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WORLD MARITIME UNIVERSITY
Malmö, Sweden

**DEVELOPMENT OF POLICY FOR CLIMATE
CHANGE ADAPTATION FOR SOUTH AFRICAN
PORTS**

By

TEBOGO ABIA MOJAFI
South Africa

A dissertation submitted to the World Maritime University in partial
Fulfilment of the requirements for the award of the degree of

MASTER OF SCIENCE
In
MARITIME AFFAIRS
(PORT MANAGEMENT)

2014

DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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Most importantly, Glory be to God, our Creator. Great things he has done.

"I Can Do All Things through Christ Who Strengthens Me"

Philippians 4:13

ABSTRACT

Title of Dissertation: **Development of Policy for Climate Change Adaptation for South African Ports**

Degree: **MSc**

This dissertation is a study of the South African National Climate Change Response policy as it relates to adaptation in ports.

The study determines how climate change possibly impacts on port businesses. This starts by trying to understand climate change and the effects that it has on the global environment, in South Africa and in the port. The risks that the ports are faced with are looked at together with its vulnerability.

The importance of policies in addressing climate change is also explored. This entails observing how other ports around the globe have dealt with this challenge. Examples of ports in the United Kingdom, Australia and America are highlighted and lastly the Adaptive Policy Framework introduced.

Climate change policies at the global, regional and local level including South Africa are investigated to determine how they address adaptation especially in ports. In addition to that, the role of stakeholders is expanded on. The last section provides possible policy recommendations

KEY WORDS:

Adaptation, Climate Change, Disaster, Policy, Resilience, Ports, Stakeholders, Vulnerability

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LIST OF ABBREVIATIONS

AAPA	American Association of PORT Authorities
AfDB	African Development Bank
APF	Adaptation Policy Framework
AU	African Union
AUC	African Union Commission
BCP	Business Continuity Plan
CCDAI	Conference on Climate Change and Development in Africa
COMESA	Common Market from East and Southern Africa
COP	Conference of Parties
CSA	Climate Smart Agriculture
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DEA	Department of Environmental Affairs
EAC	East African Community
EACCCP	East Africa Community Climate Change Policy
EIA	Environmental Impact Assessment
EO	Energy Office (EO)
EPA	Environment Protection Agency
EPCPD	Environmental Planning and Climate Protection Department
GDP	Gross Domestic Product
GHG	Green House Gas
IAPH	International Association of Ports and Harbours

IDP	Integrated Development Plan
IGCCC	Intergovernmental Committee on Climate Change
IMCC	Inter-Ministerial Committee on Climate Change
IPCC	Intergovernmental Panel Climate Change
IRP	Integrated Resource Plan
LDC	Least Developed Countries
LTAS	Long Term Adaptation Scenarios Flagship Research Programme
LTPF	Transnet's Long term Planning Framework
LVBC	Lake Victoria Basin Commission
M&E	Monitoring and Evaluation
MDS	Market Demand Strategy
MINMEC	Ministerial Political Forum (MINMEC)
MINMEC	National Committee on Climate Change
MOU	Memorandum of Understanding
MTEF	Medium Term expenditure Framework
NAPA	National Adaptation Programmes of Action
NCCARF	National Climate Change Adaptation Research Facility
NDP	National Development Plan
NEDLAC	National Economic Development and Labour Council
NEMA	National Environmental Management Act
NGO	Non-Governmental Organisations
OECD	Organisation of Economic Cooperation Development
R&D	Research and Development
REC	Regional Economic Community

RISDP	Regional Indicative Strategic Development Plan
SA	South Africa
SADC	South African Development Community
SALGA	South African Local Government Association
SANBI	South African National Biodiversity Institute
SARVA	South African Risk and Vulnerability Atlas
SEA	Strategic Environment Assessment
SOE	State Owned Enterprises
TNPA	Transnet National Ports Authority
TPT	Transnet Port Terminal
UK	United Kingdom
UKCIP	United Kingdom Climate Impact Programme
UNDP-GEF	United Nations Development Programme – Global Environment Facility
UNECA	United Nations Economic Commission for Africa
UNFCCC	United Nations Framework Convention on Climate Change
UNGC	United Nations Global Compact
VPA	Valencia Port Authority
WEHAB	Water, Energy, Health, Agriculture and Biodiversity
WSSD	World Summit on Sustainable Development

I. INTRODUCTION

1.1. Background of Study

Glimpsing over any media today, one is likely to come across a story that relates or indicates the impact and effect of climate change. High rising temperatures, unstable weather patterns, extreme storms, hurricanes and cyclones hitting certain parts of the world leading to floods, intense droughts and wild fires that rage over forests. On the other hand, human health is under pressure from increasing heat, flooding exacerbates cases of malaria and cholera, agricultural production has declined due to less rain and increased acid rain to name but a few. These are the results of climate change. It is here.

The effects of climate change are not only being felt by individuals but business organisations as well as governments. The profits of businesses and the economies of the countries are under pressure due to increasing costs of doing business and the lost productive hours, resulting from events borne out of climate change.

In trying to deal with these challenges, governments have come to an understanding that they need to take a leading role in combating the source and effects of climate change. This has been done by researching how climate has changed over the last years, projected changes, current vulnerabilities, and the causes of climate change. In order to deal with the changing climate, it is important to devise strategies or responses in the form of a climate change policy. The understanding that climate change affects everyone and that the most vulnerable will feel the impacts of it quickly and drastically, has led to the importance of adaptation and mitigation.

Globalisation has facilitated the pattern of trade amongst the world. Countries depend on trading with one another in order to meet the demands and needs of their respective citizens. Goods moved by vessels in and out of the ports and through the logistical chain, find their way to the end user. This indicates the importance of ports as an essential component of the chain. It also indicates the importance of stakeholder engagement in realising an effective and efficient logistics value chain.

1.2. Research Objectives

The objectives of this study are to:

- To determine how climate change possibly impacts on port businesses in general
- To determine importance of policies in addressing climate change.
- To review existing climate change policies at global, regional (African) and local (South Africa) levels and assess their relevance in addressing climate change at ports.
- To determine the role of stakeholders in adapting South African Ports to changing climate within the context of the existing policies.
- To provide policy recommendations.

1.3. Scope, Methodological Approaches and Limitations

This paper is a qualitative research.

In responding to climate change, you either mitigate and or adapt. This study is focusing on Climate Change Policy with a focus and limitation on adaptation in ports as it relates to South Africa.

A review of the South African Climate Change Policy was undertaken. The objective of this review was to have a better understanding of how the policy addresses climate change challenges with specific focus on ports.

The first step entailed investigating the policy work that has been done on climate change adaptation at the global stage. This involved looking at how countries and ports have utilised policy as a set of rules and framework necessary to guide citizens and organisations to deal with the challenges of climate change.

The second step looked at the work that has been undertaken at the regional level. This entailed investigating how countries have collectively worked on developing climate change policies for the benefit of ports in their regions and purpose of regional integration.

Thirdly, an investigation into the South African environment is undertaken with reference to how Transnet (the custodian of South African Ports) is dealing with policy on port adaptation. In doing so, an in-depth analysis of the South African Climate Change Policy was undertaken with a purpose of identifying whether it provides a clear guideline to Port Management on the rules and framework to be followed in dealing with climate change in ports. This exercise was also aimed at identifying stakeholders and their role in dealing with climate change policy implementation.

An in-depth literature review was undertaken with the intention of getting a better understanding of adaptation in ports. Other information was gathered from the official websites of organisations (in the form of reports, presentations and policy documents) that deal with climate change policy.

The author has also attended a climate change workshop which was organised by the Council for Scientific and Industrial Research (CSIR) held at the Port of Durban.

Based on the analysis and review process, policy recommendations were developed with the aim of guiding South African Ports in dealing with climate change adaptation.

1.4. Structure of Study

This study is structured as follows:

- Chapter 2 determine the impacts of climate change on ports.
- Chapter 3 determine the importance of policies in addressing climate change
- Chapter 4 reviews existing climate change policies at global, regional and local level and assess their relevance in addressing climate change at ports. This also determine the role of stakeholders in adapting South African ports to changing climate change within the context of the existing policies
- Chapter 5 provide policy recommendations
- Chapter 6 provide the study conclusions

II. IMPACTS OF CLIMATE CHANGE ON PORTS

2.1 Introduction

The world is faced with continual economic and environmental challenges emanating from climate change. These challenges are experienced in many sectors within the global countries. Ports like other environments are one of those areas that are significantly faced with the impact of climate change.

2.2 Definition of Climate Change

Intergovernmental Panel Climate Change (IPCC, 2007) defines climate change as a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Scientists attribute this change in climate to internal or external natural variability processes or to persistent anthropogenic changes in atmosphere or in land use composition.

Meanwhile, the United Nations Framework Convention on Climate Change (UNFCCC, 2011) defines it as ‘a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and is in addition to natural climate variability observed over comparable time periods’ (IPCC, 2007). The definition by UNFCCC does not

include changes attributed to natural causes. Whilst the two definitions are acceptable depending on the particular context, this study adopts the definition of the IPCC due to its inclusiveness.

2.3 Effects of climate change on the global environment

The world is faced with the challenge of climate change which is seen in the form of rising sea levels, extreme weather events and rising temperatures. Extreme weather is in the form of cyclones, hurricanes, strong winds, flooding, high waves and unusual rain patterns (Haveman & Shatz, 2006; IPCC, 2007; Becker, Acciaro, Asariotis, Cabrera, Cretegny, Crist, Velegrakis, 2013).

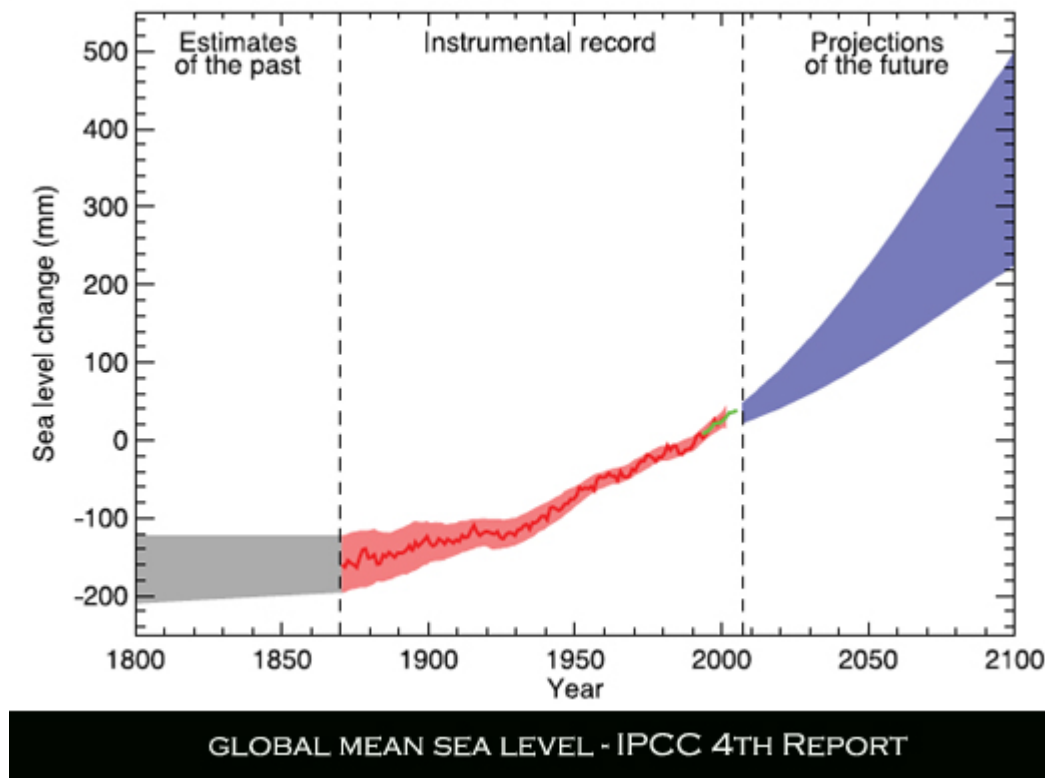


Figure 1 Global Mean Sea Level

Source: (IPCC 4TH Report, 2001)

Figure 1 indicates the global mean sea level as per the 4th report of IPCC. The grey shade indicates the uncertainty in estimated rate of change (long term). The red shade indicates variation range from smooth curve whilst red line is reconstructed global mean sea level from tidal gauges. Green line is global mean sea level as observed from satellite altimetry. Blue shade indicates 21st century model projections relative to 1980-1999 mean.

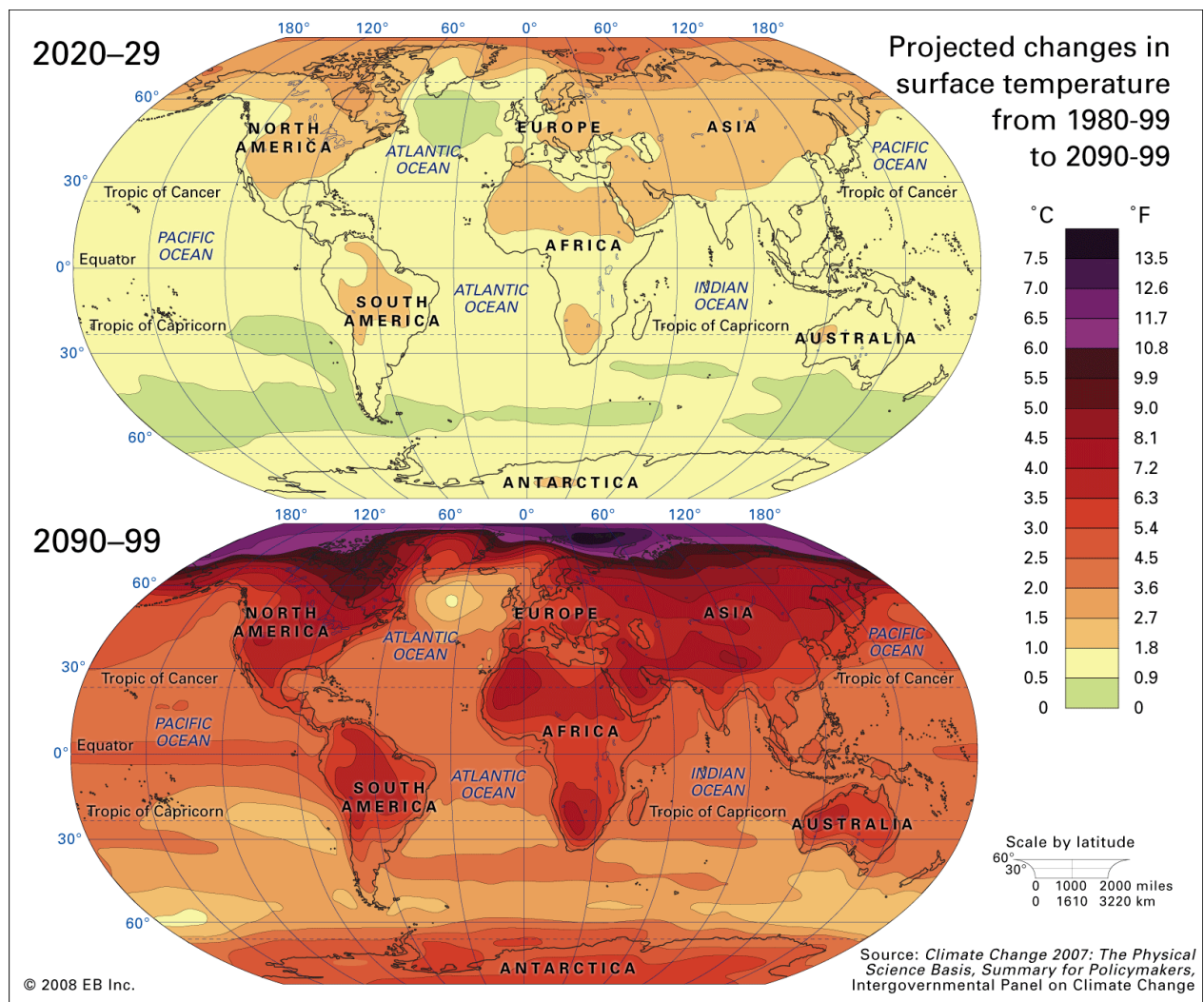


Figure 2 Projected changes in surface temperature

Source: (IPCC, 2007)

Figure 2 indicates how the world temperature is projected to increase as a result of the climate change.

The World Bank indicates that depending on the level of Green House Gas (GHG) emissions into the future, the average global temperatures are expected to increase by 1 to 5 degrees by 2100. It is also projected that some regions will see a higher temperature compared to the global average. On land, the ground level air temperature will warm up more rapidly than oceans. The ocean has been able to take over 80% of the heat added to the climate system, to the extent that it has warmed up to 3000m depth. This means that the land has not been able to take up the heat, resulting in rising air temperatures. This creates a heat wave that will negatively affect the performance of port workers. It is also expected that snow covers will shrink, cyclones intensified and the Arctic and Antarctica will experience a decrease of sea ice. The decrease of these mountain covers and the global warming which causes the sea water to expand are contributing to the rising sea level (IPCC, 2007). The above indicates how climate change impact on the business of ports.

2.4 Effects of climate change on South Africa in general

South Africa's interior will experience a rising temperature of between 3 and 7 degrees, with the coastal experiencing 1 and 4 degrees by 2100. Rising temperatures tend to put a health risk to the communities and affect the country's competitiveness. Rainfall patterns will change leading to increased evaporation, droughts, health outbreaks like Cholera and wildfires ravaging vulnerable grazing fields and forests. The country's biodiversity will be negatively impacted with the possibility of extinction of some of the unique plants like fynbos.

Alien invasive species will spread and have a negative impact on the already vulnerable water resources. Agricultural production of fruits and maize will also be affected by the diminishing rainfall. South Africa's sea level rates is presently +1.87 mm/per year in the west coast, 1.47 mm/yr and 2.74mm/yr. Rising sea levels with the Agulhas current warming up will negatively affect the creatures and species living in these waters. Damage resulting from weather related events like flooding, fire, storm and drought experienced during the years 2000-2009, is

conservatively estimated at a cost of 1 billion rands per year (Mather, Garland, & Stretch, 2009; Davis, 2011; DEA, 2013).

2.5 South African Climatic Trends - Effects on the Port

The following climatic trends have been observed in South Africa between 1960 and 2010:

- The Mean annual temperatures increased by approximately 1.5 times in relation to the global average of 0.65 degrees Celsius. There has been a significant minimum and maximum temperature increase annually.
- The changes indicate an increase in frequency of extreme high temperatures with a significant decrease in low temperatures annually.
- A fluctuation of the rate of temperature with highest rates observed between mid-1970s and early 1980s and late 1990s to mid-2000s
- Seasons of rainfall have shifted, with rainfall intensity increasing (DEA, 2013).

The high temperatures mean hot days at the office, requiring more and prolonged usage of air conditioners. This will increase the energy consumption and electricity costs for ports. Rising temperatures will also affect the health of employees, their productivity, storage and handling of dangerous flammable goods and the operation of cargo handling equipment.

The increasing intensified rainfall affects the movements of vehicles and cranes in and around the port yard and gate. This can also affect the operational targets due to safety measures that require speed to be reduced. The rainfall is likely to cause flooding and accidents within the port and possibly port closure.

