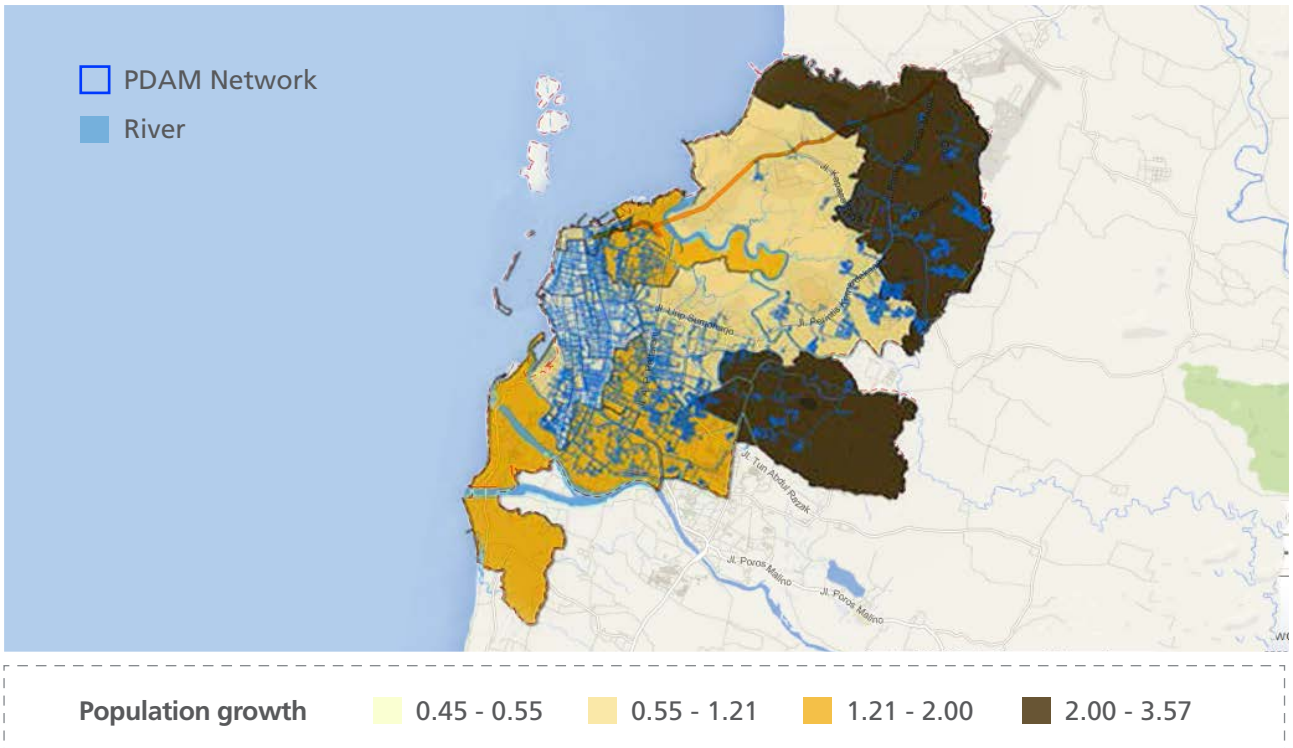
3.3 Climate Change Sensitivity

The following sections will summarize the impact of climate hazards identified by the assessment on the city's systems, as well as describing the factors that make certain systems more sensitive.

3.3.1 Sensitivity and Physical Urban Systems

Makassar's physical urban systems, such as roads, water networks, and drainage systems, provide a functioning infrastructure for the city that supports its many economic sectors, services and inhabitants. But climate hazards put many of these urban systems at risk because they are dated, lack maintenance and repair, and also require investments to extend service and capacity. Some parts of the city still are not connected to drainage networks and so they can remain flooded for days after rainfall stops. Part of the problem is that rapid growth of the periphery of the city proceeds at such a pace that the municipal water company does not have the funds to extend the service quickly enough. There are also problems of connecting urban poor areas where there are disputes over land tenure and also where current densities are too high to lay water pipes. In addition, the city's water supply is threatened by a reduction of the capacity of the watershed to supply enough water for a constantly growing population, with ever increasing demand. The city's existing drainage system is outdated and its capacity to drain water has been compromised by years of deterioration and rapid urban growth.

