

Towards a LAGOS STATE CLIMATE CHANGE ADAPTATION STRATEGY

Prepared for the
Commissioner of Environment, Lagos State

January 2012

Prepared by the
Building Nigeria's Response to Climate Change
(BNRCC) Project



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FOREWORD

Lagos State Climate Change Adaptation Strategy (LAS-CCAS) has been produced to reinforce proactive actions already being taken by the State Government to address the challenge of climate change. It is an integrated and systematic approach to providing the framework for building informed responses and enhancing capacities at individual, community and state levels for effective response to climate change. Ultimately, LAS-CCAS should help to reduce vulnerabilities, increase resilience and enhance adaptive capacity to climate change in Lagos State, in order to alleviate negative impacts that are particularly severe on the poor, the elderly, women, children and the disabled.

Lagosians may already be adapting to climate change in various ways, but because of the complexity and urgency of the problem, and because of the power of inertia that makes people slow in changing from usual ways of doing things, LAS-CCAS provides Government with a ready instrument for putting in place a regime of guided, coordinated change for the rapid responses needed to reduce climate risks. It is a comprehensive instrument covering the key sectors of water resources; wetlands and freshwater ecosystems; coastal zone and marine resources; agriculture and food security; land use, forestry and biodiversity; energy; transportation; industry and commerce; financial services; human settlements and health; and the issue of disaster management, with gender considerations taken fully into account in all of the sectors and issues. Impacts of the key climate change elements of temperature, rainfall, extreme weather events and sea level rise, as they occur now and in the future, are dealt with; while roles and responsibilities are carefully assigned to key stakeholders for action on the policies, programmes and measures proposed in the strategy. It is, however, emphasized that ultimately every Lagosian has a role to play in realizing the provisions of this strategy.

On behalf of His Excellency the Governor of Lagos State, Babtunde Raji Fashola (SAN), and indeed every Lagosian, I wish to express immense gratitude to Nigerian Environmental Study/Action Team (NEST) who under the broader framework of Building Nigeria's Response to Climate Change (BNRCC) and with support from the Canadian Government made this possible. It is my hope and expectation that through the instrumentality of this document, we will be better informed on available adaptation strategies in our quest to stem the tide of Climate Change.

Tunji Bello
Honourable Commissioner
Ministry of the Environment

April 2012

EXECUTIVE SUMMARY

Introduction

Climate change is now generally recognized as the greatest challenge to sustainable development, especially in a developing country such as Nigeria. Lagos State is particularly vulnerable to the impacts of climate change and unless concerted and urgent action is taken, it could result in widespread ecosystem degradation, thus disrupting socio-economic development and the welfare of the people. Due to these potential impacts, some of which are already manifesting, and because there are several factors that make it vulnerable, Lagos State must make adaptation to climate change a priority. This document, *Towards a Lagos State Climate Change Adaptation Strategy* (LAS-CCAS), has been designed to make this happen.

Vision, Mission, Objectives

The vision of the LAS-CCAS is *a prosperous and climate change resilient Lagos*.

The mission of LAS-CCAS is *to develop new and strengthen existing actions toward adapting to climate change through all stakeholders working together*.

The main objectives of LAS-CCAS are:

- To provide an integrated and systematic approach to reducing vulnerabilities to climate change and increase the resilience and sustainable well-being of the people of Lagos State; and
- To provide a framework for building informed responses and enhancing capacities at individual, community and state levels to implement effective climate change adaptation policies and measures.

Expected Climate Change in Lagos State

Recent studies suggest that the expected climate change in Lagos State may include:

- A temperature increase of 0.04 degrees Celsius per year from now until the 2046-2065 period, with areas near the coast expected to warm up at a slower rate than elsewhere;
- A wetter climate, with the annual rainfall increasing by about 15cm and a rainy season that will be longer by up to two weeks by 2046-2065; and
- An increase in the frequency and magnitude of extreme weather events, such as extreme heat days (with the temperature exceeding 38 degrees Celsius), and more violent tropical storms.

Furthermore, sea level will rise by about 3.1mm per year as a result of increasing global temperatures, and the concomitant thermal expansion of water and melting of polar ice caps. The projected sea level rise in the coastal areas of Lagos State could be more than 1m by 2100, resulting in substantial loss of land to the sea.

