

# Building Climate Resilience

A Handbook for **Temeke Municipal Council**,  
Dar es Salaam, Tanzania



A Handbook for adaptation to climate change and increasing resilience for  
Dar es Salaam, Tanzania

This Resilience Handbook is a key deliverable of the ICLEI-Africa Project  
Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation  
through Participatory Research & Local Action

**ICLEI - Local Governments for Sustainability's** mission is to build and serve a worldwide movement of local governments to achieve tangible improvements in global sustainability through cumulative local actions.

The **Climate Change Adaptation in Africa (CCAA)** program seeks to improve the ability of African countries to adapt to climate change in ways that benefit the most vulnerable.

Funded by the UK's Department for International Development, the program supports African researchers' efforts to help communities adapt to the effects of climate change.

Originally planned as a five-year initiative, the CCAA program was extended to March 31, 2012. The program has funded 46 research and capacity-building projects in 33 African countries. A wealth of new knowledge on adaptation is emerging and being shared with those who will most directly benefit. Some of the results CCAA grantees are achieving can be found [here](#) (access to technical reports, research papers, policy briefs, and much more).

## Authorship

This Handbook has been conceptualised, written and edited by the following people and should be referenced as such: ICLEI-Africa 2012. Josefsson J, Stephen V and Fairhurst, L. Building Climate Resilience. A Handbook for Temeke Municipal Council, Dar es Salaam, Tanzania.

ISBN: 978-0-9921794-2-7

A copy of this report can be downloaded at [www.ResilientAfrica.org](http://www.ResilientAfrica.org).

**Lucinda Fairhurst** is the principal coordinating author of this publication, and the Project Manager of the Five-City Network Programme to pioneer Climate Adaptation through Participatory Research and Local Action. Lucinda has been responsible for leading the conceptualisation of the project, its deliverables and outputs.

**Jenny Josefsson** is a freelance consultant working mainly with environmental and biodiversity communication. Jenny is currently pursuing her PhD investigating the social impacts of private wildlife production jointly through the University of the Free State (RSA) and VU University, (NL).

**Vanessa Stephen** is a freelance consultant specialising in ecology, media and education. Her experience covers a range of different environments, having completed research in savannah, fynbos, wetlands, the Benguela upwelling system and deserts, creating conservation plans, testing ecological impacts and resilience whilst also creating environmental awareness through writing and film.

### Contributing research:

**Priscilla Rowswell**, Professional Officer in Climate Change Adaptation at ICLEI-Africa, assisted with research development, participatory action research planning and implementation, coordination of stakeholder workshops, coordination of the Network communications and assisted with the development and implementation of the participatory action research tools.

**Faith Chihumbiri**, Junior Professional Officer at ICLEI-Africa, was instrumental in bringing disaster risk reduction aspects into the Five-City Network project. She played a pivotal role in undertaking background research, coordinating and facilitating certain sessions during the workshops.

## Foreword

Climate change is anticipated to have severe physical, social, environmental and economic impacts in cities worldwide. These are expected to be felt with greater intensity in the developing world, particularly Africa. There is strong evidence that a changing climate will affect people's access to, and the quality of, basic goods and services such as water, food and shelter, and that this will result in significant impacts on people's livelihoods. Local governments are faced with dealing with the challenges that these impacts bring in the face of normal day-to-day developmental challenges. In the context of this Climate Change Resilience Handbook, the key goal of these African local governments is to reduce vulnerability and increase resilience to climatic change through pro-active planning and forward thinking, whilst considering the projected changes. In this instance, understanding the anticipated impacts, the bases of local livelihood asset security, is key for successfully meeting these challenges.

Adapting to a changing climate is therefore crucial in order to manage the risks and threats to people's livelihoods and local government infrastructure and service delivery. As a strategy to tackle this, adaptation is becoming increasingly recognised as vital for resilience to climate change induced impacts that are already being experienced across the world. There is a general consensus that scientific evidence is projecting that these impacts will increase in frequency and severity, and that urban local governments will experience these in ways that will exacerbate the developmental issues that they already face. Adaptation resilience strategies will therefore play a pivotal role in how local governments and communities are able to ensure continued and improved resilience to climate change impacts.

African cities in particular are faced with the two-fold challenge of managing climate change risk and simultaneously extending their services, providing housing and infrastructure, and ensuring that this development doesn't compromise the health and the environment of future generations. However,

**“For cities that get this right, there is the potential to not only safeguard their assets and inhabitants, but to advance local development, competitiveness and to draw down some of the finance and donor support that is emerging for cities that are seen to be pro-active against climate change.”** (Cartwright, 2012.)

Therefore, being at the forefront of managing climate change risk through the use and implementation of adaptation strategies will not only have short-term benefits, but is likely to furnish the cities' future with a competitive advantage over others if high levels of sustainability and socio-economic resilience is achieved and demonstrated.

This Handbook places its emphasis on three key concepts: **Interconnectivity, Continuity and Local Relevance**. The first one, interconnectivity, refers to how the different climatic impacts and the associated adaptation options are connected. Through addressing one particular impact or implementing one adaptation option, there are generally knock-on effects affecting a multitude of people, sectors and economies (the ripple effect). Essentially, no activity or event occurs in isolation, social, economic and ecological systems are connected, and it is imperative that we make the best use of the opportunities that come from this interconnectivity. **Just as climatic events and patterns are likely to keep changing, so must our responses!**

Adaptation is an ongoing process, which must be continuously monitored and evaluated for its appropriateness and effectiveness. Building resilience is not a 'once-off' effort, it is a way of moving forward that considers the dynamic environments and systems in which we operate. In order to ensure relevance and the use of this Handbook for Temeke Municipal Council, it is important to consider the local context. By including local and recent examples of impacts of climatic events within the context of a changing climate, the links to everyday situations at the local level are made stronger. Although the concept of adaptation and resilience is rather universal and relatively new, it is the actual implementation that determines its success.

## Recommendations

Temeke Municipal Council faces many challenges in its quest to become resilient to climate change. Dealing with a large, growing population, many of whom struggle with poverty, the task at hand will not be easy, yet it is essential.

Many plans are in place across Dar es Salaam to improve infrastructure and alleviate poverty, however many within local and national government and much of the population are not aware of, or do not fully understand the challenges that a changing climate brings.

It is recommended that all local government departments focus on inter-departmental communications and work together to address the issues that can be avoided or rectified. Temeke Municipal Council has done well to identify and work to alleviate certain stresses, however better communication will go a long way to ensuring seamless functionality of the systems installed and overall lead to far greater resilience to climate change. It will be worthwhile for Temeke to share its experience and knowledge with Kinondoni and Ilala Municipalities and work towards climate resilience together. As will be explained in more detail in this Handbook, interconnectivity is key. One impact may affect several departments therefore it is necessary that all sectors work together to achieve the desired outcomes. As finances are always under pressure, shared knowledge can help to prevent misallocation of these scarce resources and the correct implementation of adaptation options can alleviate stresses across the city of Dar es Salaam.

# Table of contents

1. Setting the scene - the project and its process	6
1.1 A brief look at climate change	6
1.2 About the Climate Resilience Handbook	7
1.3 Who should use the Handbook?	8
1.4 Suggested sources of information	10
2. Adaptation: The road to increasing climate resilience	10
3. Projected changes in climate for Africa	13
3.1 Climate change projections for Tanzania and Temeke Municipal Council, Dar es Salaam	14
3.3 Governance tools and institutions relevant for adaptation to climate change	16
4. Risks for Temeke Municipal Council	16
4.1 Reasoning with climate related risks	18
4.2 Climate-related risks to service sectors	19
5. Locally identified adaptation options	20
6. SMART Goals	21
7. Monitoring and evaluation	22
8. Capacity-building	23
8.1 What has been achieved so far?	24
9. A framework for action	25
10. Conclusion	26
11. Further reading	27
12. Glossary and acronyms	28
Annex 1 – Identified risk per sector	29
Annex 2 – Local adaptation options	33



# 1. Setting the scene - the project and its process

This Climate Resilience Handbook is a key deliverable developed during an ICLEI-Africa project entitled, *Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation through Participatory Research & Local Action*. The project has addressed the knowledge, resource, capacity and networking gaps through strengthening and facilitating the ability to plan for, and adapt to, impacts associated with climate change. This tailor-made Climate Resilience Handbook outlines locally specific actions that have been decided upon through a number of consultative, interactive processes. These took place with key local stakeholders, for implementation to increase adaptive capacity at the local government level, through their stakeholder platforms. The aim has been to identify and prioritise appropriate and tangible local actions for enhancing the cities' resilience and adaptive capacity whilst increasing local level understanding of climate change, climate change risk and adaptation in order to enhance climate change considerations in decision making processes.

The project, managed by ICLEI-Africa, South Africa, has been undertaken in partnership with five Sub-Saharan African local governments (Walvis Bay Municipality, Namibia; The City of Cape Town, South Africa; Maputo Municipal Council, Mozambique; Temke Municipal Council, Dar es Salaam, Tanzania and Port Louis Municipal Council, Mauritius). ICLEI-Africa is mandated to work with local governments across all Sub-Saharan countries towards environmentally sustainable development. It is within these parameters that ICLEI-Africa has focused its attention on adaptation in these local governments. This project falls within a broader research context of the Climate Change Adaptation in Africa Programme, a jointly funded initiative by the International Development Research Council (IDRC) and the Department for International Development (DFID).

The five local governments were selected as they are each rapidly growing, urban centres located on the African coastline, comprising a broad range of urban socio-economic demographics. Each is considered to be a fast developing, coastal economic hub with harbour and is fundamental when considering national Gross Domestic Product (GDP). Each urban centre contributes significantly towards the understanding of climate change induced impacts on, and within coastal urban environments in developing countries, and demonstrates how local governments and communities can include climate change consideration in decision making processes towards the risks associated with a changing climate.

