



ADAPTING TO CLIMATE CHANGE AND ENHANCING RESILIENCE

*A guide to building adaptive capacity
and resilience to the impacts of
climate change in coastal urban areas*

•I.C•L•E•I
Local
Governments
for Sustainability

Funded by

The production of this guideline document is funded by the Western Indian Ocean Marine Sciences association (WIOMSA) which has been supported through generous funding from the Government of Sweden.

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At ICLEI Africa, we serve our African members, working with cities and regions in more than 25 countries across the continent. We offer a variety of urban sustainability solutions through our dynamic and passionate team of skilled professionals.

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Citation

ICLEI Africa. 2020. Adapting to Climate Change and Enhancing Resilience: A guide to building adaptive capacity and resilience to the impacts of climate change in coastal urban areas. Cape Town, South Africa: ICLEI Africa.

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*A guide to building adaptive capacity and resilience to
the impacts of climate change in coastal urban areas*



The strategy is an operational framework to foster regional cooperation in addressing the impacts of climate change through the assessment of the degree of preparedness and the vulnerability and adaptive options of communities within the Nairobi Convention area.



FOREWORD FROM THE WESTERN INDIAN OCEAN MARINE SCIENCES ASSOCIATION (WIOMSA)

In 2015, the Convention for the Protection, Management, and Development of the Marine and Coastal Environment of the Western Indian Ocean (Nairobi Convention) in collaboration with the WIOMSA produced the first ever comprehensive Regional State of the Coast Report for the WIO region, which was approved by the Eighth Meeting of the Contracting Parties (COP 8) to the Nairobi Convention. The report made several recommendations of relevance to coastal cities of the region. Some of these are disaster risk reduction and climate change adaptation must be prioritised in order to better manage extreme events as well as distinctive slow-onset ones, semi-permanent changes such as sea level rise or rising temperatures. Vulnerability and resilience assessments as well as explicitly human security considerations are core concerns of disaster risk reduction and climate change adaptation and should be taken into account. It was further recommended that adaptation options are mainstreamed into integrated coastal management and sustainable development plans and key stakeholders must work together to establish a framework for adaptation.

Further, a Climate Change Strategy for the Western Indian Ocean region developed by the Nairobi Convention and WIOMSA was approved in the same COP. The strategy is an operational framework to foster regional cooperation in addressing the impacts of climate change through the assessment of the degree of preparedness and the vulnerability and adaptive options of communities within the Nairobi Convention area.

Since 2018, WIOMSA has been implementing a project on Cities and Coasts, which is funded by the Government of Sweden. The goal of the Cities and Coasts project is to build and strengthen human and institutional capacity in coastal and marine planning for sustainable coastal cities in the WIO region. In recognition that coastal cities of the region are in the frontline of climate impact thereby necessitating an urgent need for clear adaptation pathways, WIOMSA is working with different groups to assist coastal cities to build their capacity to adopt and implement disaster risk reduction and management, reduce vulnerability, build resilience and responsiveness to natural and human-made hazards and foster mitigation of and

adaptation to climate change. This is in line with the UN-Habitat's New Urban Agenda,

It is for these reasons that WIOMSA, through the Cities and Coasts project, approved the proposal by ICLEI Africa to organize the 'Train the Trainer Course: Climate Change Adaptation and Resilience Training for Coastal Cities', which is designed to build adaptive capacity and resilience to the impacts of climate change in coastal urban areas in the region. In addition to the organization of the course, ICLEI Africa is producing a climate change guideline that will provide guidance to city's stakeholders on how to develop climate change adaptation plans and actions.

On behalf of WIOMSA, I gratefully acknowledge the financial support from the Government of Sweden for the Cities and Coasts project, through which this manual is produced. WIOMSA is pleased to be associated with the production of this important manual. We thank all the authors for their contributions. We are looking forward to continuing working with ICLEI Africa to implement outcomes of the course.

Jacqueline Uku
WIOMSA PRESIDENT



MESSAGE FROM ICLEI AFRICA DIRECTOR



The stakes could not be higher for climate action in Africa – climate change will put almost 50 percent of the continent’s GDP at risk by 2023. The continent is also expected to experience an average increase in atmospheric temperature of between 1.8 and 4.3°C by 2080, which is 1.5°C higher than the global average¹. It will thus experience more significant climate change impacts than elsewhere, and this will overlay its existing socio-economic challenges and vulnerabilities. During 2019 Cyclones Idai and Kenneth struck southern African countries, inflicting catastrophic damage on Mozambique and Malawi. The estimated cost of recovery soared into millions of US dollars (US\$), with 603 lives lost as well. The cyclones brought home the type of devastation that may well become the ‘new normal’ if climate change continues unabated. Mitigative action has never been more urgent and necessary. Sustainable energy access is also a major priority for the continent. In light of this, we are privileged to have worked with the Western Indian Ocean Marine Science Association (WIOMSA) in the development of this climate change adaptation guide which offers political and technical leaders practical guidance on why it is necessary to respond to climate change and how to develop associated adaptation plans and actions. It provides a comprehensive overview of key climate change adaptation issues of relevance to African local governments and offers tangible examples of good practice. We hope that it will be used far and wide, and invite all of our partners and friends to work with us in taking this important work forward.

A handwritten signature in black ink, appearing to read 'Kobie Brand', written in a cursive style.

Kobie Brand
ICLEI AFRICA REGIONAL DIRECTOR



We are privileged to have worked with the Western Indian Ocean Marine Science Association in the development of this climate change adaptation guide which offers political and technical leaders practical guidance on why it is necessary to respond to climate change.

¹ This equates to a 0.032°C average increase per year.



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ACRONYMS



CCAP	Climate Change Adaptation Plan	NDCs	Nationally Determined Contributions
CDP	Carbon Disclosure Platform	NSAZCA	Non-State Actor Zone for Climate Action
CH₄	Methane	O₃	Ozone
CO₂	Carbon dioxide	OPCC	One Planet City Challenge
CoM SSA	Covenant of Mayors for Sub-Saharan Africa	R&VA	Risk and Vulnerability Assessment
ENSO	El Nino Southern Oscillation	SEACAP	Sustainable Energy Access and Climate Action Plan
GCoM	Global Covenant of Mayors	SDGs	Sustainable Development Goals
GHG	Greenhouse Gas	SEIA	Solar Energy Industries Association
H₂O	Water	UNDP	United National Development Programme
HFA	Hyago Framework for Action	UNFCCC	United Nations Framework Convention on Climate Change
IPCC	Intergovernmental Panel on Climate Change	US\$	United States Dollar
IUCN	International Union for the Conservation of Nature	WIOMSA	Western Indian Ocean Marine Science Association
ITCZ	Tropical Convergence Zone	WWF	World Wide Fund for Nature
MDGs	Millennium Development Goals		
NAPs	National Adaptation Plans		

INTRODUCTION



Local governments – particularly African coastal local governments – are on the frontline when it comes to being affected by the impacts of climate change. These include but are not limited to, increases in average atmospheric temperatures, extreme events such as heatwaves, droughts, flooding and tropical storms, and changes in rainfall patterns. Such calamities not only affect the natural environment, but threaten the livelihoods of those living in urban areas, and thus local governments, the economy and human well-being. Particularly vulnerable groups include the poor, the elderly, women, children, the disabled and communities living in informal areas in and around urban areas.

The impacts of climate change are already a measurable reality and if not addressed head-on immediately, will significantly exacerbate current challenges faced by local governments such as poverty, water and sanitation issues, access to energy and job security. In doing so, they will create new challenges, making it more difficult for local governments to become sustainable and climate

resilient in the long term. Achieving sustainability and climate resiliency requires local governments to adapt to climate change. Both they and their citizens stand to gain far more by starting to adapt today, rather than waiting or not taking action at all.

ICLEI Africa has a long history of helping local African governments respond to the impacts of climate change and reduce their emissions footprint. One way in which the organisation does this is to design and implement standalone capacity building and interactive training workshops for local government officials. Funded by WIOMSA, this guide aims to improve the climate change knowledge of coastal local government officials working in urban planning, disaster risk reduction or environmentally related areas and in turn, equip them with the necessary tools to develop their own Climate Change Adaptation Plans (CCAPs). Such a document is necessary to enable them to effectively plan and respond to the impacts of climate change leading to a better, more sustainable and climate resilient future.

CHAPTER 1

CLIMATE CHANGE 101



What you will learn in this chapter:

- The differences between weather and climate
- Global warming and the greenhouse effect
- What climate change is
- The impact of climate change on a global scale
- The impact of climate change along the East African coastal region

Between 20 and 30 years ago, the terms ‘global warming, climate change’ and ‘disrupted weather patterns’ became commonly used in everyday conversations. However, scientists, particularly climate scientists, have been engaging with these challenges for a much longer period, as the Earth’s atmospheric temperature has increased steadily over the last century, resulting in shifts in observed weather patterns such as changes in rainfall patterns and an increase in extreme events such as flooding, droughts, tropical storms and heatwaves. Scientists have associated this increase with a rise in atmospheric Greenhouse Gases (GHGs) and have attributed this largely to human activities. The changes in climate patterns have impacted on local governments and communities globally.

1.1 The difference between weather and climate?

Although the terms ‘weather’ and ‘climate’ are often used interchangeably, they refer to two very different phenomena. ‘Weather’ is best defined as the state of the atmosphere at a particular place and time. When we speak of weather, we refer to daily temperature fluctuations, daily rainfall patterns and humidity levels as well as the amount of cloudiness on a given day.

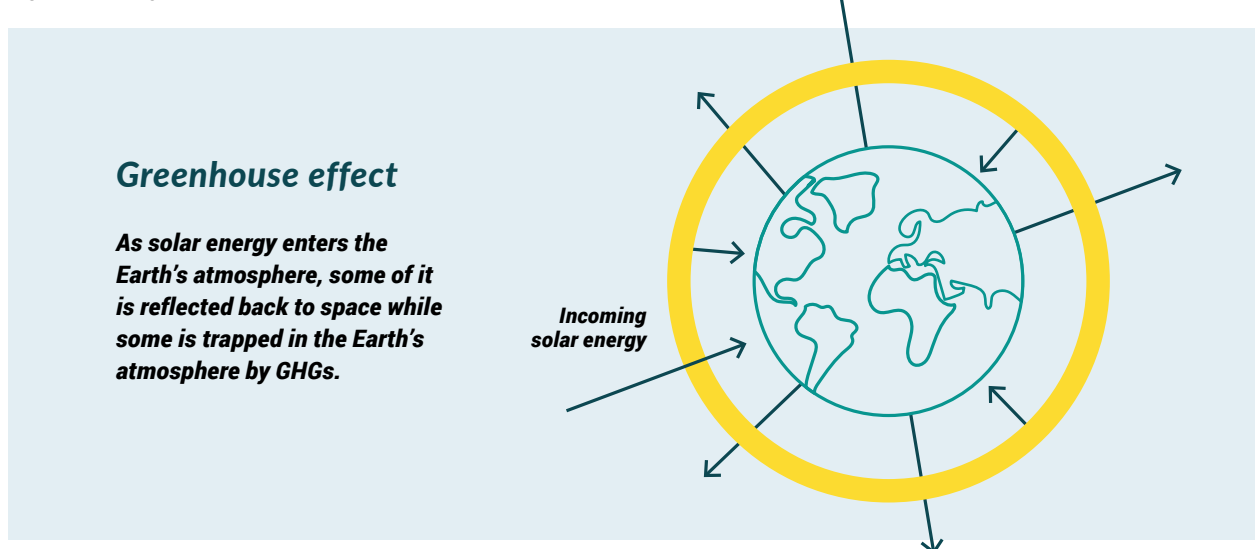
‘Climate’ differs from ‘weather’ in that it is defined as the prevailing weather conditions or trends for a specific geographical region over a long period of time (usually about 20 to 30 years). Climate information includes statistical weather data that tells us about the normal weather for a location, as well as its range of weather extremes.

1.2 The greenhouse effect and global warming

In order to understand climate change, it is first necessary to understand the ‘greenhouse effect’ and why GHGs such as carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄) and water vapour (H₂O) are important. The greenhouse effect is a naturally occurring phenomenon. As energy from the Sun enters the Earth’s atmosphere, some of it is reflected back into outer space, while some is trapped by GHGs. This flow of energy traps enough heat in the atmosphere to warm the Earth sufficiently to allow for life to flourish. This is known as the greenhouse effect.