Critical factors for Ports - A Cobweb

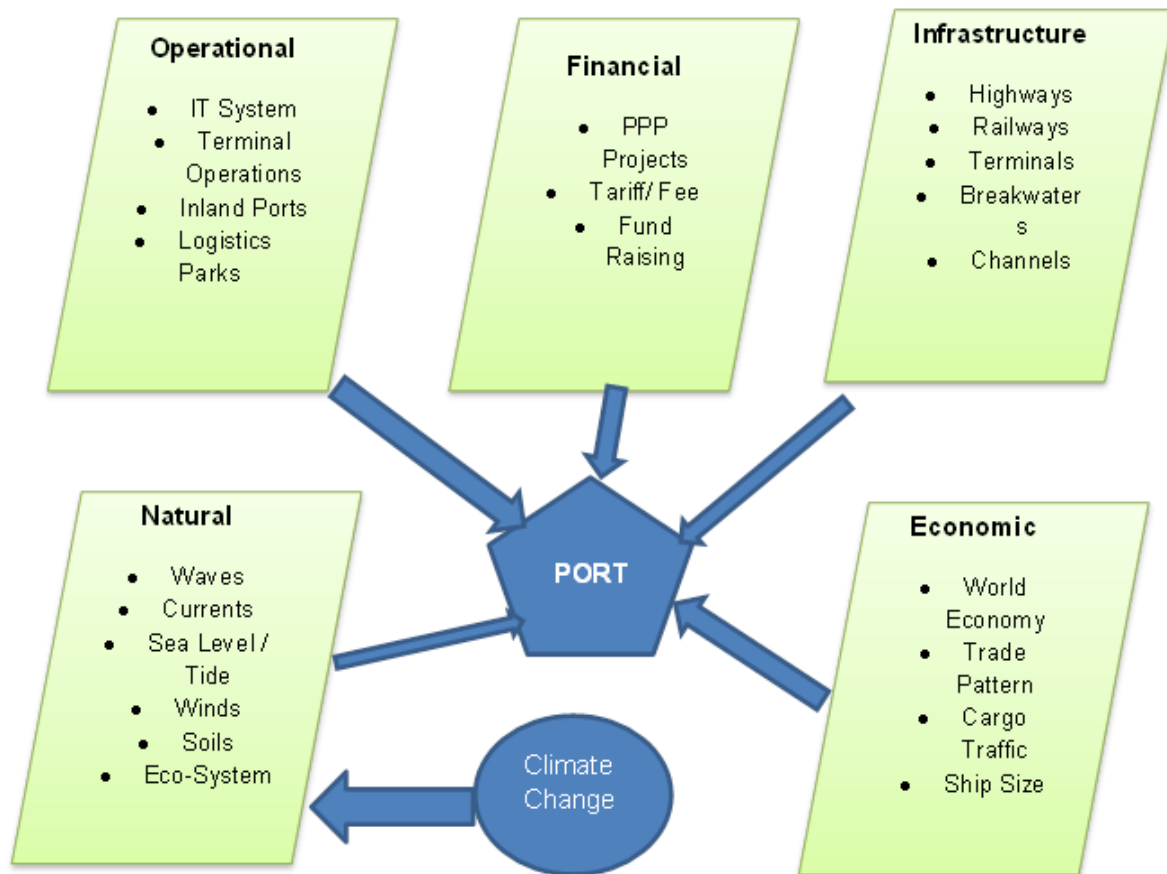


Figure 3 Cobweb of critical factors for a Port (Adapted from Inoue, 2013)

Figure 3 indicates the critical factors that affect the business of ports. Natural factors are closely linked to the advent of climate change. Other critical factors like infrastructure and operations are directly impacted by climate change with their deterioration affecting the financial and economic opportunities of the port.

Potential climate impacts on different sub-components of the port system

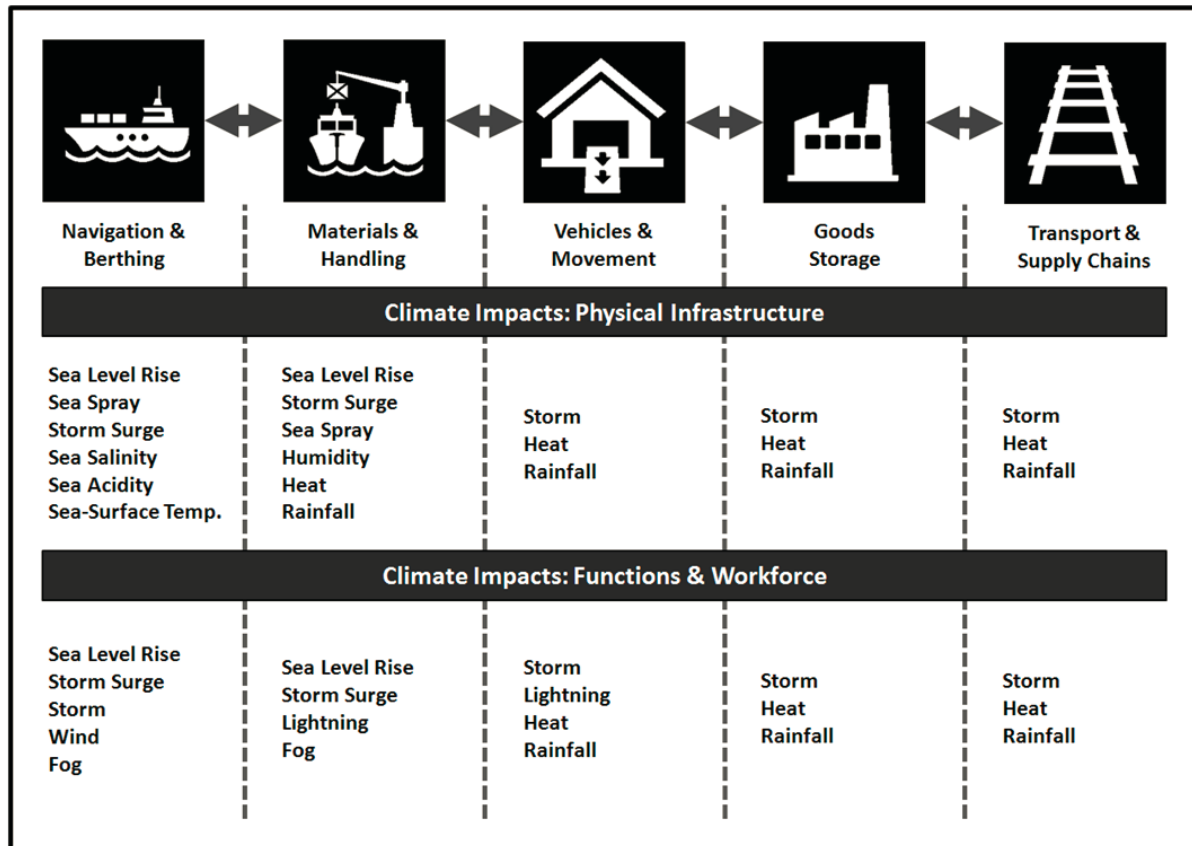


Figure 4 Potential climate impacts on the Port system Source: (McEvoy et al. 2013)

Figure 4 refers to the potential climate change impacts on the port system. Whilst sea level rise is one variable that is mostly considered when dealing with climate change, this figure highlights other variables that must be considered within the complex port system.

2.6 Vulnerability and Future Risk

Organisational planning timeframe is normally between 5-15 years whilst climate change is projected over a period of 30-90 years. This inconsistency and uncertainty of local climate

projections lead decision makers to delay putting action until they have certainty of the threat (UKCIP, 2007). Whilst they wait for certainty, their vulnerability continues to worsen as climate continues to change.

Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability of extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC, 2001; Ibarrarán, Malone, & Brenkert, 2008).

Scott, McEvoy, Chhetri, Basic, & Mullett (2013) proposed a hybrid “risk / vulnerability” approach to better understand and adapt to climate change. This is a consideration of current risks related to weather events that organisations are experiencing, integrated with futuristic climate risks assessments. A hybrid approach is about bottom up (vulnerability led) approach, requiring ports to begin with identifying already known impacts through historical and current meteorological data and native knowledge as well as “top-down” or scenario-led approach which extract information from Global Climate Models and refining it to create information at a regional scale. Figure 5 refers to the process that ports should follow using the Hybrid Vulnerability / Risk Assessment.

Hybrid Vulnerability / Risk Assessment Process for Ports

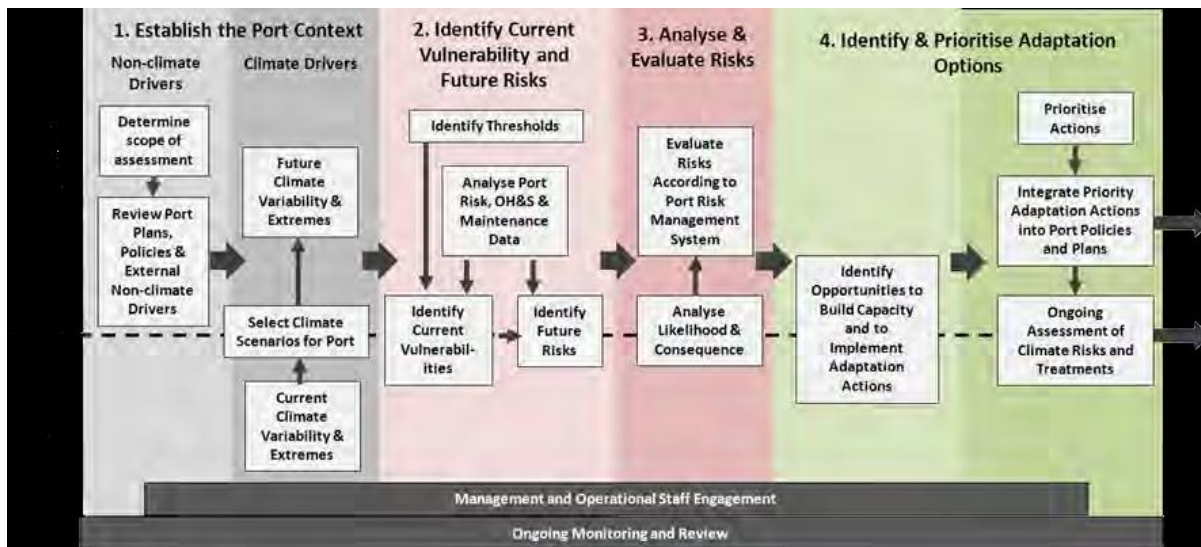


Figure 5 Hybrid Vulnerability Assessments for Ports Source: (Scott et al. 2013)

Scott et al. (2013) suggest that whilst assessing vulnerability is vital for better understanding and commitment, it is important to seek executive support early on so as to have the initiative properly implemented.

Table 1 Indicative Risk

Climate Variable	Indicative Risks
Increased intensity of rainfall	<ul style="list-style-type: none">- Extreme flooding could lead to loss of radar and radio equipment- Capacity overload of the drainage system may lead to flooding and consequently erosion of road, railway foundations, cause pollution, flooding of stacking and stockpiling yards and lack of road access- Damage to storage buildings due to flooding
Heatwave	<ul style="list-style-type: none">- Higher risk of rail track buckling- Higher deterioration rates of pavements and roadways- Higher energy consumption of refrigerated containers
Increased intensity of storms	<ul style="list-style-type: none">- Closure of linked modes of transport, affecting supply and distribution of goods to and from the ports- Toppling of containers in stacking yards
Increased intensity of storm surge	<ul style="list-style-type: none">- Increased wave action at waterfront structures and consequently an increase in overtopping rates, hence flooding of berth facilities- Beach erosion
High speed winds	<ul style="list-style-type: none">- Damage to navigation and communication equipment- Delays/stoppages to unloading/loading vessels- Damage to older buildings and warehouses
Other	<ul style="list-style-type: none">- Reputation of port operator damaged by impacts of a severe weather incident- Insurance premiums rising due to growing global losses from weather-related incidents

Source: (Scott et.al. 2013)

Table 1 refers to climate variables and the risks that they pose to the port environment as identified by Scott et al. (2013) using the Hybrid / Vulnerability Assessment approach. They argue that these risks must be properly understood by decision makers' so-that they will develop proper policies to mitigate or adapt against climate change.

2.7 Ports and Climate Change

According to Becker et al. (2013), adaptation requires the development of organisational ability to respond effectively to climate change challenges. This entails raising awareness, skills development, data collection, monitoring and a focused research. Due to the large investments that are needed for climate change adaptation, they urge organisations to start planning large scale projects early especially as it is unclear what adaptation strategies should be undertaken for different ports and the timeline thereof.

International Association of Ports and Harbours (IAPH) also conceded that due to ports having different natural, social and historical backgrounds, it becomes difficult to have a one size fits all adaptation measures (Naruse, 2011). This should always be considered and applied to individual ports within a country.

2.7.1 Ports are at risk

According to IFC (2011), ports are likely to be particularly at risk from climate change for a number of reasons:

- Due to their long lifetimes, they will face considerable climate change. The design life of breakwaters is in the region of 60-100 years, berthing facilities are designed for 30-45 years and cargo handling equipment for 15-20 years (Asariotis & Benamara,2012)
- By virtue of their locations on coasts, rivers or lakes, they are often exposed to a range of climate hazards, including sea level rise, storm surges, extreme wind and waves, and river flooding (Becker, Inoue, Fischer & Schwegler,2012)
- Shipping movements into and out of ports can be affected by adverse climatic conditions, causing delays to port operations.

- They are vulnerable to the economic impacts of climate change, through impacts on global trade,
- They transport goods for which demand or supply is climatically-sensitive, such as agricultural products or fuel,
- Inland movement of goods from ports relies on transport infrastructure which is likely to be managed by others, and which is, in turn, vulnerable to climate change,
- Like any other industrial facility, ports are vulnerable to utilities (e.g. water and power) disruptions. Water and power supply are also individually vulnerable to climate change.

2.7.2 Effects on the business of Ports

The mean sea level rise, storm surges, floods, increased cyclone intensities or destructiveness and potential wave regimes pose a risk of having to close the port. Such operational delays can cause up to a billion US dollars per day (Haveman & Shatz, 2006). Such delays can affect the trade flow of a country as has been seen in the US whereby customers of ports in the Gulf of Mexico opted for alternative ports as a result of delays which were caused by Hurricane Katrina (Grenzeback et al, & Emigh as cited in IFC, 2011). Thao et al. (as cited in Filho, 2011) indicate that one state owned operator in Vietnam suffered a demurrage of 1 122 days from operating 21 general cargo vessels mainly because of waiting for high tides and cargo handling.

Asariotis and Benamara, Notteboom and Winkelsman, EPA, AAPA (as cited in Becker, 2013) estimated that by 2100, sea level rise will have gone up by 1.9m leading to storm surge impacts and wave damage in many regions. They assert that this is likely to cause coastal inundation, erosion, wind hazards and inland flooding which will disrupt ship navigation, as well as transport networks in and out of the port on roads, rail and air.

Stored customer goods may also be damaged as a result of increased flooding. Extreme temperatures and precipitation changes may lead to equipment failures and disruption of port services. Such events may also affect tourism, agriculture and seafood production which will undermine port competitiveness. This is true for developing regions with low adaptive capacity.

Long lifetime of port assets could result in infrastructure being under-designed and unable to cope with future climatic conditions.

Due to winds and waves, the vessels are not always in a stable position whilst berthing. Cargo handling systems are designed to be functional in fluctuating water levels within a reasonable range. This include adjustable ramps for roro vessels, flexible hoses for handling liquid bulks and quay cranes with the reach to deal with fluctuating vessels whilst cargo is being handled (Landon & Knight, 2014).

The above indicate the real challenges that customers are facing and a threat that can negatively affect ports' business and economy at large if it is not dealt with timeously. Filho (2011) thus highlight the need to improve the capacity of port infrastructure to take care of a potential increase in future downtime, and to improve the resilience of port infrastructure and operations in general.

2.7.3 Categories of climate change adaptation

Climate change adaptation can be categorised into two areas namely

- i. Capacity Building - This involves building capacity to deal with climate through raising awareness, skills development, collection of climate data and engaging in monitoring and research.
- ii. Implementation of adaptation Initiatives - Technological, engineering change, planning, design, legal/regulatory, insurance/financial measures and management system change (UKCIP,2011)

Inoue (2013) recommends an incremental approach to port adaptation through:

- Frequent updating of action program rather than planning for a long term

- Partnership with other stakeholders on monitoring coastal conditions using remote sensing systems
- Development of temporary facilities and measures for flexible facility usage
- Incorporating adaptation measures to port projects for early returns of benefits

Pielke (2007) (as cited in Filho, 2011) further argues that policy action should focus on reducing vulnerabilities, at least in the short term whilst the protection work to improve resilience against tropical cyclones continues. The improvement in the standard of flood defences, whether by enhancement or new construction schemes, is an immediate adaptation option which is widely adopted although it can involve substantial investment (Asariotis & Benamara, 2012). Becker et al. (2013) advise those who are responsible for ports to create an enabling environment for investment in adaptation.

2.7.4 Adaptation in South African Ports

It is estimated that climate change will alter the size, the timing and how storms get distributed. Davis (2011) points out that the frequency of floods and drought will intensify as a result of these storms.

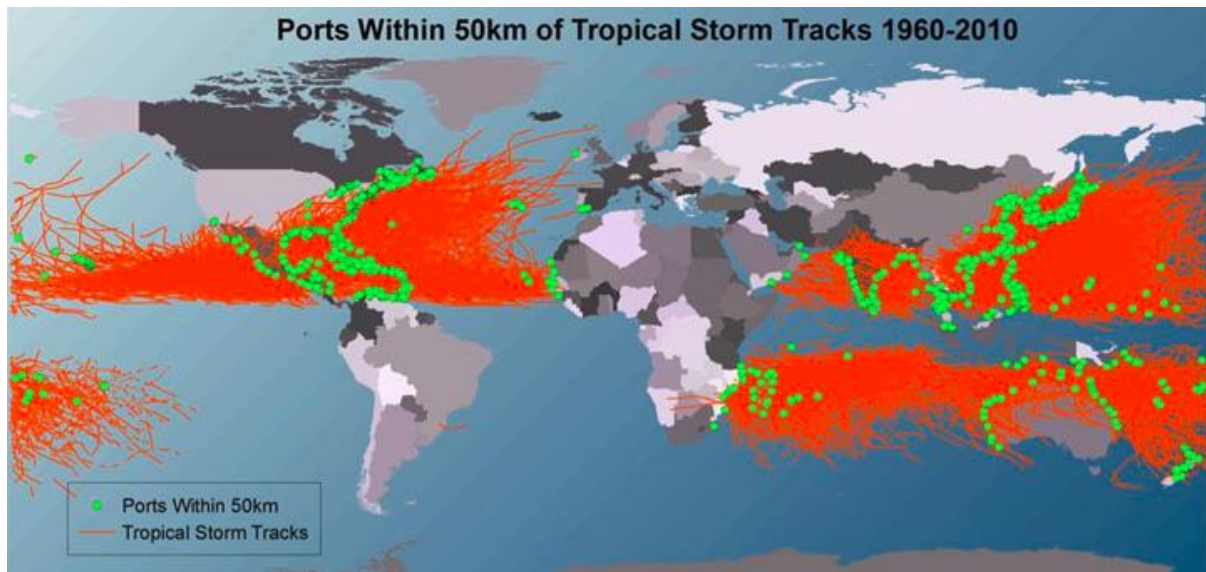


Figure 6 Ports within 50km of tropical storm tracks

Source: (Becker et al. 2013)

As is evident from Figure 6, Southern Africa especially around the Eastern part of the continent is on the pathway of these storms. This is where South African ports (Richards Bay, Durban, East London, Port Elizabeth and Ngqura) are located. This further indicates the potential risks that these commercial ports are faced with, based on their geographic location.