## 1.1 A brief look at climate change

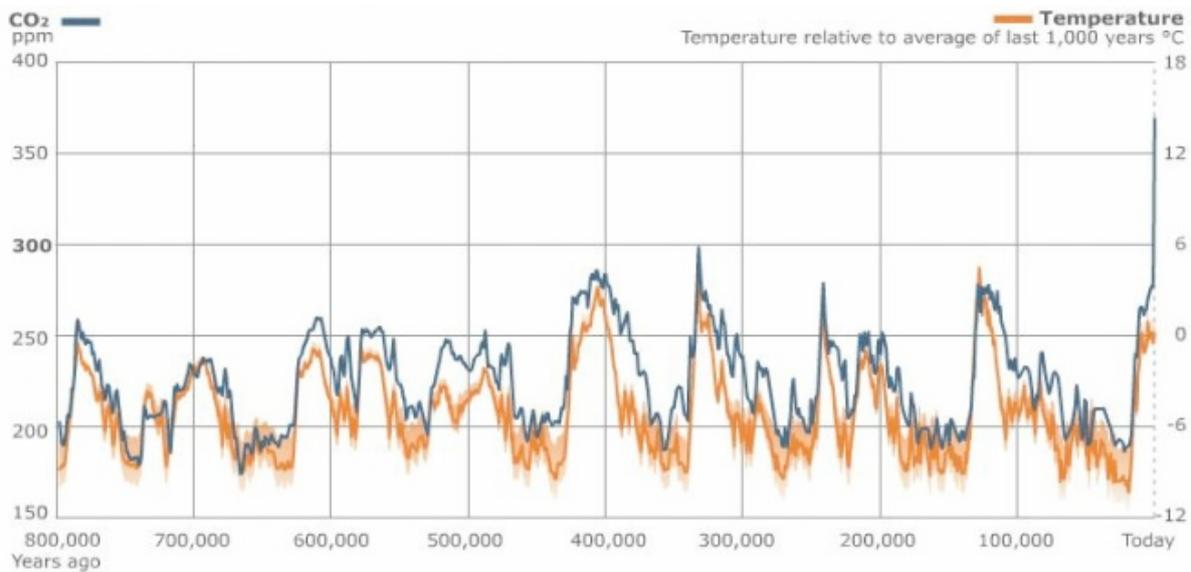
**“A changing climate leads to changes in the frequency, intensity, spatial extent, duration, and timing of extreme weather and climate events, and can result in unprecedented extreme weather and climate events” (SREX, 2012).**

Research into climate change has grown enormously over the past decade and while it remains an inexact science, the models and projections are becoming clearer. A changing climate is a natural occurrence, however, the rate at which changes are projected to occur are happening faster than has ever, to our knowledge, happened in the past and will lead to enormous challenges to the human populace and the natural world. Human development since the 1800s has relied heavily on fossil fuels that has resulted in many millions of tons of carbon dioxide (CO<sub>2</sub>) being released into the atmosphere. As can be seen in the British Antarctic Survey's data of atmospheric CO<sub>2</sub> levels over the past 800 000 years, it is clear that a rise in CO<sub>2</sub> directly correlates with a rise in temperature. Due to human activity, the level of atmospheric CO<sub>2</sub> is now much higher than it has been at any time in the past and will continue to rise in the future as human development and industrial activity continues.

Temperature changes correlating to CO<sub>2</sub> increases happen over a slightly longer time period, what is known as a 'lag effect', however research has shown that we are now committed to a global rise in temperature of 2.2°C.

The IPCC 4<sup>th</sup> Assessment report (2007), has stated that this rise in temperature affects all weather systems leading to changes in precipitation patterns, wind speed and direction, ocean currents and sea level, each varying depending on the location on the earth. However, the latest report for the IPCC, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* (SREX) states that climate change will manifest itself through extreme climatic

events. Whether they be storms, hurricanes, flash flooding or drought, these will become more intense in their severity, last longer and occur more frequently, throughout the globe. The challenges to countries and their governments, national and local will likewise become more intense. Adaptation to this changing climate will not be easy and will need constant reassessment, investment and new thinking, however the costs of doing nothing will be far more severe in the long term.



Data: British Antarctic Survey; Graph BBC

While CO<sub>2</sub> emissions continue unabated, these projections will become ever more extreme so it is worth bearing in mind that a global rise in temperature of 2.2°C is not necessarily the worst case scenario, but may in fact end up to be several degrees higher.

It is worth noting that each of the cities participating in this Five-City Network Project have already noticed changes in the local climate.

## 1.2 About the Climate Resilience Handbook

This Climate Resilience Handbook draws upon an interactive participatory, consultative process that has worked through the identification of climate related risks, impacts and adaptation options prioritised by Temeke Municipal Council, as part of the ICLEI-Africa Project *'Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation through Participatory Research & Local Action Project'*. It outlines a framework for action for enhancing adaptive capacity and building resilience within Temeke's municipal jurisdiction, in order for the local key stakeholders to identify realistic timeframes, responsibilities and economic considerations associated with each step, and thus make the informed and well considered locally appropriate decisions regarding the social, economic and ecological sustainability of the local government.

This Handbook briefly describes the context of the overarching Five-City Network Project and its findings, whilst focusing specifically on Temeke Municipal Council, providing an account of the projected changes in climate that are anticipated to compromise the Municipal Council's basic services, functions and the livelihoods of the various communities and public sectors that fall within Temeke's Municipal jurisdiction. The main aim of the development of this Handbook is to assist the local authority and its key stakeholders in increasing adaptive capacity through the implementation of sustainable and smart solutions. **The Climate Resilience Handbook's success is dependent upon the commitment and follow-through of all key stakeholders.**

**“At the local level there is traditional knowledge about disaster risk and grassroots actions to manage it. Functional or physical units such as watersheds, ecological zones, or economic regions operate at the local level, including the private and public institutions that govern their use and management.” (SREX, 2012)**

### 1.3 Who should use the Handbook?

This Handbook has been designed and developed over a three year period with a variety of key local stakeholders, undertaking a number of participatory processes aiming to provide guidance and steps for the implementation of actions towards enhancing resilience to climate change for Temeke Municipal Council. It is targeted at local government officials, sustainability practitioners in the private and public sectors, and in particular those in the field of spatial planning and the built environment, whilst incorporating civil society organisations and decision makers.

#### What is so special about this Climate Resilience Handbook?

This Handbook represents a culmination of processes that Temeke Municipal Council and key stakeholders have undertaken in collaboration with ICLEI-Africa and the other local governments that partnered in the project, to create a platform for discussion and engagement around multi-level, inclusive and integrated adaptation solutions for increasing resilience to a changing climate. The contents of this Handbook are based upon rigorous research, relevant data from a wide range of sectors, and stakeholders in Temeke Municipal Council in order to ensure wide and inclusive applicability to enhance implementation.

The knowledge-base of this project, and Handbook, has been built upon:

- Science – downscaled climate models, desktop research
- Documentation – workshops, photographic evidence
- Anecdotal information – peoples' real-life experiences and understanding
- Observations – by the ICLEI-Africa adaptation team, consultants and the stakeholders
- Participatory Action Tools – developed by ICLEI-Africa for use with the key local stakeholders to ensure inclusion of the local specific needs and collaboration with the ICLEI-Africa team and the other local governments in the project

As such, the Handbook comprises a unique and wide representation of climate change impacts, its consequences and adaptation options for Temeke Municipal Council.

#### Want to read for yourself?

All documents generated through the ICLEI-Africa Project *Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation through Participatory Research & Local Action*, are available for download at [www.ResilientAfrica.org](http://www.ResilientAfrica.org).

Here you will find the following documents for each participating city:

- The Sector Risk Baseline Studies
- Local level (for each participating local government) Climate Systems Reports
- The Climate Resilience Handbooks
- Stakeholder Workshop reports
- Local Interactive Climate Change Risk and Adaptation Prioritisation Training Tool (RAP)
- Local interactive Climate Change and Climate Impact Training Tool (ICCCI)

You can also download:

- A Climate Risk Concept paper developed for this project
- A Regional Climate System Analysis report developed through the use of historical climate data and climate models providing projections on Climate Change over Southern Africa: Namibia, South Africa, Mozambique, Tanzania and Mauritius respectively.

## Defining **resilience** within an urban context

Resilience is a system's (social, economic or ecological) capacity to adapt to external changes without losing its basic functions or ability to keep performing the same services within the changed environment.

Local environments are constantly fluctuating, but over time they become relatively stable with ecosystems and environmental services working in an equilibrium until there is some form of external disturbance exerting pressure on that environment. Disturbances are a natural part of all environments, and more broadly nature, taking place in the form of fire, drought, flooding and storms to name some examples. These and other disturbances in the environment drive plants, animals and people to adapt to those changes in order to ensure survival. That adaptation, and the ability to



survive after such an event is the first of two factors of ecological resilience. The second is when a tipping point is reached and an ecosystem begins to fail due to increased, prolonged external pressures (such as pollution, development disturbances, loss of keystone species and changes in rainfall or temperature patterns) due to the fact that species within that environment are unable to adapt at a rate that equals the levels of disturbance and begin to decline.

For example, dams and reservoirs are essential to providing water to industries, communities and individuals. Algae will grow naturally in these dams and in the right quantities actually help to filter out impurities, thus improving the water quality. However, if the dam becomes polluted by, for example, fertiliser run-off, the added nutrients in the water will fuel algal growth (also known as an algal bloom). This can reach a point where there is too much growth and the plant matter starts to shade the areas underneath it. The shaded algae then die, creating more nutrients and fuelling the growth of bacteria that breaks it down. These bacteria use oxygen in their respiratory process and remove too much oxygen from the water and create an anoxic environment which then kills more algae. This cycle continues until a tipping point is reached where the ecological resilience of that ecosystem is compromised. The system can no longer cope with the changes and the water quality deteriorates so much that it cannot be used for public needs, such as consumption, without being treated, adding to expense. The stress of added costs puts pressure on the economic and other related system's resilience, as poor water quality poses health risks that can undermine the social system.