Expected Impacts of Climate Change in Lagos State

The impacts of climate change are being felt in every sector of Lagos State, including agriculture and food security; water resources; wetlands and freshwater ecosystems; coastal zone and marine eco-systems; land use, forestry and biodiversity; energy; transportation; industry and commerce; financial services; human settlements and health; and disaster management. These impacts include:

- Loss of land to the sea;
- Loss of livelihoods;
- Loss of physical infrastructure (transportation, industrial, energy, water storage/supply; real estate, etc.);
- Displacement of settlements and population;
- Loss of ecosystems and biodiversity;
- Pollution of surface water and groundwater;
- Increased frequency and magnitude of climate-related disasters; and
- Increased risk of water-borne diseases.

Recommended Adaptation Strategies, Policies, Programmes and Measures

Adaptation actions recommended in this document for the various sectors may be grouped into five main categories, namely:

- Policy making and planning;
- Awareness raising, public education and capacity development;
- Information management (including early warning systems);
- Design and decision-making for investments; and
- Specific practices in the areas of risk reduction, livelihoods development and resource management.

The following is a selection of key recommended adaptation actions:

Vulnerability Assessment

1. Conduct a statewide vulnerability assessment of sea level rise with a view to preparing an inventory of coastal natural and human-made assets that are at risk (including an economic valuation).
2. Carry out a disaster vulnerability assessment of the state.

Planning and Preparedness

1. Develop a long-term physical plan for the coastal zone, using the principle of integrated coastal zone management.
2. Develop a long-term plan for the relocation of settlements and transportation and energy infrastructure within the context of the Lagos Megacity project.
3. Develop a long-term plan for the relocation of farming communities that are most at risk from flooding and sea level rise.
4. Integrate a disaster avoidance policy into the state's land use planning and development control.
5. Place strict control over all new land reclamation along the coast, increasing the standard to 4 metres above sea level with a requirement for sea defenses against storm surges.
6. Develop a computer-based, flood early warning system for Lagos State.
7. Put in place a comprehensive disaster response plan.

Agriculture

1. Strengthen gender sensitive agricultural research into the expected impacts of climate change and needed adaptation in the areas of crop and livestock agriculture and food security.
2. Put in place a community-based climate change adaptation support programme targeted at crop and livestock agriculture and food security in the state.

3. Promote diversification of livelihoods among the farming population.
4. Raise the awareness of and educate the farming population about the threat posed by climate change, its impacts, the need to adapt to it and how to do so.

Wetlands and Freshwater Ecosystems

1. Support the implementation of the National Biodiversity Strategy and Action Plan with particular reference to recommendations that relate to climate change adaptation as they affect wetlands and freshwater ecosystems.

Gender Analysis and Equality

1. Undertake gender analysis to assess the implications of any course of intervention in the area of climate change adaptation for men, women and other vulnerable groups.
2. Ensure gender equality in access to all climate change adaptation initiatives.

Implementation: Roles, Responsibilities and Costs

Every Lagosian has a role to play in the successful implementation of the Lagos State Climate Change Adaptation Strategy. However, there are frontline stakeholders, namely the Federal Government or its agencies, the Lagos State Government or its agencies, the Local Governments, the Community Development Areas, members of the private sector, NGOs, CBOs and communities. The roles and responsibilities that these stakeholders are expected to have are presented in a table in the main report. These entities must work together in synergy in order to enable Lagos State to adapt successfully to the threat of climate change. The table also gives an estimate of the relative costs of the recommended strategies, policies and measures. An Inter-Ministerial Committee made up of all the key stakeholders, with the Honourable Commissioner of Environment as Chairman, shall coordinate the implementation of LAS-CCAS.

Strategy Review

LAS-CCAS must be viewed as a living document that will be reviewed and improved upon periodically as knowledge of climate change and its impact on Lagos State increases and as strategies to respond to it evolve. Its implementation shall be subjected to evaluation three years after the State Executive Council approves it. This evaluation, which shall be carried out by the Inter-Ministerial Committee, shall form the basis of a comprehensive review of the strategy. The evaluation shall be concerned primarily with whether or not the recommended adaptation policies, programmes and other measures have been put in place or are being implemented.