Figure 6. High population growth is occurring in the city's periphery where the city's current water supply network is limited. The map demonstrates the need to expand the water supply network to keep up with increasing demand.



Source: Google map redesigned

Sea level rise will increase the vulnerability of coastal and island communities who live in areas exposed to strong waves and erosion. These communities seek to protect themselves from waves by constructing physical barriers, but these barriers are no match for sustained and powerful waves and erosion. Improvised barriers take the form of concrete, rocks and wooden structures, but these are often piecemeal, community initiatives and last only the initial impacts of each climate hazard.

3.3.2 Sensitivity and Economic Systems

Around 49 per cent of the city's GDP is derived from the manufacturing, hotel and restaurant and tourism sectors. These industries are mostly located along the coast and are at risk from flooding and sea level rise. The development plans and vision for the city designate a number of projects located along the coast including industrial districts, new port facilities and the 'Centre Point of Indonesia' land reclamation site. In addition, much of the city's fishing industry, which is synonymous with the identity of Makassar's people, is also located along the shoreline and vulnerable to sea level rise and storm surges.

The projected delays in the rainy season and increase in temperature will likely also have a negative impact on crop yields in agricultural land around Makassar. The climate models for Makassar shown previously show that the dry season will be prolonged, together with an increase in evaporation, exacerbating water shortages. The transportation sector represents 14.36 per cent of Makassar's GDP and almost all businesses rely on the mobility of their goods and people to function. Sea level rise could hinder the transportation of goods from factories in the industrial area by the port, and flooding of the toll road and airport infrastructure could hinder the passage of tourists and conference attendees substantially impacting the local economy.
Sensitivity and administrative systems

The impacts of climate hazards are felt from the community, district and city-scales, to the provincial and national levels. Reducing vulnerability to climate hazards requires coordination between these different administrative jurisdictions, for example between two different districts, and between the community and city scales. River watersheds for example, are extensive ecosystems that usually extend beyond administrative boundaries, and to manage them requires effective coordination between districts. New developments and conversion of agricultural land that previously absorbed water provokes increased run-off and exacerbates the risk of flooding for coastal and low-lying communities.

3.3.3 Sensitivity and Ecosystems

Healthy balanced ecosystems provide a wide number of environmental services for communities living within its bioregion. However, damage to them can expose the city to increasing vulnerability. Ecosystems that serve urban areas can help to filter polluted water, protect from floods and storm surges, generate oxygen, and provide shelter for biodiversity. When a city grows, ecosystems are gradually replaced by human engineered systems (e.g. natural rivers for concrete canals). In Makassar, climate change sensitivity will depend to a great extent on the way in which urban development is approached and the degree to which ecosystems are protected and conserved.

Landfill extraction sites up-stream stir up soil particles and increase soil run-off into the river, increasing water turbidity and disrupting the ecosystem. This decreases the availability of clean water for urban dwellers, and drives up costs by making it more expensive to treat. Furthermore, when the landfill is discharged off shore it changes the chemistry of the water. By changing the coastal and marine ecosystems, coral reefs and wildlife are damaged, and this affects natural ecological cycles and the breeding of fish and other marine life forms. Fish and marine populations are reduced, negatively impacting the livelihoods of fishing communities.

