Building Climate Resilience

A Handbook for **Walvis Bay Municipality,** Namibia

A Handbook for adaptation to climate change and increasing resilience for Walvis Bay, Namibia

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

Adaptation IDRC CRDI DFID Department for International Development

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. CCAA's support for climate change initiatives aims to help Africans create better, more informed adaptation policies and plans. 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 Walvis Bay Municipality, Namibia. ISBN: 978-0-9921794-0-3
A copy of this report can be downloaded at www.ResilientAfrica.org.

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Cover image: Walvis Bay Municipality.

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Foreword

Climate change is anticipated to have severe physical, social, environmental and economic impacts in cities worldwide. These are expected to be experienced 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 climate change through pro-active planning and forward thinking, whilst considering the projected changes. In this instance, understanding the anticipated impacts on 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 as well as local government infrastructure and service delivery. As a strategy to tackle this, adaptation is becoming increasingly 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 Walvis Bay Municipality, produced as part of the Five-City Network Climate Adaptation Programme, 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 for Walvis Bay Municipality

The town of Walvis Bay, and indeed the entire country of Namibia is highly dependent on the port to secure imports and exports as it is one of the major links to the rest of the world. Due to the arable land space available, Namibia needs to import many goods ranging from fuel to food, and the predominant mining sector exports are necessary to enable a healthy Gross Domestic Product (GDP). With this in mind, it is essential that the functionality of the port is prioritised at the highest level with climate adaptation options keeping this functionality as a core goal to ensure the city's resilience to a changing climate.

However, there are very severe risks to the port and Walvis Bay in general from climate change - particularly a rise in sea level and more extreme storm surges. The sand spit, Pelican Point, is a natural barrier which alleviates many of the effects of storm surges by sheltering the harbour and the town. This sand spit is being eroded by wave action and it is essential that this is monitored and the spit maintained in order to conserve the ecological services that it naturally provides. This future maintenance needs to be carefully researched by a number of different disciplines in order to find the correct method at the lowest cost. Bear in mind that reinforcement with concrete is likely to move the wave action erosion to the areas around the concrete structure, undermining it and transferring the problem to different areas and will therefore not provide the best solution. One possible solution would be to harvest sand from the tip of the spit, which continuously grows naturally as more sand is deposited there through the nature of the currents, and transport it back to the areas at risk of breaching. It is acknowledged that this will be an ongoing process, however, it approaches the issue in a natural way, is not prohibitively expensive and is unlikely to cause further problems.

The Walvis Bay Municipality has done well to identify and work to alleviate certain stresses. The initiative and reactions shown over the past three years of this project has been superb. As many impacts of a changing climate may only come to the fore in the future, it is necessary that this impetus to adapt is maintained and the stresses continually re-evaluated. 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.

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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 adapting to, impacts associated with climate change. This tailor-made 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 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; Temeke 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).

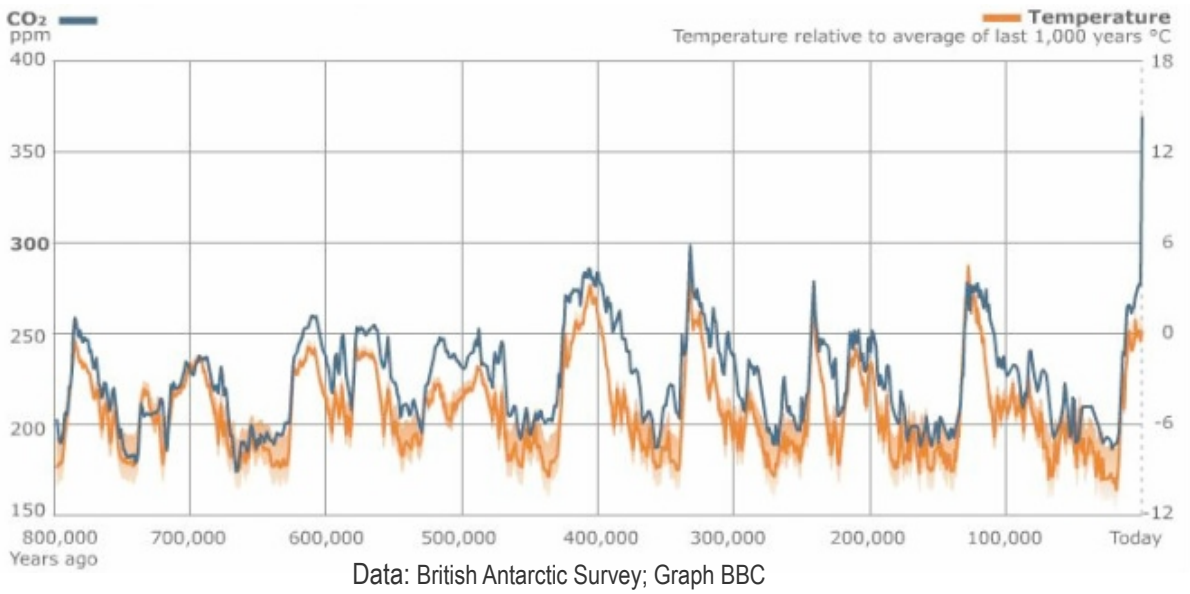
The five local governments were selected as they are each rapidly growing, urban centres located on the African coastline, comprising a broad range of urban socio-economic demographics. Each is considered to be a fast developing, coastal economic hub with harbour and is fundamental when considering national 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_2) being released into the atmosphere. As can be seen in the British Antarctic Survey's data of atmospheric CO_2 levels over the past 800 000 years, it is clear that a rise in CO_2 directly correlates with a rise in temperature. Due to human activity, the level of atmospheric CO_2 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_2 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 4th 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.



Data: British Antarctic Survey; Graph BBC

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.

While CO_2 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 Adaptation Network have already noticed the effects of a changing climate.