Any implementation lags and deficits shall be noted and explained for purposes of review of LAS-CCAS and further entrenchment of climate change adaptation in the state. Specific indicators to be used for the evaluation are presented in the main report.

ACRONYMNS

BNRCC	Building Nigeria's Response to Climate Change
BRT	Bus Rapid Transit
CBN	Central Bank of Nigeria
CDAs	Community Development Associations
CDCs	Community Development Committees
CIBN	Chartered Institute of Bankers of Nigeria
CIIN	Chartered Institute of Insurance of Nigeria
CSOs	Civil Society Organizations
ICLEI	International Council for Local Environmental Initiatives
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter-Tropical Convergence Zone
GHG	Greenhouse Gas
LAS-CCAS	Lagos State Climate Change Adaptation Strategy
LASEMA	Lagos State Emergency Management Authority
LGs	Local Governments
MAC	Ministry of Agriculture and Cooperatives
MCI	Ministry of Commerce and Industry
ME	Ministry of Education
MEnv	Ministry of Environment
MEPB	Ministry of Economic Planning and Budget
MF	Ministry of Finance
MH	Ministry of Health
MIS	Ministry of Information and Strategy
MJ	Ministry of Justice
MLGCA	Ministry of Local Government and Chieftaincy Affairs
MPPUD	Ministry of Physical Planning and Urban Development
MRD	Ministry of Rural Development
MT	Ministry of Transport
MTIR	Ministry of Tourism and Intergovernmental Relations
MWF	Ministry of Water Front Infrastructure Development
MWI	Ministry of Works and Infrastructure
MYSSD	Ministry of Youth, Sports and Social Development
NACCIMA	Nigerian Association of Chambers of Commerce, Industry, Mines and Agriculture
NACRDB	Nigerian Agricultural Cooperative and Rural Development Bank
NCF	Nigerian Conservation Foundation
NESREA	National Environmental Standards and Regulations Enforcement Agency
NIMET	Nigerian Meteorological Agency
NIOMR	Nigerian Institute for Oceanography and Marine Research
UN	United Nations
UNIDO	United Nations Industrial Development Organization

DEFINITIONS OF TERMS

Climate change has been defined as any change in climate over time, whether due to natural variability or as a result of human activity. Current global concern is focused on climate change resulting from human activity, and specifically from the release of carbon dioxide and other greenhouse gases to the atmosphere. The burning of fossil fuels, clearing of forests, and certain other human activities are major sources of greenhouse gas emissions.

Vulnerability to climate change is the degree to which a system is susceptible to, or unable to cope with, the adverse effects of climate change. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity.

Adaptive capacity is the ability of communities and individuals to adjust to climate change, to moderate potential changes, to take advantage of opportunities or to cope with the consequences. The adaptive capacity of individuals or social groups varies and is dependent upon their access to and control over resources. The poor have particularly limited access to such resources, and as such are most vulnerable to climate change and least able to develop viable adaptation strategies.

Adaptation to climate change refers to longer-term strategies that deal with climate change (in contrast to short term coping strategies). Adaptation is an adjustment in natural or human systems that moderates the harm or exploits beneficial opportunities associated with climate change. Adaptation is usually a longer-term livelihood activity and is a continuous process where results are sustained. Adaptation uses resources efficiently and sustainably, involves planning, combining new and old strategies and knowledge, and is focused on finding alternatives.

Resilience is the ability to recover from shock or, in this context, the ability to deal with change. Resilience is a concept complementary to the concepts of vulnerability and adaptation. It refers to the capacity for self-organization, learning and adapting to change, so that basic structures and ways of functioning are quickly recovered.

Sources: IPCC, 2001; 2007; CARE, 2009; Chinwe Ifejika Speranza, 2010.

1. INTRODUCTION

1.1 Climate Change and Its Impacts

It is now generally recognized that climate change is the greatest challenge to sustainable development, particularly in a developing country such as Nigeria. For a number of reasons, Lagos State is particularly vulnerable to the impacts of climate change. Unless concerted and urgent action is taken to meet the challenge, climate change impacts could lead to:

- Widespread ecosystem degradation;
- Threats to social and economic development efforts; and
- Disruption of livelihoods, living conditions, health and well-being of a large proportion of the population, particularly the vulnerable groups, such as the poor, women, children and the elderly who depend on natural resources for their livelihood and live in marginal environments.