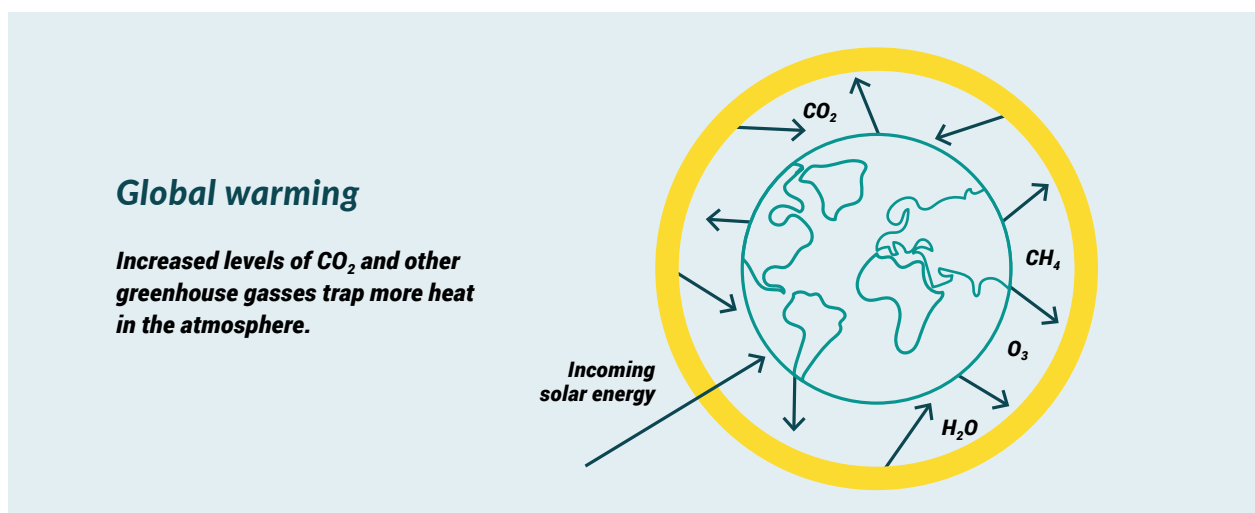


Figure 1: The greenhouse effect



Since the industrial revolution (1760 – 1840), human activities that rely on fossil fuels (such as coal, oil and natural gas) are increasing the number of GHGs in the atmosphere. These activities include the burning of coal to generate energy, driving of petrol and diesel powered automobiles, chemical processing in industry as well as many farming practices. This increase in GHGs in the atmosphere is causing more of the sun's energy to become trapped in the atmosphere. The effect may be likened to adding a blanket that is getting thicker and thicker as more GHGs are released into the atmosphere, trapping more heat. This heat disrupts the delicate balance required to keep the Earth's atmospheric temperature at a constant. The warming of the Earth's atmosphere is called 'global warming'.

Figure 2: Global warming



1.3 What is climate change?

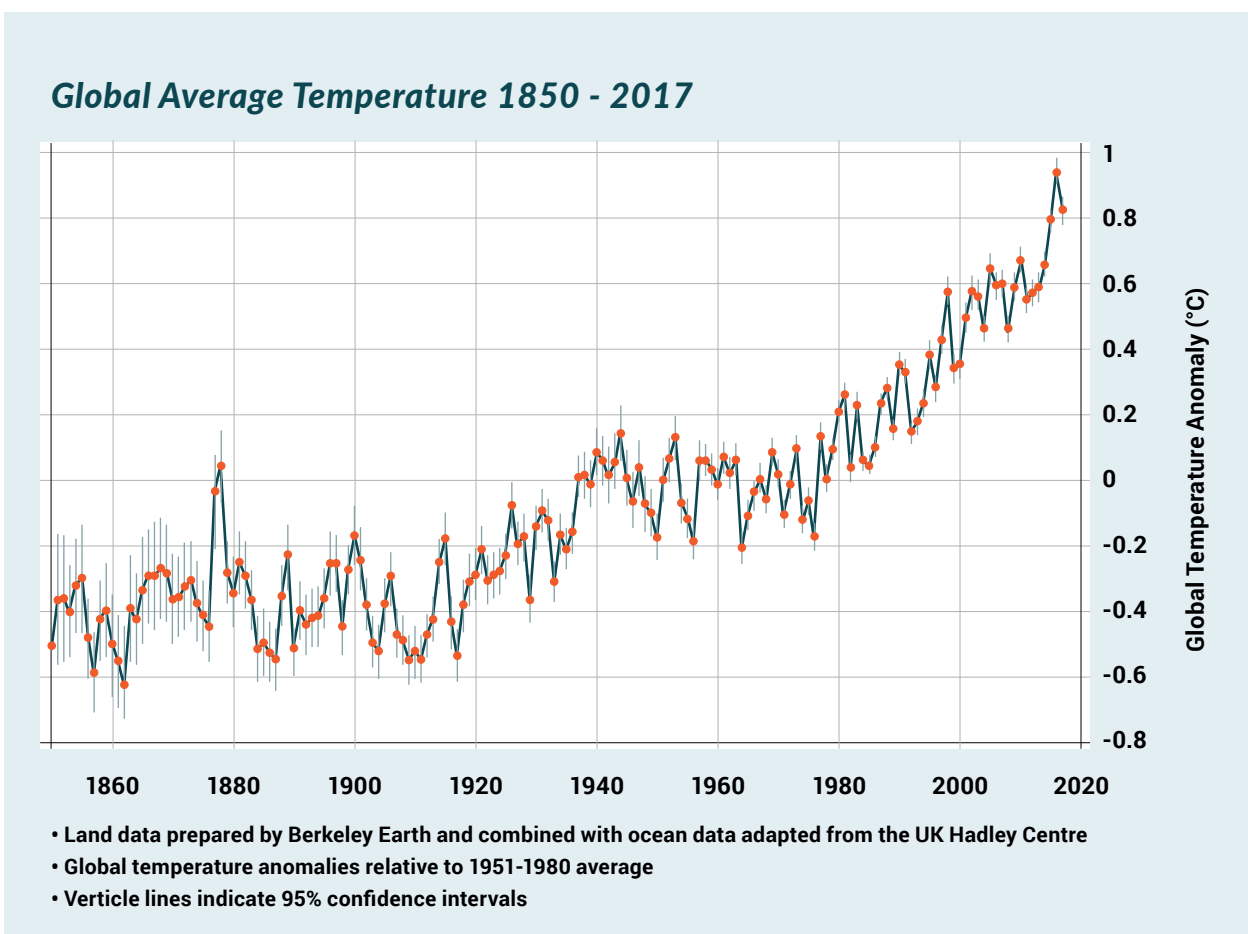
As the number of GHGs in the Earth's atmosphere increases, so too does the average atmospheric temperature. This in turn impacts regional climate systems, with some areas experiencing an increase in temperature combined with an overall drying effect, resulting in a marked decrease in rainfall, increase in droughts and heatwaves/fires. Other areas may experience an increase in temperature with an overall increase in moisture resulting in increases in incidences of rainfall, storms and floods. The shift in global and regional climate patterns as a result of the increase in Earth's average atmospheric temperature is known as 'climate change'.

1.4 The impacts of climate change at a global scale

As previously noted, shifts in the Earth's climate as a result of global warming manifest differently in various regions around the world. However, there are a number of common trends which are experienced throughout the world regardless of location.

Firstly, the entire globe is experiencing an increase in atmospheric temperature. Studies indicate that over the past 5000 years the Earth's temperature has fluctuated within a 0.5°C range. Since the industrial revolution, it has increased dramatically, as illustrated in Figure 3.

Figure 3: Changes in the Earth's atmospheric temperature 1850 - 2017 (image courtesy of BerkeleyEarth.org)



While the increase in temperature does not appear to be major, it has been sufficient to melt the Earth's polar ice caps, causing sea-levels to rise. This has major implications for local governments located along coastlines as



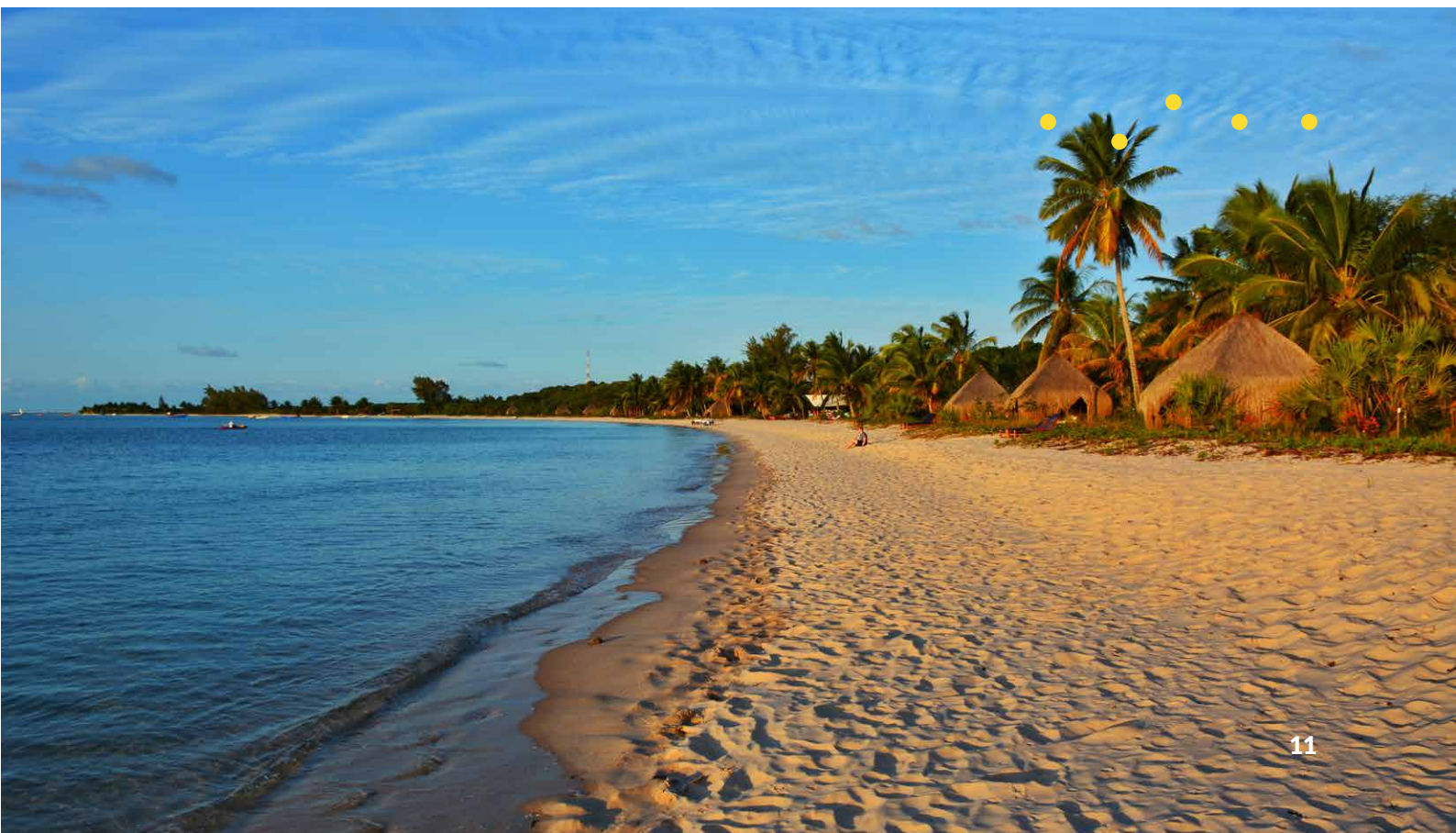
low-lying areas then become increasingly flood prone. Additionally, as the oceans' average temperature rises, they become more acidic and less able to absorb significant quantities of GHG emissions. This negatively affects coral reef systems (causing 'coral bleaching') and thus the the oceans' ecosystems, which has a negative effect on fish populations. This in turn impacts on people who rely on the oceans for food (in the form of fish) as well as tourism, which supports local economies and livelihoods. Coral bleaching has been reported in the Seychelles in 2002, 2003 and 2010, impacting fish species' habitats and population size. Ultimately, this could not only impact the Seychelles but fish populations between the Seychelles, Madagascar and the Mozambique Channel.

The increase in the Earth's atmospheric temperature also has an impact on global rainfall patterns. Evaporation and transpiration rates have been altered, which in turn affects the amount of moisture in the soil and air. The net effect of this is either an overall drying, such as what is predicted for the Sub-Saharan region, or an overall increase in moisture, such as what could potentially be the case for the tropical belt. Either way, rainfall patterns are likely to be disrupted in the form of shifts in their timing, changes in seasonal rainfall and in the intensity and frequency of rainfall events.

The final impact of global climate change is the increase in the intensity and frequency of extreme weather events. As the Earth's climate becomes increasingly unstable, extreme weather events have been observed with increasing regularity by climate scientists. In 2018, more than 60 million people were affected by extreme weather and natural hazards, with even more in 2019. These included tropical cyclones such as Cyclone Idai which made landfall in Beira, Mozambique in March 2019, killing more than 1300 people and causing more than US\$ 773 million in damage including damaging or destroying more than 100 000 homes; heatwaves such as that which occurred in July 2019 in Europe, which resulted in the deaths of 567 people from heat stress; and widespread fires due to increasing temperatures and drying such as the fires that raged in Australia in the 2019/2020 summer, killing 28 people, destroying one in every 10 000 homes and causing an estimated US\$ 3 billion in damages.