Resilience to a cause of impact can be difficult to measure, and while ecosystems in general are relatively tough, if a tipping point is reached causing a system to go into decline and lose its functionality, it can be very difficult to rectify and may take many years with huge financial costs. In the face of climate change this is an increasing worry. Climate change models and projections agree that average global temperatures will increase in the future and rainfall patterns will change, resulting in some regions getting more rain, and others less. As temperature and water are driving forces in ecosystem functionality, we need to consider the worst-case scenarios in order to attempt to remove as many environmental stresses as possible in efforts to make our ecosystems resilient to these projected changes.

Ensuring ecological resilience is necessary not only in terms of conservation but for human safety and security as we make use of numerous ecosystem services and that which they provide, such as clean drinking water, building materials (wood, thatch) and food. Without effective adaptation and increasing ecological resilience, we are likely to lose these services to our cost.

## 1.4 Suggested sources of information

Although this Climate Resilience Handbook is a stand-alone document, users are recommended to read other documents and reports that have been developed through the undertaking of research, peer review and consultative participatory processes.

Temeke key stakeholders and decision makers can also benefit from reading the reports developed through project processes undertaken with other participating cities, whilst also taking their success stories, challenges and lessons learned into account continuously so as to avoid undertaking adaptation options that may not result in increasing climate change resilience. ICLEI-Africa further recommends that the leaders of the project (both political and technical), and participating local governments, (Walvis Bay Municipality, Namibia; The City of Cape Town, South Africa; Maputo Municipal Council, Mozambique; Temeke Municipal Council, Dar es Salaam, Tanzania and Port Louis Municipal Council, Mauritius) continue to communicate with each other, building on the network that has already been created throughout the implementation of project adaptation processes, and that they each also communicate with other cities and local governments in the ICLEI Global Network.

## 2. Adaptation: The road to increasing climate resilience



Storm water drains can be compromised when litter and debris is allowed to accumulate, blocking the drains and causing water to dam up and stagnate.

One aspect of adaptation is the process of preparing communities for the impacts associated with climate change. It is acknowledged that climate projections are to some extent, an uncertain science. As with all development issues, the key to effective adaptation is to ensure that communities have an understanding and the capacity to deal with unforeseen changes and impacts.

Effective adaptation also needs to be strategic, and measures chosen need to be well-founded and based upon on existing local conditions and contexts. The processes undertaken in the development of this document are the first important

steps towards strategic adaptation planning and effective implementation.

Adaptation measures at the local government level can be focused around five main areas to ensure successful implementation:

1. Enhancing the adaptive capacity of local decision-makers, planners and other stakeholders.
2. Mainstreaming adaptation into existing policies, plans and day-to-day operations of local government.
3. Understanding the socio-economic impacts of climate change, with particular concern for vulnerable communities.
4. Promote and improve cooperation between stakeholders on multiple levels and ensuring that all aspects have been considered.
5. Understanding the full concept of climate related risk so as to assist in the prioritisation of climate action.

Each participating local government has completed the outputs outlined in Figure 2.1, whilst developing, in a participatory manner this Handbook. All steps are well-documented in supporting literature and are referred to within this Handbook. The next step required to enhance adaptation to climate change within Temeke Municipal Council is to anchor the Handbook within the relevant government structures, (local, regional governments), to assist with securing its implementation and inclusion in the processes, and to start implementing the identified adaptation options.

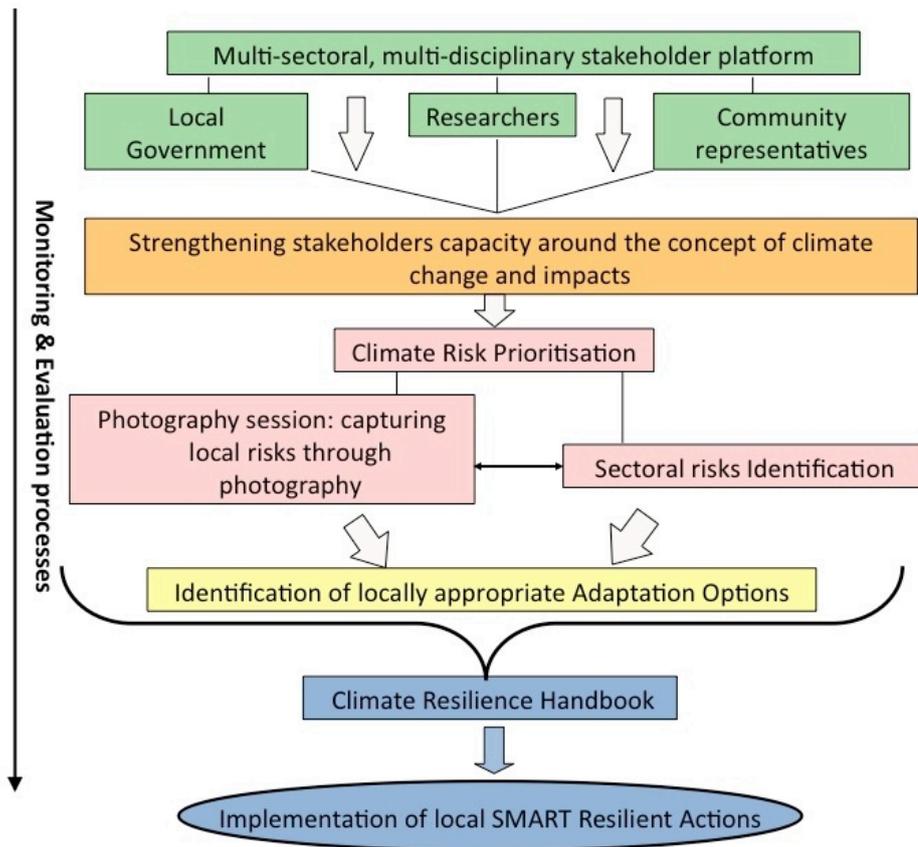


Figure 2.1 Illustrated step by step process undertaken within the timeframe of this project to enhance and improve climate adaptation and thereby increase climate resilience.

## Interconnectivity, continuity and local relevance

Everything in this world is connected. Building resilience means considering how social, economic and ecological systems – the three pillars of sustainable development – are interconnected. The human world is dependent upon the natural world, and human activities inevitably impact upon the world's ecosystems. Major changes in one of the systems will therefore have some sort of effect on the other. This is also true at the local level. Prolonged dry-spells in Dar es Salaam has consequences for local economic activities, such as agriculture, livestock keeping and also for municipal service provision, such as water and waste supply. The reduced availability of water will lead to a decline in agricultural output. It also means less water for human consumption and use, whether it is for drinking, washing or sewerage systems. The knock-on effects are many and spread over a range of sectors: Less agricultural output means less income; compromised access to potable water and water for sewerage systems have negative health effects, such as increased risk for water-borne diseases and dehydration. Failing sewerage systems will contaminate local ecosystems such as fish habitats, which are valuable sources of income for local people. Any measure to tackle the consequences of prolonged dry-spells should therefore consider the cross-sectoral impacts, and the **interconnectivity** of systems and events. This will also make it easier to identify opportunities and to reduce risk.

Due to the ever-changing nature of the urban environment, adaptation should be a way of doing things and not an add-on to the to-do list, or an afterthought. It requires changing the way of thinking, planning and acting. Adaptation will therefore never be a complete process. It requires constant monitoring and evaluation in order to ensure effectiveness and appropriateness. Adapting continuously and planning for a wide range of scenarios, to avoid maladaptation, will thereby increase resilience to climate change. Whether it involves staff capacity-building, technical innovations or legislative frameworks, it is essential to bear in mind that the higher adaptive capacity these measures have, the better able they will be at dealing with the unforeseen. The concept of **continuity** hence applies to all aspects of an effective adaptation process: Planning, implementation and monitoring and evaluation.

Since there is no blue-print for 'correct' adaptation, especially at the local level, **local relevance** is what gives an adaptation strategy or an action plan its edge. Local knowledge, data and social networks are essential for the success of any adaptation measure and for building resilience at the local level. Plans for adaptation therefore need to be developed where they will be implemented, as no two areas are the same, influenced by exactly the same scenarios. Local governments all have different spatial plans, land use practices, social demographics, governance structures, infrastructure and service delivery, while also being embedded in their unique histories and heritages. To ensure relevant and effective adaptation measures, all of these factors need to be considered for them to be locally relevant, keeping the understanding and implementation of all actions undertaken at the same level.



Figure 2.2. The five milestones to climate resilience. following the appointment of a local government champion.

Increasing resilience to a changing climate is an ongoing process. As we cannot know all that may change, it is important to re-evaluate and acknowledge where the weaknesses and strengths are and keep all the stakeholders informed.

### 3. Projected changes in climate for Africa

Below follows a brief summary of the projected climatic changes for Africa, Tanzania and Dar es Salaam. More detailed information can be found in the Climate System Analysis Reports for Southern Africa and the downscaled climate systems analysis report for Temeke Municipal Council.

Although there are some uncertainties surrounding the understanding of Earth's complex systems, there is strong evidence in current literature and climate related measurements to demonstrate that, as a result of increasing green house gas emissions, global atmospheric and sea surface temperatures are rising. As a result we can expect impacts on environmental, social and economic systems. In some cases these impacts are anticipated to have severe consequences for people's livelihoods as well as governments' ability to provide and maintain basic service delivery. This is also considered to be the case for local governments and communities throughout Africa.

Due to increasing global atmospheric and sea surface temperatures a number of climatic changes are expected to impact upon the Earth's socio-ecological systems:

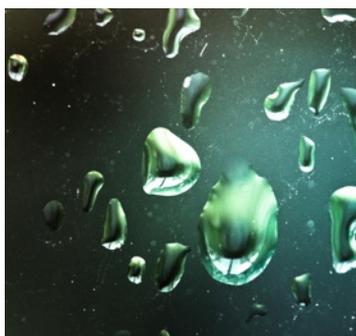
- Changes in rainfall and precipitation patterns (flooding and drought),
- Increases in temperature,
- Increasing frequency and intensity of storm surges and extreme events,
- Increasing average global sea levels due to melting glaciers and thermal expansion, and
- Changes in wind speeds and prevailing directions.