1.2 Why Climate Change Adaptation Must Be a Priority for Lagos State

There are several reasons why climate change adaptation must be a priority for Lagos State:

- Climate change is a threat to development and therefore needs to be taken into account in *all* ongoing and future development efforts;
- Climate change and its impacts are not just distant possibilities but are already taking place;
- There is already an adaptation deficit given that the impacts of climate change variability have not been effectively tackled to date. If not addressed with the urgency that it deserves, this adaptation deficit could jeopardize what has already been achieved in the State's development efforts and could compound the problems being caused by climate change;
- Climate change impacts are increasing, as evidenced by an increased incidence of destructive storms and flood disasters in Lagos State. This trend is likely to continue, making it increasingly difficult to cope with the impacts of climate change;
- Although people at the grassroots level are already adapting to climate change (Concern Universal, FARM-Africa, Find Your Feet, Self Help Africa and Utviklingsfondet/The Development Fund, 2009), they do not have the capacity to act as quickly and as comprehensively as the situation demands. Therefore, there is a need for external stimuli in the form of plans, policies and legislation, as well as external support for local initiatives;
- Lagos State has several key climate change vulnerability factors, including:
 - Because of its coastal location, the state is exposed to the threat of sea level rise and the risk of storm surges;
 - Its predominantly low-lying topography makes it susceptible to submergence and widespread flooding;
 - The state possesses fragile ecosystems, such as lagoons, swamps and freshwater bodies;
 - The water table in large parts of the state is high;
 - The state has a large and rapidly growing population;
 - Poverty is pervasive; and because people are poor they are dependent on the exploitation of natural resources which are under threat from climate change (UNFCCC, 2006);
 - A large proportion of the population is living in unplanned settlements in marginal environments;
 - Women, who are more vulnerable to the adverse impacts of climate change, have less access to climate change information.

Many, if not all sectors of the state are likely to be adversely affected by climate change, including agriculture and food security, water resources, wetlands and freshwater ecosystems, coastal zones and marine ecosystems, land use, forestry and biodiversity, energy, transportation, industry and commerce, financial services, human settlements and health, and disaster management. As it is the commercial and industrial hub of Nigeria and West Africa, adverse impacts of climate change on Lagos State will have far-reaching consequences on the country and the sub-continent.

1.3 The Lagos State Climate Change Adaptation Strategy (LAS-CCAS)

This document is based primarily on two technical studies that had been conducted separately for two clusters of sectors of the economy of Lagos State, one by Beachland Resources Limited (2011) and the other by The Justice Research Institute (JRI) (2011). Additional material was sourced from existing literature (e.g. Heda Resource Centre, 2011) and emerging BNRCC findings and from the Internet.

The first draft of this document was presented to a wide spectrum of stakeholders at a workshop that was held in Lagos on August 31, 2011. There it was reviewed, critiqued and further developed in order to produce this final version.

LAS-CCAS must be viewed as a living document that will be reviewed and improved upon periodically as knowledge of climate change and its impact on Lagos State increases and as strategies to respond to it evolve. Its implementation shall be subjected to evaluation three years after the State Executive Council approves it. This evaluation shall form the basis of a comprehensive review of the implementation of the strategy.

1.4 Geographical Background

Lagos State is located in southwestern Nigeria, bordered in the north and east by Ogun State, in the west by the Republic of Benin and in the south by the Atlantic Ocean. The state has an area of approximately 3,345 square kilometres, which is about 0.4% of the total land area of Nigeria (Figure 1).

Lagos State has a coastline of approximately 180 km. Underlain by sedimentary rocks; the State is on a coastal plain characterized by predominantly flat terrain, with an average elevation of less than 1.5m above sea level. The land slopes gently from the interior to the sea. Water bodies and wetlands cover over 40% of the total land area of the state and an additional 12% is subject to seasonal flooding. The coastal areas consist of lagoons, creeks and swamps, separated from the open sea by a strip of sandy land that varies in width from 2 to 16 kilometres. The entrance into Lagos Lagoon is the only major outlet through which the lagoons and creeks drain into the sea.