1.2 About the Climate Resilience Handbook

This Climate Resilience Handbook draws upon a participatory, consultative process that has worked through the identification of climate related risks, impacts and adaptation options prioritised by the Walvis Bay Environmental Management Forum, a key Stakeholder Platform officially recognised by 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 Walvis Bay's municipal jurisdiction, so that the local key stakeholders can identify 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 whilst focusing specifically on Walvis Bay Municipality, providing an account of the projected changes in climate that are anticipated to compromise the municipality's basic services, functions and livelihoods of the various communities and public sectors that fall within the Walvis Bay 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. It should be noted that **the Climate Resilience Handbook's success is dependent on 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 together with a variety of key local stakeholders. This involved undertaking a number of participatory processes aiming to provide guidance and steps for the implementation of actions towards enhancing resilience to climate change for Walvis Bay Municipality. 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 Resilience Handbook?

This Handbook represents a culmination of processes that Walvis Bay Municipality and key stakeholders have undertaken in collaboration with ICLEI-Africa and the other local governments that partnered in the project. This has created 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 Walvis Bay Municipality 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 Walvis Bay Municipality.

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 on 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 equilibrium until there is some form of external disturbance exerting pressure on that environment. Disturbances are a natural part of all environments, including natural environments, 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.


Image: V Stephen

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. Some of these documents are listed in section 1.3 and are available to download at www.ResilientAfrica.org.

Walvis Bay 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 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 change resilience

Members of the Topnaar community traveling to market using traditional donkey carts. Image: ICLEI-Africa

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. However, 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 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 ensure 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.

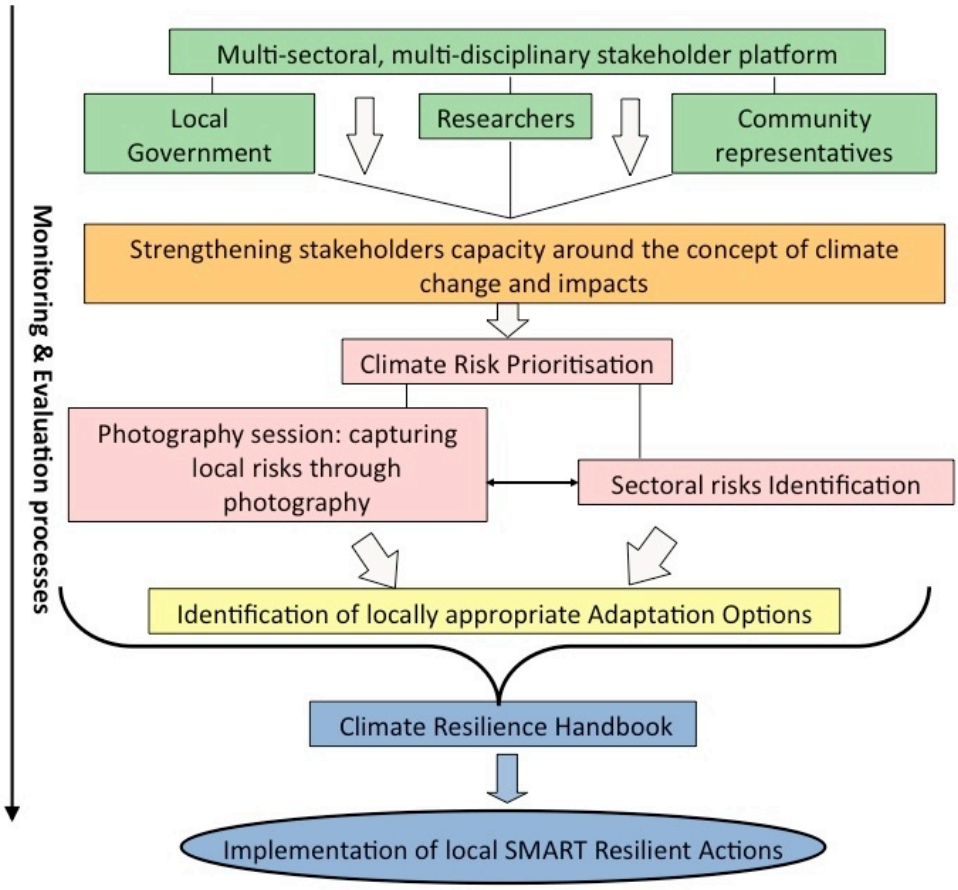


Figure 2.1 Illustrated step by step process undertaken within the timeframe of this project to enhance and improve climate adaptation and thereby increase climate resilience.

Each participating local government has completed the steps outlined in Figure 2.1 whilst developing, in a participatory manner this Climate Resilience 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 Walvis Bay Municipality is to anchor this Handbook within the relevant government structures, (i.e. local, regional governments) and planning tools, and to start implementing the identified adaptation options.

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. A sea storm surge event in Walvis Bay has consequences for local economic activities such as the fishing industry, for municipal services such as road infrastructure, and for the local birdlife. Flooding events can compromise energy and waste services, impacting the local community and potentially leading to losses in productivity as well as potentially placing added pressure on health services. Any measure to tackle the consequences of this 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, 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 identification 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 weaknesses and strengths are and keep all stakeholders informed.

3. Climate change projections for Africa

Below follows a brief summary of the projected climatic changes for Africa, Namibia and Walvis Bay. More detailed information can be found in the Climate System Analysis Reports for Southern Africa and the downscaled climate change report for Walvis Bay.

Although there are some uncertainties surrounding the understanding of Earth's complex systems, there is strong evidence in current literature and climatic measurements to demonstrate that, as a result of increasing green house gas emissions, atmospheric and sea surface temperatures are rising. As a result we can expect impacts on our 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 maintain basic service delivery, as is the case for Southern Africa.