Although Africa is a continent with abundant natural resources it still remains one of the most underdeveloped continents globally. Development is hampered by extreme poverty, which is exacerbated by poor access to water, sanitation, health services, and inadequate food supplies (Sandbrook, 1985). Such 'multiple stresses', including limited access to capital, complex governance and institutional dimensions, and ecosystem degradation, make the continent particularly vulnerable to the impacts associated with climate change (IPCC, 2007). Africa's one billion people will unfortunately bear the burden of a three-fold population-based risk of suffering adverse effects of climate change compared to the global total. As stated in the Stern Review (2006), the consequences of a changing climate will be most severe and widespread among the Sub-Saharan African population, and issues of water scarcity, health and malnutrition are likely to be exacerbated.



#### Temperature:

- A rise in temperature of between 1°C and 3°C is anticipated by 2050,
- Increases in warm spells over western and southern Africa has been observed,
- The number of extreme cold days are declining,
- Mean sea surface temperatures are anticipated to increase by between 1.5°C and 6°C by 2100, and
- The warming trend is likely to change precipitation patterns.



#### Rainfall and precipitation:

- A 10 - 20 per cent decline in rainfall is anticipated by 2070,
- River water-levels may fall by 50 per cent by 2030 in various parts of Africa, and
- Climate change projections indicate that 230 million Africans will experience water scarcity by 2025 as a result of declining water resources and increasing constraints on water resources.



#### Frequency and intensity of severe weather:

- Over the next 50 years extreme weather events are anticipated to increase in frequency and intensity on the African continent,
- Tropical cyclones (typhoons and hurricanes) will likely become more intense with larger peak wind speeds and heavier precipitation, and
- There are strong indications that paths, intensity and frequency of strong storm and wave events will be affected by climate change leading to extreme rainfall events.

### 3.1 Climate change projections for Tanzania and Temeke Municipal Council, Dar es Salaam

The IPCC 4<sup>th</sup> Assessment report (2007) explains that extreme events are likely to pose the greatest climate change threat to Tanzania, specifically in the form of droughts, floods and tropical storms. Such events are projected to increase in frequency and intensity, as well as becoming more unpredictable.

Most districts in the country are already experiencing the impacts of prolonged drought and Dar es Salaam has recently experienced a number of flooding events after long dry periods. Coastal areas in general will be less exposed to droughts than inland areas due to the impact of the ocean. Additionally, projected increased mean rainfall and its cyclical variation indicates more frequent and severe flooding to be a likely impact. Climate change projections further show that the glaciers and snow on Mount Kilimanjaro are likely to disappear (melting) between 2015 and 2020 if current climatic conditions persist.



#### Climate change projections for Tanzania include:

- An average temperature rise of 2.2 C° with higher increases in the months of June to August (2.6 C°),
- Further to this, mean daily temperatures are expected to increase by 3°C - 5°C throughout the country, and mean annual temperatures by 2°C - 4°C,
- Rainfall cycle variability is likely to increase, and this is already being experienced in many parts of the country,
- Areas with two rainfall seasons are likely to experience increased precipitation of 5 - 45 %, and areas with one rainfall season will experience a decrease in precipitation of 5 - 15%, and
- Changes in mean temperature and rainfall, and increases in rainfall variability, are together likely to prolong the annual dry seasons and increase the severity of periodic droughts.

The impacts of these projections will have severe consequences on social-ecological systems, as well as the country's and Dar es Salaam's and Temeke Municipal Council's economic sector:

It should be noted that the impacts of climate change do not occur in isolation, but are all part of a complex larger climatic system. For example, increased mean sea surface temperatures contribute to the intensification of tropical cyclones. Increased storm intensity in turn promotes more extreme storm surges, which will have greater impacts on coastal areas due to sea level rise, both permanent and impermanent. Also, saltwater intrusion into the water aquifer puts pressure on water supply infrastructure and compromises water quality. Flooding events endangers lives, reduces accessibility in and out of town for businesses and individuals due to the deterioration of road networks, and has a number of knock-on effects for the fishing industry and on vulnerable communities in particular.

## Other impacts on the City of Dar es Salaam associated with a changing climate are:

- Dar es Salaam is one of the fastest growing cities in the world, and is already experiencing water stress. Its rivers are polluted, with many pollutants coming from a larger catchment area and further upstream, and therefore pose a health risk. Reduced access to fresh water, as a result of changes in precipitation and possible saltwater intrusion into coastal aquifers (caused by increases in flooding and storm surge events), will further exacerbate this challenge.
- Dar es Salaam's road and drainage infrastructure was severely damaged by flooding in 2006, 2011 and 2012 and with the projected increasing frequency of such events, the risk of such impacts will also increase.
- Rain-fed agriculture is the dominating sector of Tanzania's economy, and considering the projected changes in rainfall patterns, both the country's economy as a whole and peoples' livelihoods are expected to be severely impacted.
- Increases in temperature and changes in rainfall patterns will impact upon wildlife species migratory patterns, and competition for food and water is likely to increase. Pests and diseases (for example malaria) are also expected to increase through an enlarged geographical distribution.
- Mangroves and coral reefs are vulnerable to sea-level rise, storm surge events, and increases in sea temperatures, and such impacts pose a risk to these valuable and species-rich ecosystems, their ecosystem services and their associated economic benefits (tourism, fishing, natural resource production).
- Frequent and prolonged droughts have already resulted in temporary shut downs of major hydroelectric infrastructure at the dams, which are the main source of electricity in the country.
- A shift to a generally drier climate, and the intensification of human activities, is likely to exacerbate the risk of fire. For example, over the last 30 years 10% of Kilimanjaro's forests have been lost to fires, which in turn has resulted in a 25% reduction of water sources derived from fog, affecting the fresh potable water for 1 million people living in the area.

### What use are mangroves and why spend money replanting them?

Coastal mangroves have been shown to be highly beneficial in protecting coastlines from storm surges. They provide a buffer between the ocean and the land which reduces a storm's strength and prevents waves from travelling as far inland. They also prevent erosion of the coastline through tidal action and provide an essential nursery for fish fry, thereby replenishing fish stocks and enhancing sustainability. Mangroves grow along most of Africa's east and west coastlines but in many places they have been utilised and removed for fuel, often to smoke fish or to provide building materials. These denuded areas have since become more susceptible to damage from storms. As climate projections suggest that temperatures will increase and strong storms may become more frequent in the future, these degraded swamps will provide no protection and will likely suffer flooding, erosion, damage to roads and buildings and possibly, loss of life.

Temeke Municipal Council has established a mangrove rehabilitation scheme in the denuded Mtoni Kijichi area in order to tackle this, which will increase resilience to climatic changes. It is a relatively low cost exercise, which provides employment and also huge environmental protection benefits for the people living in the area, and is beneficial to the environment as a whole. This is a part of the broader Marine and Coastal Environmental Management Programme (MACEMP) which aims to promote sustainability and poverty alleviation.



Mangrove Action Project/Marine Photobank

### 3.3 Governance tools and institutions relevant for adaptation to climate change

Climate change adaptation frameworks and strategies for local governments should be situated within the context of other locally relevant governance tools. Identifying synergies and win-win situations between these different tools is part of building long-term resilience to climate change and its associated impacts, whilst enhancing existing capacities and efficiency. It also helps reduce the risk of unnecessary misallocation of the often limited resources through repetition and duplication.

The development of the Temeke Municipal Council Climate Impacts and Sector Risk Baseline Study included a thorough assessment of existing strategies and policies relevant for managing sustainability and building resilience for Dar es Salaam. Some of the national key tools and institutions identified are:

- The National Reform Water Sector Policy of 1991 aims to ensure access to clean water to all citizens within 400 metres from their homes.
- The National Environmental Action Plan (NEAP) of 1994 is one of the Tanzanian government's Division of Environment's strategic plans from which, among other things, the National Environment Policy (NEP) of 1997 was born. The policy provides a framework for mainstreaming environmental considerations into government decision-making processes.
- The Environmental Management Act (2004) addresses all environmental management issues in Tanzania and governs related policies and frameworks.
- Tanzania's National Adaptation Programme of Action (NAPA) (2007) links national policies, objectives, plans, goals, and programmes with multilateral agreements, such as the United Nations Convention to Combat Desertification (UNCCD), United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD) among others. These have led to the National Biodiversity Strategy and Action Plan (NBSAP), the National Action Programme (NAP), and the National Bio-safety Framework (NBF). (See <http://unfccc.int> and go to 'submitted NAPAs').

The following environmental sustainability strategies for the city of Dar es Salaam incorporate and apply to Temeke Municipal Council,

- The Sustainable Dar es Salaam Programme, initiated in 1993 and completed in 1997, aimed to strengthen the Municipal Council's capacity to plan and manage the growth and development of the city in close dialogue with the urban farmers.
- The Strategic Urban Development Plan (SUDP, 2004) provides a framework for city expansion and land use among other necessary inputs for urban productivity and poverty alleviation.
- In 2009 the Mayor of Dar es Salaam, together with Mayors from 33 capital and major African cities, pledged to quicken climate change adaptation and mitigation plans for their cities and to integrate these plans into city development strategies.

## 4. Risks for Temeke Municipal Council

Through a series of consultative, participatory stakeholder workshops, Temeke Municipal Council and key local stakeholders have identified which climatic variables, their projected changes, sectoral risks and adaptation options, are anticipated to have the most significant impact on the city's climate resilience.

**The key local stakeholders identified flooding as the climate change variable exerting the most pressure upon service-delivery, infrastructure and local communities.** However, another climatic variable coming to the fore is drought. These apparently conflicting factors are due to the fact that Dar es Salaam is experiencing longer dry periods in between shorter, more intense rainfall events and stresses on the fresh water supply are becoming evident. Climate resilience plans therefore need to take both flooding and drought into consideration.