The eco-regions of Lagos State and their ecological features are summarized in Table 1. Wetlands and upland forest (Rain Forest) are the dominant ecozones. In fact, the state falls within the Tropical Rain Forest zone, but the vegetation cover in areas that are not built up is mostly a mosaic of mangrove swamps, freshwater swamps, secondary forest, farmland and fallow land. The topography is gently sloping throughout and the soils are mostly deep and poorly drained.

Table 1 Eco-regions of Lagos State and their Ecological Features

Eco-region	Geology	Topography	Soil features	Ecozone
Badagry, Ibeju-Lekki, Ojo, Lagos Island, Surulere, Eti-Osa and areas close to the coast	Deltaic basis and tidal flats	Nearly level plains of 1-2 % slope	Very deep, poorly drained and moderately well drained soils; sandy, sandy loamy or sandy clay loam surfaces over sandy clay, loam sub soils.	Wetland
Part of Ebute-metta, Mushin and Shomolu, Kosofe Agbowo, Ejirin, parts of Epe and parts of Ikorodu like the Igbogbo areas.	Recent Alluvium	Nearly level to gently undulating plains of 2-4 % slope	Deep, well drained and deep poorly drained soils; sand, sandy loam, loamy sand or sandy clay loam surfaces over sand, sandy clay, sandy clay loam, clay loam or loamy sand sometimes gravel sub soils.	Wetland
Ikeja, part of Ebute-Metta, Mushin and Alimosho, Agege, Epe, part of Eredo, and part of Ejirin.	Coastal Plain Sands (Alfisols)	Nearly level plains with 1-2% slope	Very deep well drained soils, loamy, sand, sandy loam or sandy clay loam surfaces over sandy clay loam, clay loam, sometimes gravel type sub soils.	Rain Forest
Part of Eredo towards Ijebu-Ode mainly the boundary of Lagos and Ogun States.	Transitional materials of sub-recent alluvium and coastal plain sands	Nearly level plains of 1-2% slope	Very deep to deep and moderately deep well drained and few imperfectly drained soils; sand, sandy loam, or loamy sand surfaces over sandy loam, sandy clay loam or gravel type sandy clay loam sub soils.	Rain Forest
Parts of Ikorodu leading to Shagamu.	Coastal Plain Sands	Gently undulating plains of 2-4%	Very deep well drained, and very deep poorly drained soils; sandy, sandy loam or sandy clay loam surfaces over sandy, loam, sandy clay, loam, sandy clay, or clay loam sub soils.	Rain Forest

Source: Adapted from Reconnaissance Soil Survey of Nigeria, FDALR (1995)

The climate of Lagos State is the wet equatorial type influenced by its nearness to the equator and the Gulf of Guinea. It is affected by atmospheric interactions in which the Inter-Tropical Convergence Zone (ITCZ) is a controlling factor. The northward movement of the ITCZ is associated with the coming onshore of a warm, humid maritime tropical air mass, while its retreat is associated with the hot and dry continental air mass from the interior. These two air masses give Lagos two contrasting seasons; a rainy season, which usually lasts from April to October; and a dry season, which lasts from November to March.

The rainy season has two peak rainfall periods: May to July and September to October, with rainfall being heaviest during the first peak period. Floods usually occur during these periods of peak rainfall. These floods are aggravated by the poor surface drainage systems of the coastal lowlands. The mean annual rainfall varies from one location to another with Ebute-Metta, Yaba, Bariga on the mainland areas recording 1750mm, Badagry in the extreme west of the State recording 1636.1mm, Epe in the extreme north-east recording 1676.5mm and Agege in the north-west recording 1567.2mm.

Lagos State has consistently high temperatures, with the mean monthly maximum temperature of about 30 degrees Celsius (Iwugo et al., 2003). The state experiences the highest temperatures in November to December and February to March, while the lowest temperatures occur in June to July, which coincides with the middle of the first period of peak rainfall.