3.3.4 Sensitivity and Urban Poor Housing

The urban poor are very sensitive to climate change because they have fewer means to respond to, or avoid climate disasters and hazards as they also often live and work in locations that are vulnerable. Informal settlements need not necessarily be associated with vulnerability, they can be socially supportive and economically thriving communities, but often they are supplied by fewer social services, water and sanitation infrastructure, and are generally located in areas that are more exposed to flooding and sea level rise.
The official estimate of households living in areas defined as slums in Makassar in 2012 by the Ministry of

Environment was 58,268. What is significant is that this figure has risen from 13,904 in 2003, an increase of 320 per cent in approximately ten years. The trend is undoubtedly one of growth as the city itself expands and absorbs new migrants seeking employment. Of the total number of households living in slum areas 55,268 live in tidal areas, along the coast or rivers, and this represents 95 per cent of the total number of inhabitants. Many slums are located on public land or private land that is in dispute, but when land prices rise their value makes them a target. The urban poor are sensitive to these changes in land prices and speculation because they often occupy strategic areas near employment centres and markets and in the case of Makassar near the port and city centre.

Trash and improvised infrastructure in Tanjung Bunga, a vulnerability 'hot spot' in the middle of the city with high levels of poverty, which are strongly linked with vulnerability to climate change. The urban poor are particularly vulnerable to climate change as they have fewer means of adapting and avoiding its negative impacts.

Sensitivity relates to both the presence of climate hazards as well as the socio-economic context of the system that is being affected. The following six indicators employed to quantify and map sensitivity in Makassar utilize available city-wide data collected from the city government:

1. **Areas located along river basins or canals:** If a river or canal flows through a district, it will score 1. Those with no rivers or canals score 0.

2. **Slum areas:** The city government identified the slum areas of the city through their official criteria, and if a district has a slum within its boundaries, it will score 1.Those without score 0.

3. **Poor coastal communities:** The presence of poor coastal communities was identified by verifying the official city slum maps through an analysis of aerial photography and field visits. Those districts with poor coastal communities will score 1.Those without score 0.

4. **Flood areas:** Districts that flood regularly were identified using the BPBD department's flooding maps. Districts that have areas that flood regularly score 1. Those that do not score 0.

5. **Poverty rate:** Poverty data was accessed from the city's poverty data set (TKPKD) and a per capita poverty rate was established. Districts with a poverty rate above the average score 1. Those that are below average score 0.

6. **Absentee rate for school-aged children:** Data about absenteeism was accessed through the city's education data and used to establish a city average. Districts with an absenteeism rate above the city average score 1.Those that are below average score 0.

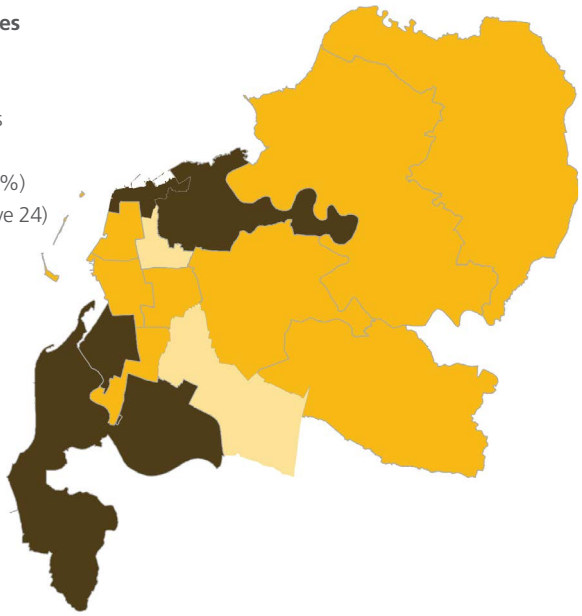
The scoring of each indicator was summed up to create an aggregate sensitivity indicator and can be seen in figure 7.