Key local stakeholders for Temeke identifying and prioritising climate risks and adaptation options during the consultative process.

## Flooding in Dar es Salaam



In December 2011, Dar es Salaam experienced their worst flood in more than 50 years. Dozens of people died and 5000 were displaced, mostly poor communities living in low lying areas. Camps were set up in the city for those who had lost their homes but everyone was affected.

The transport system broke down, leaving people unable to get to work, get to their families or get to market. The knock-on effects were enormous. Livelihoods were affected, health risks increased, with cholera, diarrhoea and malaria rife in the communities. Children were unable to get to school, family members were unable to get home,

the sick and injured were unable to get treatment, the power supply was disrupted and food spoiled. Several small to medium sized businesses were decimated. One chicken farm lost every bird to the flood water.

Once the flood receded, many costs were incurred fixing bridges and repairing road surfaces. Dar es Salaam is a large city with many inhabitants and to maintain infrastructure in all areas is difficult, particularly as many roads and houses are unplanned. Badly impacted roads damaged vehicles, and some potholes were so deep that people broke their legs after falling into them.

Large scale flood events have been relatively rare - previously the most extreme flood was in 1954, but then at the beginning of March 2012, another extreme flood occurred. When these events follow on from each other in rapid succession, there may not have been enough time to address all the outstanding issues from the previous flood, and the severity of the situation increases as all impacts compound to create worse problems, increasing the cost of cleaning up and rebuilding lost infrastructure.



## Fixing flood damage in Mangaya Road, Temeke and adapting to the next flood

The floods that ravaged Dar es Salaam in 2006 and 2011 caused massive damage to the road network and flooded houses situated close to verges.



Temeke Municipal Council, in keeping with the view that the climate is changing and the risk factor of large-scale flooding events is increasing, have incorporated infrastructure to prevent this destruction happening at this same scale by constructing storm channels. Regrading the road at the correct camber will channel rainwater into these drains, to be carried away, preventing damage to the road surface as well as the potential for flooding. Provided the storm water channels are kept clear of debris and litter, this should also discourage the accumulation of stagnant water which can become breeding grounds for mosquitoes and harbour disease.

### 4.1 Reasoning with climate related risks

Climate 'risk' as a concept should be viewed in a holistic manner to consider the impacts of climate change over a range of sectors and disciplines. It is imperative that the planning and implementation of actions to minimise climate risk sustains a holistic approach, in order to choose the most locally appropriate action. **A comprehensive risk analysis should consider the environmental, institutional, political, social and economic/financial spheres for each impact chosen actions.**

As stated in the Climate Risk Concept Paper (Cartwright, 2012), a stand-alone publication to build capacity of key stakeholders at the local government level, risk refers to the probability of a climate related event occurring, multiplied by the cost to people and the things they value. Although risk is a part of everyday life, most people are averse to it and consider risk reduction necessary. In terms of risks associated with climate change, it is important to understand and acknowledge that determining the probability and ways in that such risks will have an impact is difficult. This is because climate change risk is:

- Peculiar: It is difficult to grasp and relate to (abstract concepts)
- Of an unprecedented nature: A global phenomenon caused by the accumulation of individual actions, accompanied by high levels of uncertainty
- As a result of the two, it is potentially damaging, and especially to areas and countries already faced with significant social, environmental and economic challenges.

It is imperative that local governments and the key stakeholders adequately understand the concept of climate change risk, as this forms part of the foundation for making appropriate and realistic decisions for adaptation (Cartwright, 2012).

## 4.2 Climate-related risks to service sectors

Through a consultative and participatory process, combined with scientific research, (i.e. documented impacts and effects, local anecdotal information and service provider experiences), key stakeholders from within Temeke Municipal Council have identified the prioritised climate-related risks per service sector. Interactive engagement processes resulted in the effective prioritisation of climate-related risks pertaining to local service sectors. The most prioritised risks are outlined below (a complete list of the identified risks can be viewed in Annex 1).

<b>Water and sanitation</b>	<b>Livelihood impact</b>
Decreased fresh water supply, quality and availability for human consumption	Compromised potable water, availability and quality, water-related health risks (dehydration, water-borne diseases), increased poverty
Changes to water bodies (rivers, canals, ponds)	Loss of income and livelihood options (compromised navigability of rivers; compromised fish production, less water available for livestock and crops)
Reduced water supply for sewerage systems	Compromised sanitation and hygiene causing health risks
Increased flooding events through intense storms and sea surges	Infrastructure damage, public health risks, loss of property and income
<b>Transport</b>	
Water transport routes may be compromised	Limited access, loss of work hours and income
Increased risk and accidents	Danger to public health
Erosion of road networks	Compromised road quality and accessibility, higher maintenance costs, increased time spent travelling
<b>Health</b>	
Increased cases of dehydration, water-borne disease, heat stroke	More sick days compromising income, death. Potential conflict over water sources
<b>Energy</b>	
Reduced water supply for hydroelectric capacity	Limited water supply for drinking, industry and agriculture
Increased demands on wood fuel combined with prolonged drought and increased erosion will compromise forests' recovery	Less available wood fuel, potential conflict over fuel sources, compromised ecosystem services, increased costs and energy disruptions leading to loss of income
Damage to infrastructure and increased erosion from flooding compromising energy supply	Increased costs, limited energy for cooking, boiling water, power cuts for business leading to loss of income

Table 4.1. Prioritised risks and impacts relating to climate change for Temeke Municipal Council.

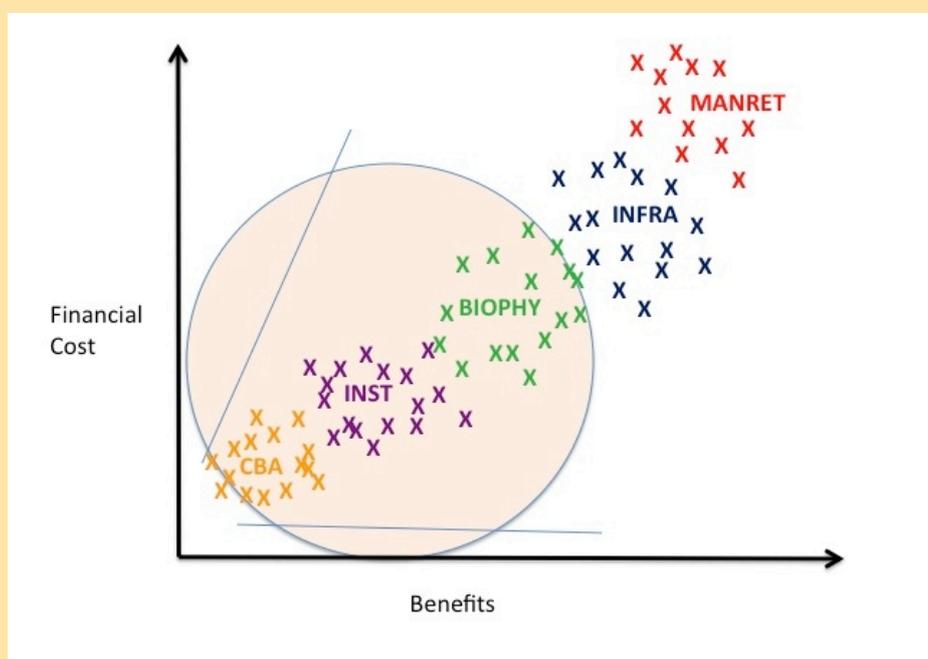
For choosing and implementing appropriate adaptation options, these risks and their impacts must be considered in order to ensure that the adaptation strategy is holistic and accounts for all levels of society. Risk management is also pivotal when considering the interconnectivity between different systems, events and actions.

## 5. Locally identified adaptation options

This section of the Climate Resilience Handbook presents the adaptation options which have been identified and prioritised for implementation by the Temeke Municipal Council and key local stakeholders. These have been chosen from the adaptation options identified in the third stakeholder workshop, and subsequently categorised according to the climate SMART Goal template (see Annex 2 for a complete list of the identified adaptation options).

There are five separate categories which encompasses the range of expenditure and effort required to implement each adaptation option. They are:

- Community based adaptation options (CBA i.e. community owned actions)
- Institutional adaptation options (INST. i.e. institutional arrangements and governance practices)
- Biophysical adaptation options (BIOPHY. i.e. the use of natural, soft and ecosystemic measures)
- Infrastructural adaptation options (INFRA.)
- And finally, preparing a managed retreat (MANRET.)



It is generally accepted that the infrastructural options require a great deal more in terms of logistics, expenditure, implementation and maintenance, although they deliver great benefits. If higher-end infrastructural adaptation options are undertaken, there may be little or no room for the inclusion/undertaking of the community, institutional and biophysical options and whilst their benefits are great, their implementation costs are also high. Conversely, community, institutional and biophysical options can all be undertaken at the same time providing benefits across the board for a potentially lower total cost.

From the adaptation options selected during stakeholder workshops, these were organised in a manner that addressed all the identified and prioritised risks whilst keeping an emphasis on interconnectivity and local relevance for Temeke Municipal Council. They address mainly flooding, but were extended to also address drought, and form the climate SMART Goals for Temeke Municipal Council. These options are not exclusive of the implementation of additional climate adaptation goals.

These local adaptation options (listed in Annex 2) have been entered into the [online tool](#) developed by ICLEI-Africa specifically for this project, in order to prioritise and refine your SMART Goals. Temeke Municipal Council now needs to finish this online process by determining specific deliverables, actions, outputs responsibilities and timeframes in order to receive a report delivering the SMART Goals crafted to your local specifications and situation.

## Introducing a new transport system

The road network within Temeke Municipal Council and indeed throughout Dar es Salaam has been compromised by the unauthorised construction of numerous additional, unplanned roads. Without the correct flow of traffic, the roads become highly congested throughout the day and night, adding significant amounts of time to commuting and impacting on access for emergency vehicles. Traffic at a standstill also adds to air pollution through excessive exhaust emissions, lowering air quality and leading to possible health issues. Many of the vehicles in commuting traffic carry only one individual and reducing the number of cars on the roads can have a large beneficial impact. With a significant, continually growing population needing to commute, an improvement on the existing public transport system, (which originated through a large number of independently owned minibuses before being regulated by local government in 1983), will have numerous benefits.