The state has a population of 17 million with approximately 85% living in the city of Lagos making it one of the most urbanized regions in Nigeria. The UN estimates that at its present growth rate, Lagos will be the world's third largest city by 2015, after Tokyo in Japan and Mumbai in India. The population density of the state is about 4,193 persons per square km. However, in the built-up areas of Metropolitan Lagos, the average density is over 20,000 persons per square km. The rate of population growth is about 600,000 per annum, which is ten times faster than that of New York and Los Angeles, with grave implications for urban sustainability (www.lagosstate.gov.ng).

2. VISION, MISSION AND OBJECTIVES OF LAS-CCAS

Vision

The vision of the Lagos State Climate Change Adaptation Strategy is a prosperous and climate change resilient Lagos.

Mission

The mission of the Lagos State Climate Change Adaptation Strategy is to develop new and strengthen existing actions toward adapting to climate change through all stakeholders working together.

Objectives

The Lagos State Climate Change Adaptation Strategy (LAS-CCAS) is planned to reinforce early actions that are already being taken by the State Government to address the challenge of climate change. Its main goals are to:

- Provide an integrated and systematic approach to reducing vulnerabilities to climate change, and increase the resilience and sustainable well-being of the people of Lagos State; and
- Provide a framework for building informed responses and enhancing capacities at individual, community and state levels to implement effective climate change adaptation policies and measures.

The specific objectives of LAS-CCAS include:

- Raising people's awareness of the threats posed by climate change and educating them on how to adapt to this threat;
- Identifying the climate change hazards to which the various socioeconomic sectors of Lagos State are exposed;
- Assessing the impacts of these hazards, as well as the vulnerabilities of each sector;
- Reviewing the existing governance structure and institutional arrangements for the various sectors;
- Identifying the roles of government, private sector organizations, non-governmental organizations, community-based organizations, community development authorities and individuals in tackling climate change impacts in the state;
- Making recommendations for key policies and measures for addressing climate change adaptation in the state;
- Ensuring gender mainstreaming in the state's climate change adaptation initiatives in order to take into account the implications of any course of action on men and women as well as vulnerable groups such as children, the poor and the elderly; and
- Suggesting evaluation criteria and monitoring procedures for adaptation policies and programmes.

3. OVERVIEW OF EXISTING SITUATION

In this section, each of a number of critical sectors of the state is examined with a view to identifying the challenges that it faces with reference to the threat posed by climate change, the associated vulnerabilities and the implications of these challenges and vulnerabilities for designing effective adaptation strategies, as well as relevant existing governance structures and government policies.

3.1 Agriculture and Food Security

A substantial proportion of the rural population of Lagos State earns its living from subsistence, rain-fed agriculture, fishing, aquaculture and livestock rearing. Recent changes in rainfall patterns have made it difficult for farmers to know the best time to plant their crops.

State policy is to concentrate on areas of comparative advantage, such as fishing and aquaculture, poultry farming, rice farming and dry season irrigation farming. The state provides support to farming communities through its Agricultural Input Supply Agency to boost production and as part of “climate-proofing” the agricultural sector.

3.2 Water Resources

With its high mean annual rainfall, Lagos State has abundant water resources in the form of surface water (rivers, lagoons, lakes and creeks) and groundwater. The groundwater is contained in four main aquifers: a water table aquifer which is about 10m thick, and deeper aquifers at 5-20m, 20-70m and at 450m below sea level.

About 26% of residents of metropolitan Lagos have access to piped water. Many residents provide their own supply or supplement the public supply by sinking their own wells and boreholes or buying water from vendors. The state government is putting into place a new Water Supply and Sanitation Policy that aims to facilitate climate change adaptation in this sector.

Aspects of the state’s water resources that are particularly relevant to climate change adaptation include:

- A generally high water table in the state, which predisposes it to flooding;
- Widespread pollution of surface and groundwater resources with human waste, industrial waste, hydrocarbons and salt water;
- The unregulated nature of groundwater exploitation in the state;
- Lack of comprehensive management of surface water in the state;
- The fact that women are largely responsible for water collection in various communities throughout Lagos State, which means that they will be more affected if the quantity and quality of water and/or its accessibility change as a result of climate change.