Due to increasing atmospheric and sea surface temperatures we can expect a number of climatic changes that will impact upon the Earth's social-ecological systems:

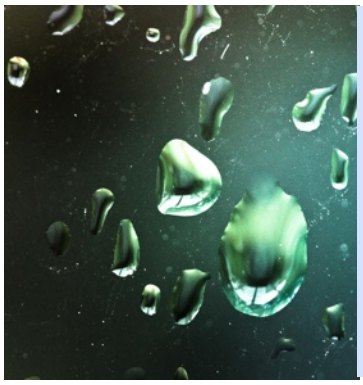
- Changes in rainfall and precipitation patterns (flooding and drought),
- Increases in temperature,
- Increasing frequency and intensity of storm surges or extreme events,
- Increasing average global sea levels due to melting glaciers and thermal expansion, and
- Changes in wind speed and direction.

Although Africa is a continent with abundant natural resources it still remains the most underdeveloped continent globally. Development is slowed by extreme poverty, poor access to water, sanitation and 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 of climate change (IPCC, 2007). Its 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.


Images: V Stephen

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 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:

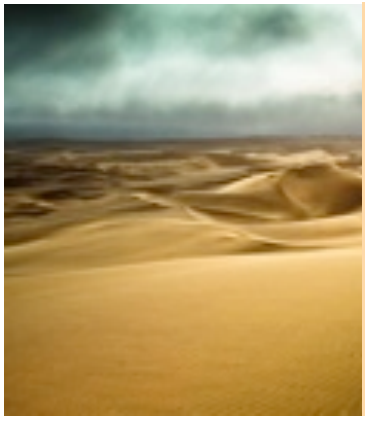
- Over the next 50 years extreme weather events are anticipated to increase in frequency and intensity on the African continent,
- Tropical cyclones (typhoons and hurricanes) will likely become more intense with larger peak wind speeds and heavier precipitation, and
- There are strong indications that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

It has been projected that climate impacts on Namibia's natural resources would cause annual losses of 1 to 6% of GDP. Livestock production, traditional agriculture, and fishing are expected to be hardest hit, with a combined loss of US$461 to $2,045 million per year by 2050. (Reid *et al*. 2007; SREX, 2012)

3.1 Climate change projections for Namibia and Walvis Bay Municipality

Coastal urban areas are regarded as being the regions most vulnerable to the impacts of climate change, due to their geographic (proximity to the ocean) and topographic (altitude relative to mean sea level) location, heavy development pressure and urban population growth, which is increasingly focused on coastal regions and often accommodate large populations of poor communities (Fairhurst, 2009). Coastal settlements in low-lying areas tend to be vulnerable to the impacts of sea-level rise, as even a small rise in mean sea level can have severe impacts on coastal infrastructure, services, natural resources and livelihoods. It can also cause saltwater intrusion into freshwater aquifers and erosion of the coastline (MSM, 2009).

Namibia's arid environment, recurrent drought and desertification have contributed to make it one of the most vulnerable countries in Africa to the effects of climate change. Considering the natural resource-based economy and limited technical and financial resources, climate change could potentially become one of the most significant and costly issues that affect the national development processes in Namibia (MET, 2003).



Climate change projections for Namibia include:

- A hotter climate with a 2°C increase in temperature by 2050
- More variable rainfall
- Increased evaporation (20% by 2020)
- A rise in mean sea level
- Increased coastal erosion as a result of sea-level rise and sea storm surges (this impact has already been observed)
- Increases in mean sea surface temperature which are anticipated to shift wind and pressure regimes, and upwelling processes (which in turn are anticipated to change primary production in the Atlantic Ocean)

Walvis Bay Municipality has been identified as the Namibian coastal municipality most vulnerable to sea-level rise (UNFCCC-NAM, 2009). It is protected by a sand spit called Pelican Point, which currently provides a barrier against storm surge events and impacts associated with mean sea-level rise. Sea-level rise and changes in the mean sea surface temperature are anticipated to have a number of social, environmental and economic impacts on Walvis Bay Municipality. Pelican Point protects the harbour as well as Walvis Bay Municipality from the effects of sea storm surges. However, this spit is being rapidly eroded. The effects on Pelican Point's capacity to protect Walvis Bay will be key for shaping the city's future.

Climate change projections indicate the following anticipated impacts for Walvis Bay:

Sea-level rise

Image: ICLEI-Africa

- Sea-level rise in combination with an increase in the frequency and intensity of storm surge events can, if it reaches critical levels, breach the Pelican Point sand spit,
- Without the protection of Pelican Point, the coastline of Walvis Bay Municipality and the harbour will become highly vulnerable to mean sea-level rise, storm surge events and subsequent impacts (coastal erosion, permanent and temporary inundation, salt water intrusion into freshwater aquifers, contamination of water resources, infrastructure damage and a loss of natural resources),
- As Walvis Bay is only 3m above mean sea level at its highest point, it is particularly vulnerable to the effects of even a relatively small rise in mean sea level. By 2100, a 20cm rise in sea level will greatly enhance coastal erosion leading to a coastal setback estimated at almost 100m. Extreme weather events coinciding with spring tides will increase this overall rise up to as much as 6m in unsheltered areas. In the long-term it is likely to cause permanent inundation of low-lying coastal areas and complete disruptions to infrastructure and development along the coast,
- This will, in turn, have implications for the offshore and onshore diamond industry, and
- Compromise opportunities for coastal tourism and coastal recreation. According to climate change projections for 2030, Walvis Bay will experience a coastal set-back, which inevitably will alter the entire coastal landscape and its activities. In addition to rising sea-levels, Walvis Bay has during the past three years experienced issues with **flooding** that have severely impacted upon several aspects of the local economy and peoples' livelihoods:

Flash flooding

- **Heavy rainfall**, which has historically been very infrequent in the catchment area, has recently caused a number of flash floods along the Kuiseb River delta, damaging water and electricity supply infrastructure and thus exacerbating vulnerabilities for some communities and their livelihoods.
- **Sea storm surges** also cause impermanent coastal flooding, and with the increased intensity and frequency of such events, more flooding and associated erosion can be expected, and
- **Flooding**, whether it is due to storm surges, mean sea-level rise or heavy rainfall, has a number of impacts on Walvis Bay Municipality and its immediate surrounding areas. Roads become severely eroded, and saltwater intrusion into the water aquifer puts pressure upon potable water supply infrastructure, compromising water quality. This can endanger lives, it reduces accessibility in and out of town for businesses and individuals, and it has a number of knock-on effects due to the interconnected nature of infrastructure and services, on the fishing industry (particularly export to Europe) and on vulnerable impoverished communities in particular (such as the Topnaar community who require access to and from market).