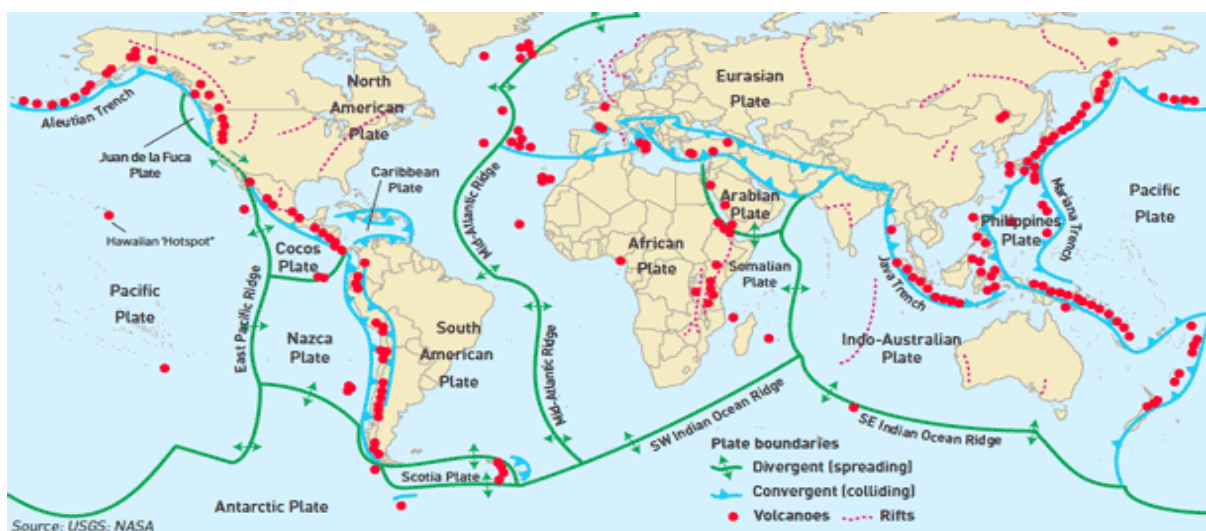


Figure 7 Plates, Quakes and Volcanoes

Source: (Tunza, 2010)

Figure 7 indicate the areas of Eastern Africa and between South Africa, Mozambique and Madagascar as being susceptible to volcanoes and earthquakes. These natural hazards send shock waves to areas close by. Tunza (2010) suggested that in order to safeguard against these disasters, it is important to invest in earthquake proof construction.

According to Mather (as cited in Landon & Knight, 2014), South African ports are designed to reduce wave energy from the Southern Indian Ocean. He note that many ports are now facing increased penetration as a result of the changing direction of the swell. South easterly winds affect the port operations in Cape Town whilst Port of Ngqura and Port Elizabeth experience long waves which disrupt cargo handling and breaking vessel mooring.

Mather (Landon & Knight, 2014) adds that looking further most eastern-coast ports are facing increasing sedimentation rates since many are on estuaries or rivers. Despite this, the ports prefer to deal with it on a day-to-day basis rather than admitting that other measures might be necessary. He points out the fear and worry that ports and government do have on putting a price tag on what they do and adding a financial burden to the economy. Mather opines that South Africa is lagging behind in responding to the effects of climate change. He warns that if organisations do not want to spend now to alleviate and manage climate risk, they will regret so much if they were to face a calamity (Landon & Knight, 2014).

The most notable recent storm events that have impacted the South African ports were experienced in March 2007 in Durban and September 2008 in both Port Elizabeth and Cape Town. In 2007 swells in the region of 8.5 metres led to an estimated damage of 1 billion Rands. In the past years it has been normal to experience waves of about 7 meters annually, and 10 meters every 20 years (Mather et al. 2009; SAEON, 2011)



Figure 8 Storm wave on Breakwaters **Source: (Mather & Theron, 2011)**

Figure 8 shows how the breakwater was unable to cope with the 2008 storm wave in Cape Town.



Figure 9 The effects of the Storm **Source: (Mather & Theron, 2011)**

Figure 9 indicates the after-effects of the storm that passed through Port Elizabeth which damaged the rail lines.



Figure 10 Destruction of coastal infrastructure Source: (SAEON, 2011)

Viljoen (2013) is of the opinion that Transnet National Ports Authority (TNPA) has not done enough on assessing specifically the impact of climate change on South African Ports and the maritime technology. Figure 10 is an example of how coastal infrastructure is being destroyed in South Africa. In 2014, Transnet tasked the Council for Scientific Industrial Council (CSIR) with the responsibility to assess vulnerability of the South African ports. This will assist and inform the baseline of future planning for the Port Authority.

2.8 Transnet Sustainability Planning

Transnet's Long term Planning Framework (LTPF, 2013) acknowledges that the choices that are taken today have profound implications for future generations. It defines sustainable development as a development of today, meeting today's needs without compromising the needs of future generations. Sustainable Development relates to balancing social, economic and the environment needs whilst improving the wellbeing of humans, communities and the organisation.

Transnet Sustainability Framework

Transnet is the custodian of ports, rail and pipeline infrastructure which have to be managed in a sustainable manner. Through its vision of ‘demonstrating a concern for sustainability in everything we do’, Transnet has developed a framework for planning and decision making. The sustainability framework is presented in Table 2. The Spatial and Environment is one of the seven (7) sustainability themes identified by Transnet planning team to deal with proactive response to the environmental demands brought by climate change. The framework also acknowledges the importance of engaging stakeholders in planning and aligning plans with those of government and other stakeholders.

Table 2 Transnet Sustainability Framework

Economic Dividends	Social Dividends	Environmental Dividends
<ul style="list-style-type: none"> • Cost-effective freight logistics infrastructure ahead of demand. • Reliable and efficient rail, port and pipeline services. • Skilled human resources aligned to infrastructure and services. • Local supplier industry development. • Job creation. • Rural development. • Regional integration. • Financially stable business, able to raise and service debt, reinvest revenue and pursue agreements with private parties to optimise investment and services. 	<ul style="list-style-type: none"> • Good governance, accountability and transparency. • Zero tolerance of fraud and corruption. • A representative workforce. • Safety. • Staff wellness. • Broad-based black economic empowerment. • Corporate social investment. • Community benefits. • Proactive stakeholder engagement. 	<ul style="list-style-type: none"> • Model shift from road-to-rail, lowering South Africa’s carbon footprint. • Energy efficiency. • Climate change mitigation. • Climate change adaptation. • Water use efficiency. • Waste management optimisation. • Biodiversity enhancement.

Source: (LTPF, 2013)

SRK Consulting was contracted by Transnet to conduct a Strategic Environment Assessment (SEA) of the LTPF. By using the South African National Biodiversity Institute (SANBI) 2011's National Biodiversity Assessment, SEA took a spatial approach comparing expansion plans of the LTPF and environmental constraints. It can be deduced that ports of South Africa experience different environmental challenges which do not require a single solution plan.

SEA document provides an indication of the work that still needs to be undertaken on both mitigation and adaptation within the port environment. It is a starting point highlighting the need to have a detailed vulnerability assessment which will facilitate the development of adaptation action plans necessary for the port to deal with climate change challenges.

It also lays an opportunity area for stakeholders to engage and better plan on how to ensure a balance between social, economic and environmental development. This will ensure multi-stakeholder satisfaction and facilitate co-ownership of the developments into the future.

2.9 Expansion Plan Cost for South African Ports

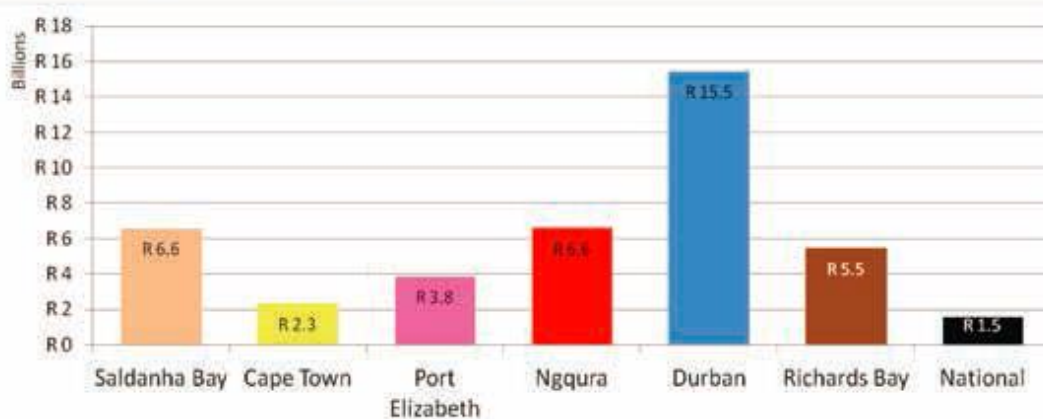
Transnet has set aside R274 Billion spread over 30 years to be invested in the South African port system. This will be done through the implementation of the Market Demand Strategy (MDS) which is primarily funded by Transnet's balance sheet. MDS is more concerned about delivering infrastructure development ahead of demand, thus creating capacity for projected cargo volume increase. The majority of the total capital expenditure is in the first 10 years.

- 10 years – 2013/14 to 2022/23: R171 billion (63%)
- 20 years – 2023/24 to 2032/33: R69 billion (25%)
- 30 years – 2033/34 to 2042/43: R34 billion (12%)

Total Amount R2 74 Billion

Table 3 TNPA Seven Year Investment

Port	Total Project Cost (millions)	1-7 Year Cash Flow	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Saldanha Bay	R 10 776	R 6 576	R 73	R 69	R 40	R 447	R 1 963	R 848	R 3 136
Cape Town	R 3 361	R 2 327	R 349	R 82	R 86	R 425	R 301	R 184	R 901
Port Elizabeth	R 4 202	R 3 828	R 37	R 94	R 310	R 499	R 957	R 1 002	R 932
Ngqura	R 12 328	R 6 588	R 271	R 189	R 860	R 2 148	R 1 064	R 1 283	R 773
Durban	R 17 161	R 15 451	R 429	R 413	R 3 692	R 2 634	R 2 318	R 2 266	R 3 699
Richards Bay	R 12 293	R 5 452	R 176	R 452	R 766	R 644	R 1 276	R 832	R 1 305
National	R 1 603	R 1 540	R 171	R 361	R 495	R 411	R 42	R 25	R 35
Total	R 61 725	R 41 762	R 1 505	R 1 659	R 6 249	R 7 208	R 7 921	R 6 439	R 10 780

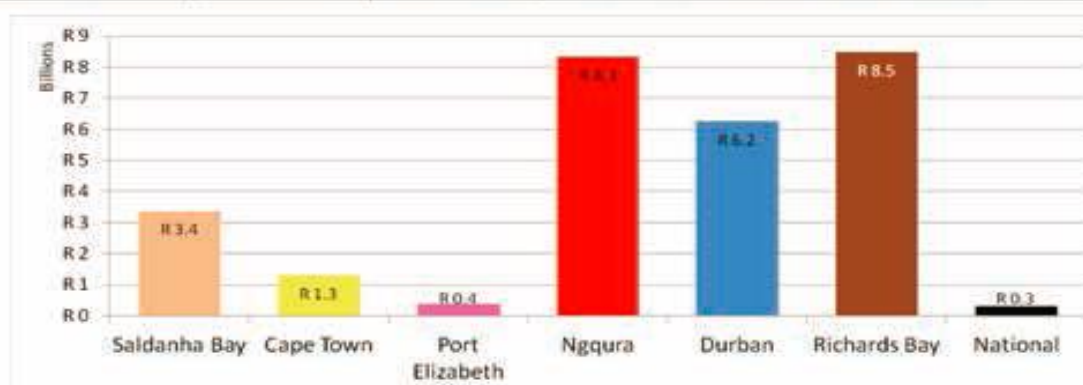


Source: (LTPF, 2013)

Table 3 depicts the investment cost that TNPA, which is the landlord, will spend mostly on infrastructural development over the coming years. Table 4 depicts the investment cost for Transnet Port Terminal, (TPT) which is the Terminal operator. It illustrates the amount of investment that has been put in trying to increase South African ports operations efficiency to be able to deal with estimated volumes necessary for the country and regional trade. If such expansions are done without integrating climate change impacts, the country is likely to miss the financial, economic and social benefits that are supposed to result from this plan.

Table 4 TPT Seven Year Investment

Port	Total Project Cost (millions)	1-7 Year Cash Flow	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Saldanha Bay	R 3 721	R 3 356	R 83	R 78	R 69	R 729	R 1 258	R 1 043	R 96
Cape Town	R 1 285	R 1 285	R 76	R 92	R 144	R 209	R 263	R 251	R 250
Port Elizabeth	R 384	R 384	R 53	R 25	R 9	R 117	R 180	R 0	R 0
Ngqura	R 8 323	R 8 323	R 153	R 528	R 215	R 1 674	R 1 960	R 3 792	R 0
Durban	R 12 293	R 6 248	R 533	R 171	R 239	R 290	R 258	R 757	R 3 999
Richards Bay	R 8 482	R 8 474	R 219	R 231	R 851	R 2 104	R 2 471	R 2 359	R 239
National	R 311	R 311	R 27	R 48	R 127	R 63	R 14	R 32	R 0
Total	R 34 800	R 28 382	R 1 144	R 1 174	R 1 654	R 5 187	R 6 404	R 8 235	R 4 584



Source: (LTPF, 2013)

2.10 TNPA Disaster Management

Disaster is defined as a negative outcome which is likely to happen due to high vulnerability or low adaptation capacity. This vulnerability can be equated to determination of capacity to cope or not. Adaptation is closely related to disaster risk reduction in that both are concerned with reducing the likelihood of disasters to happen (Vincent, Tanner, & Devereux, 2008).

TNPA has developed a Business Continuity Plan (BCP) which aims to ensure that critical business operations and IT infrastructure continue to operate in the event of a disaster. This plan contains the contact details of internal and external people or institutions that should be contacted and provides an easy maintainable common data source, necessary during crisis management. Vincent et al. (2008) argues for developing a stakeholder framework intended in developing long term plans for dealing with disasters emanating from climate change. They argue that Non-Governmental Organisations (NGO) are ideally placed on the ground and have great experience to deal with disasters which can be used in planning adaptation.

2.10 Conclusion

Climate change has brought about many biophysical changes. Uncertain and changing weather patterns in the form of floods, storms are but some of the challenges that ports and local government will have to face. This also includes the responsibility to manage the planning and development of infrastructures which have long term lifetime and faced with rising sea levels, increasing temperatures and intensified storms.

Port users and communities are migrating towards resilient areas. Climate change has the ability to force community and port users to consider relocation especially when resilience has not been built. This tends to affect the rental income and taxes that might normally be accrued by local economy leading to the declining economic activity. Port tenants may also decide to move out of the port environment and decide to rent space somewhere else. They might also move their business to other neighbouring ports.

Vessels might decide not to call at the ports that have not built resilience, thus crippling their social, economic and financial viability. At the same time, those who do not have the financial ability to move, depends on the local government to provide assistance at the time of disasters and vulnerability periods. This puts pressure on infrastructure, housing, planning, social service and the economy.

III IMPORTANCE OF POLICIES IN ADDRESSING CLIMATE CHANGE

3.1 Introduction

Climate change is being felt at different levels depending on vulnerability. Organisations and individuals continue to seek interventions in trying to adapt to this particular challenge. This means that they need a framework to guide them through the process.

3.2 The case of Mozambique

According to Buys (cited in Artur and Hilhorst, 2012), South Africa's neighbouring country Mozambique is one of the poorest and most vulnerable to weather related damage in the world and is ranked 3rd following Bangladesh and Ethiopia. Mozambique experiences spring tides of up to +3.7 m above mean sea level, with South Africa reaching about 1 m (Mather & Theron, 2011). Floods that affected 4.5 million people, with 700 lives lost were experienced in the year 2000. 500 000 more Mozambicans were affected by flood the following year.

Droughts, cyclones and other climate related disasters have continued in the past decades with increased frequency and intensity. 77 disasters have hit Mozambique since 1970, 41 of which happened between 2000 and 2009. Mavume et al (cited in Mather & Theron, 2011) studied and compared the frequency of cyclones in the West Indian Ocean between 1980 -1993 and 1994-

2007. Mozambique and South Africa's eastern ports are located within this oceanic area. The study concluded that there is an increase in the number of cyclones.

The government of Mozambique adopted a policy of disaster risk reduction as a critical element of climate change adaptation, based on the projection that temperature will increase by 5 to 6 degrees Celsius by 2100 and lead to extreme droughts, cyclones and floods. Artur and Hilhorst (2012) are in support of investing in multi-stakeholder governance arrangements and integrating monitoring and evaluation into policy and response implementation programmes.

South Africa has experienced various environmental disasters in the past years, with those being affected having to deal individually with the issue as they happened. The interventions of Mozambique and South Africa based on the past storms have been fragmented with time and efforts being wasted in the process. Nobody was prepared for such happenings and depending on the individual capacity had to devise ways of rebuilding. Mather and Theron (2011) argue for a coordinated or cooperative approach in dealing with adaptation matters. For this coordination to effectively work, it needs to be driven by a climate change policy.

3.3 The importance of policy

Developing countries tend to focus on recovering from disasters other than on vulnerability reduction. These countries would rather focus on addressing issues resulting from emergency situations other than planning for the future climatic changes. This could be as a result of poor planning, competing priorities and lack of resources or knowledge.

Davis (2011) argues that with integrated risk reduction and recognising the need for climate change adaptation, countries are beginning to change from that system. In order to ensure that this change lead to success, new institutions and coordination mechanisms will be required to share information and manage knowledge. Regional networks and partnerships are important in that regard (Davis, 2011).

Climate policy helps port managers to fully appreciate and understand the compelling reasons for sustainability and resilience building. According to O'Brien et al. (2006), the policy goals of reducing vulnerability, mainstreaming adaptation and risk development should be highlighted when dealing with climate change. They suggest that radical shift in thinking and institutional architectures are the necessary requirements in implementing the identified changes. This entails creating awareness for decision makers and those affected by climate change on implementing the policy. It is critical that methods of stimulating those who take up the challenge get explored.

For many developmental projects that ports want to undertake, they have to follow a specified process to get it approved. They could be seeking approval for expansions which means a need for more land and having to build infrastructure. For that to happen, Environmental Assessment Plans have to be presented to municipalities and Treasury in instances when more funding is required. Through climate change adaptation policy, the port can pursue those who grant permission to favourably look at their projects. It is therefore vital that project planners make climate change adaptation an integral part of their development plans.

Vincent et al. (2008) points out that failure to integrate policy in the development plans is likely to ensure that climate change reverse the positive developments achieved and have a negative financial bearing. Whilst this true, it is also critical that policy is not just reflected in developmental plans but it should be seen to be implemented.

When Hurricane Mitch hit the coast of Belize (Eastern Coastline of Central America) in 1998, it created huge waves and high tides which had negative effect on the coast. The coral reefs and coastal infrastructure were badly damaged leading the city to engage in the process of reconstructing the seawall. The Project Coordinator informed the government of the projected sea level rise and advised that the seawall should be built higher or in a way that would allow it to be raised in the future. The national government agreed to factor in the projected climate change by raising the height of the seawall (Burton, Malone, & Huq, 2004).