As well as tackling the issue of unplanned construction of roads, Dar es Salaam is introducing a new bus rapid transport system (BRT) with funding from the World Bank which will include the upgrading of roads, drainage systems, pedestrian areas and bicycle lanes and make use of the latest in green technology in the buses obtained. Plans

are for the construction of 21km of dedicated bus lanes with reasonable transport costs. Non-motorised forms of transport will be actively encouraged through pedestrianising sections of the city as far as possible and planting trees for shade along these pedestrian paths. Additionally, a far-reaching network of bicycle lanes is planned, along with facilities for parking of bicycles.



Illustration of the proposed BRT system. Image from Dar es Salaam Rapid Transport (DART)

## 6. SMART Goals

**SMART** stands for **S**pecific, **M**easurable, **A**chievable, **R**ealistic and **T**ime-framed, and is a tool to set feasible goals and to identify the different steps that are necessary for their implementation. Goals that are too abstract are difficult to break down into actions, and can leave decision-makers and practitioners feeling 'lost' in terms of how and who should initiate the implementation process. It is imperative that when a goal is set, key steps, responsibilities, time frames and budgets should be at least approximately determined.



Image: V Stephen

The prioritised options (below) will be designed for implementation through setting **SMART Goals** and breaking them up into deliverables and actions with assigned responsibilities. These options have been chosen based on workshop discussions and consultation with all key stakeholders. Temeke Municipal Council will need to design their implementation through breaking them up into deliverables and actions with assigned responsibilities. This needs to be done in ICLEI's online tool at [www.ResilientAfrica.org](http://www.ResilientAfrica.org). Some of the adaptation options will require further research and information before they can be taken to the implementation stage. The chosen adaptation options here should also be subject to a Cost-Benefit Analysis (CBA), bearing a holistic approach to risk in mind, to test their viability in the short-medium- and long-term. Remember that these options do not mean that further options should not be sought, but at this point encompass the majority of the adaptation options already chosen, necessary to move towards climate resilience.

**The proposed SMART Goals for Temeke Municipal Council based on the consultative process are:**

- 1. Mainstreaming adaptation at the local government level through the Master Plan (MP):** The MP provides an excellent opportunity to incorporate adaptation into municipal development planning. As a large-scale plan, it has the capacity to include several of the adaptation options identified by the key local stakeholders. As the MP is valid until 2030 the steps taken need to be reassessed and frequently re-evaluated.
- 2. Raising public preparedness through Communication, Education and Public Awareness (CEPA):** CEPA is absolutely essential to ensure continuous capacity-building, buy-in from stakeholders and decision-makers, and proactive and strategic communication of immediate and long-term risks and livelihoods impacts.
- 3. Implementing a Disaster Risk Reduction Strategy (DRRS):** A well-planned and integrated DRRS will save lives and minimise vulnerability whilst dealing with the environmental situations which trigger them. Proactive DRRS systems will reduce response times to reacting to extreme climate events. Dar es Salaam is in the process of setting up a DRRS but there are some shortfalls which need to be addressed and Temeke Municipal Council has the opportunity to fine tune it for their jurisdiction.

## 7. Monitoring and evaluation

Monitoring is important for gauging if the adaptation strategies and the implemented actions work as anticipated, and to what extent they are successful. It is also a mechanism to ensure that implementation is taking place as planned and agreed. Evaluation means that each step or action that is implemented is being assessed, as well as the overarching strategies. Bearing the continuity of resilience in mind, the monitoring and evaluation process is a key component to ensure efficient use of resources and processes. It prevents unnecessary repetition and helps improve the quality and scale of the resilience-building.

Monitoring and evaluation should be built into the plan or strategy from the start, which should include a monitoring and evaluation framework, defined roles and responsibilities, a documentation protocol and a programme for evaluating results. Monitoring should be carried out throughout the entire process, while evaluation happens at strategic points in the process, and the timing of these should be included in the original planning. Monitoring and evaluation should also be budgeted for, and be carried out by skilled professionals. A good test for effective monitoring and evaluation is to ask, "What has changed since the project was implemented?"

The SMART Goals are ideal for monitoring and evaluation as they are systematic, measurable and have clear outcomes and outputs. In order to evaluate impacts and success, there also has to be baseline data, in other words something to compare with. The Baseline Study for Dar es Salaam is a good starting point, but further ongoing documentation will be required. Documentation can take various forms, ranging from photos to meeting notes to physical improvements in infrastructure.

## Dynamite, lime production and coral reefs

Dynamite fishing is an ongoing problem along much of Tanzania's coastline. This illegal fishing practice is highly unsustainable and damaging to reefs. Firstly, the dynamite kills all fish in its vicinity whether they are fully grown or small fry, common or endangered, and regardless of whether or not they are edible. Secondly, where blasting occurs on top of coral reefs, the reef is damaged and coral killed which reduces the habitat for fish to hide and spawn. This will lead to a reduction in the numbers of fish, and later, potentially to food security issues.

Dar es Salaam has a team comprising the Ministry, Department of Livestock and Fisheries and key stakeholders which is implementing patrols of the coastline in order to prevent the incidents of dynamite fishing. They are also spot checking construction sites, the main source of dynamite, in order to ensure that the explosives remain under tight security. This programme needs to be reinforced and supported by all involved and it will become effective. Dynamite fishing is still a major problem, but it can be tackled and it is imperative that it is done in order to secure fish stocks for the population and maintain a healthy ecosystem.



Additionally, coral reefs are being mined in order to produce lime for construction. It is prepared by roasting broken coral on open fires or kilns (which are often fuelled with mangrove wood). Only about 50% of the coral is reduced to usable lime, the rest is discarded.

Areas where coral mining is rife have experienced increased erosion through the loss of breakwater that reefs provide, and fish abundance and diversity is more than 40% lower than pristine reefs (Dulvy et. al, 1995). If Dar es Salaam, is to become resilient to a changing climate, which will see more intense storms and food security issues, this practice needs to be carefully monitored, alternatives sourced and the practice of coral mining phased out as soon as possible in order to protect the environmental services that these reefs provide.

## 8. Capacity-building

Adaptation entails more than addressing the risks associated with climate variability. As the climate is changing so too is the operating environment for local governments. Decision making processes must therefore incorporate support and capacity-building of staff to identify the risks and opportunities that arise from changes in the biophysical and political climate.

**“Acknowledging complexity and uncertainty as relevant dimensions in policy and decision-making regarding the management of climate change impacts requires a high level of sophistication from the risk management process and those involved. Although councils have systems to deal with change in the short term, planning rarely incorporates predictions for climatic variations in the medium to long term.”** (CCP Adaptation Toolkit, 2008.)

The goal is to capacitate decision makers and officials to think and act proactively to harness such opportunities or mitigate any risks, and not to be passive observers with reactive responses. In this project ICLEI-Africa has been working with the five local governments to build such capacity through the development of this Resilience Handbook, as well as other resources, which benefits from the experiences from the project's process and the cities' local knowledge and specific capacity.

## 8.1 What has been achieved so far?

### The Durban Adaptation Charter for Local Governments

At the COP 17 in Durban 2011, Dar es Salaam signed the Durban Adaptation Charter for Local Governments to “commit and upscale action to accelerate their adaptation efforts” by committing to a number of clauses:

1. Mainstreaming adaptation as a key informant of all local government development planning.
2. Understand climate risks through conducting impact and vulnerability assessments.
3. Prepare and implement integrated, inclusive and long-term adaptation strategies designed to reduce vulnerability.
4. Ensure that adaptation strategies are aligned with mitigation strategies.
5. Promote the use of adaptation that recognises the needs of vulnerable communities and ensures sustainable local economic development.
6. Prioritising the role of functioning ecosystems as core municipal green infrastructure.
7. Seek the direction of direct access to funding opportunities.
8. To develop an acceptable, robust, transparent, measurable, reportable and verifiable (MRV) register.
9. Promote multi-level and integrated governance and advocate for partnerships with sub-national and national governments on local climate action.
10. Promote partnerships at all levels and city-to-city cooperation and knowledge exchange.

Through the development of this document, and through the participatory research process of this project, a lot has already been achieved in terms of preparing for adaption building resilience in Dar es Salaam.

Dar es Salaam has:

- **Demonstrated local political commitment:** By signing the Durban Adaptation Charter for Local Governments. Also, through the NAPA of 2007, which links national policies, objectives, plans, goals, and programmes with multilateral agreements, such as the UNCCD, the UNFCCC and the CBD there is a national platform for international commitment.
- **Started the process of mainstreaming adaptation into government planning:** The participatory research undertaken through this project has contributed to putting making adaptation a priority for Dar es Salaam.
- **A framework and the first steps for developing and implementing a comprehensive adaptation strategy and action plan:** This handbook is the first step and also outlines a clear structure for the strategy and initial actions.
- **Included the needs of vulnerable communities:** Temeke Municipal Council and its communities have been involved in the project from the start.
- **Given priority to sustaining and enhancing local ecosystems:** The identified adaptation options recognises the importance of healthy and resilient ecosystems as a first line of defence against climatic variability.
- **Promoted and engaged in multi-level partnerships, locally and internationally:** Through its participation in this project Dar es Salaam is part of a network of cities worldwide committed to implementing adaptation towards building resilience. It has also been a platform for forging local multi-level partnerships on which further work can be built.

## 9. A framework for action

This section is a guide to identify the necessary steps and tasks for kick-starting the implementation of the chosen adaptation options. The ultimate aim is to increase climate change resilience for the municipalities, to maintain and improve infrastructure and service delivery, and to ensure that peoples' livelihoods are secure.