1.5 The impacts of climate change within the WIOMSA region

While the impacts of climate change manifest differently around the globe, they are relatively similar across the East African coastal region (i.e. South Africa, Mozambique, Tanzania, Kenya, Somalia, Seychelles, Comoros, Madagascar, Mauritius and Reunion). According to the United National Development Programme (UNDP), atmospheric temperatures in this region are estimated to increase between 1.8°C and 4.3°C by 2080.



According to the UNDP, projected changes in the region's precipitation are much less clear largely due to uncertainty regarding the alteration of the inter-related processes of the three phenomena that currently influence its weather: the Inter Tropical Convergence Zone (ITCZ), tropical monsoons and El Nino Southern Oscillation (ENSO) patterns. The organisation states that available reports (as synthesised in the 2007 Assessment Report of the Intergovernmental Panel on Climate Change ((IPCC)) indicate that the East African coastal region will likely experience an increase in overall average precipitation during the wet months (5 to 20 percent increase in precipitation from December to February). However, this increase will likely be accompanied by greater seasonal variation in rainfall patterns.

In addition to the above changes, the region will likely be affected by an increase in extreme weather events. According to the UNDP, there will be an increase in the occurrence of intense precipitation events and frequency of droughts. Additionally, due to increasing ocean temperatures, conditions will become favourable for the development of tropical storms and tropical cyclones and it is anticipated that there will be an increase in their intensity and frequency. Coupled with rising sea-levels, this will mean that coastal local governments are also increasingly at risk from storm-surges and coastal flooding.

If no mitigation efforts are immediately undertaken, these climate change impacts will undoubtedly affect various local economic sectors and ultimately impact entire regional economies. For example, a temperature increase of 1.2°C along with the changes in precipitation, soil moisture and water irrigation could render large areas of land in Kenya that support tea cultivation unusable. Some of the ways in which climate change could affect key sectors within the East African coastal region are listed below:



1. Water. As noted above, it is anticipated that temperatures in the region will increase and rainfall patterns will be disrupted. Depending on when and how the rain falls, this could disrupt stream and river flows and impact the steady supply of water. Additionally, a rise in sea-levels will result in coastal flooding and salt water intrusion into freshwater sources, limiting water supplies further. On the other hand, warm sea surface temperatures may lead to increased droughts in equatorial and subtropical Eastern Africa.



If no mitigation efforts are immediately undertaken, these climate change impacts will undoubtedly affect various local economic sectors and ultimately impact entire regional economies.





2. Energy. A large number of countries in the region rely on energy generated by hydropower. Should rainfall patterns be disrupted, not only will stream flows be interrupted, creating water insecurity as indicated above, but access to energy may become an increasing challenge.



3. Agriculture. Greater rainfall variability within and between seasons may impact crop productivity. Certain crops may begin to decline while others may thrive. Scientists and farmers have already observed a decline in rain, and thus long-cycle crops between March and May. Additionally, climate change is also anticipated to negatively affect the livestock and fishery sectors – significant sources of employment for vulnerable communities living along the coast.



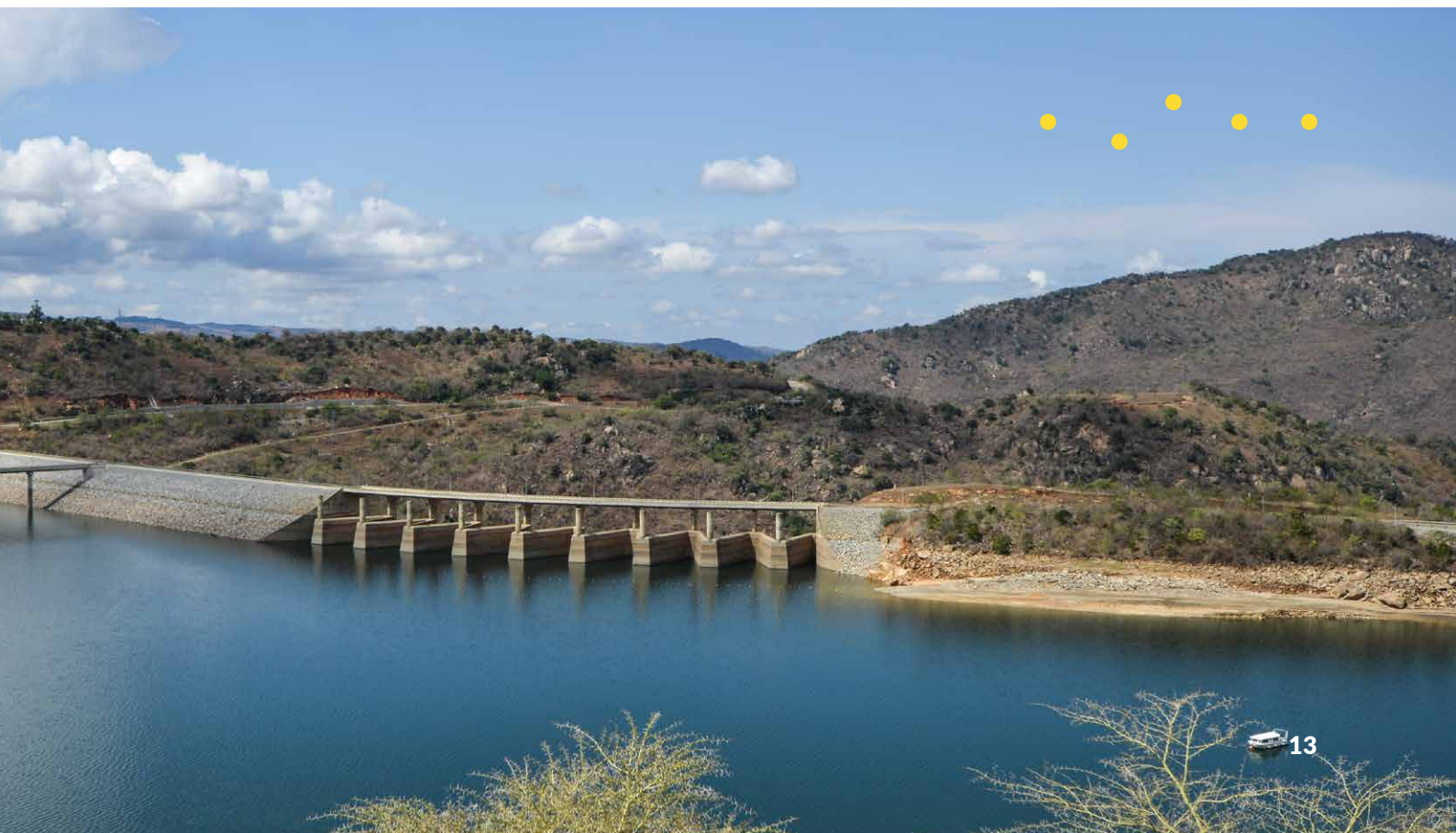
4. Tourism. Estimates suggest that due to warmer temperatures and altered rainfall patterns, 10 to 15 percent of species across Africa may become critically endangered or extinct by 2050. This has serious implications for countries that rely heavily on biodiversity to support their tourism sectors.



5. Human Health. Studies indicate that higher temperatures combined with an increase in rainfall could create more suitable conditions for vector-borne disease (illnesses caused by parasites) transmission, not only in countries that are traditionally susceptible to them (such as Tanzania, Kenya, Mozambique etc.) but in those that have never been exposed to them, such as South Africa. Additionally, climate change is expected to exacerbate the occurrence and intensity of future disease outbreaks.



Refer to **Chapter 3** for suggestions on how nature-based solutions can be utilised to reduce the impacts of climate change.



CHAPTER 2

WHY RESPOND TO CLIMATE CHANGE?



What you will learn in this chapter:

- The impact of climate change on local governments
- The difference between the direct and indirect impacts of climate change
- The answer to the question ‘What is climate change adaptation?’
- Tips for African local governments to enhance their adaptive capacity and limit global warming
- The benefits of climate change adaptation
- Why local governments have a responsibility to respond to climate change

2.1 The impact of climate change on local governments

Local governments across Africa, particularly those that are urbanising at a rapid rate, are faced with a myriad of challenges which hamper local government planning. These include water and sanitation issues, access to energy, widespread informality, unemployment and poverty. In addition to these, African local governments are also already facing significant environmental challenges not linked to climate change that affect the liveability of their regions. These include:

- 1 **The urban heat island effect.** Compared to their rural counterparts, urban areas have a much higher number of hard surfaces such as tar and concrete and a much lower amount of vegetation. These absorb and retain heat throughout the day and slowly release it throughout the night. This makes cities and peri-urban areas much warmer than rural areas. As global temperatures rise, temperatures in urban areas are also expected to increase and the urban heat island effect is expected to worsen.
- 2 **Air pollution.** Human activities that produce emissions such as driving automobiles and burning waste tend to be concentrated within urban areas. Furthermore, tall buildings reduce air flow, resulting in much higher concentrations of air pollution than in rural areas.
- 3 **Extreme weather events.** Local governments are already subject to extreme weather events such as cyclones, heatwaves, droughts and flooding that need to be planned for and responded to.

Local governments have a mandate to provide critical services to people living within their jurisdiction. Such services include the provision of clean water, affordable energy, access to food and job security. The above listed issues make the provision of these a continual day to day challenge.

As a result of climate change, not only will East African regions begin to experience direct climate change impacts (such as increases in temperature, changes in rainfall patterns, a rise in sea-levels and an increase in the frequency and intensity of extreme weather events), they will also experience subsequent indirect climate change impacts which will add to the aforementioned challenges faced by local governments. The indirect impacts of climate change include aspects such as:

- A reduction in water quality and quantity as a result of droughts caused by fluctuating rainfall patterns and prolonged dry-spells. This will threaten the supply of drinking water



- A reduction in agricultural production as a result of increasing temperatures and fluctuating rainfall patterns. This will affect food security
- Increased demand for energy access and distribution for cooling as a result of the increase in the incidence or duration of heatwaves
- Local governments could also experience greater in-migration of inhabitants of rural areas as a result of drought or other climate extremes

It is important to note that the impacts of climate change are not uniform and will vary from region to region. Additionally, the short and long term consequences for local governments will vary depending on how they respond. Regardless, the direct and indirect impacts of climate change can leave local governments and regional economies economically vulnerable. **If no action is taken, climate change has the capability to exacerbate and compound current challenges whilst adding new problems to the mix.** Table 1 provides an overview of some of the possible impacts of climate change on local governments.

Table 1: Possible impacts of climate change on cities around the world:

PROJECTED CHANGE IN CLIMATE	IMPACT ON LOCAL GOVERNMENTS	GEOGRAPHIC LOCATIONS MOST AFFECTED
Warmer temperatures with fewer cool days and nights and an increase in hot spells/heatwaves.	Exacerbation of the urban heat island effect, resulting in an increased risk of heat-related mortality and illness, especially for the elderly, sick, very young and those who are socially isolated. This also places an increased demand on energy for cooling, declining air quality, greater stress on water resources and the potential for wider geographical incidence of vector-borne diseases (such as malaria spreading to higher-altitude local governments).	All, especially inland local governments
Increased frequency in heavy precipitation; increase in the intensity of tropical cyclone activity	Disruption of water supply and sewer systems, and adverse effects on the quality of surface- and groundwater as a result of flooding, strong winds and landslides. Consequences include damage to and losses of assets and infrastructure. There will be an increased risk of deaths, injuries and illnesses, especially water-borne diseases	Coastal local governments, those on riverbanks or marginal land in floodplains, and mountainous regions
Decrease in rainfall and increase in dry spells between rainfall creating drought conditions	Greater stress on water resources as a result of increased water demand and potential for a decline in water quality. Additionally, there will be a decrease in hydropower generation. The impacts associated with droughts include land degradation (resulting in lower agricultural yields and increased risk of food shortages) and the potential for population migration from rural to urban areas	All, especially local governments in regions unused to arid conditions
Rising sea levels	Permanent coastal erosion and submersion of land, increasing costs of coastal protection or relocation costs. A decrease in groundwater availability due to saline intrusion into aquifers. Associated with this is an increase in the frequency and intensity of tropical cyclones and storm surges, particularly coastal flooding	Coastal local governments

2.2 What is climate change adaptation?

Although climate change has the capability to exacerbate and compound current challenges whilst adding new problems for local government planners to solve, effective planning will not only reduce the impacts of climate change but enhance the potential for harnessing opportunities associated with them.

Climate change adaptation is defined by the IPCC as “initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects.” Essentially, climate change adaptation involves responding to anticipated impacts, thereby reducing vulnerability and enhancing resilience. Vulnerability is defined by the IPCC as “the degree to which a system is susceptible to and unable to cope with adverse effects of climate change, including climate variability and extremes” whilst resilience is defined as “the ability of a system to absorb disturbances while retaining the same basic structure and ways of functioning.”