Figure 7. Sensitivity rating by district in Makassar. Sensitivity was measured by scoring six different indicators that suggest climate change sensitivity: if the districts have slums areas, areas that flood, have poor coastal settlements, are in a river basin and if they are above the city's poverty and school absenteeism averages

Kecamatan	Exposure
Mariso	√ √ √ √ √ √
Mamajang	√ √ √
Tamalate	√ √ √ √ √
Rappocini	√ √
Makassar	√ √ √
Ujung Pandang	√ √ √ √
Wajo	√ √ √
Bontoala	√ √
Ujung Tanah	√ √ √ √ √
Tallo	√ √ √ √ √ √
Pamakkukang	√ √ √ √
Manggala	√ √ √
Biringkanaya	√ √ √
Tamalanrea	√ √ √ √

6 Climate related sensitivities

- √ Areas next to river basin
- √ Slum areas
- √ Poor coastal settlements
- √ Flooded areas
- √ % of poverty (above 19%)
- √ % of absenteeism (above 24)



Sensitivity rating Low Medium High Very high

Source: UN-Habitat

3.4 Adaptive Capacity to Climate Change

Adaptive capacity refers to the ability of a system to adjust to climate change in a way that moderates potential damage, takes advantage of opportunities, or helps cope with the consequences of climate hazards. The qualities that contribute to a system's adaptive capacity combine both physical and social/institutional elements that support its ability to adapt to climate change. In the context of an urban area such as Makassar, it can refer to the extent of infrastructure and public services, accessibility of information, technological capacity of institutions and communities, levels of wealth, the amount of social capital of a given community, and the capacity of public institutions.

The vulnerability assessment of Makassar's different forms of adaptive capacity revealed both opportunities and challenges for reducing vulnerability to climate change. Some of the factors that seem to determine future vulnerability reduction are as follows:

- Successful government programmes are essential to ensuring widespread action in reducing climate vulnerability, but the government often struggles with effective implementation.
- A lack of time invested in community engagement has resulted in lower local ownership levels and lack of sustainability in adaptation initiatives. For example, the Lantebung community reported that the government planted 5,000 mangroves but had minimal community engagement.

The assessment also identified the need for greater support for urban poor communities to overcome barriers. Individual adaptive strategies are common in sensitive households, but efficiency is limited. Urban poor communities may also have lower levels of public services, education and income, all of which lowers their adaptive capacity. By increasing organizational capacity and leveraging the presence and activities of community organizations and leaders, then the potential for successful adaptation policies and programmes can increase.

Government climate change adaptation policies and programmes have largely been concentrated at the national level, and to a lesser degree at the provincial level. The government of Indonesia has been developing several national level policies and legal frameworks that specifically address climate change adaptation. A successful link between the city government and these national initiatives can augment the financial and institutional resources available to increase adaptive capacity. Collective adaptive strategies are also limited, but benefits generally reach a wider group. Many of the promising examples of adaptive capacity in Makassar are initiatives in which NGOs and civil society organizations partner with community groups and local government. NGOs such as Kupas, IPPM, Map and Oxfam have been of key importance in community engagement and mangrove regeneration programmes for vulnerable communities in Makassar. Such programmes may focus on supporting communities through building infrastructure, social programmes or capacity building and can be further promoted through partnerships with local government agencies.

Civil society organizations, such as the NGO IPPM, have worked with local communities to raise awareness about the importance of mangroves for both coastal protection to high winds, waves and sea-level rise, but also to benefit local fishing communities. This mangrove, along on the coastline of the Lantebung community, is healthy and provides both for the livelihoods and safety of residents.

04

Ecosystem-based Adaptation Assessment

An ecosystem-based adaptation assessment seeks to understand what environmental services are available from the ecosystems in or around Makassar city? What is their current state? And what environmental services do they provide? The assessment was conducted by reviewing secondary data, strategic field visits to ecosystems in and around Makassar, focus group discussions with vulnerable communities, semi-informal interviews with academics, civil society organizations and heads of relevant municipal agencies. Satellite imagery and government maps were also consulted while preparing the ecosystems based adaptation assessment.

Ecosystems are not bound by political or administrative boundaries, but align to eco-regions and extend far and beyond the city of Makassar. Urban settlements tend to gradually replace ecosystems services for what is perceived as more reliable man-made's structures (e.g. creeks for concrete canals or mangrove forest for sea walls).The assessment of ecosystem services can be used by government officials, civil society and community based organizations to design informed programmes to tackle climate change impacts in vulnerable communities by enhancing understanding on available ecosystems in the city and its vital services for vulnerable communities.