### **Step 1: Acknowledge what has already been achieved**

By participating in this project, Temeke Municipal Council has already built the foundation for implementing resilience. This Handbook is a result of a participatory process, and the adaptation options, risks and vulnerabilities were identified and prioritised by the key local stakeholders. This, together with the work done by Dar es Salaam on the Sustainable Dar es Salaam programme and the Strategic Urban Development Plan provides the Municipal Council with a stable platform on which to start implementing adaptation options.

### **Step 2: Identify resources needed to start making decisions**

It is a good idea to start with a focus group with some key people, including technical experts and community representatives. Knowing the resource requirements to implement any particular action should help to determine who should be included at this level. Think about what needs to be done and who would be the best people to implement this. You might need to have a brainstorming session, or some funding for a site visit, or more research. It is imperative that the focus groups makes tangible decisions concerning the identified adaptation options.

### **Step 3: Determine who the key stakeholders are**

Who should be included in this process? Who has the necessary expertise or first-hand experience? Perhaps an external consultant should be brought in. What kind of political buy-in do you need? Remember that climate adaptation crosses multiple sectors so stakeholders need to be determined for every sector. As there are multiple impacts on each sector, each impact will need an action in order to move towards resilience, so again, examine who will be relevant and necessary to implement these and where necessary, identify appropriate specific stakeholder groups.

### **Step 4: Consider already existing institutional documents**

It is imperative to consider laws, policies or frameworks at an early stage. This has multiple benefits such as avoiding repetition, ensuring a holistic approach to the task at hand, and exploring synergies, which can reduce both cost and time. Laws already in place form a solid basis from which to further mainstream climate adaptation within the local government. Funds can then be disbursed in the most effective way, resources are correctly allocated and the collective thinking is not diluted. Working with existing institutional documents will enhance the end result of implementation and action.

### **Step 5: Analyse costs and benefits associated with the adaptation options**

In order to define how much funding is required to implement the adaptation option, the costs must be analysed and weighed against the benefits. Know the intricacies of what the costs involve and what benefits they will deliver. - and the time period involved. This will allow you to choose the best course of action by weighing up the pros and cons for each option. Certain actions may bring short-term relief and others, much longer term. Bear in mind that future maintenance costs should be included and assess whether the long-term costs will outweigh the benefits. Where this happens, it would be advisable to re-evaluate your actions and prioritise them again. This step should result in an estimated budget for the chosen adaptation options.

### **Step 6: Use the SMART Goal template**

Using the SMART goal template you have to break each goal into actions, deliverables, outcomes etc. and assign

timeframes and measurable items. This action is perhaps the most important one so don't rush this! The local government Climate Champion together with the key stakeholders must together **spend adequate time and brain power on the SMART Goals, which will reduce the cost and time further down the line of implementation.** Bear in mind when identifying your goals the definition of the SMART Goals. They are required to be **Specific, Measurable, Achievable, Realistic and Time-Framed.**

**Step 7: Identify mechanisms for monitoring and evaluation**

This step means that you should decide on an overarching mechanism for monitoring and evaluation. It is a way to ensure follow-up of decisions and action, and to properly record the process. Keep your end goal in mind along with the actions being undertaken to reach the goal. Look at where in the process it is necessary to update other stakeholders, who is responsible and communicate both successes and failures. Focus on lessons learned and proper communication of these to relevant stakeholders so as to avoid repetition of mistakes, but also to capture and duplicate success.

**Step 8: Incorporate capacity-building**

Adaptation is an ongoing process, and key to resilience is a system's adaptive capacity. This means that stakeholders, decision-makers, officials and anyone involved in the implementation process should understand these concepts and how they transform into practice in terms of their specific tasks. To enhance peoples' adaptive capacity, and to ensure that adaptation becomes a way of doing things, and not an add-on, you need to build capacity to strengthen the institutional resilience.

**Step 9: Align with CEPA**

How to incorporate a CEPA (Community, Education and Public Awareness) strategy into the process should be considered at an early stage. Who should the process be communicated to? Where is the need for education and awareness? What are the key messages that we want to communicate regarding this particular process? Do we need a public face or a specific campaign?

Prepare checklists with designated tasks for stakeholders to complete. It is essential that they are able to choose the steps that need undertaking in order to effectively implement the chosen adaptation options. Keep communicating between all stakeholders and keep to deadlines as far as possible.

Task	Person responsible	Timeframe	Task complete

Having undertaken this process it is important to look at the adaptation cycle again and evaluate if 1) Is it realistic that the goals will be achieved and the adaptation option successfully implemented? 2) Determine how these steps will make Temeke Municipal Council more resilient to a changing climate. The steps should also consider that adaptation is a continuously evolving process that must take dynamic social, political, economic and ecological systems into account.

10. Conclusion

This Climate Resilience Handbook has been developed specifically for Temeke Municipal Council, within the City of Dar es Salaam, Tanzania. Extensive consultative processes incorporating local key stakeholders has identified and prioritised that adaptation options most likely to move Temeke Municipal Council towards climate resilience. This three year consultative project has resulted in this Handbook, specifically designed to tackle the most important climate variables for Temeke. However, it should be noted that this is the start of the implementation of actions process and

Temeke Municipal Council is now required to put into practice the discussions, workshops, scientific research and consultation which this Handbook incorporates.

The implementation process is unlikely to be easy, however with the buy-in and support of local government and key local stakeholders, as well as the communities who will ultimately benefit from these actions, and by following the rules of the SMART Goals, i.e. that each one is Specific, Measurable, Achievable, Realistic and Time-framed, Temeke Municipal Council will move steadily towards resilience to climate change.

## 11. Further reading

The adaptation recommendations and process covered within this handbook is based on a numerous reports, workshops and scientific papers. There have also been a number of tools developed to assist in implementing the SMART goals. To read more, the following papers and websites are recommended:

Cartwright, A. (2012). A Risk Concept Paper developed for the ICLEI-Africa project Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation through Participatory Research & Local Action

Chambwera, M. & Macgregor, J. (2009). Cultivating success: the need to climate-proof Tanzanian agriculture. IIED Briefing. (Download report [here](#))

CSAG: (Climate System Analysis Group), at the University of Cape Town

Dulvy, N.K, Stanwell-Smith, D, Darwall, W. R. T, and C. J. Horrill. (1995). Coral Mining at Mafia Island, Tanzania: A management dilemma. *Ambio* 24, 6. Royal Swedish Academy of Sciences. Pp 358-65

### Durban Adaptation Charter for Local Governments

IPCC (2007). The Fourth Assessment Report (AR4) of the United Nations Intergovernmental Panel on Climate Change

Fairhurst, L. (2009). Draft Report: City Adaptation Plan of Action for the City of Cape Town

Local Interactive Climate Change Risk and Adaptation Prioritisation Training Tool (RAP)

Sandbrook, R. (1985). *The Politics of Africa's Stagnation*. Cambridge: Cambridge University Press

SREX (2012). IPCC. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

Stern, N. (2006). Review on the Economic Effects of Climate Change. *Population and Development Review*. 32: 793–798. doi: 10.1111/j.1728-4457.2006.00153.x

## 12. Glossary and acronyms

**Adaptation:** In natural or human systems adaptation is a response to actual or expected stimuli, e.g., climate change or their effects, which moderates harm or exploits beneficial opportunities. In natural systems adaptation is reactive. In human systems adaptation can be both anticipatory and reactive and can be implemented by public, i.e., government bodies at all levels and private actors, i.e., individuals, households, communities, commercial companies and NGOs.

**Adaptive capacity:** The ability of people and systems to adjust to environmental change, e.g., by individual or collective coping strategies for the reduction and mitigation of risks or by changes in practices, processes or structures of systems. It is related to general levels of sustainable development such as political stability, material and economic well-being, and human, institutional and social capital

**Capacity-building:** "Specifically, capacity building encompasses the country's human, scientific, technological, organizational, institutional and resource capabilities. A fundamental goal of capacity building is to enhance the ability to evaluate and address the crucial questions related to policy choices and modes of implementation among development options, based on an understanding of environment potentials and limits and of needs perceived by the people of the country concerned". - Agenda 21's definition (Chapter 37, UNCED, 1992.)

**CCAA:** Climate Change Adaptation in Africa Programme

**Coastal set-back:** The actual distance that a coastline moves inland due to sea-level rise

**IPCC:** Intergovernmental Panel on Climate Change

**Resilience:** Amount of change the exposed people, places and ecosystems can undergo without permanently changing states. That is, their ability to recover from the stress and to buffer themselves against and adapt to future stresses and perturbations

**SMART Goals:** Goals set to the specific requirements of being Specific, Measurable, Achievable, Realistic and Time-framed

**SREX:** Special Report Managing the Risks of Extreme Events and Disasters to Advance Climate Change

**Subsistence:** The action or fact of maintaining or supporting oneself at a minimum level

**Sustainability:** Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations

**Vulnerability:** Vulnerability is the degree to which a system or unit (such as a human group or a place) is likely to experience harm due to exposure to risk, hazards, shocks or stresses. In relation to the concept of poverty, vulnerability is more dynamic since it captures the sense that people move in and out of poverty

## DROUGHT

### Water and Sanitation

Impacts: Water and Sanitation	Impacts: Livelihoods
<ul style="list-style-type: none"> <li>• Decreased water supply and availability</li> <li>• Reduced quality due to siltation and stagnant water</li> <li>• Increased demand on water resources for human consumption</li> <li>• Increased demand on water resources for agricultural irrigation</li> <li>• Increased demand on water resources for livestock watering</li> <li>• Increased temperatures cause increased surface water evaporation and evapotranspiration</li> <li>• Damage to fish habitat, loss from fishery production</li> <li>• Loss of navigability of rivers and canals.</li> <li>• Increased costs for Water companies on new or additional water supplies</li> <li>• Availability of water to fight wildfires is reduced</li> <li>• Rusting of water pipes</li> <li>• Reduced water supply for sewerage systems</li> <li>• Reduced water for flushing of toilets</li> <li>• Reduced water for residential purposes and hygiene</li> <li>• Higher costs, levels of competition and potential conflict for water resources between users including industrial facilities, power generators (for cooling and hydropower), public water suppliers and the agricultural community</li> </ul>	<ul style="list-style-type: none"> <li>• Increased casualties from dehydration</li> <li>• Increased geographical dispersal of water borne diseases</li> <li>• Decreased availability of fresh water supply (drinking water and for cooking purposes)</li> <li>• High livestock mortality rates</li> <li>• Decreased water supply causing dehydration</li> <li>• Decreased water supply reduces sanitation and hygiene</li> <li>• Decreased food production (food shortages)</li> <li>• Loss of human life from food shortages, heat, suicides, violence</li> <li>• Increase poverty rates</li> <li>• Water user conflicts</li> <li>• Low water supplies and water pressure make fire fighting more difficult</li> <li>• Fewer recreational activities</li> </ul>