It should be noted that the impacts of climate change do not occur in isolation, but are all part of very complex and much larger climatic systems. For example, the anticipated increased mean sea surface temperature in the Atlantic Ocean and the prevailing wind speed and direction, are believed to change the upwelling processes. This may possibly result in changes to the productivity of the marine resources on which Walvis Bay Municipality's and Namibia's national economies are dependent.



Flooding in Walvis Bay in 2011 and erosion alleviation measures on Pelican Point. Images: ICLEI-Africa

Other impacts on Walvis Bay associated with climate change are:

- An increased number of extreme weather events,
- Loss of important biodiversity, as well as terrestrial and marine natural resources,
- Changes in local temperature and precipitation,
- An increase in sand storms through strong winds, and
- Increased health problems due to heat stress.

Climate change impacts - sea-level rise


Images: ICLEI-Africa

The majority of Walvis Bay's freshwater supply comes from an underground aquifer located in the lower part of the Kuiseb river delta at Rooibank and Dorop South. Sea-level rise has already begun to impact upon the aquifer as well as the infrastructure. First of all, the quality of the fresh water is at risk of being compromised by saltwater intrusion. This requires a long-term action plan and solutions and alternative options need to be sourced.

Secondly, sea water (from sea-level rise and flooding) is causing pressure on the underground water pump station, and some pumps have started to rise up from below.

In October 2010 Walvis Bay Municipality experienced a significant sea storm surge event that ripped the guano platform into pieces. The platform is a human-made wooden structure that is located at Longbeach and extends into the sea. It has a large bird population inhabiting it and is a popular tourist attraction. (It provided roosts for the northernmost population of crowned cormorants, the largest population of white-breasted cormorants and several other species including great white pelicans and African black oystercatchers).

After the storm surge, debris from the platform washed up along the coastline, which required extensive clean-up actions. Damage to the platform, is suspected not only to impact on the bird population, it may also result in the loss of a birdwatching asset and ultimately, the associated tourism.

3.2 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 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 Walvis Bay climate impacts and Sectoral Risk Baseline Study included a thorough assessment of existing strategies and policies relevant for managing sustainability and building resilience for Namibia and Walvis Bay.

Some of the national key tools and institutions identified are:

- Namibia's Green Plan (presented to the UNCED conference in Rio 1992), the ratification of the Kyoto Protocol in 1993, and the legal obligations following the agreement to the UNFCCC in 1995.
- The Initial National Communication on the status of climate change and actions to reduce the projected impacts.
- Vision 2030, which is aligned to the Millennium Development Goals and has a number of sustainability targets, aims to transform Namibia into a developed high-income country.
- Namibia's participation in the Conference Of the Parties (COP) Climate Change Convention and its membership in the G77+China.
- Namibia further has a National Climate Change Committee (NCCC): A multi-stakeholder committee that advises government on policies and strategies required for dealing with projected climatic changes.
- The National Climate Change Policy (NCCP), currently in its developing phase, aims to provide a legal framework and overarching national strategy for development, implementation, monitoring and evaluation of climate change mitigation and adaptation activities.
- The National Adaptation Action Plan, currently in development through the UNDP's AA Programme.

Since Walvis Bay Municipality's reintegration into Namibia in 1994, the municipality has actively worked towards sustainable management and integration of environmental issues across decision-making and forward-planning processes. Below are a number of initiatives that aim to address these issues.

- The Environmental Management Fund is a grant programme established in 2001 which aims to finance activities and initiatives for environmental and nature resource management.
- The Walvis Bay Local Agenda 21 Project for achieving sustainable development was initiated in 2001. It includes the Walvis Bay Nature Reserve Management and Operational Plans.
- The Coastal Area Action Plan addresses coastal issues in Walvis Bay, including the lagoon, the harbour and Pelican Point.
- The Sea Shore by-law regulates use of the sea shore, the sea and its environment. (Walvis Bay and Off-Shore Islands Act 1).
- Walvis Bay has also joined the Local Action for Biodiversity (LAB) Programme, an initiative launched by ICLEI addressing the importance of urban biodiversity.
- The Walvis Bay Local Biodiversity Strategy and Action Plan (LBSAP) is a milestone of strategic planning on the way to 2030.
- Walvis Bay Municipality has an Integrated Environmental Policy outlining environmental responsibilities for the municipality, and a Coastal Strategic Environmental Assessment which was commissioned in 2005 to provide a balanced protection of the coastal environment.

An Integrated Coastal Zone Management Plan is currently being developed, and the plan will be used to integrate environmental considerations into development and management plans for the Walvis Bay Municipal coastline. (The Walvis Bay Baseline Study provides a more detailed account of local governance tools and institutions relevant for building local resilience and can be downloaded at www.ResilientAfrica.org or is available on request from David Uushona DUushona@walvisbaycc.org.na.)

4. Risks for Walvis Bay Municipality

Through a series of Stakeholder Workshops, the Walvis Bay Municipal stakeholders have identified which climatic variables, their projected changes, sectoral risks and adaptation options are anticipated to have the most significant impact on the municipality's climate resilience.

The key local stakeholders identified sea-level rise and flash floods as the climate change variables exerting the most pressure upon service-delivery, infrastructure and local communities.