3.3 Wetlands and Freshwater Ecosystems

In 1965, wetlands covered about 53% of Lagos State. This included mangrove swamps along the coast and freshwater swamps along the major rivers. Mainly as a result of human activities, especially uncontrolled urbanization, the percentage of wetlands has been reduced to about 2% (see Figure 2), with great loss of biodiversity. As a result of pollution, much of the wetlands have been invaded by water hyacinth. The state government is cooperating with a number of NGOs, particularly the Nigerian Conservation Foundation (NCF), in managing and conserving the state’s remaining wetlands.

According to Triple-E et al. (2010), up to 80% of Lagos State could be inundated by the end of the century as a result of climate change-induced sea level rise. This would mean the disappearance of practically all of its freshwater wetlands.

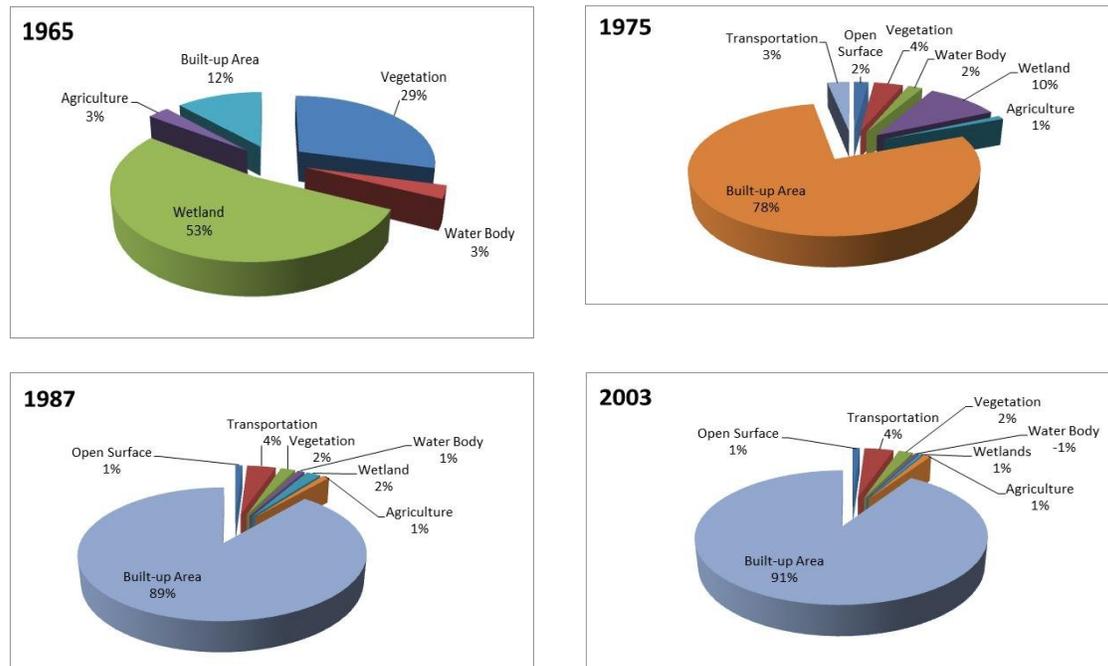


Figure 2 Wetland Loss in Lagos State Between 1965 and 2003

Source: Shakirudeen Odunga, 2008, found in Triple 'E' Systems (2010)

3.4 Coastal Zone and Marine Ecosystems

Lagos State has a long coastline immediately behind which is a complex belt of barrier islands with active ocean beaches, lagoons and lagoon beaches, lagoonal inlets, creeks, rivers, swamps and sandy uplands and plains. The importance of the coastal zone lies in the fact that it is not only already heavily urbanized but rapid urbanization is continuing, exposing people, infrastructure and the tourism industry to a greater risk of climate change impact, particularly sea level rise. Moreover, the marine ecosystems are the mainstay of many fishing communities. The dumping of waste and the discharge of industrial and domestic effluent are also threatening the integrity of the coastal zone for these communities.

Governance structures that have been put in place that should help the state to adapt to climate change include:

- The Lagos State Ministry of Waterfront Infrastructure Development, which was established in 2007; and
- The Lagos State Urban and Regional Planning and Development Law 2010.