This provides the benefits of stakeholder (city, port and government) integration by sharing of resources. Climate change policy help the stakeholders to understand their roles and how they can integrate by sharing of resources. Policy helps partners to collectively focus and build synergy on the issue that needs to be addressed.

Policy provides a guideline to employees and the organisation on areas that they should consider and work on as part of addressing the challenge of climate change. Through policy, ports can be seen to be working towards addressing the issues of climate change.

3.4 Ports use policy to deal in dealing with Climate Change

Literature shows that globally there are some ports that have taken a leading role in addressing the challenge of climate change adaptation. This has been achieved by developing and implementing climate change policies.

The port of Rotterdam engaged with stakeholders to develop the Rotterdam Climate Proof Programme, the objective of which is to ensure that the city becomes resilient to the impacts of climate change by 2025. The port's adaptation strategy addresses the issues of safety during flooding, ensuring safe access for both vessels and passengers, building adaptation, the urban water system, and city climate. The programme directs that all new developments and reconstruction of the port be designed to deal with the changing climate. In addressing the issue of uncertainty, the assessments of the climate change are to be integrated in the port's spatial planning and development with knowledge recognised as a pillar of the port's adaptation strategy (Becker et al. 2013).

In California, the port of San Diego together with the surrounding communities established the Climate Mitigation and Adaptation Plan. This multi-stakeholder effort comprised of those who have responsibility of responding to emergencies, protection of vital utilities and drainage of storm water (Becker et al. 2013). Commercial operations, recreational, ecosystems and safety are four elements that are integral for any infrastructural assessment at the port of San Diego. In addition to that, Douglas Doherty of Environ International Corporation advised that ports

should also be proactive and ready to quickly deal with difficulties as they arise before they multiply (Landon & Knight, 2014).

Fletcher, Taylor, Rambaldi, Harman, Ganegodage, Heyenga, McAllister (2013) indicates that the decision makers preferred In Cartagena, Colombia the port of Muelles El Bosque and the International Finance Corporation conducted a climate risk study for the port which assessed the impacts on finance, environment and social matters envisioned to be the results of climate change. Based on the conclusions of the study, the port of Muelles El Bosque set aside 30 million US dollars to invest in climate change adaptation in the two ports under their operation.

Australia's National Ports Strategy recommends that any documentation on port planning that span a period of 15-30 years should consider external factors that may impact on ports ability to effectively function in the future (McEvoy & Mullett, 2013). Climate change is an external factor that needs to be incorporated in such plans. It is also a standard requirement in Australia that a risk assessment is conducted as part of the EIA for any new developments (Landon & Knight, 2014). In Australia, the National Climate Change Adaptation Research Facility and RMIT University developed a framework for studying risk, vulnerability and resilience of Australian ports. The framework document highlights that adaptation in ports involves the development of innovative practices in many areas which may include amongst others, technology and engineering, design and maintenance, planning, insurance and systems management (Bryan, Deressa, Gbetibouo, & Ringler, 2009).

Fletcher et al. (2013) indicate that the decision makers preferred gradual, incremental adaptation options which are implemented within council rules and regulations of the Australian government. The responsibility of managing coastal inundation risks is the function of local governments. They observed that whilst it is the responsibility of national governments to coordinate, finance and underwrite climate change policies at the global level, Australia took a policy position of managing that process at the local level. These findings suggest that there are new models for considering risks and costs across the Australian government and industry.

The European Commission indicates that Mediterranean ports are beginning to seriously consider the impacts of climate change by reducing their GHGs and adapting to climate

changes. Valencia Port Authority (VPA) is highlighted as trying to achieve an economic growth, as well as commercial and environmental protection balance. Its environmental policy was approved in 2000 and revised in 2006, lists general environmental principles and those that are deemed necessary for port area improvements. VPA's environmental actions are integrated in the port's strategic plan, and as a designing tool necessary for control and monitoring purposes.

These initiatives are grouped into two categories of Research and Development (R&D) and Internal projects. Internal Projects refer to those initiatives which improve environmental aspects of water, air and land within the port precinct. R&D projects are those that are singularly carried out by VPA, or in partnership with other ports or European bodies with the aim of establishing a unified criteria and solution to regional environmental challenges affecting ports. Through training identification, communication and awareness creation, the Authority's approach is multidisciplinary in dealing with stakeholders, customers and employees.

In the UK, seaports are required to develop and report their climate change risk assessments and strategic measures on adaptation. This requirement is made through the UK Climate Change Act of 2008. The government avail this information as a measure to promote transparency and shared knowledge for those who have an interest in climate change. There is a strong awareness level of how climate change affects the UK's economic infrastructure. This is evidenced through improved scientific and technical knowledge, publication of the UK climate projections, media interest and leading actions by the UK government and other stakeholders. The port of Felixstowe also identified and prioritised disruption to cranes, pilotage and power supplies as climate change vulnerabilities.

The Peels Port Group (2011) in the UK, highlights uncertainty on climate predictions, insufficient power drivers and commercial interests as barriers to implementing adaptation programmes. They also highlight a need for a justifiable business case for major investments outside existing capital programmes or the maintenance and review schedules. Fletcher et al. (2013) opines that due to the seriousness and costs involved, the adaptation process should not

be delegated to anyone but those institutions that are seen by decision makers as practical and equitable.

In order to support adaptation and build capacity, many OECD countries have invested in building a sophisticated evidence base. This has been done through establishing policies that drive adaptation and make it an integral part of the day to day operations and regulations. Coordinated mechanisms are established in order to ensure governmental action. Whilst Mullan, Kingsmill, Kramer, & Agrawala (2013) acknowledge the role that local and regional governments have played in adaptation efforts, they argue that minimal progress has been established in coordinating systems approach with national governments. OECD countries have listed challenges that they are faced with in implementing their strategies and plans. This includes accessing adequate financing, success measurement of adaptation interventions and overcoming climate information shortfall. In order to translate planning into outcome improvements, these challenges have to be properly addressed (Mullan et al. 2013).

3.5 Mitigate or adapt policy option

In dealing with climate change, organisations have an option of mitigation and or adaptation. The idea of incorporating future climatic risk into policy making is new, although the adaptation process has been there for many decades (Burton et al.2004). According to IPCC (2007), many adaptation options are clearly persistent with pathways towards effective and long term mitigation, thereby resulting in several mitigation options becoming facilitators of planned adaptation. Applying a climate policy in isolation when faced with an environmental challenge does not always yield positive results depending on the situation.

In other instances there is a need to have a mix of one or more instruments deployed due to the complication and overlapping effect of the challenge being faced. It is always important for ports to understand the environmental issues that need to be addressed before deciding on the instrument to be used. Secondly, it is vital to have a clear understanding of how the current

policy links and coordinates with other environmental policies and with other related policy areas. The interaction between the different instruments is indeed important.

3.6 Adaptation Policy Framework

Through the support of the governments of Switzerland, Canada and the Netherlands, the United Nations Development Programme – Global Environment Facility (UNDP-GEF) developed the Adaptation Policy Framework (APF) with the intention to assist governments, organisations and communities with a road map for the adaptation policy making process. Its purpose is to support the processes of adaptation in protecting and enhancing the wellbeing of humans in dealing with the challenges of climate change. It can be used as an assessment, planning and implementation framework by countries for evaluating and complementing existing planning processes for sustainable development.

3.6.1 Principles of the Adaptation Policy Framework

- In order to reduce vulnerability to the long term climate change, it is important to begin by adapting to the short term climate variability and the current developing extreme weather events.
- It is also critical that to acknowledge that climate change risk affect society at varying levels. This requires that adaptation get conducted at local level and at different levels in the society (Burton, Diringer, & Smith, 2006).
- The policy and measures of adaptation should be assessed in a context of development.
- Striking a balance between the adaptation strategy and stakeholder process is very critical (Burton et al. 2004).

3.6.2 Components of Adaptive Policy Framework

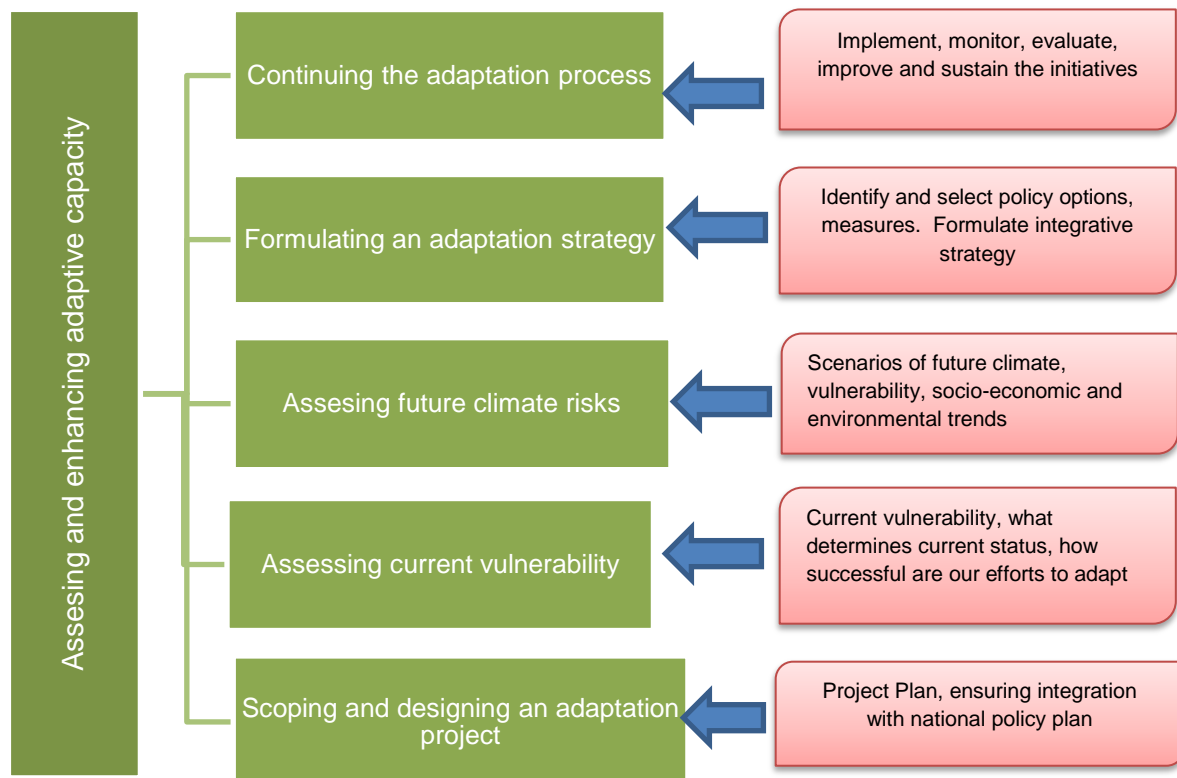


Figure 11 Adapted UNDP Components of APF

The components of APF start with the process of scoping and designing an adaptation project, assessing current vulnerability, assessing future climate risks, formulating an adaptation strategy and continuing the adaptation process. Continual stakeholder engagement is critical in the process of assessing and enhancing adaptive capacity.

Burton et al. (2006) add that localised adaptation should be guided by policies and strategies of the national governments and in other instances facilitated by international regimes.

They suggest that the response efforts should meet the following interrelated needs:

- Information - in order to develop effective strategies, it is critical that local quality data on projected impacts over time is utilised taking cost and efficacy of possible response measures into consideration
- Capacity - there is a need to strengthen technical and planning capacity for better climate change understanding and development of responses
- Financial Resources - financial resources are needed for poor countries to build capacity, take adaptation measures and have the ability to cope with climate change impacts.
- Institutions – there is a need to have central points at national or international level with the purpose of garnering expertise, coordination of strategies and serving advocacy function for wider planning and auctioning. However, it is vital that adaptation continues to be the integral part within the existing institutions.
- Technology - depending on the circumstances and needs, success of adaptation like mitigation, depends on technology employed based on the available circumstances. Technology continues to play a vital role in today's business operations.

The data and knowledge that developing countries have on vulnerable systems and sectors like agriculture, water, resources, health, transport, biodiversity and disaster management should be used to exploit the synergies and integration themes in order to enable better informed policy making (Burton et al. 2004).

The UNDP hopes that the following realignments will continue whilst the dialogue around adaptation unfolds (Burton et al. 2004):

- The process of reversing trends such as increasing maladaptation which risk human population and natural system
- The reassessment of existing plans needed for infrastructure design robustness and long term investments
- Improving awareness of the society (i.e. policy makers and vulnerable local

communities) and getting everybody ready for the projected climate change

- Better understanding of factors that increase or decrease the adaptation capacity of those who are vulnerable
- A new focus on assessing flexibility and resilience of social and managed natural systems.

Finally, Mullan et al. (2013) warns that by being one of the many cross cutting priorities, adaptation risk becomes a victim of ‘mainstreaming overload’. This is a risk that policy makers need to be aware of and properly manage to avoid stagnation in dealing with the challenge of climate change.

Whilst countries like Sweden and the Netherlands have estimated the costs of adaptation, it is equally important that they indicate the benefits of adaptation. Consequently several countries have now begun to assess the costs and benefits thereby making a useful input into the policy making process (Mullan et al. 2013). This is an important ingredient and balance to get the attention of the decision makers.

The above examples and the Adaptive Policy Framework, highlight that policy is an important tool that countries, ports and other organisations should use in addressing climate change. The response measures of adaptation or mitigation should be rolled out following a clear policy framework. Without policy, the responses to climate change will always be fragmented and difficult to achieve.

3.7 Conclusion

Policy is a critical tool that guides ports on dealing with climate change. It provides framework to identify and help stakeholders to understand their roles, responsibilities and the resources that are needed in dealing with climate change. Through policy, ports are able to understand the vulnerable areas and develop the necessary response actions to specifically deal with them.

Stakeholders are able to focus with synergy and avoid dealing with climate change in a fragmented manner.

Many ports around the world have managed to use policy to drive their efforts as they deal with climate change. The UK has used policy to drive their ports to report on risk assessments and measures, thus promoting transparency reporting. Integration and coordination of activities are made easier by change policy.

Both local government and ports will have difficulty in ejecting maladaptive developments when they do not have well defined adaptation related roles and responsibilities which can be shown by a policy framework. This failure exposes them to litigation risks.

Policies work well individually or with others depending on the circumstances. The policy framework like APF is used globally to guide organisations on following a clear path to achieve an adaptive capacity.

IV CLIMATE CHANGE POLICIES AT GLOBAL, REGIONAL AND LOCAL LEVEL

4.1 Introduction

Climate change is a world phenomenon, affecting all international States and humanity. With the international communities trying to address it at a high level, it is noted and acknowledged that its effects are mostly felt at a local level. In order to deal with climate change, most countries have finally taken time to assess their vulnerability and developed policies with the intention of dealing with the projected challenges. This has been done individually and within regions in the form of integration.

4.2 Country Level

In 2002, the World Summit on Sustainable Development (WSSD) held in Johannesburg identified five sectors that needed urgent attention on matters of sustainable development. These sectors are Water, Energy, Health, Agriculture and Biodiversity (WEHAB) initiative. The various global States agreed on various targets and committed action to implement these sustainable developments taking in consideration economy, environment and social dimensions (Sibley, 2007). Whilst these sectors are not directly incorporating ports, they do have an indirect but close relationship with the port business.

Employees in the port need access to clean water to be able to perform their duties properly. The cargo handling equipment in the form of cranes and vehicles consume energy. The electricity demands for vessels, buildings and other functions require the port to utilise energy. The high temperatures contribute to health risks for employees, crucial biodiversity like coral reefs and mangroves are found in ports whilst agricultural products are commodities that get transported through the ports.

4.3 The Republic of South Africa

Since the country's democratic elections of 1994, South Africa has been active in the international front and has signed and ratified the UNFCCC and Kyoto Protocol. UNFCCC was signed in 1993, ratified in 1997, the year the Convention came into effect. It is intended for reporting on the GHG emissions, vulnerability, adaptability and how the country plan to address climate change. The Kyoto Protocol was signed and ratified in 2002 and came into effect in 2005. This relates to reporting and reducing GHG emission by 34% in 2020 and 42% by 2025. South Africa is not a high contributor on emissions and is therefore not compelled to introduce these measures.

The National Development Plan (IDP) which was launched by the government in August 2012, also highlight the importance of climate change and commits the country to deal with this challenge as government develop infrastructure (NDP, 2012; Taylor, Cartwright, & Sutherland, 2014). In addition, South Africa signed the United Nations Global Compact (UNGC), which is a strategic policy initiative for businesses who care committed to align their operations with ten (10) globally accepted principles covering human rights, labour, anti-corruption and environment, thereby advancing sustainable development. The signing commitment was done through the department of Public Enterprise which is the shareholder of Transnet, the custodian of ports, pipelines and rail.

4.4 National Climate Change Response White Paper Of 2011

Since South Africa is part of the African continent, it is vital that in introducing its policy, it alludes first to the status of climate change in the continent. The African continent is regarded as the most vulnerable continent with regard to climate change and variation (IPCC, 2007). This is despite the fact that the African Continent is not a significant contributor to GHG emissions. This is attributed to the low adaptive capacity of the African states which can be contributed to the development challenges that are being experienced and the shortage of continent resources (Pressend, 2011; NCCR, 2011). Agriculture, transport, health, energy, water and infrastructure are the main areas which are identified as challenged.

Parry et al (as cited in Ibarrarán et al. 2008) opine that resilience should not be seen as the inverse of vulnerability. They highlight IPCC's definition of resilience as the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change (IPCC, 2001). This understanding is critical as it highlights the importance of building resilience.

Climate change policies have been robustly developed but the continent has lacked capacity to implement them accordingly. It becomes important that the continent invests time and resources to implement policies aimed at addressing the challenges of vulnerability so as to build resilience by way of climate change mitigation and adaptation.

4.4.1 UN Climate Change Regime

The United Nations Intergovernmental Negotiating Committee which was established in 1990, UNFCCC and the Kyoto Protocol brought about the development of law and policy on climate change at an international level. South Africa's climate policy is based on these regimes.

According to Pielke (as cited in Huq, Rahman, Konate, Sokona, & Reid, 2003), the Kyoto Protocol of 1997 was as result of the 1990's negotiations and scientific research which concentrated on mitigation. The developing countries were concerned with reducing their vulnerabilities to climate change whilst developed countries were more concerned with reducing GHG emissions. This has changed in the last few years with the members realizing the importance of adaptation for both developed and developing countries and understanding that even if emissions were halted today, there will still be some degree of climate change leading to the suffering of the Least Developed Countries (LCD). This is why climate change continues to be a crucial topic every day.

The Kyoto Protocol does not dictate to Parties to the Convention, the legal emission reduction targets that developing countries should meet. This is a bit problematic as this means some countries might just continue to emit without facing any repercussion. These countries' development processes are expected to conform to the principles of sustainable development. The developed countries, regarded as the main contributors to climate change are also expected to assist the developing countries in their initiatives aimed for mitigation purposes. The assistance will be financially, technologically and in the form of capacity development. To help in increasing resilience to climate change impact, the Protocol facilitates the development and deployment of technologies (NCCR, 2011).

The development of NCCR was started in October 2005 and it took several years and efforts to complete. The process involved scientific modelling and research activities, two national

conferences, workshops and provincial conferences, bilateral and key stakeholder engagements, NEDLAC review and Parliamentary hearings. Mullan et al. (2013) highlight stakeholder engagement as a vital aspect that Austria stressed in their national planning. South Africa has followed the concept of stakeholder engagement in this regard.