Key local stakeholders for Walvis Bay Municipality identifying and prioritising adaptation options during the consultative process. Images: ICLEI-Africa

The importance of the !nara plant

The Topnaar community is a self-reliant community living just outside the Walvis Bay Municipal jurisdiction, close to the Kuiseb River Delta. Their main source of income and livelihood is through livestock and the !nara plant which grows alongside the river bed. As the !nara plants are located in low-lying areas, most get washed away during flooding events, which has severe impacts on the Topnaar community's livelihood.

The Topnaar community also graze their goats along the banks of the river. Flash flooding may separate the owners from their livestock, and as the elders are considered too weak to make the journey from one side of the river to the other, the children are sent to traverse and fetch the livestock animals. If they are unable to gather them, the goats move away and are sometimes lost, resulting in severe economic and asset loss. The children are therefore also in danger of being hurt, or drowning, and sometimes they too get cut off from by the flood and have to spend the night on the other side of the river without shelter.

Image: Harald Süpfle, Wikimedia Commons

The !nara plant plays an important role in stabilising sand dunes, being one of the few plants that can survive in these conditions. Their tap roots are able to extend up to 40m underground to water, and thus contributes to stabilising windblown sand. Dune stabilisation reduces the intensity of windblown sand particle movement and the buildup of sand particles around infrastructure such as electricity pylons, which may cause structural damage or, if the buildup is intense, the collection of sand may infringe on the power lines and interrupt power supply.

It has been reported by community members in and around Walvis Bay Municipality, that these !nara plants are declining in number, not only destabilising sand dunes but threatening the livelihoods of the historical Topnaar community and other wildlife that also depends on them. The decline in numbers is reported to be largely due to decreased groundwater levels from the extraction of water for potable use in Walvis Bay and Swakopmund Municipalities (Breuninger, 1997). Less water affects the plant's ability to reproduce by affecting the male's flowers and the female's fruits (Eppley & Wenk, 2001).
In addition, salt water intrusion into the aquifer has increased the !nara plant's salt uptake and many of their roots are now encrusted with salt crystals.

4.1 Reasoning with 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 and their chosen actions.**

As stated in the Climate Risk Concept Paper, 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).

Where the wind blows

Walvis Bay Municipality is reportedly experiencing an increase in sand storms and wind-blown sand. Although it is difficult to pin this down as a direct result of climate change, it is a climatic event that together with other climatic variables impacts Walvis Bay's economic sector, and peoples' health and livelihoods.

According to a consultative process with Topnaar community members, when there is a sandstorm, the community cannot travel to and from market in the urban centre with their donkey carts, which results in the loss of opportunities to sell their products. Windblown sand also has negative health impacts, and may cause respiratory discomfort and diseases.

Image: Asco, Wikimedia Commons

During sandstorms in the past, the visibility has reportedly been so poor that the road to the airport could not be used, and all air traffic suspended. The sand particle movement also erodes the road surfaces, blocks water pumps and covers the railway tracks. The municipality employs people to sweep the railway tracks as the train supplies surrounding regions and countries with commodities moving to and from the port.

If sand storms and windblown sand continue to increase in scale and frequency, this will exacerbate the impacts of other climatic changes, like damage to infrastructure and compromised livelihood options, especially for vulnerable people.

Flash floods and the ice supply

Walvis Bay is a very dry area that typically receives little rain. The Kuiseb is an episodic river and as such only flows after rainfall. After a heavy shower it can be prone to flash flooding. Due to recent extreme weather events with heavy rainfall, the upper catchment area flooded, creating a flash flood that caused damage to water supply infrastructure, resulting in serious impacts on residents, businesses and the fishing industry.


Image: V Stephen

The fishing industry is dependent on the water supply for quality water and ice to store the fish on. If Namibia wants to export its fish to the EU, which is a big market, there are very specific requirements regarding the ice on which the fish is stored. If the ice standard is compromised, the door to the EU market is closed. In the 2011 flash flood, a water pipe broke and the town was without water until the pipe was fixed. The flood water also made it difficult to access and mend the broken pipe, further delaying the water supply.

The plight of Pelican Point

A major feature in Walvis Bay's coastal landscape is Pelican Point - the sand spit that stretches around the harbour, creating a sheltered environment for both the important marine ecosystems that exist, and Walvis Bay's main economic sector – the fishing industry. The sand spit is now being eroded at a rate which puts it at risk of shrinking in size to an extent where it no longer provides shelter for the harbour. The erosion is caused by three main factors: mean sea-level rise, storm surge events and coastal erosion. In other words, the sand spit is being eroded from all sides. A possible impact of this is that ships may not be able to dock at port during storm surges if the sand spit has lost its capacity to shelter the harbour.

In this example, there are multiple risks to be considered. The risk of economic losses due to compromised docking conditions in the harbour may have long-term negative economic impacts for Walvis Bay Municipality. If the sheltering-capacity of Pelican Point is lost, the tourism- and recreation industry is also likely to suffer due to coastal erosion. The risks of damage caused by sea storm surge events will also increase, as will the pressure on coastal infrastructure as well as services.


Image: ICLEI-Africa

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 Walvis Bay Municipality 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).

Water and sanitation	**Livelihood impact**
Salt water intrusion	Compromised potable water quality, health risks
Damage to infrastructure	Reduced water availability
increased flooding	Damage to infrastructure, danger to public health, loss of property
Transport	
Erosion damaging infrastructure	Limited access, loss of work hours and income
Increased risk and accidents	Danger to public health
Health	
Increased pressure on emergency services (temporary and permanent impacts)	Increased health risks
Energy	
Erosion of coastal power lines	Limited water supply for drinking, industry and agriculture

Table 4.2.1. Prioritised risks and impacts relating to climate change for Walvis Bay Municipality.