Complete ecosystems rarely fit within a city boundary; rich environmental relationships usually expand beyond man made political boundaries. Makassar is not the exception as there are three key ecosystems providing environmental services that cross the territory but expand beyond:

- ***Jeneberang watershed*** – Expands to the municipalities of Gowa and Makassar, the Jeneberang river basin provides 80 per cent of the raw water for Makassar, sustains peri-urban agricultural activities and provides timber and other forestry products.
- ***Tallo River and wetlands*** - Covers the municipalities of Maros and Makassar, complements raw water availability for the city, provides a wetland that is not only rich in biodiversity, but that acts as a flooding buffer zone for the city.
- ***Islands and the coast*** – There are 11 shallow islands around the coast of Makassar that create a rich marine ecosystem, composed of coral reefs, mudflats, sea grass zones and mangrove forests. The coastal ecosystem provides a source of livelihood for thousands of households in Makassar, protects the shores from erosion and promotes biodiversity. Multiple agencies at different levels are responsible for managing specific parts of surrounding ecosystems.

Environmental services provided by the three above mentioned ecosystems play an essential role in minimizing sensitivity to climate change impacts for poor and vulnerable communities. The locations of these pockets of poor households are distributed across Makassar, with a higher concentration by the coast and along the Tallo River, near Losari beach and to a lesser degree in peri-urban areas.

4.1 Management of Ecosystems

At the national level the Ministry of Environment is in charge of producing environmental impact assessments for new developments, and producing recommendations on how to minimize or compensate for damages to environmental services. At the local level a number of agencies from within the city government are sensitive to the importance of ecosystem services. The Marine and Fisheries Department, for example, is aware of ecosystem services, regulates fishing activities, promotes mangrove and fisheries regeneration programmes and creates artificial reefs in areas where coral reefs were bleached or damaged due to climate

change or human activities. The water supply agency PDAM is also concerned about challenges faced by climate change on water quantity and quality, temperature rise represents an increase in evaporation, while upstream landslides have an impact on water turbidity.

4.2 Jeneberang Watershed

The Jeneberang watershed was chosen for the assessment focus because of its importance to poor and vulnerable communities and its direct sensitivity to climate change impacts. In the early 1990s, the Japanese Bank for International Cooperation provided a loan to build the Bili-bili dam in the Jeneberang watershed for water provision and to minimize the risk of flooding for downstream communities including the expanding city of Makassar.

The project was initially expected to have a life span of 50 years, but in 2004 a huge landslide from Mount Bawakareng released 1.7 billion cubic metres of rock, earth and debris towards the dam, filling its reservoir with sediment. The landslide filled all 12 of the Sapo dams which the government was building in order to decrease sedimentation. According to some estimates, the mega landslide and following sedimentation have almost filled up the Bili-bili dam, shortening the project lifespan by about 25 years. The situation posed by sedimentation at the Bili-bili dam is exacerbated by upstream intense rock and sand extraction that are used for sea reclamation projects in Makassar; a conservative calculation estimated that about 5,000 trucks carrying about 10 tons of material travel every day from Gowa to the Makassar coast. The retro excavators in charge of loading the trucks with material from the rivers are inevitably increasing the sedimentation in the Bili-bili dam. In addition, there are also extraction activities occurring downstream from the dam, which presumably increase the turbidity of the water in the Jeneberang River.

Figure 8. Exposure rating by district in Makassar. The very high indicates the districts that are exposed to all four climate related hazards: increased temperature, rainfall, droughts and sea-level rise. Some of the districts along the coast and in the periphery are exposed to all four hazards.