For example, one of the anticipated climate impacts that will affect the majority of local governments across Africa is rising average temperatures. There will likely be an increase in the number of hot days as well as a possible increase in heatwaves, particularly in the summer months. If temperatures become too high in urban areas, local government functions will be impacted as will human livelihoods. If local government planners do not adapt to this challenge, citizens will be directly impacted, particularly those who are elderly or living in informal areas, which will in turn reduce the ability of the local government to cope long term. However, if local government planners implement measures to combat rising temperatures and reduce urban heat (i.e. adapt to the impact), not only will they address it, they could also capitalise on opportunities associated with intervention. Measures to cool urban areas include planting avenues of trees along roads, creating green spaces and encouraging roof-top gardens. Not only will such measures promote urban cooling (trees and vegetation have the capability to cool surrounding areas by as much as three to four degrees celcius), they will also promote beautification, create spaces for recreation, boost the value of surrounding properties by making areas better and cleaner, and enhance human health.

The level to which a local government is able to adapt is dependent on its ‘adaptive capacity’. According to the IPCC, this term is defined as “the capabilities, resources, and institutions of a country, region or local government to implement effective adaptation measures.” If local governments have a high adaptive capacity, they will find it easy to implement adaptation measures. Conversely, if they have a low adaptive capacity, they will find it difficult to implement adaptation measures. Figure 4 provides an overview of what African local governments can do to enhance their adaptive capacity while limiting their contribution to global warming.



Figure 4: Ten tips for African local governments to enhance their adaptive capacity and limit global warming



2.3 The benefits of climate change adaptation

As previously noted, African local governments across the continent already face significant challenges in providing their citizens with safe and affordable housing, drinking water and basic sanitation, affordable and reliable energy, safe and livable communities, and an environment that promotes economic success. According to the World Development Report 2010, “development will get harder, not easier, with climate change.” This is not only true for developing local governments but for those that have already achieved progress in fulfilling their mandates. In light of this, planning for climate change may seem an overwhelming task that burdens local government planners with more work than there is time or budget for. However, as noted above, effective adaptation planning can not only reduce the impacts of climate change but enhance the potential for harnessing associated opportunities that can support local governments with achieving their mandates. Some of the top benefits of climate change adaptation for local governments are listed below:

- 1 Climate change adaptation actions can be incorporated into existing mandates.** Climate change adaptation actions are often seen as actions that are to be undertaken over and above existing work. However, they can be incorporated into existing mandates very easily, meaning that local governments can address their mandates whilst responding to climate change impacts. For example, one of the mandates of local governments is to provide access to affordable energy. Instead of investing in coal fired power stations, local governments can invest in clean energy sources such as solar, wind or hydro power. These not only provide electricity but reduce the amount of GHGs being emitted into the atmosphere and governments’ reliance on non-renewable energy sources.
- 2 Climate change adaptation actions are often associated with a number of co-benefits.** Whilst climate change adaptation actions are primarily intended to address the negative impacts of climate change, more often than not they have a number of co-benefits or additional benefits which enhance citizens’ livability and support local government with development along a more sustainable and resilient trajectory. For example, Dar es Salaam, Tanzania is a low-lying coastal city that has become increasingly vulnerable to coastal flooding and storm surges due to rising sea levels. The effect of this is that properties on the coast are being damaged, roads are being washed away and accessibility through portions of the city has become limited. In response to this, the City has constructed a sea wall along the most severely affected areas. Trees have been planted alongside it and a boardwalk with numerous benches has been built. The impact is that not only has the issue of coastal flooding been addressed but properties in these areas are now protected, flooding has



The Government of Mauritius embarked on a project in which mangroves were used to protect a kilometre of its coastline. It included propagating mangrove propagules (seeds) and planting them.



ceased (with people now being able to get to and from work safely), and residents enjoy the boardwalk as a recreational area, which positively impacts their health. Likewise, rehabilitating and conserving a coastal city's mangroves not only contributes towards carbon sequestration but helps protect and buffer it from storm surges. Such action can also shield coastal communities from flooding while creating livelihood opportunities and supporting healthy ecosystems. Kenya's Gazi Bay has become a both a research and an active demonstration site in this regard, promoting successful mangrove management practices to other countries in the region.

3

Climate change adaptation actions can reduce costs in the long term. The impacts of climate change, particularly the increase in intensity and frequency of extreme events can have huge cost implications for local government. For example, as previously noted, it is estimated that Cyclone Idai caused more than US\$ 773 million damage to Beira, Mozambique (a developing city). If a local government fails to implement measures to adapt to the increase in frequency and intensity of cyclones, it could face similar or even further costs with increasing regularity. However, local governments that immediately assign budget towards reducing the impacts of climate change can avoid these costs in the future. Additionally, pursuing an agenda that includes adaptation actions can also result in other financial advantages, such as lower insurance rates and increased access to financing opportunities.

4

Climate change adaptation actions can create new job opportunities. Climate change adaptation action often entails building and maintaining new grey or green infrastructure. This provides job opportunities which in turn supports local livelihoods, reduces poverty and boosts the local economy. According to the Solar Energy Industries Association (SEIA), the United States' solar industry estimates that it created more than 15 000 jobs between 2007 and 2008 while its wind industry created more than 35 000 jobs within the same period. As demand for energy increases, so too does the potential for job creation, enhancing the economic situation of more and more people and reducing their vulnerability to climate change. For example, the Government of Mauritius embarked on a project in which mangroves were used to protect a kilometre of its coastline. It included propagating mangrove propagules (seeds) and planting them. This in turn opened up new opportunities for income-generating activities and women's empowerment. This simple, low-cost, yet highly effective nursery method is scalable and can be applied in other coastal regions. Additionally, the longer-term benefits (beyond climate change adaptation) of such a project could be the development of a new Mauritian ecotourism industry.



5

Climate change adaptation action can reduce food insecurity. Increasing temperatures and shifts in rainfall patterns pose a threat to agriculture. Shifts in the timing of rainfall could affect germination of crops, less water could result in stressed plants and reduced yields and in some cases even crop failure. If local governments promote adaptation actions within agriculture such as changing to crops that are more resistant to fluctuating rainfall patterns, changing planting dates and investing in livestock cooling systems, the sector may not be as hard hit. For example, in southern Africa where maize is a staple crop, sorghum could be used instead as it fares better in areas with less rainfall. Such actions would support local governments maintain food security despite the challenges created by climate change.

While the above listed benefits are not exhaustive, they serve to illustrate that climate change adaptation can be considered to be the smartest option for local governments, especially for those in low income countries.

Why local governments have a responsibility to respond to climate change

Local government authorities, non-governmental bodies and other local actors are at the forefront of climate action, with many already demonstrating increasing willingness to address climate and broader environmental challenges. However, both worldwide and more specifically in Africa, local government areas exhibit an immense diversity of conditions, capabilities and responses to the challenges of changing environments and climatic conditions. Local governments are dynamic spaces with various components that are always in transition, shaped by multiple spheres of influence and actors seeking power over resources, processes and more recently, climate action agendas.

While local governments may be separated by politico-administrative borders, adjacent municipalities are connected through biophysical, politico-economic and social systems which are likely to transform under changing climatic/environmental conditions. However, for many local governments, politico-administrative borders and country governance systems have determined the parameters of their climate change adaptation strategies.

Over the past decade, international bodies and national governments have increased their interest in the role that local governments can play as sites of transformation in the fight against climate change. Local governance underpins both the greatest challenges faced by African local governments, and the potential solutions. Africa's challenges are significant, and include high levels of poverty, inequality and lack of access to clean water, coupled with a recent slowing of economic growth, increasing urbanisation and informality. Climate change overlays these challenges, with local government officials being required to deal with ever-increasing complexity and uncertainty in their decision making. Given the recognition that business-as-usual practices will not suffice under a climate change influenced future, there are opportunities for much of Africa's development to still occur and for the continent to lead the way in harnessing resilient solutions and resource efficient practices. Such action is necessary to reduce vulnerability at a local level. Local governments are well positioned to take the necessary steps to ensure sustainability and climate resilience by simply institutionalising and enforcing flexible adaptation plans.

While adaptation planning and policy has historically been focused largely at the national level, such as via National Adaptation Plans (NAPs), attention to adaptation actions at the local level has rapidly increased in recent years. This emphasis on local adaptation stems from the opinion in adaptation literature that 'adaptation is local'. The impacts of climate change are experienced locally, and therefore, geographic variability in climate impacts emphasises the need for local scale approaches to climate adaptation. In addition, local governance systems are often responsible for managing such impacts. It has been argued that local governments have three critical roles in climate adaptation, namely 1) structuring responses to local impacts; 2) mediating between individual and collective responses to vulnerability; and 3) governing the delivery of resources to facilitate adaptation.

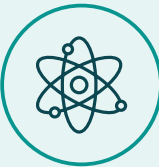





Ultimately local government is central to adaptation as vulnerabilities and impacts are experienced at a local scale, in the forms of inundation, heatwaves and rising sea levels. To adequately plan and adapt to these challenges, local governments need to take the lead, include a focus on adaptation into their planning, seek change at higher levels of government to enable changes in the planning frameworks that may currently hinder local adaptation efforts, and mainstream climate adaptation into their decision making processes.



Convening role of local governments

Adaptation is not solely the responsibility of the local government and can be undertaken by an individual for his or her own benefit, or consist of actions by governments and public bodies. There are many ways in which the adaptation process can be organised or governed, including a climate change unit in the mayor's office or a task force consisting of the local government officials and wider stakeholder groups. Local governments are well positioned to integrate or collaborate with multiple stakeholders and foster partnerships with experts. External partnerships can be very useful, especially if a local government does not have the internal capacity for a dedicated climate change team. Partnerships with civil society organisations, academia and the private sector can offer strategic capacity-sharing benefits.

Table 2: Common stakeholders involved in adaptation measures

STAKEHOLDER	ROLE
 <p>Academia and scientific organisations</p>	<ul style="list-style-type: none"> • Provide information on scientific developments, vulnerability and information on potential policy responses
 <p>Community based organisations</p>	<ul style="list-style-type: none"> • Can be helpful especially when led by influential individuals who know how to navigate local social networks and dynamics • May already be implementing adaptive responses, either formally or informally
 <p>Governments</p>	<ul style="list-style-type: none"> • Departments or individuals often serve as first responders to climate-related hazards and as primary planners for hazard mitigation or disaster risk reduction measures • Important to also consider other local government bodies: county, regional and national entities; and neighbouring towns
 <p>International non-governmental organisations</p>	<ul style="list-style-type: none"> • Support advocacy and dialogue about adaptation • Offer strategic advice and technical assistance on mitigation and adaptation measures
 <p>Financial institutions</p>	<ul style="list-style-type: none"> • Provide financing for specific investments and adaptation projects
 <p>Private sector</p>	<ul style="list-style-type: none"> • Potentially interested in how to make their operations resilient to climate change impacts. Some businesses may be interested in adaptation investments as part of their corporate humanitarianism strategies/initiatives

CHAPTER 3

ADAPTING TO CLIMATE CHANGE USING NATURE-BASED SOLUTIONS



What you will learn in this chapter:

- The role of natural assets in supporting local government functions and development
- Overview of coastal natural assets
- The value that coastal natural assets bring to support local governments to enable them to withstand and adapt to the impacts of climate change
- Overview of nature-based solutions
- Benefits of nature-based solutions for coastal local governments

Chapters 1 and 2 have highlighted the fact that climate change is inevitable if GHGs continue to be emitted into the atmosphere at their current rate; and that the impacts of climate change, if unplanned for, can have major impacts on local governments. Chapter 2 also discussed the necessity for local government decision-makers to start taking climate change adaptation actions into consideration in their day to day work; this will not only ensure that local governments build adaptive capacity to cope with the impacts of climate change but that they become more resilient and develop along a more sustainable trajectory.

The role of natural assets in supporting local government functionality and development

Natural assets have an important role to play when it comes to supporting human livelihoods in that they provide ecosystem services, which are the basis for life. Natural assets are environmental systems such as wetlands, rivers and forests that produce a flow of beneficial (free) ecosystem services. These services include benefits for people, society and the economy such as water purification, local climate and air pollution regulation, food production and recreation space. For example, wetlands and rivers have the ability to filter and clean water whilst regulating stream flows; and forests and groves of trees filter, clean and cool the surrounding air. Natural assets provide these ecosystem services at no cost and thus support local governments with developing more sustainably.

Healthy functioning ecosystems and natural assets also have the ability to support local governments in withstanding and adapting to the impacts of climate change. For example, wetlands can support local governments in times of drought by slowly releasing water into rivers whilst trees can cool surrounding areas by as much as four degrees.

It is crucial to note that natural assets are only able to provide these free ecosystem services if they are not degraded or damaged. Human activities such as draining wetlands, emptying waste into rivers or clearing land of trees and vegetation to make space for development compromises the ability of these natural assets to perform ecosystem services, and once these systems are compromised, people do not benefit from these services to the same degree. Additionally, if ecosystems or natural assets become degraded they also become vulnerable to the impacts of climate change in and of themselves. It is thus in local governments' interest to preserve their natural assets to continue to benefit from the free ecosystem services that they provide.