This new direction requires that climate change policy become an integral part of the country's development strategy. The South African National Development Plan acknowledges the importance of sustainable development in transforming and driving the country's development agenda. The economic policy tools are to be developed to assess the costs and benefits of proposed policy measures and to periodically evaluate policy effectiveness in terms of its economic, social and environmental impacts.

South Africa's climate change policy was approved by the cabinet on the 12th of October 2011. It outlines the country's mitigation and adaptation path aimed towards achievement of a socio-economic transition to a climate resilient and low carbon economy. The policy proposes the usage of market mechanisms in promoting mitigation action. Chevallier (2011) argues that despite this proposal, clarity is still needed on South Africa's renewable energy feed-in tariff regulation, its Integrated Resource Plan (IRP) II and the proposed design of a carbon tax – policies that will further demonstrate through practical action, the seriousness of the intent.

According to the National Climate Change Response (NCCR) White Paper of 2011, South Africa's response to climate change has two objectives:

- Effectively manage inevitable climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity.
- Make a fair contribution to the global effort to stabilise greenhouse gas (GHG) concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe that enables economic, social and environmental development to proceed in a sustainable manner

4.4.2 Principles

The principles set out in the South African Constitution, the Bill of Rights, National Environmental Management Act (NEMA), Millennium Declaration and the United Nations Framework Convention on Climate Change guides this response policy document.

These principles include amongst others the following:

- Alignment of local measures in the plan to reduce emissions and increase adaptation in dealing with climate change with South Africa's different circumstances, development stage and capacity
- Fair allocation of efforts, costs and benefits in dealing with unequal vulnerabilities, disparities and responsibilities
- Policy measures should address the vulnerable and simultaneously achieve social, environmental and economic sustainability
- Our measures and current activities should be sustainable for the benefit of the current and future generations
- Those who harm the environment should be made to take full responsibility by paying the costs of their harm and rehabilitation activities that have to follow from such.
- Creating awareness of the causes and impact of climate change so that everybody can participate in dealing with the climate change issue.
- Understanding that enhancing economic, social and ecological sustainability is integral component for climate change response efficiency and effectiveness (NCCR,2011)

4.4.3 South Africa's Response Strategy

In preparing for hosting the Conference of Parties (COP) 17 meeting, South Africa realised the importance of community engagement, following the amount of protests that happened in

Copenhagen as a result of Denmark excluding civil society on engagements before the conference. Public climate change outreach and mobilisation programmes, youth development and media training were initiated by the country as they were preparing for the conference. Business was also included in the greening framework plan which was looking at how business could adopt using initiatives to offset carbon emissions and building sustainable legal projects (Chevallier, 2011)

Climate change responses are either categorized as mitigation or adaptation. Climate change adaptation refers to changes in processes, practices and structures to moderate potential threats associated with climate change (McDonald, 2011; Leary, Dokken, & White, 2001). It is also referred to as the ‘adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts’ (IPCC, 2001). Adger (as cited in Bryan et al. 2009) views adaptation as a dynamic social process and believes that the ability of the society to act collectively determines its ability to adapt. Adaptation does involve the adjustments to decrease the vulnerability of communities and regions to climate change and variability (IPCC, 2001). The enhancement of the adaptive capacity is a way of reducing vulnerabilities and promoting sustainable development.

Response measures are about managing any unintended negative consequences of climate change policy and measures. South Africa’s climate change response policy acknowledge that the country’s response requires economic, social and environmental interventions integrating both mitigation and adaptation elements within a developmental framework. It also highlights the need for the country to manage any response measures emanating from its own action and those generated by its counterparts when addressing the challenge of climate change. It is not clear how the country will manage the response measures of its counterparts. It becomes important that ports should also be aware of the need to balance the three interventions (social, economic and environmental) as well as integrate both response measures within the developmental framework.

South Africa’s climate change policy deal with both mitigation and adaptation measures with

the overarching strategic approach known as climate change resilient development.

A new kind of sustainable economic development is brought by adaptation and mitigation opportunities. This is expected to improve the distribution of resultant economic gains. Ports as a vital component of the logistics chain become more relevant in this instance.

The climate change response of South Africa, with an overarching strategic approach is:

- Customized and needs driven - the approach of which is underpinned by the adopted principles, tailored to deal with the vulnerable and best available solutions as per the needs of those affected
- Developmental in nature – prioritizing those whose responses are most likely to yield the most benefits
- Seeking to transform, empower and encourages participation – with innovative ideas, opportunities for skills and sector development, communities are having an opportunity to participate in transforming both social and economic in line with the New Growth Plan (NGP)
- Dynamic and evidence based – Taking cognizance that the policy and measures were not developed in a vacuum but was researched by sectors that are experienced in policy implementation
- Balanced and cost effective – with regard to cost benefit, prioritization, focus, action and resource allocation. It is not clear how the policy is cost effective and balanced
- Integrative as well as aligned – when cross cutting responses are required, the policy is seen as catering for sector planning and is aligned to three spheres of government planning (i.e. local, provincial and national).

The above strategic approach means that the South African Port Authority cannot have a generic response to the different ports under its auspice. Response will be customised and dictated by the specific need based on vulnerability and necessary solution. This indicates that the most vulnerable ports should be prioritised and integrative response used for alignment

purposes.

4.4.4 Strategic Priorities

The policy document aims to strategically set the South African's climate change response. The following strategic priorities: risk reduction and management; mitigation actions with significant outcomes, sectoral responses policy and regulatory alignment, informed decision making and planning, integrated planning, technology research, development and innovation, facilitated behaviour change, behaviour change through choice, and resource mobilization are aimed at achieving the NCCR objectives consistently.

4.4.5 South Africa's Adaptation Response

For the immediate future, sectors that need particular attention are water, agriculture and forestry, health, biodiversity and human settlements.

An adaptation risk based process is adopted by the NCCR for identification and prioritization of short and medium term interventions within the various sectors. This process is envisaged to identify areas where sectoral coordination is required and is expected to be reviewed every 5 years.

Whilst the country can be directly impacted by climate change, it may also be impacted by measures taken internally and or by other countries in their expedition for reducing GHG emissions. This is referred to as secondary economic impacts. In the address and management of response measures which have negative economic impacts, the South African government has proposed a multi-facet approach. It then becomes the responsibility of government departments and State Owned Enterprises (SOE) like TNPA to continually engage in reviewing policies, strategies, legislations, regulations and all plans for proper alignment with the NCCR.

The country took a developmental approach of continual review of the policy so as to

determine adjustments, additional legislations or regulations needed to achieve alignment. A review of the response policy is expected to be done every five years going forth. It is important to continually review a policy to ensure that it serves its purpose and to establish areas of improvement. These areas can be properly identified based on the experience of those who work within that environment.

The creation of the green economy requires the response strategy to promote investment in both the human and productive resources. Ports are expected to promote the concept of green economy. This is critical especially taking into consideration that ports have critical areas like mangroves which are quite threatened. At the same time vessels are required to reduce their carbon emissions as part of climate change mitigation measures. Through assessing and identifying the different economic sectors' vulnerability, the government will be developing Sector Job Resilience Plan.

4.4.6 Alignment of Government levels

The three levels of government have a positive role to play in addressing climate change as well as ensuring that it is integrated in their programmes and policies. Alignment between the different spheres of government is necessary to realise the objectives of the national policy.

National government role

- Formulation of the climate response policy
- Amendment and promulgation of legislation dealing with climate change
- Establish and administer regulation framework for management of emission reduction
- Consider and implement short and long term market based instruments e.g. carbon tax and investigating the appropriateness of emissions trading schemes
- Resource allocation and incentives through Medium Term expenditure Framework (MTEF)
- Participation in international talks on climate change. It is important to note that for the

national government to fully participate at international talk, they will need input from ports.

Provincial

- Coordination of provincial mitigation and adaptation responses
- Development of provincial response strategy

Local

The South African Local Government Association (SALGA) of which the coastal cities are members of, is a body mandated to support, represent and advise local government action. Their active participation in all spheres of government is critical as they ensure the integration of adaptation and mitigation actions and are lobbyists for local government to be supported with regulatory measures and resources necessary to deal with the advent of climate change.

Climate change is becoming a central strategic topic on sustainable development in Africa especially the threats that it bring to the continent. Burton et al. (2006) indicate that response measures to the impacts of climate change must be localised and guided by policies and strategies of the national governments and in other instances facilitated by international regimes. Mokwena (2009) submitted that it is vital that the role of local authorities is assessed in combating, managing and adapting to climatic change threats. This is because the local authorities are the ones who are within close proximity to the communities that will be mostly and immediately affected by these threats. Being local when you do not have the required skills to deal with the matter does not advance the objective of the policy. It is therefore important that those in the local authorities are trained on how to deal with climate change

Goldblatt and Middleton (as cited in Mokwena, 2009) indicate that in formulating effective responses, multi-level governance that covers the climate change process is required. This starts

from the design phase and include the interventions up to the actual implementation. This multi-level governance agenda should also include intervention at local level, decision making at local government and climate change responses.

4.4.7 Partnering with stakeholders

Stakeholders need to be actively involved by participating in the challenge of addressing climate change. South Africa has realized this and acknowledged that for the objectives of the policy document to be fully realized, it is important that everybody plays an active role in this regard. It has therefore committed to substantive engagement and establishing partnerships with stakeholders (e.g. industry, business, labour, academia and civil society) in a way that strengthens coordination. This provides a learning experience for the ports to also engage different stakeholders in order to meet the objectives of the policy with reference to adaptation. For economic and business engagements, ports have managed to facilitate the realisation of the sessions.

One of the contributions of the business industry is through submission of National Green House Gas data voluntarily to government. This is done through the development of the GHG Inventory as an initiative aimed at developing the compulsory GHG emissions reporting system. Ports can also participate in this programme as part of inculcating the culture of dealing with climate change. The policy expects private sector to play a vital role by assisting in funding of climate change response programmes. The government aims to collaborate with the financial sector exploring available mechanisms to achieve efficient funding flows.

The policy document suggests that it may be useful to assign specific powers for mitigation and adaptation actions such as coastal management, infrastructure management and natural resource stewardship to local government. This is an area where ports and local government can collaborate especially with ports having to expand through infrastructural and at times coastal development. The document requires the Department of Local Government and Traditional Affairs to conduct a critical review of the policy and legislation relating to local

government functions and powers with respect to climate change.

The policy indicate that scientists and academia must work on improving climate change projections and its impact on communities. New information should be shared with government to deal with climate change better and exploring challenges and opportunities that arise. The projections data can be utilised by ports in properly planning for climate change.

4.4.8 Resource Mobilisation

South Africa understands that responding to climate change requires comprehensive resource packaging. The country has committed itself to gather all the necessary resources required for this purpose. This should be in the form of finance, technical as well as technological cooperation at all levels (i.e. local, regional, continental and international). It is not clear how and who will be responsible for this comprehensive resource packaging.

It is estimated that responding to mitigation will cost between 1 and 2.5% of the World Gross Domestic Product (GDP). The African Continent will have to spend between 1.5 and 3% of its GDP on adaptation programmes by 2030. Due to the differing economic developments within the African countries and sectors, the impact and benefits distribution will be unevenly felt. Considering the magnitude of the current and future costs of dealing with these challenges, it is important that every effort is put in place to avoid maladaptation in the short term (Mather et al. 2009; NCCR, 2011; Davis, 2011; DEA, 2013).

4.4.9 Settlements – Coastal, Urban and Human

South Africa has a coastal of approximately 3650 km which is highly exposed to moderate and strong waves. The coastline has little natural shelter to deal with frequent and intensified sea storms. This has increased the vulnerability of the coastline with regard to storm surges,

erosion, rising sea level and extreme weather events, resulting from climate change.

In establishing coastal vulnerability indicators, Mather and Theron (2011) list waves and sea water levels as the key drivers to measuring erosion and inundation. The policy recognizes that in order to reduce the likely damage, continual coastal defence assessment specifically for harbours, lagoons, estuaries and along low lying coastal land should be undertaken.

4.4.10 Contribution to Jobs

One of the objectives of the government is to ensure that policies that are put in place contribute to job creation. NCCR aims to limit jobs contraction in economic areas where excessive carbon intensity is regarded as unsustainable. At the same time, look at promoting and expanding the green economy sectors. It also aims to promote investment in human and productive resources that will grow the green economy. Sectors are expected to develop Sector Job Resilience Plans. This is based on government assessment of the different economic sector's vulnerability to climate change. With the high unemployment rate and low skills level, it might be difficult for the country to easily reduce excessive carbon intensive jobs. South African ports have to look at how they can promote green economy in the port environment.

In trying to influence the behavioral choices of the citizens, the government took a decision to inform, educate and engage citizens on climate change. Early warning systems will be set and maintained to enable people to take specific action in reducing risks to themselves, their households and properties.

4.4.11 South Africa Monitoring and Evaluation

The South African climate change response Monitoring and Evaluation (M&E) system is the legal, institutional and procedural framework for capturing, analysing and publishing information on the impact of climate change response measures, allowing this information to be

used to maximise their effectiveness and to inform future climate change response measures. The overarching objective of the M&E is to track the transition towards a lower carbon and climate resilient South Africa.

It seeks to answer the following questions:

- Is South Africa becoming lower carbon state?
- Is the country becoming more climate resilient?
- What are the financial needs and flows from mitigation and adaptation activities?
- How are the outputs of the M&E system fed back into the future decisions?

The objectives and benefits of monitoring and evaluating mitigating and adaptation initiatives South African climate change.

Table 5 M&E Objectives and benefits

Sub-objectives	Benefit
Determine what is or not working	<ul style="list-style-type: none">• Increased business confidence in action on climate change• Raising public awareness• Improved accessibility to data
Provision of information on the co-benefits of climate change action	<ul style="list-style-type: none">• Helps build broader support for action• Identifies which interventions have the widest benefits, allowing this to be factored in to future decisions
Meeting domestic reporting requirements	<ul style="list-style-type: none">• Meets Policy objectives of annual reports to Parliament• ‘Systems approach’ encourages continuous improvement and increases credibility
Meeting international requirements	<ul style="list-style-type: none">• Ensures appropriate recognition for the actions South Africa is taking
Demonstrate impacts of SA Climate change response measures to funders	<ul style="list-style-type: none">• By raising awareness and improving confidence, helps attract international private and public funding
Develop a more joined up approach on climate change M&E	<ul style="list-style-type: none">• Allows for more effective sharing of data• Enables rationalisation• Encourages learning on M&E across sectors

Source: (SANBI, 2014)

The Long Term Adaptation Scenarios Flagship Research Programme (LTAS) was established by the Department of Environmental Affairs to develop national and sub-national adaptation scenarios for South Africa. LTAS is in the process of producing a series of reports which present a consensus of climate change trends, projections, and key impacts and identify response options for primary sectors, namely water, agriculture and forestry, human health, marine fisheries, human settlements and biodiversity. The purpose of Flagship programme include amongst others consolidation of current adaptation and mitigation initiatives, identification of implementation barriers and opportunities for scaling up and leveraging both private and public funding necessary for addressing the challenges presented by climate change (SANBI, 2014).

4.5 Continental and Regional Level

Hernes et al. (as cited in Davis, 2011) estimated that Africa will experience on average sea level rise of about 25 cm by 2050. Sea level rise on regions and local areas will be different as it will depend on ocean current and atmospheric pressure. IPCC projections suggest that temperature in the sub-Sahara region is expected to be higher than the global average with the amount of rainfall declining (Bryan et al. 2009).

With the Declaration on Climate Change and Development in Africa, The African Union (AU) adopted a common position on Climate Change in 2007. Through this declaration, member States made a commitment to improve public awareness, integrate climate change in their respective development programmes, promotion of science and technology and funding of climate change initiatives.

Since AU relies on foreign funding, it tends to experience challenges when it wants to pursue certain climate change programmes. The funders have the ability to dictate the speed and structure of mitigation or adaptation strategy which may at times be unsuitable for Africa's needs. This highlights how reliance on funders continues to be problematic. Gogo (2013) advise that Africa Union institutionalise climate change to be a security issue due to the potential threat of conflicts which might arise as a result of its impact like water or food scarcity.

4.5.1 First Conference on Climate Change and Development in Africa (CCDAI) 2011

The United Nations Economic Commission for Africa (UNECA) plays an important role in providing technical assistance to African countries to stimulate economic development. The impact of climate change presents a threat, thus limiting the economic progress and the fight against poverty in most African countries. Instituting adequate adaptation measures has become a primary focus for leaders to minimise exposure to this challenge. Most African countries with river or seaports depend on the ports for their livelihood. In order to stimulate economic

development, ports have to be adapted to ensure that the communities can continue to utilise these assets into the future.

The first Climate Change and Development in Africa (CCDA-I) Conference report, which is a work of the joint effort by the African Union Commission (AUC), African Development Bank (AfDB) and UNECA, highlights the following areas as critical for supporting policy development and investments towards building capacity to climate change adaptation:

- climate science,
- data and service delivery;
- climate resilient development and adaptation;
- low carbon development;
- the economics and finance of climate change.

The overall objective of CCDA-I was to create dialogue, awareness, mobilisation of effective commitment and actions from stakeholders, with the aim of mainstreaming climate change concerns into developing policy, strategies, programmes and practices in the continent. It also strengthens Africa's position and global participation to ensure that its concerns and priorities are entertained.

In dealing with the Africa's climate challenge, the CCDA-I Conference which had a theme 'Development First: Addressing Climate Change in Africa' recommends the following:

- Development of robust infrastructural decision is needed to enhance infrastructural readiness to help climate finance
- More money should be allocated to distributive systems;
- Required responses are huge despite discrepancies in numbers, and this obviously

means there is more work to be done, including access to resources;

- Better studies are needed for a better understanding of what will happen, and to integrate socio and cultural dimensions in development planning;
- African leaders should focus on integrating climate change into their development plans
- Capacity needs to be developed in the area of the economics of climate change; and
- Developing effective assessments of policies, strategies and measures should be based on robust economic analysis.

In dealing with the current and future climate change impacts in the East and Southern African regions, country members of the South African Development Community (SADC), the Common Market from East and Southern Africa (COMESA) and the East African Community (EAC) realised the importance of climate adaptation and mitigation. Consequently, they committed themselves to implement regional and national laws, regulations and strategies to deal with this phenomenon.

Increased extreme weather events, floods, storms and droughts are frequently increasing in the Southern African region. These developments are not insignificant but rather impact on social, economy and politics matters of the region. Water availability poses a serious threat to the region's ability to reduce food and progress towards reducing poverty and unemployment.

As per the UNFCCC report of 2007, the ability to adapt by most African countries is hampered by challenges of limited capital finance accessibility, low Gross Domestic Products (GDP) per capita, poverty, weak institutions and low levels of education (Viljoen, 2013). According to Chevallier (2011) countries respond to the challenge of climate change differently depending on their circumstances and priorities. As such, African countries by virtue of their vulnerability need to strive for adaptation with outcomes that are ambitious, respectable and fair.

Whilst this conference came up with good intentions, its biggest challenge is financing the identified sectors. This also highlights the lack of self-sufficiency of the AU which stagnates the necessary developments.

4.5.2 Common Market from East and Southern Africa (COMESA)

COMESA is a Regional Economic Community (REC) within the AU framework with a common vision and a shared conviction, individually and collectively on a path of a sustainable growth and development.

Achieving economic prosperity and climate change protection is the goal of COMESA's Climate Change Initiative, with the overall objective being to address climate change and its impacts in a manner that builds economic and social resilience for present and future generations.