Source: Google map redesigned

05

Institutional Capacity Assessment

The institutional capacity assessment is an important component of the vulnerability assessment as it provides direction for responses to climate change. The capacity assessment identifies a broad set of capacity building issues for different stakeholder institutions and city organizations to consider in order to better respond to climate hazards. It also provides suggestions for cooperation on these issues. The assessment seeks to identify challenges and strengths, and to put forward recommendations that build upon new findings as well as existing institutional activities and capacities that are seen as opportunities. In total, ten institutions or organizations were selected and interviewed for the Institutional Capacity Assessment, representing a range of bodies currently dealing with climate hazards and the impact of climate change on the city of Makassar from local government agencies to community groups and NGOs.

At the community-level institutional capacity was assessed through interviews and discussions with community groups and local NGOs.

A summary of the key lessons learned from the interviews follows:

- There is a need for greater inter-departmental cooperation at the local government level. Rarely are projects or policies planned or implemented in collaboration as there is no formal mechanism or incentive for cooperation.
- The technical and organizational capacity of NGOs, civil society organizations and community groups should be strengthened to enable them to become key actors in efforts to reduce climate vulnerability.
- Institutions should reformulate their organizational vision to focus on reducing vulnerability to climate hazards.
- There are no clear guidelines or regulations concerning climate change, which will be necessary to guide action within the city. General reliance upon regulations to guide action itself creates a problematic, reactive mind-set that discourages departments from seeking the causes of problems.
- Communities require support to develop and maintain climate resilient infrastructure and services that are more robust and systemic, in proportion to the large scale of climate hazards.

06

Analysis and Recommendations

The following recommendations are aimed at providing guidance to stakeholders in city government; civil society organizations and NGOs; and local community groups and residents, to better prepare for the challenges of responding to climate change hazards in Makassar.

Policy recommendations to increase climate resilience include:

- Articulate a coherent vision for the city that promotes climate change resilience and pro-poor development. Such a vision can spur better coordination amongst departments, orient city policy measures, and raise awareness amongst citizens.
- Revise existing regulations, planning documents and project proposals to incorporate necessary measures related to climate change hazards and human vulnerability.
- Undertake a legal and regulatory review of existing regulations to identify which ones already exist and where new regulations need to be developed or updated to implement the city vision.
- Promote greater institutional coordination amongst government and civil society institutions to strengthen the ecosystem management of Makassar and surrounding areas.
- Build capacity and increase financial resources in order to implement a climate change-focused agenda.
- Design new policies or adapt existing policies to ensure a focus on specific vulnerable groups and places that are identified in the vulnerability assessment.
- Propose specific regulations for the management of coastal areas (for example to strictly regulate the growth of development and settlements in coastal areas).
- Strengthen law enforcement through capacity building of legal measures, investigation and litigation.
- Ensure that climate change considerations are included in infrastructure and building permit regulations.

Policies to enhance greater institutional coordination on climate change issues should be led by strong leadership such as the Mayor and senior city government officials at BAPPEDA and may include:

- Development of a coordination framework for greater institutional cooperation. Different departments should work in partnership on planning and implementation of policies and projects, opening lines of communication and appointing focal points, sharing information and collaborating as a team.
- Adherence to this coordination framework by institutions working on climate change related issues should be mandatory in order to design, plan, and implement policies and activities in collaboration with one another.
- Establish a multi-stakeholder climate change resilience working group which BAPPEDA will lead. The working group should be supported by mayoral decree, and the coordination of actions should occur not only at government level but also at regional, city, district and community levels.
- Promote greater inter-departmental coordination, especially between those working at the community level, and also between community groups and government, through community-level institutions. Local institutions should be supported and encouraged to implement projects at the community level.
- Local government should foster coordination with national agencies to enhance adaptation capabilities and to advocate for increased allocation of climate-related budgets from the central government.
- Revision of local, regional and national land use regulations in local ecosystems (i.e. Jeneberang watershed) to control built structure development in key hotspots to strengthen the sustainable provision of key ecosystem services.