The value of coastal natural assets to coastal local governments

Coastal natural assets are the natural assets that are specifically located on the coast and include sandy beaches, coral reefs, mangroves, seagrass beds, dune forests, estuaries, hypersaline environments and riverine vegetation. Coastal natural assets each contribute in their own way to the healthy functioning of a coastal local area. For example, mangroves absorb the shock of storm surges, thereby protecting the coast, while coral reefs provide nurseries for fish which in turn support local livelihoods. As with all natural assets, if coastal natural assets are well protected and preserved, they are able to support local governments with developing sustainably as well as in withstanding and adapting to the impacts of climate change.

Coastal environments are constantly changing due to dynamic natural processes such as tides, waves and storms. Additionally, they are under immense pressure by humans, which creates a unique set of management challenges. If coastal management is well balanced, coastal natural assets can continue to thrive and people can continue to benefit from their free ecosystem services. However, if they are not well managed, coastal natural assets can quickly become degraded and/or destroyed, resulting in them being unable to provide the ecosystem services on which local communities depend, and unable to support local governments in withstanding and adapting to the impacts of climate change. Table 3 illustrates the range of coastal natural assets which can support local governments, their key ecosystem services and their key threats.



Table 3: The value of coastal natural assets for coastal local governments

COASTAL NATURAL ASSET	DESCRIPTION	ECOSYSTEM SERVICE(S)	THREATS
Sandy beaches	Sandy beaches are loose deposits of sand and include gravel and shell deposits (Pettijohn et al., 2012). As a general rule, they tend to be gently sloping and quite flat. Sandy beaches account for a large portion of the world's coastlines	<ul style="list-style-type: none"> • Sandy beaches act as buffer zones or shock absorbers that protect the coastline, sea cliffs or dunes from direct waves • They act as coastal recreational areas for local communities and tourists 	<ul style="list-style-type: none"> • Coastal development • Harmful recreation activities such as the launching of motor boats • Pollution • Sand mining • Natural erosion which is exacerbated by inappropriate coastal development and sea level rise
Coral reefs	Coral reefs are large underwater structures composed of the skeletons of colonial marine invertebrates called coral. There are hundreds of different species. Corals have a dazzling array of shapes and colours, from round, folded brain corals to tall, elegant sea whips and sea fans that look like intricate, vibrantly coloured trees or plants. Most coral reefs occur in shallow waters near the shore. The biggest coral reefs are found in the clear, shallow waters of the tropics and subtropics	<ul style="list-style-type: none"> • Coral reefs protect shorelines by absorbing and thus slowing wave energy • They protect coastlines from the damaging effects of tropical storms and storm surges • They act as a breeding site for fish and a protective area for juvenile fish to grow up safely away from predators. This in turn supports subsistence for commercial fishermen • They provide habitat and shelter for many other non-fish marine organisms • They provide recreational sites for divers • They assist with recycling, the breaking down of pollutants and the purification of water 	<p>Roughly one-quarter of the world's coral reefs are already damaged beyond repair, with another two-thirds under serious threat from the following:</p> <ul style="list-style-type: none"> • The increase in sea surface temperatures (as a result of climate change) which causes coral bleaching (and ultimately death of the coral) • Unsustainable fishing practices such as dynamiting corals to kill fish quickly and bring them to the surface • Careless tourism activities such as touching or standing on the coral • Coral mining • Pollution • Sedimentation from erosion
Mangroves	A mangrove is a shrub or small tree that grows in coastal, saline or brackish water. Mangroves are unique in that they are able to survive and thrive in hot muddy, salty conditions that the majority of other plants cannot (Spalding, 2010).	<ul style="list-style-type: none"> • Mangroves act as coastline protectors as they naturally absorb influxes of water and cope with flooding associated with storm surges and cyclonic storms (Randall, et al., 2010) • They absorb and store carbon from the atmosphere. As the trees grow they take the carbon from CO₂ and use it as building blocks for their leaves, roots and branches • They act as fish nurseries for breeding and juvenile fish • They support a diversity of creatures important to human wellbeing • Mangroves also provide humans with food, fruit, medicines, fibre and wood – when sustainably managed 	<ul style="list-style-type: none"> • Deforestation to make way for coastal development, shrimp farms, building materials and fuel • Coastal development which restricts inland movement as sea levels rise • Invasive species that are able to move beyond their native habitats and out-compete mangroves for space



COASTAL NATURAL ASSET	DESCRIPTION	ECOSYSTEM SERVICE(S)	THREATS
Seagrass beds	Seagrass is often confused with seaweed, but is more closely related to flowering plants as it has roots, stems and leaves, and produces flowers and seeds (Den Hartog and Kuo, 2007). Seagrass is found in shallow, salty and brackish waters	<ul style="list-style-type: none"> • Seagrass beds form dense underwater meadows which provide shelter and food to a diverse community of animals • They provide grazing areas for megafauna such as endangered manatees, dugongs and sea turtles 	<ul style="list-style-type: none"> • Coastal pollution • Dredging for harbours and shipping lanes • Overfishing • Invasive species that outcompete seagrass for space • Sea level rise • Overgrazing (usually as a result of other seagrass beds being disturbed) • Storm surges (which are increasing in intensity and frequency as a result of climate change)
Hypersaline environments	Hypersaline environments are extreme habitats characterised by high salt concentrations. Examples include lagoons and mudflats. Hypersaline environments are unique because of their geochemical properties, microbial populations and aesthetic appeal. Microbial activities and the diversity seen in hypersaline environments are distinct in comparison to many other environments (Vernberg and Vernberg, 2001).	Hypersaline environments are used for: <ul style="list-style-type: none"> • Mineral extraction • Shrimp production • Attraction of shore birds • Archeological sites • Natural spas 	<ul style="list-style-type: none"> • Changes in salinization levels due to water diversions and/or extensive mineral extraction • Pollution due to sewage, agricultural and industrial process runoff • Urbanisation
Estuaries	Estuaries are partially enclosed bodies of water in which salt water from the ocean mixes with fresh water from rivers or streams. The coastal habitats that surround estuaries as well as the populations of plants and animals that inhabit them are specially adapted to their environment and are able to deal with constant changes in salinity (Mclusky and Elliott, 2004).	<ul style="list-style-type: none"> • Estuaries act as a natural buffer between the land and ocean, absorbing flood waters and dissipating storm surges • Water filtration • Tourist attractions • Estuaries provide critical habitats for species that are valued commercially, recreationally and culturally • Birds, fish, amphibians, insects, and other wildlife depend on estuaries to live, feed, nest, and reproduce • Estuaries are also important recreational areas for boating, swimming, bird and other wildlife watching, and fishing • They are important centres of transportation and international commerce 	<ul style="list-style-type: none"> • Sea level rise • Large-scale conversion by draining, filling, damming or dredging • Destruction and loss of estuarine habitats • Creation of shipping ports and expansion of urban areas • Pollution • Population growth in watersheds • Oil and gas drilling • Overharvesting

COASTAL NATURAL ASSET	DESCRIPTION	ECOSYSTEM SERVICE(S)	THREATS
Dune forests	Dune forests consist of scrub-like vegetation and trees found above the high-tide mark. These ecosystems are adapted to growing in harsh conditions associated with climatic extremes such as strong winds, salinity and an excess of humidity	Dune forests are necessary for: <ul style="list-style-type: none"> • Land stabilisation • Erosion prevention • The prevention of the silting up of coastal lagoons and rivers 	<ul style="list-style-type: none"> • Deforestation to clear land for coastal development, construction poles and fuel • Repeated burning • Sea level rise
Salt marshes	A salt marsh (saltmarsh), also known as a coastal wetland, is a coastal ecosystem in the upper coastal intertidal zone between land and open saltwater or brackish water that is regularly flooded by tides. They are marshy because the soil may be composed of deep mud and peat	Salt marshes are responsible for: <ul style="list-style-type: none"> • Maintaining healthy water • Protection from flooding and erosion • Nursery areas for fish, crustacea and insects • Supporting recreational activities that have become part of the coastal lifestyle • Protection against waves and sea level rise 	<ul style="list-style-type: none"> • Changes to natural hydrology: tidal and reduced tidal flow • Environmental pollution • Coastal development • Dredging • Wave erosion • Agricultural activities

Table 3 illustrates the wide variety of benefits that coastal natural assets can provide if effectively managed. These are not purely economic and instead protect people from extreme weather events such as cyclones, tropical storms and storm surges; support human livelihoods and local economies (through the provision of food, fuel and medicine, which can be sold), reduce poverty (through the provision of food) and support human wellbeing through the creation of spaces for rest and recreation. In light of their value and sensitivity, it is of the utmost importance that the natural functioning of these coastal systems is promoted.

What are nature-based solutions?

Although coastal local government areas are as vulnerable as every other local government to the impacts of climate change, they are also at risk from rising sea levels, coastal flooding, storm surges and an increase in the intensity and frequency of coastal related extreme weather events such as tropical storms.

Nature-based solutions are defined by the International Union for Conservation of Nature (IUCN) as “actions to protect, sustainably manage and restore natural or modified ecosystems, to address societal challenges whilst effectively and adaptively providing human well-being and biodiversity benefits.” Investing in nature-based solutions preserves the health and functionality of coastal natural assets and offers local governments the opportunity to capitalise on the free services they provide (see Table 3). Such investments also provide local governments with additional armour to withstand and adapt to the impacts of climate change whilst creating ‘green jobs’, and a healthier, cleaner space in which to live.

The benefits of nature-based solutions

Nature-based adaptation solutions provide local governments with an opportunity to combine climate change adaptation actions with biodiversity conservation and sustainable resource management all-in-one go. In the long



term, they are often more cost-effective than purely technical approaches and can produce important additional socioeconomic benefits for the environment, citizens and the local economy.




Nature-based solutions are also considered to be ‘no-regret’ options, as should the effects of climate change not occur as predicted, the measures that have been taken will still be extremely valuable. Any measures that are taken to cope with a constantly changing climate and its associated risks must be flexible and cost-efficient, which nature-based solutions offer.

Unlike most grey infrastructure options, nature-based solutions can also complement one another exceptionally well. For example, a single measure such as the restoration of mangroves not only reduces GHGs but increases the adaptive capacity of ecosystems and their ability to protect against damage from storm surges or cyclones. Nature-based solutions can thus have multi-layered and cross-sectoral benefits and several interventions can often be utilised to achieve the same goal – at lower cost. They can also effectively complement existing technical solutions and in some instances even replace them.



Nature-based solutions can include the following: restoration of mangroves, rehabilitation of dune forests, establishment and management of marine protected areas to improve the resilience of fisheries, protection of coral reefs, rehabilitation of wetlands, replanting of forests and planting of trees and vegetation. Table 4 provides an overview of possible climate change impacts that could affect various coastal local government sectors and highlights nature-based solutions that not only address the issue but enhance the local government’s adaptive capacity.



Table 4: How nature-based solutions can support local governments using climate change adaptation measures

SECTOR	CLIMATE IMPACTS	POSSIBLE NATURE BASED SOLUTION	CO-BENEFITS OF NATURE-BASED SOLUTION
<p>Water</p> 	<p>Increased temperatures and a disruption in rainfall patterns resulting in an overall decrease in rainfall. These would impact stream and river flows and in turn affect the steady supply of water (creating water insecurity)</p>	<p>Rehabilitation and maintenance of the health of wetlands in the upper catchment areas of rivers. Wetlands have the ability to store rainwater (much like a sponge) and then release it slowly when rainfall stops over a period of up to several months. Such action ensures that stream and river flows are maintained thereby supporting water planning efforts</p>	<p>Wetlands in and of themselves provide a range of ecosystem services over and above water storage. These include:</p> <ul style="list-style-type: none"> • Slowing down flash floods, thereby protecting infrastructure and downstream housing • Water purification • Provision of edible plants, fish and crustaceans which can supplement human diets • Provision of medicinal plants • Provision of habitat for birds and aquatic animals which encourage tourism
<p>Agriculture</p> 	<p>Increased temperatures and greater rainfall variability between seasons which may impact crop productivity. This in turn affects food security</p>	<p>Plant a variety of different types of crops (polyculture) which all have a resistance to increased temperatures and variable rainfall patterns whilst simultaneously practicing conservative agricultural methods (such as drip irrigation, mulching etc.)</p>	<p>Steering away from monocultures has the following additional benefits:</p> <ul style="list-style-type: none"> • If one crop fails despite best efforts, the farmer can still sell produce from the other crops that have not been affected. This benefits not only the farmer but the local economy • Polyculture has additional environmental benefits which are otherwise not realised when monoculture is pursued, including better nutrient utilisation in the soil, better soil health and increased biodiversity in the surrounding areas
<p>Fisheries</p> 	<p>The increase in global average temperatures will cause warmer ocean temperatures and some fish species to either migrate to cooler waters or die, which results in a decrease in available fish for consumption. This in turn impacts on local communities as well as commercial fisheries</p>	<p>Protect known fish breeding areas (such as mangroves and coral reefs) and establish and manage additional marine protected areas to improve resilience of fish and support population growth</p>	<ul style="list-style-type: none"> • By protecting existing and establishing more marine protected areas, local governments can benefit from the additional ecosystem services provided by mangroves and corals (see Table 2) • Job creation