COMESA has set specific objectives which are about:

- Consolidating a shared vision for Africa on climate change
- Fostering cooperation to address climate change and its impact
- Promoting integration of climate change into policies, sectoral planning, development and budgeting
- Enhancing human and institutional capacity to address the challenges
- Mobilising technical and scientific communities for increasing knowledge base
- Promoting and enhancing collaboration, synergy, partnerships and participation of stakeholders

Through capacity building and networking, COMESA aims to assist the most vulnerable states to embrace the challenge and deal with their specific vulnerabilities. Through the IAPH, ports can also work on capacity building, networking and partnering to share the costs of dealing with climate change adaptation in the East and Southern regional ports.

In July 2014, COMESA signed a memorandum of understanding with the United Kingdom Department of International Development to avail £3,000,000 (Three Million Pounds Sterling) to the COMESA-EAC-SADC Tripartite Climate Change Programme, whose objective is to

improve policy on Climate Smart Agriculture (CSA). This programme will be informed by evidence, supported by community and attracting adaptation and mitigation finance.

The CSA funds will be used to promote the activities, increasing capacity of member states to negotiate, supporting climate change response strategies, research purposes as well as setting up CSA pilots in selected tripartite countries. This follows the agreement of the same nature with Norway in 2011.

The regional cooperation programmes of COMESA-EAC-SADC are about the region having a stronger voice in international engagements, facilitating access to funding, capacity building through research and training, assessing climate vulnerability and driving mitigation solutions. Agriculture and forestry adaptation seems to be the areas that are currently getting much attention.

4.6 Southern African Development Community (SADC)

4.6.1 Southern Africa Region

To ensure equitable and sustainable use of environment and natural resources for the benefit of present and future generations, SADC established the Regional Indicative Strategic Development Plan (RISDP) in 2003. This plan is seen to highlight the role of harmonised regional environmental policies as an adaptive measure. In order to reach the goal of uniform regional response, the RISDP identifies regulation and legal framework focusing on promoting cooperation on environmental issues as the main focus area. It encourages regions to develop policies integrated in multilateral environmental agreements which are time bound and have emanated from developed international climate change policies (Barnard, 2014).

Between 2006 and 2008, SADC member states classified as Least Developed Countries (e.g. Tanzania, Mozambique and Angola) have contributed to the UNFCCC by submitting their National Adaptation Programmes of Action (NAPA). Ports from the region will have to consider the work under taken by UNFCCC and IPCC in dealing with climate change challenge.

According to Richards (2008), SADC'S policy context on climate change is more related to that of South Africa and that of others in the continent. It is made up of a range of international, continental and regional policy frameworks, protocols and declarations. As a collective entity though, SADC is lagging behind compared to South Africa with regard to the extent of policy development and legislation in the area of environmental policy governance and climate change (Richards, 2008). He points out that clearly defined climate change objectives, pursued through uniformly agreed strategies by SADC members is important for the region. A regional climate policy is what is required to enhance the member states regional adaptability to climate change.

Since Richards's observation, SADC acknowledged some sectors as facing impacts and environmental risks resulting from the changing climate. They developed protocols that deal with environmental issues which covers amongst others sectors like energy, fisheries and wildlife conservation. This acknowledgement is viewed as a vital step in the new direction. The above sectors intertwine with ports. This requires that ports within the SADC region should take time in implementing both mitigation and adaptation policies. It is important that the region should be working in harmony to ensure that at least all member states are at the same level of development.

In 2010, SADC developed a Southern Africa Sub-Regional Framework on Climate Change in preparing for COP 17. Adaptation was identified as the most pressing issue to be prioritised in the regional response framework amongst mitigation, technology and financing (Barnard,

2014). Disaster risk reduction and management, sectoral planning and implementation, economic building and social resilience were the proposed adaptation programmes based on the framework. With specific reference to the importance of a harmonised sub-regional climate change strategy, the framework agenda proposed that SADC should table and implement a Regional Climate Change Programme of Action.

This programme of action should include priority interventions for the region such as adaptation as spelt out in Cancun, Durban and in Rio Declarations. Additional vital components of the framework agenda included: research and analysis, national climate change policies and strategies implementation of the Durban Platform Action, regional and domestic resource mobilisation, adaptation, mitigation and climate governance (Richards, 2008; SADC-CNGO, 2012; Barnard, 2014). Whilst the region prioritised adaptation, it is important to note that adaptation needs funding. It would be ideal for the region to develop a framework for assisting ports in accessing finance necessary for adaptation.

Davis (2011) indicated that Southern Africa has not been able to collect and make climate change information accessible to those who are impacted or needing the information for other purposes. The little information that is available is normally not in an easily usable format needed for decision making purposes. The vulnerability of many communities has driven a need to step up public awareness and political commitment to both adaptation and mitigation. The need to have increased access to climate change information was declared a priority at the SADC Programme on Science and Technology Support for Climate Change Response meeting held in March 2011. This information relates to climate change projections and up-to-date impact studies necessary for state gap analysis in relation to climate change.

In dealing with this challenge, the Department of Science and Technology in South Africa developed a South African Risk and Vulnerability Atlas (SARVA) which is an atlas highlighting the information on impacts and risks associated with climate change, thereby improving information and its accessibility (Davis,2011). Ports in the Southern Africa region

should be able to use this handbook as part of their planning and implementation processes for climate change adaptation.

The fact that climate change knows no boundary necessitate that neighbouring states should collaborate in developing policies and strategies to deal with this effect (Richards, 2008; Barnard, 2014).

One of SADC's key goals is to promote sustainable and equitable economic growth and socio-economic development in the region (Barnard, 2014). SADC understand that for this goal to be achieved, member states need to work in an integrated manner, sharing resources and responsibility for the good of the region. The trans-boundary nature of the effects of climate change warrants comprehensive strategies based on intense cooperation which link climate change with the broad socio-economic and political development frameworks of SADC member states (SADC-CNGO Regional Policy Paper 7 2012). Several memoranda of understanding (MOU) on intra-regional cooperation continue to be signed by the South African Port Authority with other regional ports in Mozambique (MPDC) and Namibia (NAMPORT) to name just a few. It will be ideal to have these MOU helping the different ports to fund and implement the climate change adaptation policy.

AU-NEPAD African Action Plan of 2008 stresses the importance of aligned regional policies necessary for climate change adaptation. To that effect, Barnard (2014) opines that adaptation should therefore be seen to include the formulation of harmonised sub-regional law geared towards collective action relating to climate change. Barnard (2014) stresses the importance of including adaptive action in defining adaptation at the regional level, pointing out that it is underpinned by UNFCCC, Article 4(1)'s referral to the crucial role played by regional law in facilitating adaption to climate change. Ports can utilise this regional law to advance and help one another to ensure implementation of climate adaptation programmes.

At the level of SADC as an entity, it was observed that climate change and environmental policy development is driven by a range of protocols agreed to and signed by member states, and enforced through the SADC Secretariat. However, the voluntary nature of protocols as instruments of policy implementation presents a potential constraint in terms of effective enforcement. One can only hope that the MOU's signed between ports, will facilitate and encourage ports to willingly accelerate implementation of policy. SADC also requires greater co-operation and commitment from member states in supporting the monitoring function through, among others, greater funding to ensure that the necessary technical skills are put in place to track the implementation of climate change policies (Richards, 2008).

According to Barnard (2014), addressing the challenge of climate change clearly requires more than technical and environmental solutions. As an urgent policy issue, climate change needs to be systematically mainstreamed into other broader policy, programming, planning and implementation processes, to avoid tackling it as an isolated policy issue through additional and self-standing mechanisms.

The latter usually pose risks of duplicating resources and efforts, and calls for the establishment of additional implementation and co-ordination structures without guarantees of effectiveness. As Southern Africa increasingly comes to grips with the effects of climate change, cooperation between member states will become more essential, requiring regional stability. It is heartening to notice the leading role that the South African Port Authority has taken in trying to integrate with the region. It will also be good to see other ports taking the same role in cooperating with others on sustainable development matters

4.7 East African Community (EAC)

Members of EAC are Kenya, Burundi, Rwanda, Tanzania and Uganda. In implementing uniform measures required for sustainable, social and economic development of the region,

EAC developed the climate change policy for its members. With the aim of operationalising the policy, the Climate Change Fund was established and master plan as well as regional strategy prepared. Through this Fund, ports have the opportunity to access finance necessary for adaptation plans that they might have.

The Lake Victoria Basin Commission (LVBC) was tasked with infrastructure development which included transport system revamp in and around Lake Victoria, conservation and management of aquatic resources which included fisheries (Viljoen, 2013). The EAC protocol dictates that policy and decision making rests with the members of LVBC. This is a commendable step that EAC has taken in ensuring that the Commission is properly empowered.

4.7.1 East Africa Community Climate Change Policy (EACCCP)

EACCCP is about responding to the increasing threats of climate change which are negatively impacting on EAC region's developmental goals. The policy was formulated in line with UNFCCC and the Protocol on Sustainable Development of Lake Victoria Basin. Viljoen (2013) indicate that the aim of policy is about contributing to the region's sustainable development benefits through harmonized and coordinated strategies in addressing climate change. Since these member states develop their policies based on the guidelines of global institutions like UNFCCC, it should not be a difficult task to achieve this harmonisation and coordination. This also applies to the policy on how ports should address the effects of climate change.

The Policy is founded on three key pillars, namely, adaptation, mitigation and climate change research (monitoring, detection, attribution and prediction). These pillars are supported by technology development and transfer, finance, education, training and public awareness, information and knowledge management systems, which are regarded as the critical capacity building areas. The policy aims at implementation of urgent and immediate adaption priorities

as identified in the National Adaption Programmes of Action, National Adaptation Plans (NAP) and climate change strategies (Viljoen, 2013).

UNFCCC highlight priorities like meteorological services, early warning signs systems improvement, reduction of risk, coastal and marine ecosystems. These adaptation priorities have a close linkage with ports. It is critical that regional ports embrace and implement EACCCP.

4.7.2 EAC's Adaptation Challenges

EAC is concerned about improvement of the region's adaptive capacity and resilience in dealing with the climate change impacts. The following challenges are highlighted in their adaptation policy:

- Inadequate institutional, legal and regulatory frameworks for adaptation;
- Inadequacy of finances to support climate change adaptation activities;
- Lack of appropriate technological, human skills, data and tools for impact and vulnerability assessment;
- High levels of vulnerability amongst the populations, ecosystems and infrastructure;
- High poverty levels linked to poor and inadequate coping strategies and low adaptive capacity (Viljoen, 2013).

EAC's adaptation policy statement and priority action strive to reduce vulnerability, economic and social resilience building, adaptation plans, policies and strategies focusing at the member states national development plans. It is important to note that many countries have begun to understand and appreciate the importance of ports by including them as vital drivers of their national development plans. This means, ports have to be properly adapted for them to reliably play their role in development.

EAC launched a Regional Master Plan comprising of the following objectives:

- Providing an effective and integrated response to regional climate change adaptation
- Enhancing member states' mitigation potential in the sectors of energy infrastructure, agriculture and forestry
- Streamlining and harmonizing existing programmes
- Fostering international cooperation and enhancement of the region's negotiation ability
- Mobilising resources, amongst others like finance, technology and human (Otiende,2013)

4.8 Response at Local Government Level

4.8.1 Provincial and Municipal Level – Coastal Cities Durban and Cape Town

For the purpose of this study, the focus is on the Western Cape Province, the Cities of Cape Town and Durban but reference to other cities is made. In responding to South Africa's national climate change response policy of 2011, the city of Durban (eThekweni Metropolitan Municipality) has developed a strategic document to deal with the challenge of climate change as it relates to the city. This is also an important step, with the understanding that the city played host to the COP 17 in 2011.

To this effect, the City's Integrated Development Plan (IDP) and the Integrated Transport Plan (2010-2015) list climate change as a key challenge that the municipality has to deal with as it poses a threat of reversing the developmental gains of this coastal city. In addition, climate change is also included in the city's long term development plan which is a multi-stakeholder plan, assigning responsibility action of developing sustainable city to the municipality's stakeholders under six key themes.

With climate change identified as a major challenge, the city started a process of developing a resilience plan to better prepare for the projected changes. The draft Durban Climate Change Strategy (DCCS) present a framework strategy guiding and enabling sectors of the city's community to better respond to climate change. The sector specific adaptation plans as proposed by the NCCR of 2011, will remain in place and supplemented with additional plans as more municipal sectors address the challenge of climate change (DCCS, 2014)

Cohen, Mason-Jones and Rambaran (2013) highlight some of the key climate change adaptation concerns that the municipality of Durban need to be aware of:

- Sea level rise and storm surge damage to coastal infrastructure
- More intense, more frequent rainfall events
- Flood damage to infrastructure and interruptions to service
- Accelerated wear on road surfaces
- Need for larger storm water infrastructure
- Higher temperatures
- Accelerated wear on road surfaces
- Increased fire incidence (road safety, infrastructure risks)
- Systemic interactions
- How will Arctic shipping affect world trade movements

The above mentioned concerns are directly affecting the South African ports since they are located in the same area. The events mentioned are therefore also major concerns for the ports, their stakeholders and customers.

4.8.2 Rising Sea level

Maher and Stretch (as cited in DCCS, 2014) caution of the direct impact that sea level rise and coastal storms will have on Durban's economy, infrastructure and community. The DCCS highlight that the severity of this storms and rising sea level is a threat to the viability of Durban City's plan on port expansion. The port of Durban's Container Terminal is the busiest in Africa and therefore regarded as the economic hub of the city. If it was to be closed as a result of events emanating from poor adaptation, the business community, economic and logistical activities of the municipality, country and region will be severely affected.

Durban is also one of the top South African tourist destinations with clean beaches. The rising sea level is likely to reduce the beach widths and damage the coastal infrastructure that attracts tourists, devaluing private and public prime properties. Coastal storms plus increased wind speeds will affect the shoreline, especially flat areas, increase wave heights, ultimately affecting the movement of passenger and cargo vessels in and out of the port and cargo handling operations.

According to the DCCS (2014), Environmental Planning and Climate Protection Department (EPCPD) and Energy Office (EO) will be responsible for mainstreaming the climate change strategy by promoting the introduction of climate change content into both the IDP and Long Term Development Plan of the Municipality. DCCS project will be funded and led by the EPCPD and the EO of eThekweni Municipality.

There are various goals that are listed on the draft policy but for the purpose of this study, only goal B is presented as it is closely related to the study objectives.

Goal B - Durban's coastal resources and built infrastructure are protected.

Table 6 Response to the impact of sea level rise - Durban Response

Objective B.1	
The impact of sea-level rise is limited through risk-averse planning and appropriate infrastructure and building standards.	
Responses	Implementing Sectors
B.1.1 Adopt and enforce the provincial coastal management lines to manage current and future development.	EThekwini Municipality
B.1.2 Adopt and enforce a policy of retreat wherever non-essential buildings and infrastructure is damaged or lost to erosion and/or located seaward of the coastal management line.	EThekwini Municipality
B.1.3 Adopt and enforce a risk-averse approach to spatial, land use and infrastructure planning and development control that responds to all potential coastal flooding and other coastal risks.	EThekwini Municipality, Businesses
B.1.4 Research, review and adapt infrastructure and building design standards to respond to current and future sea-level and coastal storm risks.	Researchers, eThekwini Municipality
B.1.5 Adopt and enforce adaptive engineering approaches that are flexible and can evolve in response to changing threats and coastal erosion risk.	EThekwini Municipality
B.1.6 Prioritise the relocation or upgrading of informal and low income settlements that are vulnerable to sea-level rise, coastal storms and coastal erosion.	EThekwini Municipality
B.1.7 Relocate existing buildings and infrastructure that are in high risk coastal areas to areas of lower risk.	EThekwini Municipality, Business
B.1.8 Retrofit and modify existing buildings and infrastructure to provide protection against future sea-level rise and increased coastal storms.	Business, eThekwini Municipality, National and Provincial Government
B.1.9 Recognise and make use, wherever possible, of the natural defence systems of coastal dunes to provide sea level rise, coastal storm and coastal erosion protection services.	EThekwini Municipality

Source: (DCCS, 2014)

Sectors are encouraged to work on addressing climate change by determining which areas are relevant to them and develop plans to respond accordingly. Identification of key performance indicators should be highlighted by the developed sectoral plans. DCCS also highlight the importance of establishing formal linkages between relevant national and provincial departments on responding to climate change. It is also aware of the need to have cross sectoral action and having an integration response with all its neighbouring municipalities. With the understanding that climate change knows no boundaries, the municipal regional response proposed by the City of Durban is indeed appropriate.

Durban municipality has managed to present proper responses in line with the objectives. However, it does not indicate ports as a stakeholder in implementing these responses. It will therefore, be ideal for the municipality to work together with the port in implementing this objective.

The Department of Environmental Affairs (DEA)'s monitoring and evaluation framework which is used as a tracker of national climate change response, is regarded as a base for DCCS's monitoring and evaluation's framework. Ricardo-AEA & Energy Cybernetics (as cited in DCCS, 2014) proposed three (3) adaptation building blocks of indicators necessary for the National Climate Change Response Monitoring and Evaluation System as:

- Climate observation, impacts, and projections
- Current and future vulnerability
- Adaptive capacity

Table 7 DCCS Indicator

Indicators
Number of eThekweni policies, plans, frameworks and strategies that have been updated to align with the DCCS.
Number of DCCS responses funded and implemented annually
Number of climate change responses initiated jointly with neighbouring municipalities.
An annual Monitoring and Evaluation report published
Annual review of the success of implementation of the DCCS strategy published.

Source: (DCCS, 2014)

Environmental departments in the metropolitan areas of Durban and Cape Town are championing the process of climate change adaptation. Taylor, Cartwright and Sutherland (2014) note that it is proven to be difficult to embed the plans into municipal budgets in trying to ensure operations progress. However, they note that high level political support and successful pilot project on adaptation has been evident in eThekweni municipality whilst in Cape Town institutional spaces are being opened so as to mainstream adaptation plans into existing activities. The study also noted lack of national political agenda on climate change and related this to misconception that climate change competes with economic and social development goals.

In order to carry out its mandate of delivering services effectively, the local government has to collaborate and consult with the community on various issues. This involves planning, facilitating and executing infrastructural developments and provision of basic services that advance community's socio economic interests and priorities. One of the greatest challenges that the local government is faced with is meeting the socio-economic demands of the local

communities in a sustainable way in the mix of climate change. This requires resources in the form of knowledge, technology, institutions, finance and structures.

The cities of Durban and Cape Town have put in place scientific research in assessing and determining the impacts of climate change in their respective cities. It is through assessments and empirical research that a proper case can be built and attention of decision makers drawn to the likely impact of the climate change. The risks that communities which live close to the coastal zones are facing were determined by the assessment carried out by the cities.

The Cape Town Municipality, departments of Environmental Affairs, Development Planning and the Provincial government of the Western Cape were instrumental in driving the vulnerability assessment for the province. The City of Cape Town's spatial plan and urban design as well as City of Durban Spatial Development Framework help to focus the municipalities on the effects and impacts of climate risk thereby advocating for adaptation and mitigation strategies for the City's communities. Climate change is acknowledged in these cities as a strategic policy matter that has to be considered on all developmental projects. These developments have been possible as a result of the engagement and partnerships that have been developed through the Climate Change Think Tank (WCCCRS, 2014; DCCS, 2014)

Whilst many resources have been directed at dealing with climate change, it is clear that more financial injection is still needed to implement the specified adaptation strategies. Dealing with climate change requires a collaborative and coherent effort by all those who are impacted. However, the policy documents of both cities seem not to enlist how the coastal cities are working together on dealing with adaptation matters.