Policies to increase adaptive capacity include:

- Introduce a capacity building programme for government officials and local parliamentarians in order to enhance understanding and raise awareness about: i) budget allocations for climate change-related projects, and ii) creating vulnerability maps at the Kelurahan level, iii) the need to monitor actions, and not merely implement them.
- Build capacity at the community level, in order to plan, propose and implement small-scale projects through community block grant programmes (such as the Musrenbang) that increase adaptive capacity and resilience and raise awareness at the community level through the dissemination of information about climate change vulnerability and measures that can be taken to increase adaptive capacity.
- Increase the amount of financial resources directed towards climate change-related activities in the 2014-2019 RPJMD.

Policy recommendations to improve ecosystem management include:

- Undertake a citywide Kelurahan vulnerability mapping initiative to ensure that localized vulnerability is fully mapped and understood.
- Identify areas and support the cultivation of mangroves, in collaboration with NGOs and community groups, to promote their conservation and growth.
- Develop measures to diversify and support alternative livelihoods for fisherman communities who are vulnerable to the impacts of climate change.

Policy recommendations for civil society organizations and NGOs include:

- Formulate a vision for the organization focused on climate change.
- Develop institutional and advocacy capacity. Build upon and expand engagement with community organizations:

Policy recommendations for community groups and residents include:

- Become more involved in managing and maintaining community infrastructure.
- Raise awareness and build organizational capacity.
- Engage actively with government to reduce vulnerability to climate change.

07

Conclusion

The Makassar climate change vulnerability assessment shows there is reason for optimism. There is a strong foundation of policies that the city is producing to reduce vulnerability and there is evidence of promising initiatives taking place at the community level that will enhance climate resilience.

The four main conclusions arising from the Makassar assessment are as follows:

1. Rapid urbanization of the periphery of Makassar and the changing landscape of the coast line threaten to affect the city's long-term environmental sustainability by damaging the natural ecosystems and putting the water supply system under stress. Short-term measures are necessary to restore the city's medium- and long-term ecological balance.

2. The rapid urban growth of Makassar will increase vulnerability to climate change hazards if measures are not taken to: a) limit the spread of settlements to areas disconnected from public service networks, b) allocate sufficient resources to areas of rapid population growth and critical systems (i.e. the water supply system), c) ensure traditional activities and the sustainable livelihoods of communities displaced by new developments are able to participate in the city's development opportunities. Sound urban development can thus be an opportunity to reduce vulnerability, while uncontrolled and haphazard urbanisation can threaten human safety.

3. Climate change hazards present challenges at different scales (the community, city and even the bio-region) and so actions are required to meet these challenges at these different scales. Therefore actions that are directed at reducing vulnerability at the city level (such as addressing systemic issues such as water shortages and drainage, and increasing the coordination and technical capacity of city agencies) should be implemented in conjunction with actions targeted at the community scale, at specific vulnerable areas, and for groups. Local communities should be empowered to address their infrastructure needs through local initiatives.

4. The city government can reduce climate change vulnerability by influencing the sensitivity and adaptive capacity of residents and communities of the city. This is possible through both physical actions (such as improving both natural and man-made systems and building climate proof infrastructure) as well as non-physical actions (such as improving the capacity and administration of public services, supporting local community organizations and improving the coordination of institutions).

UN-Habitat's Cities and Climate Change Initiative promotes enhanced climate change mitigation and adaptation in developing country cities. This document is an initial output of the Cities and Climate Change Initiative activities in Makassar, Indonesia. This abridged report is based on the report titled: "Makassar, Indonesia – Climate Change Vulnerability Assessment".

Starting with a brief background of the city, this report addresses Makassar's climate change situation from a comprehensive vulnerability perspective that focuses on exposure to climate change hazards, socio-economic sensitivities and the adaptive capacities of the city and its stakeholders. The report puts particular emphasis on the assessment on the role of local ecosystems for climate change adaptation as well as on an institutional assessment. Based on this analysis the report identifies vulnerable people, places and sectors and provides preliminary climate change adaptation options.

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