SECTOR	CLIMATE IMPACTS	POSSIBLE NATURE BASED SOLUTION	CO-BENEFITS OF NATURE-BASED SOLUTION
<p>Tourism</p> 	<p>An increase in global temperatures and altered rainfall patterns coupled with increasing pressure from urbanisation means that biodiversity is severely threatened. If lost entirely, countries such as Tanzania and Kenya, which rely on biodiversity to generate income through tourism, could be heavily affected</p>	<p>Protect and maintain existing biodiversity areas and establish new ones</p>	<p>In addition to preserving the habitat of critical biodiversity, this solution has the following additional benefits:</p> <ul style="list-style-type: none"> • Trees and vegetation act as carbon sinks which draw emissions out of the atmosphere • Trees and vegetation have the ability to absorb energy entering into the atmosphere instead of reflecting it and can therefore slow down global warming • Conservation mechanisms can promote additional tourism and bring more economic benefits to the country • Job creation through the establishment and maintenance of new protected areas
<p>Human settlements</p> 	<p>An increase in the frequency and intensity of extreme weather events such as cyclones. These result in storm surges and coastal flooding, which damages coastal infrastructure and has huge cost implications</p>	<ul style="list-style-type: none"> • Protect natural storm barriers such as coral reef systems and mangroves. As noted in Table 2, coral reefs and mangroves act as a barrier to waves and slow the water's passage, thereby protecting the coastline • Additionally protect, conserve and restrict development near coastal wetlands, lagoons and salt marshes, all of which can absorb flood waters 	<ul style="list-style-type: none"> • Each of these systems provide breeding grounds for various fish and crustacean species. By ensuring their protection, local governments can also boost fish populations • Enhanced tourism as people come to dive above preserved corals, swim amongst mangroves and view birdlife on coastal wetlands, lagoons and salt marshes. These activities have an economic benefit

It is important to note that the advantages of nature-based solutions are sometimes not immediately apparent, but instead accumulate over a longer period of time. Furthermore, the majority of the benefits associated with them are not quantitatively measurable. However, they undoubtedly provide high value to local governments across the world as they are cross cutting in their ability to support human livelihoods and human wellbeing through the creation of spaces for rest and recreation, reduce poverty, support local economies, and critically, provide protection for local governments from the impacts of climate change.

CHAPTER 4

OVERVIEW OF THE GLOBAL CLIMATE POLICY LANDSCAPE



What you will learn in this chapter:

- Overview of the Intergovernmental Panel on Climate Change (IPCC)
- The role of the United Nations Framework Convention on Climate Change (UNFCCC)
- Kyoto Protocol and the Doha Amendment
- The Paris Agreement
- The Sendai Framework for Disaster Risk Reduction
- The Sustainable Development Goals (SDGs)

The Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) is a United Nations established body comprising thousands of scientists from around the world dedicated to assessing the science related to climate change. Its main objective is to provide governments at all levels with the scientific information needed to develop sound government policies.

Following the establishment of the IPCC in 1988, the first Assessment Report was issued in 1990. In it the IPCC reported that while the Earth has a natural greenhouse effect, emissions from human activities are substantially increasing the atmospheric concentrations of GHGs (including CO₂, N₂O, CH₄, CFCs and nitrous oxide). These increases enhance the aforementioned natural greenhouse effect, resulting in additional warming of the Earth's surface. Additionally, the report also stated that CO₂ has been responsible for the over-enhanced greenhouse effect and predicted that under business-as-usual conditions, an increase of about 0.3°C per decade could be expected in the global mean temperature during the 21st century. This is greater than that observed over the past 10 000 years. As such as the IPCC recommended **that immediate reductions in emissions from human activities of over 60 percent are required to stabilise concentrations and keep the global climate stable.**

The IPCC's Second, Third, Fourth and Fifth Assessment Reports, issued in 1996, 2001, 2007 and 2014 respectively, have all reiterated the findings of the First Assessment Report with increasing certainty and urgency. The Fifth Assessment Report, the latest iteration of the series, has reported the following in a synthesis report for policy makers:

“Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and (the) sea level has risen. Anthropogenic GHG emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of CO₂, CH₄ and nitrous oxide that are unprecedented in at least the last 800,000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century. In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans. Changes in many extreme weather and climate events have been observed since about 1950, including a decrease in cold temperature extremes, an increase in warm temperature extremes, an increase in extreme high sea levels and an increase in the number of heavy precipitation events in a number of regions.”



“Continued emission of GHGs will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reductions in GHG emissions which, together with adaptation, can limit climate change risks. Cumulative emissions of CO₂ largely determine global mean surface warming by the late 21st century and beyond. Surface temperature is projected to rise over the 21st century. It is very likely that heatwaves will occur more often and last longer, and that extreme precipitation events will become more intense and frequent in many regions. The ocean will continue to warm and acidify, and global mean sea level to rise. Climate change will amplify existing risks and create new risks for natural and human systems. Risks are unevenly distributed and are generally greater for disadvantaged people and communities in countries at all levels of development. Many aspects of climate change and associated impacts will continue for centuries, even if anthropogenic emissions of greenhouse gases are stopped. The risks of abrupt or irreversible changes increase as the magnitude of the warming increases.”

In between its publication of the Assessment Reports, the IPCC has also issued a number of Special Reports designed to support global policy makers with key information that should be used at high level decision making moments. These similarly highlight the need for urgent action to mitigate the impacts of climate change by reducing emissions and adapt to its impacts.

The United Nations Framework Convention on Climate Change

Based on the findings indicated in the First Assessment Report issued by the IPCC in 1990, the United Nations Framework Convention on Climate Change (UNFCCC) was established in 1992 and entered into force in 1994. Its objective is “to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.” The UNFCCC puts the onus on developed countries to lead the way in reducing GHG emissions as they are considered to be the source of the majority of historical GHGs as well the producers of a large portion of current GHGs.

Kyoto Protocol

In support of this expectation, the Kyoto Protocol was adopted in 1997 (although it only came into force in 2008 owing to its complex ratification process). Between 2008 and 2012, the Kyoto Protocol operationalised the UNFCCC by committing developed countries to limit and reduce their GHG emissions in accordance with individual targets. The countries were expected to adopt mitigation policies and measures and report on these regularly. It is important to note that the Kyoto Protocol only bound developed countries and placed a heavy burden on them under the principle of ‘common but differentiated responsibility based on capabilities.’

The Doha Amendment

The Kyoto Protocol was amended in 2012 to what has since become known as the ‘Doha Amendment’ to encompass the period 2013 to 2020. The Amendment essentially acts as a second commitment period for the developed countries that ratified the Kyoto Protocol and includes new emissions reduction targets for them to achieve. However, many countries have yet to ratify the Doha Amendment.

The Paris Agreement

On 12 December 2015, the parties to the UNFCCC reached what has globally been touted as a landmark agreement to combat climate change and accelerate and intensify actions and investments needed for a low carbon future.

The Paris Agreement builds upon the work of the UNFCCC and for the first time brings together all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do the same.

The main objective of the Paris Agreement is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C and to pursue even greater efforts to limit it to 1.5°C. Furthermore, the Agreement aims to strengthen the ability of countries to deal with the impacts of climate change. In order to do so, appropriate financial resources will need to be mobilised and provided, and a new technology framework and enhanced capacity building framework will need to be established. The Paris Agreement also provides for an enhanced transparency framework for action and support. The most critical elements of the Agreement are outlined below:

- Limit global temperature increase to well below 2°C, while pursuing efforts to limit the increase to 1.5°C;
- Reach global peaking of GHG emissions as soon as possible
- Prepare, communicate and maintain a Nationally Determined Contribution (NDC) and to actively pursue domestic measures to achieve this.
- Conserve and enhance natural GHG sinks and reservoirs, such as forests
- Enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change.

The Paris Agreement also welcomes the efforts of all non-party stakeholders to address and respond to climate change, including those of civil society, the private sector, financial institutions, local governments and other sub-national authorities. These stakeholders are invited to scale up their efforts and showcase them via the Non-State Actor Zone for Climate Action platform.

Additional frameworks and agreements supporting global climate action

2015 and 2016 were years of great significance as the world's governments agreed to not only sign the Paris Agreement but to implement the Sendai Framework for Disaster Risk Reduction (Sendai Framework) and the United Nations' Sustainable Development Goals (SDGs). These frameworks communicate a set of goals and targets that if achieved, will result in a future in which significant progress will have been made towards tackling disasters and sustainable development as well as current climate and humanitarian challenges.



The main objective of the Paris Agreement is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C and to pursue even greater efforts to limit it to 1.5°C.





The Sendai Framework for Disaster Risk Reduction

The Sendai Framework for Disaster Risk Reduction (Sendai Framework) was developed to guide efforts on disaster risk reduction in the period between 2015 and 2030 and adopted in March 2015. The Sendai Framework builds on the Hyogo Framework for Action (HFA) and is a voluntary, non-binding agreement that acknowledges that while Member States have the primary responsibility to prevent and reduce disaster risks, this needs to be shared with other stakeholders including local government and the private sector.

Taking into consideration that the HFA was instrumental in raising awareness of the need to focus on disaster risk reduction, in generating political commitment and in catalysing action by a wide range of stakeholders and all levels, the goal of the Sendai Framework is *“to prevent and reduce disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and to disaster, increase preparedness for response and recovery and thus strengthen resilience.”*

The Sendai Framework has four priorities for action:

- **Priority 1:** Understanding disaster risk
- **Priority 2:** Strengthening disaster risk governance to manage disaster risk
- **Priority 3:** Investing in disaster risk reduction for resilience
- **Priority 4:** Enhancing disaster preparedness for effective responses and to “Build Back Better” in recovery, rehabilitation and reconstruction

Sustainable Development Goals

The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by all United Nations’ Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030.

The SDGs replace the Millennium Development Goals (MDGs), which started as a global effort in 2000 to tackle poverty. The MDGs established measurable, universally-agreed objectives for tackling extreme poverty and hunger, preventing deadly diseases and expanding primary education to all children, among other development priorities. For 15 years they drove progress in the following important areas: reducing income poverty, providing much needed



access to water and sanitation, driving down child mortality and drastically improving maternal health. They also kick-started a global movement for free primary education, inspiring countries to invest in their future generations. Most significantly, the MDGs made huge strides in combatting HIV/AIDS and other treatable diseases such as malaria and tuberculosis.

The MDGs undoubtedly had an impact in that since 1990, more than one billion people were lifted out of extreme poverty, child mortality dropped by more than half, the number of out of school children dropped by more than half and HIV/AIDS infections fell by almost 40 percent. However, for millions of people around the world the job was considered unfinished. The SDGs are a bold commitment to complete the task by tackling some of the more pressing challenges facing the world today and shifting it onto a more sustainable path.

Figure 5: The 17 SDGs



Seventeen SDGs were developed, with each recognising that action in one area affects outcomes in others, and that development must balance social, economic and environmental sustainability. For example, dealing with the threat of climate change impacts how we manage our fragile natural resources, achieving gender equality or better health helps eradicate poverty, and fostering peace and inclusive societies will reduce inequalities and help economies prosper.

As previously noted, the timing of the SDGs coincides with the Paris Agreement and the Sendai Framework. Together these agreements provide a set of common standards and achievable targets to reduce carbon emissions, manage the risks of climate change and natural disasters, and to 'Build Back Better' after a crisis.

Global reporting bodies

The Paris Agreement requires that all parties not only prepare an NDC and pursue domestic measures to achieve it through emissions reduction action, but that all parties engage in adaptation planning and action.



To do this, local governments must develop climate change mitigation and adaptation plans. Both of these should be preceded by two key deliverables which inform their content. A climate change mitigation plan should be preceded by the development of a GHG emissions inventory which acts as a baseline of where emissions are coming from in the local government area and where the emissions reduction focus should be, as well as setting an emissions reduction target in line with, or more ambitious than the NDC. A climate change adaptation plan should be preceded by the development of a risk and vulnerability assessment which highlights the sectors and population groups within the local government area that are most vulnerable to the impacts of climate change, as well as setting a target to reduce their vulnerability and enhance their resilience.

In accordance with the Paris Agreement, local governments are required to report on their progress in reducing their emissions and enhancing their adaptive capacity at the annual Conference of the Parties (COPs). Progress can also be tracked through several globally recognised reporting bodies:

Global Covenant of Mayors (GCoM)

The Global Covenant of Mayors (GCoM) was launched in 2016 following the merger of the Compact of Mayors Programme and the Covenant of Mayors Programme. The merger united the world's two primary initiatives of cities and local governments aiming to advance a local government-level transition to a low emission and climate resilient economy. The aim of GCoM is to support cities and local governments by mobilising and supporting climate and energy action; as well as enabling cities, local governments and the networks that support them to bridge the gap from climate ambition to action delivery. To date over 10 000 cities and local governments from over 135 countries, representing more than 800 million people, have committed to climate action by reporting through GCoM.