### Health

Impacts: Health	Impacts: Livelihoods
<ul style="list-style-type: none"> <li>• Increased casualties suffering from dehydration</li> <li>• Inequity in the distribution of drought relief</li> <li>• Increase in heat-related illnesses such as dizziness, heat stress and illnesses</li> <li>• Increased infection and distribution of disease vectors</li> <li>• Loss of human life, wildlife and stock</li> <li>• Dehydration and other heat related ailments</li> <li>• Decreased sanitation from less available water leads to water-borne diseases such as cholera as risk of contamination increases as more people use limited water sources</li> </ul>	<ul style="list-style-type: none"> <li>• Lower productivity in the work place due to dehydration or heat stroke and loss of man hours</li> <li>• In drought people may choose to prioritise their time to getting water and food supplies rather than conventional work and so productivity may decrease</li> <li>• Increased mental and physical stress</li> <li>• Increased human mortality from food and water shortages, disease and heat stress</li> <li>• Hunger and famine</li> <li>• Threat to public safety as conflict will arise as resources become scarcer</li> </ul>

## Energy

Impacts: Energy	Impacts: Livelihoods
<ul style="list-style-type: none"> <li>• Limited water reduces hydro-electric energy supply</li> <li>• Increased demand for electricity during prolonged droughts and high temperatures as cooling demands for domestic and commercial use rises.</li> <li>• Increased episodes of power outages (black outs)</li> <li>• Hydroelectric power companies will need to look into other fuel sources or alternative renewable technologies</li> <li>• Knock on effects on other sectors such as increased demand for health services; problems in the transport sector; damage to fresh produce as a result of limited cooling</li> <li>• Increased water demands by sewerage treatment plants</li> </ul>	<ul style="list-style-type: none"> <li>• Increased costs resulting from higher energy demand, particularly increased peak demand in the summer for cooling</li> <li>• Spoilage of food</li> <li>• Increased costs associated with increased power usage</li> <li>• Power cuts lead to knock on effects such as reduced working hours which limits income</li> <li>• Reduced power limits transportation options</li> <li>• Environmental degradation from other thermal energy sources</li> </ul>

## Transport

Impacts: Transport	Impacts: Livelihoods
<ul style="list-style-type: none"> <li>• Water transport routes may become less navigable</li> <li>• Increased importation of water and food (higher costs)</li> <li>• Erosion and deposit of sand make roads impassable</li> <li>• Disruption of ground and marine transportation systems as a result of severe weather (e.g., strong winds unbalancing freight trucks, sea storms disrupting shipping, and local drought affecting the navigability of inland waterways)</li> <li>• The increase in extreme heat will lead to road surfaces melting, limiting some transportation operations and causing pavement and track damage</li> <li>• Increased intensity of strong winds would lead to more evacuations</li> <li>• Infrastructure damage and failure, and transportation interruptions</li> </ul>	<ul style="list-style-type: none"> <li>• Inability to travel to work and market places and seek health assistance</li> <li>• Increased food and fuel prices</li> </ul>

## FLOODING - Precipitation and sea surges

Impacts: Water and Sanitation	Impacts: Livelihoods
<ul style="list-style-type: none"> <li>• Decreased water supply and availability</li> <li>• Reduced quality due to siltation and stagnant water</li> <li>• Damage to water and sanitation infrastructure and interruptions in supply</li> <li>• Damage to fish habitat, loss from fishery production</li> <li>• Loss of navigability of rivers and canals.</li> <li>• Increased costs for Water companies on new or additional water supplies and infrastructure</li> <li>• Rusting of water pipes</li> </ul>	<ul style="list-style-type: none"> <li>• Increased geographical dispersal of water borne diseases</li> <li>• Decreased availability of fresh water supply (drinking water and for cooking purposes)</li> <li>• High livestock mortality rates</li> <li>• Decreased water supply reduces sanitation and hygiene</li> <li>• Decreased food production (food shortages)</li> <li>• Loss of human life</li> <li>• Increase poverty rates</li> <li>• Water user conflicts</li> </ul>

Impacts: Health	Impacts: Livelihoods
<ul style="list-style-type: none"> <li>• Increased infection and distribution of disease vectors</li> <li>• Loss of human life, wildlife and stock</li> <li>• Dehydration and other heat related ailments</li> <li>• Decreased sanitation from less available water leads to water-borne diseases such as cholera as risk of contamination increases as more people use limited water sources</li> </ul>	<ul style="list-style-type: none"> <li>• Increased mental and physical stress</li> <li>• Increased human mortality from food and water shortages and disease</li> <li>• Hunger and famine</li> </ul>

Impacts: Energy	Impacts: Livelihoods
<ul style="list-style-type: none"> <li>• Increased episodes of power outages (black outs)</li> <li>• Damage to infrastructure</li> <li>• Knock on effects on other sectors such as increased demand for health services; problems in the transport sector; damage to fresh produce as a result of limited cooling</li> </ul>	<ul style="list-style-type: none"> <li>• Spoiling of food</li> <li>• Increased costs associated with increased power usage</li> <li>• Power cuts lead to knock on effects such as reduced working hours which limits income</li> <li>• Reduced power limits transportation options</li> <li>• Environmental degradation from other thermal energy sources</li> </ul>

Impacts: Transport	Impacts: Livelihoods
<ul style="list-style-type: none"> <li>• Water transport routes may become less navigable</li> <li>• Increased importation of water and food (higher costs)</li> <li>• Erosion and deposit of sand make roads impassable</li> <li>• Disruption of ground and marine transportation systems as a result of severe weather (e.g., strong winds unbalancing freight trucks, sea storms disrupting shipping, and strong currents affecting the navigability of inland waterways)</li> <li>• Inundation of transport routes, transport infrastructure and distribution facilities and flood damage caused by rising sea levels</li> <li>• Flooding from increasingly intense downpours will increase the risk of disruptions and delays in air, rail, and road transportation, and damage from mudslides in some areas</li> <li>• Sea-level rise and storm surge will increase the risk of major coastal impacts, including both temporary and permanent flooding of airports, roads, rail lines, and tunnels</li> <li>• Increased intensity of strong winds would lead to more evacuations</li> <li>• Infrastructure damage and failure, and transportation interruptions</li> </ul>	<ul style="list-style-type: none"> <li>• Inability to travel to work, school and market places and seek health assistance</li> <li>• Increased food and fuel prices</li> <li>• Damage to vehicles from poor road surfaces</li> </ul>

## Annex 2 – Local adaptation options

Below is the complete list of the adaptation options identified through the Temeke Municipal Council and key local stakeholder workshops.

### Flooding – adaptation options

#### 1. Community based adaptation options

- Early warning signal for communities to move from harm's way
- Community Platform to ensure a bottom up approach to increase community awareness and sense of responsibility
- Increase capacity by means of Communication, Education and Public Awareness (CEPA)
- Relocation of communities to higher ground
- Boil water for consumption after extreme weather event

#### 2. Institutional adaptation options

- Coastal Protection Zones
- Re-establish coastal defences (i.e. Mangroves)
- Coastal Asset Protection bylaws
- Secure infrastructure
- CEPA
- Build/maintain storm water channels
- Policy and criteria for managing retreat
- Planning rights for construction on floodplains
- Building guidelines
- Flood mapping and monitoring
- Early warning system
- Disaster risk management

#### 3. Biophysical adaptation options

- Enhance and restore protective natural systems and buffers
- Preserve natural water corridors
- Promote permeable surfaces
- re-vegetate catchment areas
- Self-cleaning after the event
- Water diversions
- Avoid building on floodplains
- Restore and rehabilitate artificial reefs

#### 4. Infrastructural adaptation options

- Relocate transport routes
- Retreat hospitals and clinics
- Water proof vulnerable community energy infrastructure
- Elevate low lying transport routes

#### 5. Manage retreat

- Move vulnerable clinics
- Relocate low lying transport routes
- Relocate vulnerable communities

### 1. Community based adaptation options

- Establish permanent committees in community for water conservation
- Tree planting - educate communities as to the benefits (Shade, protection from flash flooding)
- Education about drought and its impacts
- CEPA - education on water saving
- Roadside water-wise campaign
- Reduce grazing

### 2. Institutional adaptation options

- Instigate a Early warning system for basic provisions
- Develop a Disaster Risk Reduction strategy plan of action
- Improve government policies and strategies
- Monitoring and evaluation of water management
- More diverse expertise from NGOs and regional government
- Campaign targeting youth through the media

### 3. Biophysical adaptation options

- Re-vegetate catchment areas – reduce erosion and help to slow down floodwater
- Create more permeable surfaces
- Establish and maintain natural water corridors
- Emergency natural reservoirs
- Drought-resistant crop options
- Natural urban parks

### 4. Infrastructural adaptation options

- New renewable energy sites and backup energy sources
- Water harvesting
- Emergency bulk water storage
- Water-saving fittings
- Desalination plant
- Hospital water tanks
- Alternative energy
- Insulate buildings for increased temperatures
- Feed-in tariffs
- Change road surfaces and lighten transport loads
- Boreholes and wells

### 5. Manage retreat

- Relocate water treatment plants