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 that it 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 Walvis Bay Municipality 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, which organises them in a manner that addresses all the identified and prioritised risks, whilst keeping an emphasis on interconnectivity and local relevance for Walvis Bay. They address both climatic variables – sea-level rise and flash floods and will form the climate SMART Goals for Walvis Bay.

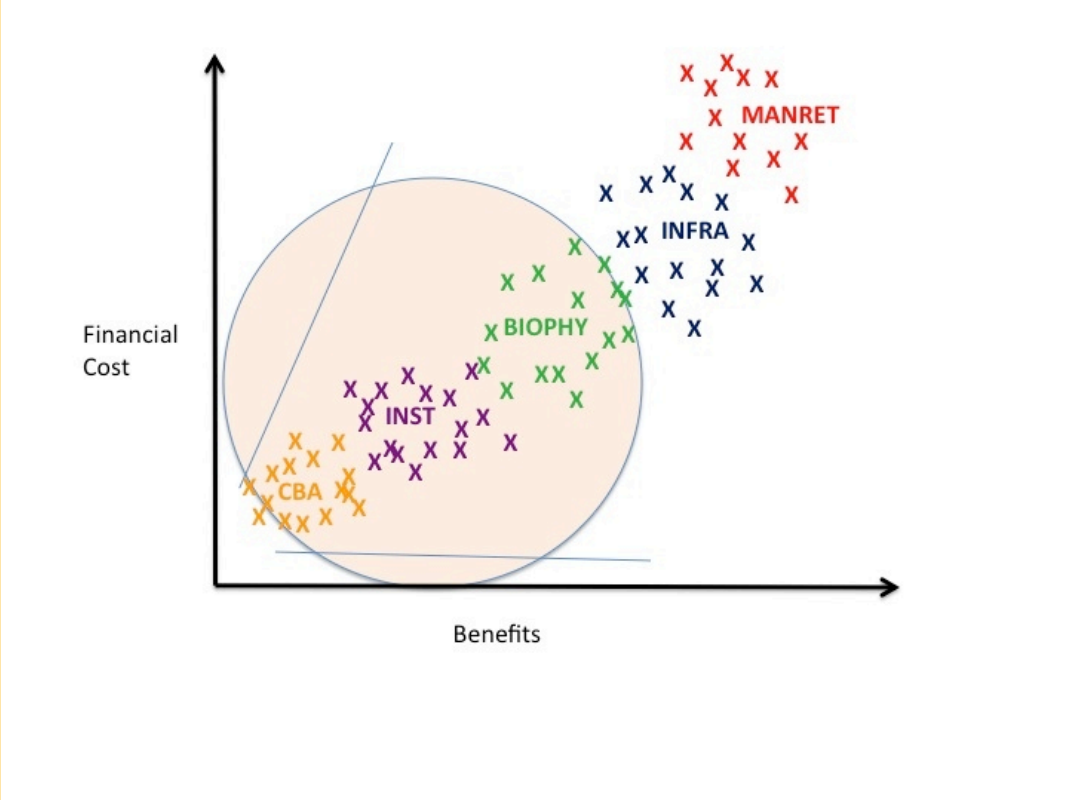
These options are not exclusive of the implementation of additional climate adaptation goals.

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. The Walvis Bay Municipality 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.

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.

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 initiatiate 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.

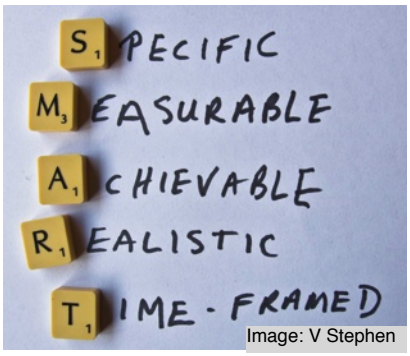


Image: V Stephen

The five prioritised options (listed in the box below) will be designed for implementation through setting **SMART Goals** and breaking them up into deliverables and actions with assigned responsibilities. 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.

To complete the SMART Goal templates for Stabilising Pelican Point (SPP) Climate Change Communication, Education and Public Awareness (CEPA), Coastal Protection Zone (CPZ), Disaster Risk Reduction Strategy (DRRS), an Integrated Development Plan (IDP), and Stabilising Pelican Point (SPP), please go to www.ReslientAfrica.org.

The proposed SMART Goals for Walvis Bay Municipality based on the consultative process are:

1. **Stabilising Pelican Point (SPP)**: As Pelican Point is a natural barrier limiting the effect of sea storm surges and protects Walvis Bay from these effects, it is essential to monitor and maintain this sand spit that is being eroded through wave action. Bear in mind that the best method of doing this is an ongoing removal of sand from the ever-growing tip of the point and moving it to reinforce where the spit is being compromised. Concrete structures will be eroded around the edges by wave action and will compound the overall problem.

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 Coastal Protection Zone (CPZ):** Implementing a CPZ is an internationally recognised tool for protecting vulnerable coastal areas and maximising sustainable social and economic benefits. It also brings coastal issues high up on the political and administrative agenda, which is essential for Walvis Bay if the city is to maintain its coastal assets and services.

4. **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.

5. **Mainstreaming adaption at the local government level through the Integrated Development Plan (IDP):** The IDP 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 stakeholders and is frequently re-evaluated.

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 Walvis Bay 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.

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, Walvis Bay Municipality 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 Walvis Bay Municipality.