Covenant of Mayors for Sub-Saharan Africa (CoM SSA)

The Covenant of Mayors in Sub-Saharan Africa (CoM SSA) is the African regional chapter of GCoM. The CoM SSA specifically supports sub-Saharan African and local governments in their fight against climate change and in their efforts to ensure access to clean energy.

Under the CoM SSA local authorities are invited to make a voluntarily political commitment to implement climate and energy actions in their communities and agree on a long-term vision to tackle three pillars, namely access to energy, climate mitigation and climate adaptation. In order to translate their commitment into practical measures, CoM SSA signatories commit to develop, implement and monitor Sustainable Energy Access and Climate Action Plans (SEACAPs). Cities receive expert technical support from CoM SSA as they plan and execute climate change and energy initiatives. CoM SSA supports a network of 200+ cities and subnational governments from over 36 countries across sub-Saharan Africa.

One Planet City Challenge (OPCC)

The One Planet City Challenge (OPCC) is an initiative implemented by the World Wide Fund for Nature (WWF) in 2012. It aims to provide local governments with the opportunity to demonstrate and report on their science-based emission reduction commitments in line with the Paris Agreement and its goal of not exceeding 1,5°C in global warming, while publicly recognising and awarding the most ambitious cities in this regard. It thus offers cities an opportunity to be profiled as climate change leaders on a global stage.

Carbon Disclosure Platform (CDP)

Should local governments choose not report directly with GCoM, CoM SSA or the OPCC, they also have the option of registering themselves on the Carbon Disclosure Platform (CDP). This provides local governments with an option of reporting to one or all of the above platforms by responding to a series of tailored questions. However, reporting through the CDP does not absolve local governments from developing climate change action plans as these, along with the details included therein, are required to be disclosed.

Notably, the CDP also includes provisions for non-party stakeholders, including those from civil society, the private sector, financial institutions and other sub-national authorities, to report, address and respond to climate change.

CHAPTER 5

PRINCIPLES OF CLIMATE CHANGE ADAPTATION PLANNING



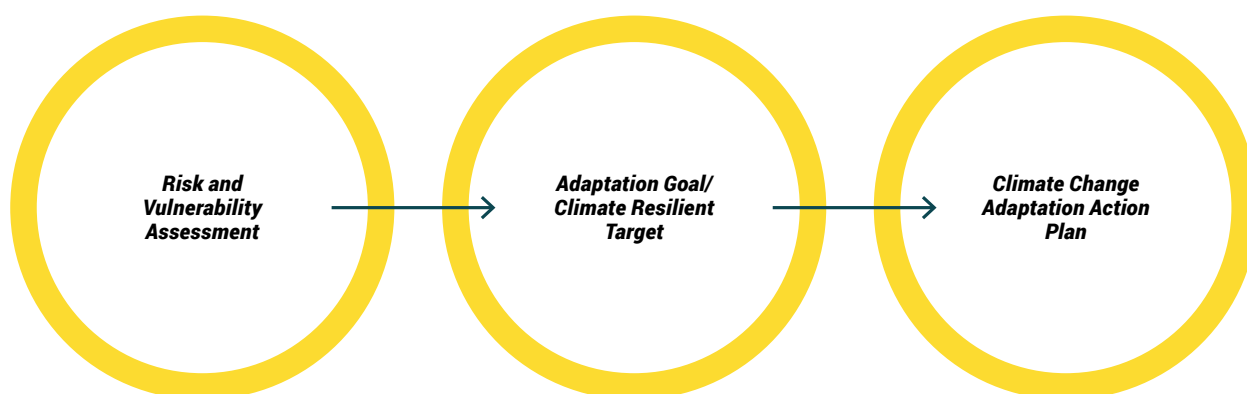
What you will learn in this chapter:

- Overview of the key steps in climate change adaptation action planning
- What key information should be included in Risk and Vulnerability Assessments (R&VAs)
- What key information should be included in a Climate Change Adaptation Action Plan (CCAP)

Key steps in climate change adaptation planning

As previously noted, one of the key aims of the Paris Agreement is to significantly strengthen national adaptation efforts. Achieving this requires that all parties engage in adaptation planning and action. The best way to guide adaptation planning and ensure targeted adaptation interventions which have the best potential for long terms success is to (1) develop a Risk and Vulnerability Assessment (R&VA); (2) set a climate change adaptation target/ climate resilience goal; and (3) develop a Climate Change Adaptation Action Plan (CCAP).

Figure 6: Key steps in climate action planning



As previously noted, the GCoM, CoM SSA, OPCC and CDP are all reporting bodies to which a local government can report its climate change adaptation aspirations and actions. To support them in this activity, each of these reporting entities have developed a set of key criteria which should be addressed; and in the development of the R&VAs and CCAPs which support local governments in achieving their NDC, and ultimately their Paris Agreement commitments. The CDP requirements for developing a R&VA and a CCAP are considered to be the strictest as they encompass all the requirements for GCoM, and by extension CoM SSA, the OPCC as well as a number of other smaller localised reporting mechanisms that are still gaining traction. As such the CDP requirements are considered to be the most comprehensive to follow. These are outlined in this chapter.



What should local governments include in a Risk and Vulnerability Assessment?

A R&VA is intended to act as a baseline to inform local governments on the development and implementation of their CCAPs. It provides an overview of their current climate and its hazards. The R&VA also provides an overview of how these are likely to change in the future as a result of the impacts of climate change. One of the most important benefits of the R&VA is that it highlights sectors within the local government area that are currently being impacted by climate hazards, to what degree, as well as how, and to what degree they could be impacted by climate change in the future. In addition to this the document also typically provides an indication of which population groups are most vulnerable to the impacts of climate change both currently and in the future. It is important to note that a R&VA does not provide any actions to address the impacts of climate change on vulnerable sectors and population groups. This detail is instead captured in the CCAP. Key aspects to include in a R&VA are highlighted below:

- 1 Local government context:** The R&VA should provide an overview of the local government context. This includes providing a general description of the local government organisation as well as information on its location, geography, official boundary and land area (usually accompanied by a map). Information on the state of the built environment (roads, infrastructure, housing etc.) should also be included. The context should also provide information on the current and projected population for the next five, 10 and 20 years as well as information about the Mayor or equivalent legal representative authority including their term length and start and end month and year. Lastly, it should also provide an overview of the area's key economic sectors and socio-economic status.



- 2 **Historical climate information:** The R&VA should follow this with an overview of the historical climate experienced in the geographical boundary outlines of the local government context section. This should include a comprehensive overview of the seasons as well as rainfall patterns. If available, detail on the average rainfall per month should be included along with the average temperature per month and the wettest, hottest and coldest days on record. This information will serve as a baseline for how much the climate is predicted to change.
- 3 **Projected climate data:** The R&VA should include an overview of the anticipated manifestations of climate change in the local government region. This should incorporate information on projected changes in temperature and rainfall patterns (as previously noted, some regions will experience less rainfall while some will experience more, and almost all regions globally will experience a shift in the timing of their rainfall), as well as the degree of sea level rise anticipated in the case of coastal local governments.
- 4 **Current climate hazards experienced by the local government.** The R&VA should highlight the most significant climate hazards faced in the local government's jurisdiction, and include an overview of the current risk level (both probability and consequence) associated with each hazard as well as its social consequences.
- 5 **Key sectors, services and population groups impacted by current climate hazards.** The R&VA should indicate all relevant sectors, assets or services most impacted by current climate hazards affecting the local government, as well as the magnitude of impact for each. This will highlight the sectors currently most at risk to climate impacts currently being experienced.
- 6 **Anticipated future climate hazards.** Once the current hazards and their impacts on sectors and vulnerable groups has been established, the R&VA should provide detail on how climate change will likely affect the intensity, frequency and timescale of each hazard (as a result of climate change). The expected change in frequency and intensity is typically measured on a scale of 'Increase', 'Decrease', 'No Change' and 'Not Known', whilst the timescale for the expected changes is typically measured as 'Immediately', 'Short-term' (by 2025), 'Medium-term' (2026-2050), 'Long-term' (after 2050) and 'Not Known'.



The creation of a CCAP offers local governments an opportunity to not only plan for climate change in a proactive way and thereby enhance the resilience of the local community, but the opportunity to capitalise on the benefits of responding to climate change.





- 7 **Anticipated sectors, assets or services and vulnerable groups likely to be impacted by future climate hazards.** The R&VA should indicate the sectors, assets or services that are expected to be impacted by future climate hazards, the vulnerable populations that are most affected, the magnitude of expected future impacts and provide a description of impacts experienced so far and how the hazard is expected to impact in the future.
- 8 **Factors that support or challenge adaptive capacity.** The final consideration that should be included in the R&VA are factors that support or challenge a local government’s adaptive capacity. The R&VA should assess whether the factor (this could include services, socio-economic factors, governmental factors, and physical and environmental factors) either challenges or supports the local government’s adaptive capacity as well as provide a description of how it does so.

What should local governments include in a CCAP?

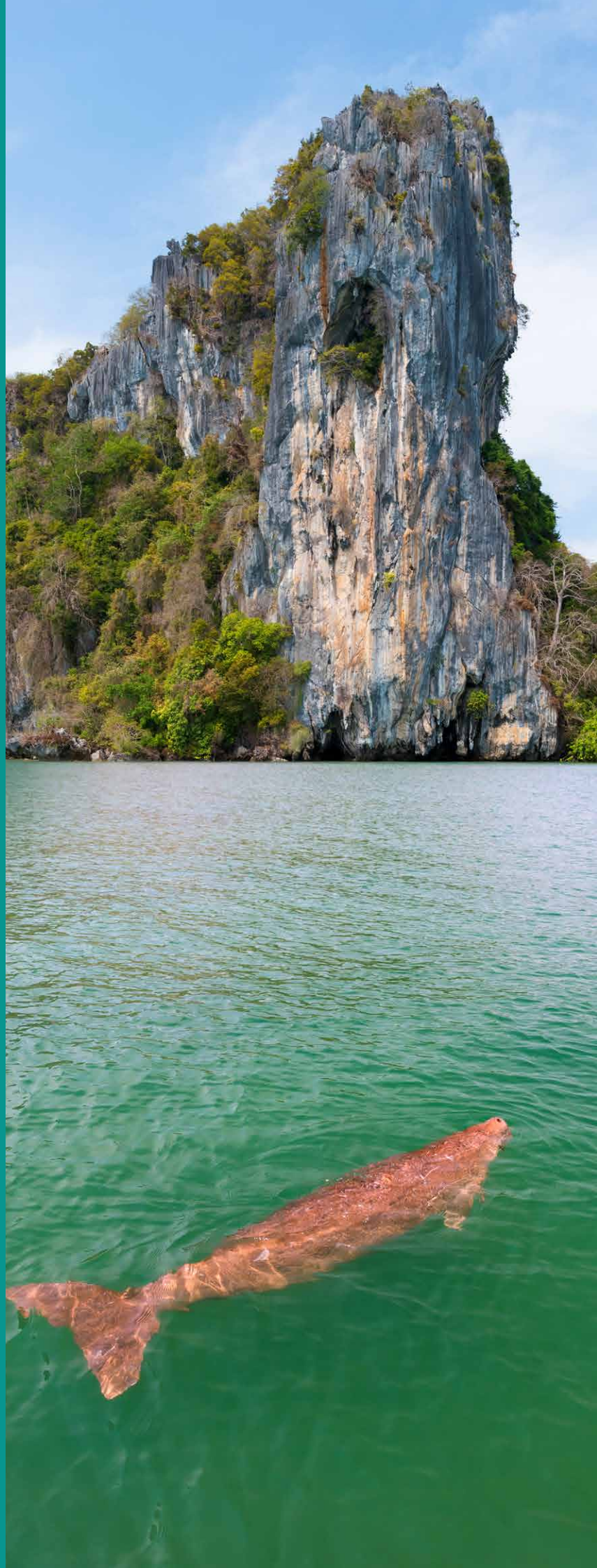
A CCAP includes sector specific actions that respond to the impacts of climate change whilst taking the local planning context and development aspirations into account. The creation of a CCAP offers local governments an opportunity to not only plan for climate change in a proactive way and thereby enhance the resilience of the local community, but the opportunity to capitalise on the benefits of responding to climate change, including growing along a more sustainable development trajectory. Key aspects to include in a CCAP are highlighted below:

- 1 **Key information extracted from the R&VA.** As previously noted, prior to developing a CCAP, local governments should develop a R&VA. Key information in such a document (i.e. local government context, historical and projected climate information, current climate hazards and the key sectors, services and population groups impacted by them, anticipated future hazards and how these are expected to affect said key sectors, services and population groups and lastly, factors that support or challenge adaptive capacity) should be included at the beginning of the CCAP to set the scene and act as a baseline for planning.





A CCAP includes sector specific actions that respond to the impacts of climate change whilst taking the local planning context and development aspirations into account.