4.9 Addressing Climate Change Adaptation in South African Ports

According to UNECA, the process of adaptation starts with understanding the current vulnerabilities, capacity building in support of the plan and its implementation, learning from

pilot programmes, strategy deployment and adjusting climate change in vulnerable areas. UNECA calls for reinforcement of NAPA projects within the African continent and argues that the implementation processes should include all relevant stakeholders and not be reactive.

4.9.1 Climate Change Adaptation

UNFCCC direct that adaptation activities revolve around five (5) areas:

A. Observation of climatic and non-climatic variables

It is important that climatic and non-climatic, socio-economic and environmental variables are observed in trying to understand the impacts of climate change. This acts as a support mechanism towards research which contributes to a better understanding, modelling and prediction of climate change and the impacts thereof. Such data can be collated on various areas of the climate system, not limited to physical, chemical, biological, atmospheric, oceanic, hydrologic, cryospheric and terrestrial processes.

The Council for Scientific and Industrial Research (CSIR) is South Africa's scientific and technology research. Together with the South African Weather Service they are able to observe and predict climate over a long period. Both have helped the government to have a projection and past information on South African climate. This information is available to be utilised by South African ports in trying to understand how their particular regions are changing.

B. Assessment of climate impacts and vulnerability

Adaptation assessment refers to the practice of identifying options to adapt to climate change, and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness,

efficiency and feasibility (IPCC, 2007). It is a policy requirement that every owner and operator of infrastructure in the UK should conduct a vulnerability assessment of the particular infrastructure (McEvoy & Mullett, 2013). This policy requirement can help to ensure that ports and other infrastructures take the responsibility of assessing vulnerability and prioritising adaptation.

C. Planning

UNFCCC provides a platform in the form of processes to support the Parties in planning efforts relating to adaptation. Least Developed Countries (LCD) are afforded the opportunity through NAPA to identify and prioritise urgent and immediate needs with regard to the effects of climate change. Through the Cancun Adaptation Framework, Parties are supported to plan and prioritise adaption action with the focus on supporting LCD and vulnerable developing countries to formulate and implement national adaptation plans as well as work programme to consider approaches to address loss and damage related to climate change. Planning for adaptation in ports should be a concerted effort. Policy should provide guidance on identifying and prioritising the need.

D. Implementation

The parties are supported to formulate and implement their national adaptation plans through the Cancun Adaptation Framework. This also includes determining approaches to address loss and damage in their respective areas.

E. Monitoring and evaluation of adaptation actions

Due to the long term nature of climate change, adaption has to be a continuous, flexible process which is continually monitored, evaluated and revised. This is in terms of the validity of the

underlying scientific assumptions and the appropriateness of projects, policies and programmes, including their effectiveness, efficiency and overall utility. A monitoring and evaluation framework may be developed to ensure clearly formulated goals, objectives and output measures as well as the availability of good quality data (<https://unfccc.int/adaptation/items/7006.php>).

Policies help in providing a clear guideline for ports and municipalities by properly defining the climate change adaptation program. Through policies, risk can be managed by ensuring a guideline with a safe, effective and consistent approach necessary for countries, local government and ports in general. Implementation of programs is easily undertaken if there is a policy framework that is followed and committed to. The use of monitoring and evaluation continues to be a critical aspect necessary for properly tracking and focusing on the adaptation process. Policy is able to make the adaptation process to be effective. By using policy, South African ports can adopt and follow the above adaptation by UNFCCC which is also closely linked to the Adaptation Policy Framework discussed earlier.

Smithers and Smit, Smit and Skinner (as cited in Bryan et al. 2009) highlight characteristics that can be used to classify adaptation response. This include timing with regard to climate stress, duration (how long or short), form (development of technology, governmental programmes, insurance, financial management) and effect (enhanced stability or resilience). The response also depends on exposure extent, nature of stress, properties of the exposed system, scale and weight of the event. Burton (as cited in Bryan et al. 2009) notes that the timing horizon and decision maker's tolerance of risk affect the willingness to adapt to climate change.

For the private sector, forecasting for five to ten years is a challenging task because of the dynamism related to time. Businesses or organisations have varying levels to which they are prepared to climate change. West and Brereton (as cited in the NCCARF, Brief 11) found that most enterprises are only vaguely aware of the breath of adaptation that may be required. They

indicate that existing risk management procedures and approaches could be used in supporting effective strategic climate change adaptation.

Artur and Hilhorst (2012) cite various researchers (Kelley & Scoones; Hilhorst; Barnett & O'Neal) who found that how people act, is largely based on their experience and conditioned by social, cultural and institutional patterns. Adaptation can therefore be seen as a consequence of interaction pattern of the concerned participants trying to shape the process in line with their perspectives relating to the issue at hand. Agarwal, Agarwal and Perrin, Isham, Eakin (as cited in Bryan et al. 2009) stress the importance of social relationships and recognising the existence of institutions (whether public or private, formal or informal) as facilitators or hinders of adaptation.

4.9.2 Issues that need to be addressed following climate risk

A balance between 'reactive' and 'proactive approach

Reactive adaptation is informed by past impacts of climate change. In this instance, it becomes easier to determine the investment cost, measures needed and the timing thereof. It is a challenge to determine the above with regard to proactive adaptation. This type of adaptation may require sizeable investment but is more effective at reducing future risk and cost (Burton et al. 2006).

The proper coupling of specific adaptations and stronger adaptive capacity

It is not always easy to distinguish between specific adaptation and stronger adaptive capacity activities. The adaptation policy should ensure that specific adaptations are successful and cost effective by ensuring that they are coupled with corresponding advances in adaptive capacity (Burton et al. 2006).

The difficulty of distinguishing climate change impacts from those due to natural climate variability

There is a challenge to differentiate specific impacts of climate change from those of natural variability within the international context (Burton et al. 2006). This uncertainty tends to complicate the issue of costs, equity and who takes responsibility. To that effect, researchers recommend that central policy objective should be of adopting comprehensive, integrated approach in managing climate change risk irrespective of their cause.

Adaptation's intersection with a broad range of other policy areas and priorities

To be addressed successfully and as cost-effectively as possible, adaptation concerns and priorities must be integrated across the full breadth of economic and development decision-making processes. Adaptation response demands different measures and strategies. Under UNFCCC processes, adaptation is proactive and facilitates comprehensive strategies with trusted funding necessary for such high priority projects. Such mechanisms should be continually strengthened. Adaptation can be factored in development projects which are financed by bilateral or multilateral lenders requiring compulsory climate risk assessments. Through climate insurance, having funds committed to climate change adaptation so as to support vulnerable countries needing relief, upon been impacted by climate change and vulnerability is another proposed option (Burton et al. 2006).

4.9.3 Adaptation in the OECD Countries

In the OECD countries, many efforts have been invested in producing evidence and tools used in developing the national planning process. This included amongst others understanding potential climate change risks and identification of possible adaptation options. The assertion of Swart (as cited in Mullan et al. (2013)) is that adaptation strategies are aimed at communicating the overall approach of government, facilitating coordination, demonstration of political commitment and providing evidence and tools necessary to deal with the impacts of climate change.

The environmental ministries have taken a leading role in coordinating and mainstreaming adaptation programmes across the interdepartmental and intergovernmental levels. This requires a strong leadership considering the diverse and conflicting priorities, needs and views of involved stakeholders. According to Mullan et al. (2013) many OECD countries have strategies that identified policies necessary for collaborating with adaptation. This followed the process of prioritising adaptation options and establishing mechanisms for responding accordingly. The prospect of delivering a better policy is enhanced by involving various stakeholders. This should be viewed as a partnership which includes the private sector and civil society. This also helps to build national awareness and knowledge on adaptation (Becker et al. 2013; Inoue, 2013; DCCS, 2014).

According to Mullan et al. (2013) following the OECD workshop, participants highlighted the need to bridge the gap between what decision makers need and what the research information presents. It is important that the produced climate data is user friendly, thus enabling decision makers to easily utilise it for planning and policy making purposes. Secondly, most of the States' strategies do not indicate the funding requirements and the sources thereof. This information is critical as it facilitates the process of budgeting and implementing the adaptation plans.

Amongst the OECD members, France took a leading role in identifying the costs and benefits. However, the participants noted that discussing costs upfront can also be viewed as a barrier to engagement. Measuring and assessing if the plans and strategies are making a difference in reducing vulnerability is a cornerstone in any programme implementation. The development of a Monitoring and Evaluation plan assists in garnering political commitment and support for funding and tracking the effectiveness of the adopted programmes. The diversity of the potential impacts of climate change indicates that all people of society will be affected by the change and that requires diverse people to participate in mitigating and adaptation measures.

4.10 Stakeholder Roles

4.10.1 Challenges for adaptation in local governments and Ports

Adaptation cannot be left solely to local government or ports and therefore requires a concerted effort by those who have an interest in the area being impacted by climate change. Communities should be empowered through capacity building to deal with the challenges of climate changes by themselves.

Ports and local government policy framework should facilitate delivery in line with wide range responsibility spectrum. This relates to legal, technical and governance framework model. This requires implementation of mainstreamed climate change adaptation approach where decisions are made based on the best available data.

According to NCCARF, governments respond better to the challenges of climate change when their adaptive responsibilities are clear and response and evaluation frameworks are consistent across jurisdiction. This is not the case within the South African climate change policy especially with regard to local government.

4.10.2 National Stakeholders

The current stakeholders and their roles based on the national climate change policy are depicted in the following table:

Table 8 National Stakeholders

Stakeholder	Responsibility
National Government	Overseeing the development and implementation of the NCCR Policy. This is done executed through parliamentary portfolio committees. The committees review legislation and initiate implementation
<ul style="list-style-type: none">• Department of Environmental Affairs	Review all government legislation, policy, strategies, plans and regulatory frameworks to ensure alignment and coordination of policies and actions. Oceans and Coasts Branch responsible for environmental protection and sustainable development of the coast.
<ul style="list-style-type: none">• Intergovernmental Committee on Climate Change (IGCCC)	Review progress (gaps and proposed adjustments) on the implementation of the policy every 5 years.
<ul style="list-style-type: none">• The Inter-Ministerial Committee on Climate Change (IMCCC)	Chaired by Minister of Environment. At executive (Cabinet) level that will coordinate and align climate change response actions with national policies and legislation. Overseeing all aspects of the policy implementation.
<ul style="list-style-type: none">• Forum of South African Directors-General clusters	Guide the response actions by guiding strategic leadership of the relevant cluster based on their mandates.
<ul style="list-style-type: none">• National Disaster Management Council	Ensure that the national framework for disaster risk management provides clear guidance to all on managing climate change related risk. Ensure effective communication strategy is in place for

Source: (NCCR, 2011)

The policy highlights the civil society as one of the important stakeholders in dealing with climate change. To that effect, it puts the responsibility of creating public awareness and motivating citizens to mitigate and adapt to the civil society. The proposed port development for the City of Durban's Dug Out port has been resisted by local communities through the leadership of civil societies and environmental groups. This type of response is expected from communities which were not party to the planning process of the project and their concerns having not being addressed at an early stage.

The policy document acknowledges that it is not clear on how local government should deal with climate change related issues. It suggests that it might be useful if other functions which cut across different governmental spheres could be assigned to local government. This could be specific powers for mitigation and adaptation actions like coastal management, infrastructure management and natural resource stewardship. The department of Governance and Traditional Affairs is expected to critically review the policy and legislations on the powers of local government with regard to climate change.

In addition, National Treasury is expected to re-examine the fiscal measures and incentives necessary for encouraging local government to drive the measures of adaptation and mitigation. This is because the current fiscal mechanism does not give municipalities incentive to integrate effective climate change responses into local government activities. The current policy does not indicate how the different governmental departments are assisting small business take business opportunities in the green economy.

Business and Industry are acknowledged for establishing the National GHG Inventory and voluntarily submitting GHG emission data in line with IPCC's 2006 guidelines. According to the policy, the government will be encouraging the voluntary reporting as established and maintained by business associations.

4.11 Ports and local government relationship

Literature suggests a multi-stakeholder engagement and interaction when dealing with matters of climate change. The South African climate change policy urges a sector specific response. This shows that the policy is in agreement with literature and international institutions on climate change.

Globally, ports and local governments have been working together in planning and implementing port adaptation measures. This is evidenced by the earlier quoted examples in this study where these two actors have worked together in taking a leading role preparing for climate change globally. However, in the South African context, the two seems not to be working in an integrative manner.

4.11.1 Port Stakeholders

Table 9 Port Stakeholders

Stakeholder	Role and Interest
TRANSNET (Freight Rail, Port Authority, Port Operations, Pipelines, Capital Projects, Capital Projects)	Responsible for managing and operating Ports, Rail and Pipelines
NATIONAL GOVERNMENT	Owners of Transnet through Department of Public Enterprises. They seek economic growth, infrastructure development through NDP and to realise an efficient transport logistics network Department of Environmental Affairs seek implementation and compliance to environmental regulations including NCCR of 2011.
LOCAL GOVERNMENT (Coastal Municipalities)	Involved in Coastal Management and Infrastructural development. They want economic activities for the benefit of the city
ECONOMIC PLAYERS (Business, Banks and labour)	Involved in Shipping and Manufacturing business. They expect efficient service, safe and secured conveyance of their cargo. Labour expects their members to work in a safe environment. Banks are interested in investment and insurance opportunities
ENVIRONMENTAL GROUPS	Business to be conducted in a sustainable manner and environmentally friendly environment
COMMUNITIES	Port to provide safe, decent work and supporting their livelihood.
RESEARCH INSTITUTIONS (Research Bodies, Academia)	Raw Data and reports from Ports needed for research purposes especially as it relates infrastructural development, plans, policies etc.
PORT REGULATOR	Regulating of port tariffs. Transnet is self-sufficient and has to finance its own infrastructural developments

Source: (Author, 2014)

4.11.2 The need for a coordinated effort

Within the logistics supply chain, ports are regarded as the operational hubs. McEvoy and Mullett (2013) argues for a coordinated approach to long term planning of land use and having partnership with logistics providers and local governments in assessing vulnerability. They assert that having identified current vulnerability requires that the information be considered into the existing decision making processes of the port, thus making a basis for long term anticipatory action. Vulnerability assessment should not be a once off event but a continual inclusive process.

By working in partnership, local, regional and national decision makers will bring greater resources and expertise together to develop policies which provide a framework and establish incentives for public and private investors to develop and effectively implement adaptation and resilience plans. National governments are well placed to assist port city adaptation efforts by funding research for specific locations to better understand the nature of the risks in local contexts and the costs and benefits for adaptation, and to facilitate the development of risk sharing approaches and appropriate insurance coverage (Asariotis & Benamara, 2012; Burton et al. 2006). Ben Lieberman, of Port Louis Berger highlights that raising certain areas like access roadways and rail line is not easy. Whilst the ports are insuring themselves against climate change, Niek Veraart of Port Louis Berger argues that having a resilient port is not enough if the other links like energy supplies, road and railroads are not. This mismatch will lead to ports accepting cargo but being unable to distribute it, thereby exacerbating port congestion (Landon & Knight, 2014).

It becomes clear that ports need to partner with stakeholders to plan their adaptation and funding to be able to deal with disruptions that may result from climate change. At the end, dealing with the effects of climate change becomes a choice between protection, elevation or relocation of the port (Becker et al. 2013).

Actors to be engaged

Becker et al. (2003) list the soft and hard strategy with the different actors that need to be engaged when these strategies are executed.

Potential impacts from climate change include: Increase in height of waves that reach the port, flooding of port and transport installations, increase in coastal erosion, increased downtime due to flooding and higher winds, increased sedimentation and erosion rates and operational delays.

Soft Strategy – Least regrets

Table 10 Climate change impact, response and actor

Actor to be engaged	Enhance emergency evacuations plan	Consider adaptation in long range ports	Learn from those at the forefront	Create financial instruments to support adaptation	Improve decision support tools and information	Increase standards of port construction to deal with higher winds	Increase funding for dredging and beach nourishment programs	Increase standards of port construction to deal with higher winds
Engineers	x	x	x		x	x	x	x
Planners	x	x	x		x		x	
Financiers		x	x	x			x	
Insurers		x	x	x				
Scientists			x		x		x	
Port Operators	x	x	x					
Shippers			x					
Regulators		x	x	x		x	x	
Emergency Responders	x	x	x					x

Source: (Becker et al. 2013)

Hard Strategy

Table 11 Climate change impact, response and actor

Actor to be engaged	Expand dredging and nourishment programmes to handle increased quantity of sediment shifting	Increase Breakwater Dimensions	Move Facilities and managed retreat	Raise port elevations	Raise transport levels or build coastal defences	Build new coastal defences	Increase port size to deal with bottlenecks
Engineers	x	x	x	x	x	x	x
Planners	x		x	x	x	x	x
Financiers	x	x	x	x	x	x	x
Insurers			x	x		x	x
Scientists	x	x	x	x	x	x	
Port Operators	x	x	x	x	x	x	x
Shippers			x			x	x
Regulators	x	x	x	x	x	x	x
Emergency Responders							

Source: (Becker et al. 2013)

They are of the opinion that these actors should be engaged and form part of the execution of the adaptation plans. Engagement of these actors is necessary since all the actors have an interest in getting benefits from port adaptation. In addition to this, it becomes important that more investment is channeled at improving the mechanisms of climate change projection.

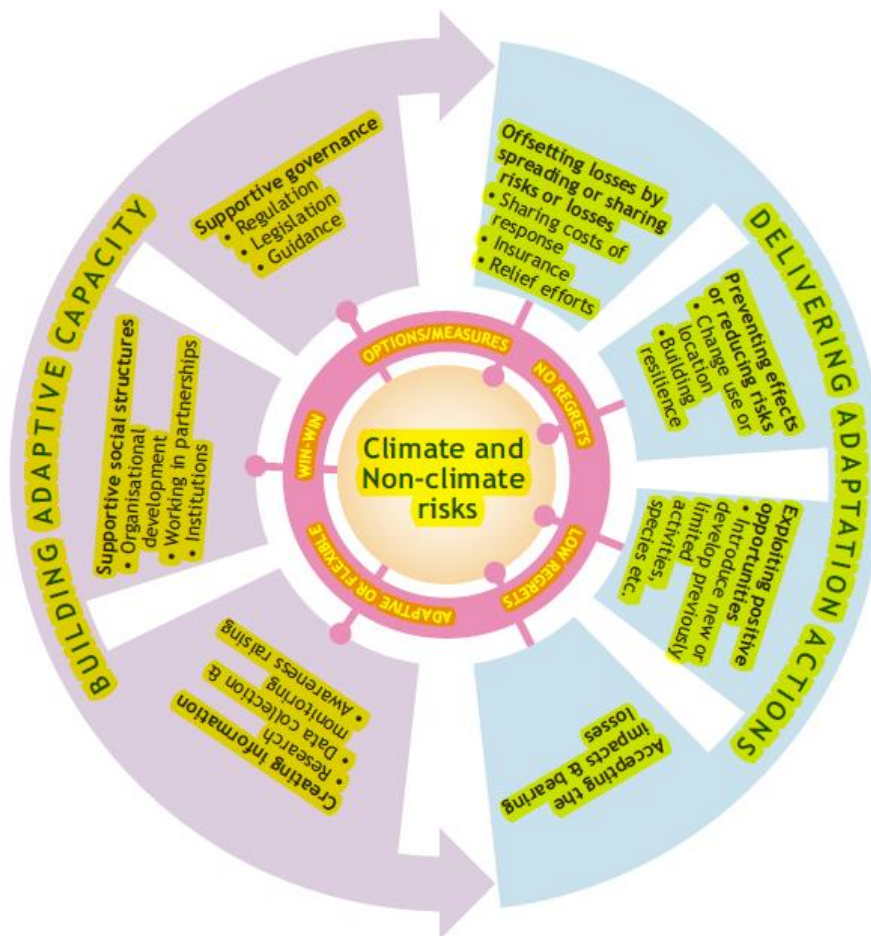


Figure 12 Framework for identifying Adaptation Options Source: (UKCIP, 2011)

Figure 12 only provides framework necessary for these stakeholders to identify the proper adaptation options that are available for them to be able to deliver action.