Walvis Bay Municipality has:

- **Demonstrated international commitment**: By signing the Durban Adaptation Charter and through joining the Local Action for Biodiversity (LAB) Programme and Local Agenda 21. Further to this, the various commitments by Namibia's national government (The Green Plan, the Kyoto Protocol) entails policies and actions relevant for the local level as well.
- **Started the process of mainstreaming adaptation into government planning**: The participatory research undertaken through this project has contributed to making adaptation to climate change a priority for Walvis Bay Municipality.
- **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**: The Topnaar community has 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 and in the LAB Programme, Walvis Bay is part of a network of cities and municipalities worldwide committed to enhancing local biodiversity and 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 resilience for the cities, 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, Walvis Bay Municipality has already built the foundation for implementing resilience. This handbook is a result of a participatory process, and the adaption options, risks and vulnerabilities were identified and prioritised by the stakeholders.This, together with the work done by Walvis Bay Municipality on the Environmental Management Fund, the Coastal Area Action Plan, the Local Action for Biodiversity (LAB) Programme and the Coastal Strategic Environmental Assessment shows that the Municipality is geared towards a sustainable and resilient future. The steps that have been taken and the knowledge gained has put the city in a position to adapt to an uncertain future through climatic changes. **This means that Walvis Bay Municipality can start immediately with defining the various steps for implementation**.

Step 2: Identify resources needed to start making decisions

It's 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. As Walvis Bay has been identified as the Namibian region most vulnerable to sea-level rise, the cost of inaction is likely to be very high as time passes.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. For example, one of the SMART Goals for Walvis Bay Municipality is Mainstreaming adaption at the local government level through the Integrated Development Plan (IDP). 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 CEPA (Community, Education and Public Awareness) 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? Walvis Bay Municipality has begun good work in this arena, particularly with the Topnaar community, providing cellular telephones in order to implement early warning systems and keep the community abreast of risks and more able to react to extreme events.

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) it is realistic that the goals will be achieved and the adaptation option successfully implemented? 2) Determine how these steps will make Walvis Bay a more resilient municipality. 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

The Walvis Bay Municipality has already achieved a great deal as can be seen by the many good practice examples within this Handbook. Having participated in the Five-City Network Project over the past three years, the Municipality has shown the necessary willingness to adapt and is well placed to achieve much more and move toward a climate resilient city.

It needs to be reiterated however, that the production of this Handbook does not indicate the end of the project, but the content and goals need to be carried forward with a continuing group of key stakeholders in order to make the goals affective. A recommended measure of carrying this out would be to officially recognise this group of stakeholders, which should comprise of members of the municipality, ministry members from all necessary departments, individuals from within the private sector as well as industry players. If the group or platform were to be officially recognised, then it would ensure that there was a mandate given to allow for time spent by each department member, provide the necessary cross-departmental communication, and move all individuals towards the common goal.

The town of Walvis Bay will in the future experience the effects of the changing climate, indeed those changes are already being felt. It is clear that Walvis Bay will confront severe challenges, specifically in terms of a rising sea level, and must therefore focus as much attention as possible on the maintenance and security of Pelican Point, which will help to buffer sea storm surges, likely to otherwise inundate the town. To fully adapt to these futures changes, Walvis Bay will need to rely on the ability and willingness of the ministries, industry, agricultural sectors and the general populace to all work towards sustainable adaptation in order to secure livelihoods and ensure the future of the town.

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:

Breuninger, B. (1997). Minutes from the !Nara workshop: Topnaar community and the Desert Research Foundation of Namibia, 19 November 1997, Lauberville.

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

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

Eppley, S.M. & Wenk, E.H. (2001). Reproductive biomass allocation in the dioecious perennial *Acanthosicyos horrida*. South African Journal of Botany 67: 10–14

ICLEI-Africa. Local Interactive Climate Change Risk and Adaptation Prioritisation Training Tool (RAP)

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

MET (2003). Namibia and Climate Change. Ministry of Environment and Tourism

MET (2009). Green Paper: Towards a Coastal Policy for Namibia. MET, 80

Reid, H., L. Sahlén, J. MacGregor, and J. Stage. (2007). The economic impact of climate change in Namibia: How climate change will affect the contribution of Namibia's natural resources to its economy. Environmental Economics Programme Discussion Paper 07-02, International Institute for Environment and Development, London, UK, 46 pp

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

Tibbets, J. (2007). Environmental Health Persepctives. Driven to Extremes. Health Effects of Climate Change. Vol. 5(4)

UNFCC-NAM (2009). Sea-level Rise in Namibia's Coastal Towns and Wetlands: Predicted Impacts and Recommended Adaptation Strategies. Final report

12. Glossary

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

MRV: Measurable, reportable and verifiable

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

Annex 1 – Identified risk per sector

Water and Sanitation

Impacts: Water and Sanitation	Impacts: Livelihoods
• Salt water intrusion into freshwater systems in coastal zones is anticipated to increase • Increased salinity levels of recycled 'grey' water • Flooding causing strong water flows in aquifers thus increasing capacity for water • Decreased availability in freshwater for domestic and industrial use • Sedimentation of aquifers • Ground water level changes; the system is already reduced due to extraction by Walvis Bay and Swakopmund Municipalities • Reducing quality of water in aquifers • Reduced ability to extract water if infrastructure is flooded • Water treatment capacity will decrease if insufficient fresh water is available • Poor and limited water supply for domestic and industrial use • Floods will damage private and municipal infrastructure	• Increased pressure and stress on fresh water supply • Impacting water sanitation in the vulnerable areas • Cascade effect on health as a result of increased likelihood of contamination of fresh water sources • Poor water access and poor water quality

Transport

Type	Impacts: Transport	Impacts: Livelihoods
Road	• Blockage of roads, in particular the seafront highway joining Swakopmund and Walvis Bay • Flooding causes diversions • Traffic congestions and accidents • Inundation of roads by water or sand • Erosion of bridges, pavements and roads adjacent to the coast	• Limits access routes • Delays to the work place and markets • Work hours lost– reducing income • Risk to public safety
Rail	• Erosion of railway infrastructure • Inundation of railways by water or sand • Reduced use of rail as a sustainable public transport system.	• Causes delays and cancellations of trains • Unable to reach destination • Work hours lost– reducing income
Air	• Reduction in business transacted through Walvis Bay and the surrounding areas that the airport services.	• Reduces accessibility to airports • Delay in exports/imports
Port	• Erosion to coastal infrastructure and equipment • Damage to boats at sea if storms are more intense as expected, with additions to the Skeleton Coast wrecks (likely) • Erosion to harbour wall • Damage to boats anchored at port, both private yachts and commercial vessels • Proposed extensions to the port should carefully consider vulnerabilities to climate change impacts	• Days at sea lost • Work hours lost – reducing income • Delay in exports/imports