- 2 Description of the stakeholder engagement process.** All CCAPs should include a description of the stakeholder engagement process undertaken to inform the development of the plan. This should include detail on exactly how the information in the CCAP (and R&VA) has been obtained so that the methodology can be assessed for robustness. Stakeholder engagements can take the form of workshops, working groups, surveys and one-on-one interviews.
- 3 Adaptation/climate resilient goal.** As previously noted, the second step in adaptation planning after the development of a R&VA is the development of an adaptation/climate resilient goal. This can be directly included in the CCAP and usually takes the form of a single overarching goal statement that aligns with the objectives of the NDC and speaks to the desired future state of the local government in terms of its resilience to the impacts of climate change. Its base year for implementation (i.e. the year that the goal is set) and the target year to reach it must also be stated.
- 4 Priority sectors and targets.** The development of the R&VA will have highlighted key sectors (such as water, agriculture, health etc.) considered to be the most affected by climate hazards, both currently and in the future. Similarly, the CCAP should also include detail on which sectors are considered the most critical (i.e. those that the local government wishes to prioritise) to support via climate change adaptation actions and provide a description of each. In addition, individual goals/targets for each sector should also be stated, as these are necessary to support the local government in meeting the overarching adaptation/climate resilient goal mentioned above. The goals/targets should be Specific, Measurable, Achievable, Realistic and Time-based (SMART) and be accompanied by information pertaining to their base year for implementation, the target year to reach them (which must align with the overarching adaptation goal), metrics/indicators for how they will be measured, an indication of the percentage of the goal/target reached so far and detail on how they align with local, sub-national and national targets.
- 5 Priority sector adaptation actions and synergies, trade-offs and co-benefits.** Once the sectors have been prioritised and targets have been set for each of them, the CCAP should include actions (for each prioritised sector) to achieve the respective targets. Each action should directly respond to a climate hazard known to affect the corresponding sector and be accompanied by a detailed description, an action title, the status of the action (i.e. pre-scoping, scoping, implementation, commenced etc.) and implementation progress, if any. Additionally, each action should also be accompanied by a detailed description of its co-benefits. This is to support local governments with 'making the case' for why the action should be prioritised in the (unlikely) event that climate change considerations are removed. Detail on synergies of the action with other work that the local government is undertaking, along with potential tradeoffs associated with the action should also be included.
- 6 Prioritised adaptation actions.** Given that there will likely be a significant number of adaptation actions included for each sector in order to enhance their resilience to the impacts of climate change, a CCAP should include an indication of which actions are considered to be an absolute priority. This can be based on the local government's development aspirations, the economic and social benefits that may arise from the actions, work that the local government has already committed to in its internal development planning, or simply the actions that have the most synergies and co-benefits.
- 7 Factors supporting the implementation of priority adaptation actions.** Once priority actions have been identified, the CCAP should provide an overview of how they are to be implemented. This includes providing information, where possible, of their *anticipated timeframe* (estimate only), their *means of implementation* (i.e. a breakdown of key activities required), the *stakeholders that should be involved in and kept informed* of the action implementation, *potential implementing agencies*, the *anticipated cost* (estimate only), the *financial strategy required to access funds* and *policies* that can support the action implementation/access to funding.
- 8 Monitoring and implementation plan to ensure the CCAP's success.** The final component of the CCAP should constitute a detailed overview of how monitoring of the implementation of the action plan will be undertaken. This usually takes the form of monitoring reports which typically include detail on the actual implementation status and cost for each of the actions. The CCAP should also provide detail on the frequency with which monitoring reports will be submitted to the CDP. This is usually every two years to allow time for implementation.

CONCLUSION



Africa is set to experience more significant climate change impacts than anywhere else in the world. These will add to and enhance the challenges that currently hamper its sustainable urban development. To ensure that the continent's local governments are prepared to withstand these impacts, each of them must proactively plan and implement timely adaptation actions.

It is intended that this guide serve as a practical tool to support coastal local governments in planning for climate change. It provides with comprehensive information as to what climate change is and how it is likely to affect local governments. Armed with this information, local government officials can begin to make the case for why responding to climate change is both necessary and urgent. The guide also provides a comprehensive overview of the value of coastal natural assets (such as coastal wetlands, estuaries, dunes, mangroves and coral reefs) in supporting local governments to enhance their resilience and adaptive capacity and thus better protect themselves from the impacts of climate change.

The guide also provides a comprehensive overview of the international climate agenda including detailed information on critical global agreements such as the Paris Agreement, the Sendai Framework and the SDGs. This in turn frames the need for the development of CCAPs. The guide provides a practical overview of what local governments should be included in these crucial plans in order to be compliant with global reporting bodies such as the CDP, GCoM, CoM SSA and OPCC.

The guide has attempted to communicate key climate related information in such a way that is both practical and useful for local government officials, given their needs and capacity constraints. Local governments should consider both it and the development of a CCAP as a roadmap to support their process in strengthening adaptation measures and ensuring that they evolve in a more climate resilient manner.



Africa is set to experience more significant climate change impacts than anywhere else in the world. These will add to and enhance the challenges that currently hamper its sustainable urban development. To ensure that the continent's local governments are prepared to withstand these impacts, each of them must proactively plan and implement timely adaptation actions.



GLOSSARY



Adaptation refers to initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects (IPCC 2007a).

Adaptive capacity refers to the whole of capabilities, resources, and institutions of a country or region to implement effective adaptation measures (IPCC 2007a).

Carbon sequestration refers to a natural or artificial process by which carbon dioxide is removed from the atmosphere and held in either solid or liquid form.

Coastal natural assets are the natural assets that are specifically located on the coast and include sandy beaches, coral reefs, mangroves, sea-grass beds, dune forests, estuaries, hypersaline environments and riverine vegetation. See Natural Asset below.

Coral reefs are large underwater structures composed of the skeletons of colonial marine invertebrates called coral. There are hundreds of different species of coral.

Climate is defined as the prevailing weather conditions or trends for a specific geographical region over a long period of time (usually about 20 to 30 years).

Climate change is a change of climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (UNFCCC 1992).

Climate change impact refers to the effects of existing or forecasted changes in climate on natural and human systems (IPCC 2007a).

Climate change mitigation means implementing policies to reduce greenhouse gas emissions and enhance sinks (IPCC 2007a).

Climate variability refers to variations in the average climate beyond that of individual weather events (IPCC 2007a).

Disaster risk reduction is the broad development and application of policies, strategies, and practices to minimize vulnerabilities and disaster risk through

society, through prevention, mitigation, and preparedness (Twiggg 2004).

Dugong refers to a medium sized marine mammals found on the coasts of the Indian Ocean.

Dune forests consist of scrub-like vegetation and trees found above the high-tide mark.

Ecosystem refers to a community of living organisms interacting within a physical environment.

Ecosystem services are the benefits that people, society and the economy receive from natural assets and include things such as water purification, local climate and air pollution regulation, food production and the provision of recreation space to name a few.

Estuaries are partially enclosed bodies of water where salt water from the ocean mixes with fresh water from rivers or streams.

'Green' jobs refer to jobs that contribute to preserve or restore the environment, be they in traditional sectors such as manufacturing and construction, or in new, emerging sectors such as renewable energy and energy efficiency

Hypersaline environments are extreme habitats dominated by high salt concentrations.

Manatees refers to a medium sized marine mammals found on the coasts of the tropical Atlantic Coast.

Mangrove is a shrub or small tree that grows in coastal, saline or brackish water. Mangroves are unique in that they are able to survive and thrive in hot muddy, salty conditions that the majority of other plants would not survive in (Spalding, 2010).

Megafauna refer to large mammals of a particular region or habitat, or geological period.

Monoculture refers to the cultivation of a single crop in a given area.

Natural assets are environmental systems, such as wetlands, rivers and forests that produce a flow of beneficial (free) ecosystem services.

Natural hazards comprise such phenomena as the following: earthquakes; volcanic activity; landslides; tsunamis; tropical cyclones and other severe storms; tornadoes and high winds; river floods and coastal flooding; wildfires and associated haze; drought; sand/dust storms; and infestations (UNISDR 2001).

Nature-based solutions provide local governments with an opportunity to combine climate change adaptation action with biodiversity conservation and sustainable resource management all in one go.

Polyculture refers to the cultivation of more than one crop in a given area.

Resilience is the ability of a system to absorb disturbances while retaining the same basic structure and ways of functioning; it is the capacity to self-organize and adapt to stress and change (IPCC 2007a).

Risk is the combination of the probability of an event and its consequences (IPCC 2007c).

Salt marsh or saltmarsh, also known as a coastal wetland, is a coastal ecosystem in the upper coastal intertidal zone between land and open saltwater or brackish water that is regularly flooded by the tides.

Sandy beaches are loose deposits of sand and include gravel and shell deposits (Pettijohn et al., 2012)

Seagrass is often confused with seaweed, but is more closely related to flowering plants as they have roots, stems and leaves, and produce flowers and seeds (Den Hartog and Kuo, 2007).

Sink refers to a natural reservoir that stores carbon-containing chemical compounds accumulated over an indefinite period of time.

Storm surge refers to a coastal flood or tsunami-like phenomenon of rising water commonly associated with low pressure weather systems. Its severity is affected by the shallowness and orientation of the water body relative to storm path, as well as the timing of tides.

Stream flow refers to flow of water in streams, rivers, and other channels, and is a major element of the water cycle. It is one component of the runoff of water

from the land to waterbodies, the other component being surface runoff.

Urban heat island: hard surfaces such as tar and concrete in urban areas absorb and retain heat throughout the day and slowly release it throughout the night. Coupled with lower amounts of vegetation (than rural areas), this makes cities and peri-urban areas much warmer.

Weather The state of the atmosphere at a particular place and time.

Vulnerability is a function of the character, magnitude, and the rate of climate change and variation to which a system is exposed, as well as the system's sensitivity and adaptive capacity (IPCC 2007a).

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ANNEXURE 1: USEFUL RESOURCES



Knowledge portals

1. World Bank Climate Change Knowledge Portal
2. USAID Climate Links Knowledge Portal
3. USAID International Data and Economic Analysis
4. Germanwatch: Global Climate Change Performance Index and Global Climate Risk Index
5. LSE Grantham Research Institute on Climate Change and the Environment
6. ACP-4CDM Project
7. UNFCCC National Communications
8. SDG Knowledge Hub

Reports

1. UNDP Climate Change Adaptation Training and Tools
2. C40 Action Planning Resource Center
3. ICLEI Local Governments for Sustainability Africa Resources
4. Global Covenant of Mayors Resources for Cities
5. Climate Links Resource Library
6. USAID Climate Risk Screening and Management Tools
7. weADAPT Platform on Climate Change Adaptation Issues
8. Flood and Drought Management Tools
9. Africa Adaptation Initiative
10. Biodiversity Management Tools
11. Nature Based Solutions Initiative, University of Oxford
12. Forests, Trees, and Agroforestry for Climate Change Adaptation and Mitigation
13. Climate Change and Forests in the Congo Basin: Synergies between Adaptation and Mitigation (CIFOR)
14. Afrik21: Green Economy and Sustainable Growth in Africa
15. WorldAgroForestry (ICRAF)
16. FRACTAL: Future Resilience for African Cities and Lands
17. CGSpace: A Repository of Agricultural Research Outputs
18. Climate and Development Knowledge Network
19. SAMSET: Supporting African Municipalities in Sustainable Energy Transitions
20. Future Climate For Africa
21. Eldis Development Research
22. Identifying adaptation options
23. Cool Cities

24. Climate change adaptation in Delta Cities
25. Planning for Climatic Extremes and Variability: A Review of Swedish Municipalities' Adaptation Responses
26. Position Paper on Adaptation to Climate Change: Recommended Measures to be Taken By and For Cities
27. Urban adaptation to climate change in Europe 2016 - Transforming cities in a changing climate
28. Urban adaptation effects on urban climate
29. IPCC Fifth Assessment Report WG II Climate Change 2014: Impacts, Adaptation and Vulnerability

Guidance and tools

1. Climate App: adaptation solutions
2. Urban green-blue grid: Adaptation measures catalogue
3. RISC-KIT Toolkit
4. SMR Resilience Building Policies tool
5. Rotterdam exchange: Water Management and Multi-Benefit solutions
6. Adapting to Urban Heat: A Tool Kit for Local Governments
7. An impact evaluation framework to support planning and evaluation of nature-based solutions projects
8. Climate Innovation Window
9. ECONADAPT- Toolbox
10. European Natural Water Retention Measures (NWRM) platform
11. UNFCCC Adaptation knowledge Portal
12. weADAPT
13. Heatwave Guide for Cities
14. The Resilient Urban Adaptation E-Guide
15. IVAVIA: A risk-based impact and vulnerability analysis methodology

Climate finance

1. Adaptation Fund
2. Africa Climate Change Fund (ACCF): For Regional Member Countries (RMCs) of the African Development Bank
3. African Development Bank: Initiatives and Partnerships
4. Africa Carbon Forum
5. Climate Finance Ready
6. UNFCCC Climate Finance Data Portal



ADAPTING TO CLIMATE CHANGE AND ENHANCING RESILIENCE

*A guide to building adaptive capacity and resilience to
the impacts of climate change in coastal urban areas*

·I·C·L·E·I
Local
Governments
for Sustainability