The ports need to continually engage the above stakeholders in their planning processes relating to climate change. Recently, the proposed Durban Dug out Port has been met with opposition from the farmers, environmental and community groups around the city of Durban. There are various media and forums like the Chamber of Commerce, Municipal and Provincial Meetings and Maritime Cluster Forum where the port can engage with these stakeholders on how to better plan and implement adaptation strategies.

A policy developed through the input of all of the above stakeholders, limits resistance and improves team work. These interactions can be used to negotiate and ensure joint efforts in incurring the costs of adaptation. Research institutions can also participate in assessing ports vulnerability and decrease the element of uncertainty in their projections with economic players funding the projects. Local government can also work together with ports on joint adaptation initiatives.

4.12 Conclusion

South Africa has a strong detailed climate change policy which tries to balance mitigation and adaptation response. The policy acknowledges the importance of the partnerships in driving climate change responses. The approach that is adopted indicates a strong focus in pursuing the need for alignment and integration between the different stakeholders. It is clear that it requires all organisations to have a balance of economic, social and environmental needs.

There seems to be an overlapping of responsibilities among the three spheres of government. This is likely to cause conflict amongst the government departments or even lead to lack of progress. This is evident when one looks at the responsibilities of IMCC and MINMEC. The function of coordinating activities is not clear especially at Provincial and local government levels.

The roles and responsibilities of the local government are not clear including how it interacts with the port on matters of climate change adaptation. The policy creates the burden of creating public awareness and motivation of citizens to participate in climate change adaptation and mitigation to civil society.

The policy indicates the importance of reducing carbon and encouraging the growth of the green economy. It is not clear on how it will move citizens and organisations into adopting the green economy. At the same time, the responsibility of reporting emissions is a voluntary exercise.

Around the globe, there have been good examples of ports taking a leading role in driving climate change adaptations. Policies have been used in these regions to encourage ports and other infrastructure operators to conduct vulnerability assessments. As part of reporting, organisations are expected to openly disclose their status. This is not the case in South Africa.

In other parts of the continent, incorporating science into policy continues to be an obstacle to integrating climate issues into the development activities. The policy has not being able to indicate who should have the responsibility of building and maintaining a climate change adaptation and mitigation reporting database.

Based on the previous storms that hit South Africa and Mozambique, the response has been observed to be fragmented. Considering the importance of ports as an integral part of the logistics value chain and understanding that it is an important infrastructure for the coastal cities' security against storms, cyclones and a hub of economic activities, it would have been prudent to include it in the priority list.

Whilst the policy strives to focus on both mitigation and adaptation for purposes of highlighting the importance of both, it has not dealt with the challenge of maladaptation.

V PROPOSED POLICY RECOMMENDATIONS FOR SOUTH AFRICA

Based on the earlier discussions the following policy recommendations are presented:

Ports and Local Government Integration

Ports are located in areas that fall under the jurisdiction of local government, thus utilising the services and infrastructures that are provided at local government like water, roads and electricity. Ports house other environmental areas that are municipal assets and managed at local government such as mangroves, biodiversity and estuaries. This relationship indicates the importance of developing joint initiatives, programmes and strategies to better manage the process of dealing with climate change. This study acknowledges the overlapping and integrative relationship between Ports and local government. It therefore recommends that the two entities partner in addressing the challenge of climate change adaptation.

Development of Sector Specific Plan

Municipalities have not clearly articulated their role and responsibilities on adaptation within the port environment. It is the author's view that an integrated approach on dealing with climate

change on matters relating to rising sea levels, storms and infrastructure development is a necessity. Ports and municipalities should be equal partners when dealing with climate change adaptation in ports due to their overlapping roles.

The National Climate Change Response Policy has indicated that sectors need to develop their sector specific plans to deal with climate change. In line with this requirement, it is recommended that a Port Specific Climate Resilience Plan should be developed. This plan should be led by a partnership between the port and local government.

The Role of Local Government

Department of Cooperative Governance and Traditional Affairs have been tasked on reviewing the role and responsibility of South African local government in adapting to climate change. The policy should be a directive in guiding local government on the exact powers and roles that they should have. It is the author's view that the responsibility of determining the powers of local government should be a joint function of the province, local and the national government. This will help to determine the issue of local government capacity and mapping capacity and powers of other governmental levels. It will also encourage dialogue necessary to ensure that every governmental level fully understands its responsibilities and role on ensuring a smooth flow of information and execution of functions related to climate change.

Recommendation on what the role of local government should be is hereby presented (Table 12):

Table 12 Proposed responsibilities for local government

Climate Change Responsibilities of Local Governments.
<ul style="list-style-type: none"> • Contribute resources for preparing, preventing, responding and recovering from negative climatic impacts • Encourage research and innovation in dealing with climate risk by working with universities and research companies • Help communities to assess their vulnerability, resilience building and adaptive capacity • Partner with Transnet National Port Authority in planning, implementing, monitoring and evaluating programmes to deal with climate change with the Port environment • Inform and engage communities and Business operating in the Waterfront on projected climate change, risks and impact • Administration, application, monitoring and enforcement of codes and legislations that promote adaption in new constructions within their area of jurisdiction • Management of risks and impacts of public assets owned and managed by local government • Collaborate with the province, national as well as the region to manage the regional climate change impact • Ensure that local government plans, policies and regulations (including local planning and development) are consistent and in support of NCCR

Source: (Author, 2014)

Coordinating Climate Change Activities

It is recommended that an independent public body should be formed with the responsibility of coordinating all climate change activities across the 3 spheres of government. This body should also build and maintain the reporting adaptation and mitigation database. It should have all the

statutory powers to deal with climate change matters of adaptation and mitigation. This body should be accountable to the Parliament. It will also be collecting data and making it available for individuals and organisations for monitoring, evaluation and research purposes. The same body should also assist in SADC regional activities and help regional ports in line with their MOUs.

Regional Integration

It has been observed in the past that the manner in which the region dealt with disasters has been fragmented. This point to the flooding that hit South Africa in 2007 and 2008 together with floods that were experienced in Mozambique between 2000 and 2009. For the purpose of regional stability, it becomes important that all members of the region coordinate their efforts under the auspice of the SADC.

Stakeholder Engagement

It is important that all port stakeholders are involved in the development and implementation of climate change adaptation policy. This will make the stakeholders to understand the need for adaptation, the role that they have to play and the possible disasters that may affect their businesses if the matter of port adaptation is not properly addressed. By truly engaging the stakeholders, there is likelihood that they will take ownership and feel that they are part of the solution.

Externally, Maritime Community Clusters and Business Chambers are some of the organisations where ports can easily engage with an array of stakeholders on the matter of climate change. It is in these fora, where commitments of mitigations and the expansion of the green economy can also be explored in line with the South African Climate Change Policy. Some of the notable stakeholders include Academia, research organisations, non-governmental

organisations and civil society especially, those that are concerned about the environment. The discussions on port developments and planned expansions could be fully explored at this level, thereby being able to address the concerns at the infancy stage.

Port Regulator is also an important stakeholder that should be considered. By being involved in the discussions, they will understand the tariffs that are being proposed by ports. These tariffs methodology will have to incorporate the need to raise the funds for building adaptation.

Internally in ports, the matter of climate change should not be seen as the responsibility of the Environment Department and the Engineering Department having to deal with adaptation. It becomes vital that other departments understand and participate in addressing this challenge.

Table 13 Proposed roles of Port Departments

Department	Proposed Roles in effecting Policy
Environment	<ul style="list-style-type: none"> • Coordinate the activities aimed at addressing Climate Change. • Management of Biodiversity, Estuaries and Mangroves.
Engineering	<ul style="list-style-type: none"> • To plan and execute designs, construction and infrastructure development. • Address maladaptation. • Plan transport network, manage Cargo Handling equipment.
IT	<ul style="list-style-type: none"> • Ensure connectivity inside the port. • Backup and storing of data.
Human Resource (Training)	<ul style="list-style-type: none"> • Create awareness and train staff on climate change.
Legal and Compliance	<ul style="list-style-type: none"> • Ensure that governance matters are adhered to.
Harbour Master	<ul style="list-style-type: none"> • Assist in addressing the challenges of vessels movement in the face of climate change
Stakeholder Management	<ul style="list-style-type: none"> • Engagement of stakeholders
Finance	<ul style="list-style-type: none"> • Costing and listing adaptation as part of the budget
Transnet Freight Rail (sister company of Transnet focus on rail)	<ul style="list-style-type: none"> • Development of railway lines in and around the Port

Source: (Author, 2014)

Development of Port Adaptation Plan

It is recommended that the port stakeholders develop a Port Adaptation Plan. It is vital that in building adaptation, a clear understanding of the resources and processes that need to be followed should be highlighted by the plan. These processes will inform the role and responsibilities of different port stakeholders and how they should relate to one another. It is through this process that stakeholders can focus their energy, integrate and collaborate in dealing with climate change.

Streamlining of adaptation and risk into port development

This should form part of the port strategic plan and any port development activities. Every effort should be put in place to create and raise the level of employee awareness.

Vulnerability Assessment

With the understanding that each port is faced with different climatic conditions, it is recommended that all ports conduct vulnerability assessments. This assessment should cover areas like technology, infrastructure which includes transport network, breakwaters, buildings and cargo handling equipment. The results will be shared and consolidated to determine the level of urgency and available adaptation options.

Following the study that determines the vulnerability of South African ports, it becomes important that adaptation plans are developed by each port based on its individual vulnerability and risk. The port has to spearhead the process of ranking and prioritising adaptation measures based on the risk, impact and urgency. This process should be undertaken on a port to port

basis whereby different local governments and stakeholders will determine how best to implement adaptation and the funding thereof. This is about reducing vulnerability.

Develop and promote disclosure of climate risk

The government of South Africa should make it compulsory that ports and other infrastructural operators conduct climate change risk assessments of the infrastructure that they own or operate. This is about promoting disclosure of climate risk and creating adaptation awareness in the infrastructural sectors. The results and measures should be disclosed for those who have any interest to easily access them.

Compulsory Reporting

Reporting on emissions is currently voluntary with data being maintained by business associations. Whilst this is a step in a good direction, as it encourages the culture of reporting, it is important that the government direct the type of data that they need business to report on as well as maintain the data for integrity purposes. It is vital that the country adopt a stance of compulsory reporting. This will create awareness to all organisations and urge them to seriously consider reducing their contribution to the climate change and global warming. This will also help in accelerating and inculcating the culture of reporting.

Incentives

To inculcate the mentality of adaptation and mitigation, the departments of Trade and Industry, Small Business and Treasury should work together and avail funding for young people and small business enterprises that are creating entrepreneurial initiatives and employment based on the opportunities that are being brought by climate change. These initiatives should be driven by women and young people, whom are regarded by the policy under the principle of special needs and circumstances as the most vulnerable to the effects of climate change.

Regional Plan for Ports Adaptation

As part of the continent's vision of promoting trade among the African regions, TNPA has been signing MOUs on working together with many ports in the SADC region. These agreements relate to sharing of knowledge and capacity between the ports. It can also be viewed as part of ensuring that all countries within the region are more or less at the same level of resilience. The author proposes that climate change adaptation capacity be included in the working relationship. This will include sharing knowledge on resilience building and working on projects that enhance adaptation capacity for the region. A regional port adaptation policy is recommended.

Collaborated effort

It has to be noted that is not sufficient to invest in port resilience without considering the other actors with the network. For adaptation to be meaningful, roads and railways in and out of port, pipelines, energy and IT systems should be properly adapted.

Identify the Costs and Benefits

It becomes important that based on the vulnerability and risk assessments, the report should also indicate the costs and benefits of adaptation. It is also the author's view that the costs of not adapting should be presented alongside the cost and benefits of adaptation. This will help decision makers to understand the necessity of adaptation in ports.

Mobilisation of Communities

Whilst it is noble to acknowledge the role of civil society on dealing with climate change, the government should not delegate the responsibility of creating awareness and educating the society. It should take the leading role of informing the citizens on this subject matter. The Department of Public Liaison within the local government is properly positioned to engage communities, thus eliminating the risk of confusion and resistance that might sometimes happen when there are municipal developments. These engagements should be driven with civil society as partners and collaborators.

The policy does not indicate the media as a stakeholder necessary for mobilizing communities. The importance of media in creating awareness, packaging and promoting the activities of both the government and other stakeholders cannot be overemphasised. In comparison to civil society, media people have been professionally trained on communication matters and are able to objectively cover a wider geographical space with ease.

Whilst it is understandable that it will be difficult to hold media accountable on their delivery, climate change affects all of us and therefore requires a multilateral approach. As a policy guideline, media should always be given information on the current risks, vulnerabilities, projections and initiatives so that they can communicate the message of mitigation and adaption to the wider public within the country and region.

Championing Climate Change

The Department of Environmental Affairs should continue to be regarded as the custodian and champion of the climate change policy. They will have to work together with other stakeholders on driving the adaptation programmes. The national policy must also set a guideline on the consequences and processes to be followed for those sectors or individual companies who do substandard work and contribute to maladaptation. Department of Engineering should be the custodian of climate change as it relates to port adaptation.

In developing climate change policies, it is recommended that Adaptive Policy Framework should be adopted to guide ports for achieving an adaptive capacity. It is also important that climate change adaptation plans are developed to accelerate the process.

It is important that a funding mechanism is developed by Treasury to address the challenge of accessing funds. It is recommended that the ports should apply for funding through the framework of the UNFCCC. This should be for urgent adaptation programmes. For longer term programmes, fund should be sourced internally or from the Treasury to minimise the country risk and dependency on international funders.

VI CONCLUSION

Globally, Climate change is acknowledged as a serious matter that poses a challenge to current generation's livelihood and threatens the future generation. It is estimated that the global mean sea level will continue to rise, so the world will experience extreme weather events, ice and snow will decrease and temperatures will increase. This weather events include amongst others flooding, strong winds and cyclones.

It is projected that by 2100 South Africa will experience rising temperatures of between 1 and 4 degrees Celsius in the coastal areas and 3 to 7 degrees in the inland. Rainfall patterns will change, droughts will be experienced in other parts of the country and, health and biodiversity will be compromised. The rising sea-level, temperatures and storms will affect the operations in South African ports

Ports are by virtue of among other things location, long lifetime, handling of goods of which demand and supply is climatically sensitive and relying on other network, regarded as being vulnerable. Ports are not just impacted by sea level rise only, but other climate impacts like storm surge, heat, rainfall and lightning. Ports are therefore vulnerable and at risk. This implies that the business of ports is highly affected by climate change. High tides, winds and waves are likely to affect movement of vessels in and out of port, and stored cargo might get damaged by water leading to claims and ship delays.

These challenges indicate the importance of port adaptation. Climate change can be categorized in capacity building (awareness, skills development, data collection and monitoring and evaluation) or adaptation initiatives (technology, design, engineering, financial and management). It is recommended that port adaptation should be incremental through frequently updating action plans, partnering with stakeholders and incorporating the measures in the port's development plans. This relates to immediate vulnerability reduction and working towards improving resilience in the medium to long term.

Eastern ports of South Africa are located close to the tropical storm tracks and not far from the East Africa which is susceptible to volcanoes and earthquakes. These areas are also home to the regional counterparts of SADC namely Madagascar, Mozambique and Mauritius to name a few. This implies that South African ports are also susceptible to these risks. South Africa experienced serious storms in 2007 and 2008, which negatively affected the coastal regions and rail and port infrastructure. Transnet has since adopted a Long term Sustainability Framework which reminds the organization that they need to balance social, economic and sustainable environment in the current and future developments. Through the MDS, Transnet has invested 274 billion rands for the next 30 years on expanding ports ahead of demand.

Mozambique has also experienced 77 disasters since 1970, with 41 of those happening between 2000 and 2009. This shows the importance and urgency for ports to invest in adaptation. For them to do that process effectively and efficiently, they need to have a framework that will guide them. This indicates a need for a climate change port adaptation policy. It is through policy that managers can fully understand the effects of climate change in their environment and also understand their role and responsibility.

Through understanding responsibilities, the stakeholders may be able to share their resources to deal with the matter. There are many ports in the world which have taken the lead of utilizing

policies to drive port adaptation. This includes ports like Rotterdam, San Diego and Port of Muelles El Bosque. Adaptation Policy Framework has been developed to guide ports and other organisations with a road map for the adaptation policy making process.

Countries have accepted that something has to be done in order to deal with the challenge, hence the establishment of UNFCCC and IPCC. Continents, regions, states and local governments have begun to develop and implement climate change policies, which are frameworks aimed at guiding adaptation or mitigation response measures to deal with this challenge.

The impact of climate change is expected to hit hard those communities who are poor and vulnerable. The African continent is expected to feel the harsh reality of climate change. This is also exacerbated by the African countries' lack of capacity resources to deal with this challenge. However, through international assistance, the African continent has begun to plan and deal with climate change. At regional level, countries within the same region have also come together to develop regional policies to guide the individual countries on how to deal with climate change.

South Africa adopted their National Climate Change Response policy of 2011 in trying to deal with the challenge of climate change. This is a detailed policy which strives to balance mitigation and adaptation as measures to respond to climate change. It was developed through in-depth engagement and consultation with stakeholders. It encourages Sector Specific Resilience Plans and has identified Water, Energy, Health, Agriculture and Biodiversity as sectors that need urgent attention.

The 3 spheres of government are expected to work together in an integrated manner to drive mitigation and adaptation. Monitoring and evaluation is a vital component of the policy. In the region UNECA, SADC, EAC and COMESA have come together to develop regional policies. The same has been developed at the local government level.

There seems to be a good policy on climate change around the African continent. The major problem seems to be lack of policy implementation. This could be attributed to competing priorities, lack of capacity, resources or lack of interest from the decision makers.

In addressing adaptation in ports, it is important to understand the current vulnerabilities, planning and capacity building for implementation, learning, strategy deployment and flexibility to adjust climate change in vulnerable areas. Stakeholders are integral in the process of policy inception to implementation and evaluation. All stakeholders should understand their role in the whole process.

In closing, South Africa has a comprehensive policy document although it still needs some improvement. This document, just like those of the region and the continent has been informed by international institutions on climate change, making the policy to be in par with other global institutions. What is lacking is the willingness to fully implement the policy and invest in adaptation especially at the port level. It is therefore important that port adaptation is prioritised and the policy is implemented accordingly.

Future Research

In order to carry out adaptation in ports, it is ideal to investigate the cost of undertaking such an exercise in South Africa. Future studies could investigate the current cost of adaptation in South African ports, how much will it be in future and what are the costs if this is not undertaken, in case of a major disaster.

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