Health

Impacts: Health	Impacts: Livelihoods
• Large waves, storms and flooding cause injury or death from drowning, electrocution, carbon monoxide poisoning and communicable diseases that often arise in the cleanup stage after such events when clean water and sanitation delivery is still affected • Increased deaths from heat waves • Increased pressure on emergency services in extreme events, with service delivery backlogs in clinics and hospitals • Chemical Hazards: contamination of flood water with oil, diesel, pesticides, fertilizers etc • Spread of infectious diseases within communities as sanitation provision suffers and water contamination occurs: skin (cutaneous leishmaniasis) and respiratory diseases and diarrhea disease (cholera), of particular risk to the young and infirm • The altered spatial distribution of some infectious disease vectors may come into play as climate change is expected to have some mixed effects, such as a decrease or increase in the range and transmission potential of malaria in Africa (IPCC 2007) • Increased frequency of cardio-respiratory diseases due to higher concentrations of ground-level ozone related to climate change (IPCC 2007) • Increases in malnutrition and consequent disorders, with implications for child growth and development (IPCC 2007). • Harmful Algal Blooms (HAB) outbreaks may increase posing a threat to those who collect mussels and other seafood along the coast. These pose a threat to both human and marine life (Tibbets 2007)	• Increased causalities with associated social and economic costs • Hours of work lost thus business productivity decreases • Medical bills to pay, particularly by vulnerable communities for whom this may be an expense they can't meet • Poor and limited water supply to residents leading to compromised immune systems, disease and morbidity

Energy

Impacts: Energy	Impacts: Livelihoods
• Erosion of coastal power lines - it is already been reported that mean sea-level rise is causing a softening of the soil surrounding poles, resulting in the instability of energy network pylons • Flood inundation would cause damage and losses to energy production facilities and infrastructure (power stations, high voltage lines etc) and reduce or negate their ability to meet energy needs • May cause an increased demand for energy as temperatures rise or fall the need for climate control in homes and commercial space increases • Power outages due to floods destroying power lines • Energy supply cut for bore hole water pumping • Loss of fresh produce from cold storage • Storage and landing facilities for import of fossil-fuel energies needs to be able to withstand increased storm frequency and potential inundation to prevent spillage • Changing to alternative energy production mechanisms such as solar and wind need careful consideration to ensure they are sustainable even in the face of a changing climate	• Limited fresh produce for consumption • Limited water supply for drinking, agriculture or industry • The Walvis Bay economy relies heavily on fishing and fish processing plants for jobs and income; the ability to freeze and store fish must be protected from energy uncertainties • Power-outs can impact the functioning of hospitals

Annex 2 – Local adaptation options

Below is the complete list of the adaptation options identified through the Walvis Bay Stakeholder Workshops.

Sea-level rise – 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

2. **Institutional adaptation options**
   - Coastal Protection Zones
   - Re-establish coastal defences (i.e. Pelican Point)
   - Coastal Asset Protection bylaws
   - CEPA
   - Establish risk and vulnerability maps
   - Policy and criteria for managing retreat

3. **Biophysical adaptation options**
   - Enhance and restore protective natural systems and buffers
   - Investigate alternate crop i.e. saline tolerant food crops (Hoodia? Could be added crop for Topnaar community. Drought tolerant with a high commercial value. Will bring in income and take pressure off the wild populations which are being poached due to their value.)
   - Restore and rehabilitate artificial reefs

4. **Infrastructural adaptation options**
   - Raise harbour defences
   - Implement mobile hospitals and clinics
   - Water proof vulnerable community energy infrastructure
   - Make use of dykes/bulkheads/seawalls along coastal areas at risk to sea storm surges
   - Elevate low lying transport routes

5. **Manage retreat**
   - Move vulnerable clinics
   - Relocate low lying transport routes
   - Relocate vulnerable communities

Flooding – adaptation options

1. **Community based adaptation options**
   - Promote and implement jobs next door reducing the need for daily travel over larger distances
   - CEPA and family planning (the smaller the family the easier it is to look after and keep out of harms way)
   - Boil water for consumption after extreme weather event
   - Develop Moisture conservation pits for harvesting during times of drought
   - Community self cleaning after an event
   - Grey water recycling from households- particularly offices or tourism venues which use more water. Household water can be used in the garden reducing the need for watering, reducing dust and eventually filtering back to underground water sources.

2. **Institutional adaptation options**
   - Instigate a Early warning system for basic provisions
   - Develop a Disaster Risk Reduction strategy plan of action
   - Develop flood mapping and monitoring
   - Incorporate flooding within building guidelines
   - Proactive planning for sustainable transport routes
   - Integrated development plan to incorporate: flood plains, protection zones

3. **Biophysical adaptation options**
   - Re-vegetate catchment areas – reduce erosion and help to slow down floodwater
   - Re-establish and maintain dune systems
   - Create more permeable surfaces
   - Establish and maintain natural water corridors
   - Investigate innovative water harvesting techniques

4. **Infrastructural adaptation options**
   - Make available pumps and generators at risk prone stations. Install wind and solar energy.
   - Create dams and flood walls to capture excess water
   - Build a bridge across the Kuiseb River to enable Topnaar community members to reach !nara plants and livestock on other side
   - Extend and maintain existing flood protection wall (wall at Gobabeb has a purpose to divert upstream water flow southwards to prevent flooding in Walvis Bay and communities however this wall is deteriorating)
   - Secure infrastructure such as pylons to make more resilient to floods and moving water

5. **Manage retreat**
   - Relocate water treatment plants
   - Move flood prone clinics to higher area