3.5 Land Use, Forestry and Biodiversity

As a result of urbanization, agriculture and other forms of human activity, only relics remain of the original rain forest, mangrove swamps and freshwater swamps that once covered much of the state. The state has five forest reserves covering about 11,295 ha (113 sq. km). Pressure on these and on secondary forests is intensifying, with increasing loss of biodiversity.

The state has embarked on an aggressive tree-planting campaign in Metropolitan Lagos that has led to the planting of over 3 million trees in the last few years.

3.6 Energy

Because of low purchasing power, most poor households cannot afford liquefied natural gas or kerosene and, therefore, they use fuel wood or charcoal for cooking. The use of wood for fuel is a major contributor to deforestation, land degradation and biodiversity loss, which diminish the capacity of the forest to support livelihoods and adaptation. Because of the size of Lagos' population, the demand for firewood and charcoal is large, meaning that the forests needed to support this demand are found both inside Lagos State and well beyond of the borders of the State.

3.7 Transportation

Lagos State relies heavily on road transport for the movement of people, freight and services. Roads are susceptible to damage by erosion and flooding caused by excessive rainfall and to the buckling of tarmac due to excessive heat. They are therefore vulnerable to the impact of climate change.

Although water transportation is being developed to take advantage of the available waterways in the state, it is a sector that has remained under-developed. However, the new initiative of improving public transportation through the introduction of the Bus Rapid Transit (BRT) programme has changed the trend in travel patterns and vehicular usage to some extent. The addition of commercial motorcycles as a means of transport has also come with its own negative implications on sustainable development in the state.

3.8 Industry and Commerce

Lagos Metropolis is Nigeria's industrial and commercial capital. The volume of commerce and industrial activities in Lagos State accounts for over 20% of the earnings in the Value Added Tax of the entire Federation. This sector is growing rapidly, putting a great deal of pressure on the State and Local Governments to provide basic infrastructure. Industry and commerce are a major source of the heat that contributes to the classic urban heat island effect, which is likely to increase as a result of climate change. This sector also contributes to pollution of land, surface water and groundwater in the State.

Most industries in Lagos State depend on raw materials obtained from sources that are climate sensitive such as the agricultural sector. Also the transportation of raw materials and distribution of the finished products are greatly affected by climate hazards such as flooding and erosion. Also, the electricity supply to the industries is facing frequent disruptions due to extreme weather events. Adaptation strategies need to be developed for the industrial and commercial sectors in Lagos State that include the provision of alternative sources of energy, water supply and distribution.

3.9 Financial Services

Over 90% of Nigeria's banks have their headquarters in Lagos, located on Lagos Island and Victoria Island. The situation is similar for the insurance sub-sector, the Nigerian Stock Exchange, and firms specializing in stock brokerage, mortgage, leasing, bonds issuance, etc. Their location close to the sea makes them vulnerable to sea level rise.

In particular, the property insurance industry is likely to be greatly affected since it is already vulnerable to extreme weather events such as the flooding that is causing wide spread displacements in Lagos State. Thus climate-induced events are likely to place undue stress on insurance markets. Financial institutions such as banking and insurance firms may be

forced into losses or bankruptcy due to claim settlements and loan defaults. These institutions may need to develop exceptional credit and premium facilities for clients to adapt to climate change impacts.

3.10 Human Settlement and Health

One of the biggest challenges facing the human settlement sector in the state, particularly as it relates to the health of the citizenry, is the state of physical planning of Lagos Metropolis. The city of Lagos was not planned from the outset, and sprawl development is continuing on swamps, riverbanks, lagoons / creek banks at an accelerated rate. The trend is one in which most of the time, development precedes physical planning, the consequences being the emergence of slums where there is an acute deficiency in basic infrastructure. As a result, a large proportion of the city is characterized by generally poor sanitation, limited access to water, inadequate drainage facilities, generally poor condition of buildings, limited amount of open spaces, poor waste management, etc. These inadequacies have adverse effects on the health of the people in terms of the incidence of such water-borne and water-related diseases as cholera, gastro-enteritis and malaria. The growth of slums that are the abode of low-income groups has increased other health-related issues.

The Lagos State Urban Renewal Authority reports that over 65% of the population of the State lives in slums and under-supplied communities. This gives an indication of the number of inhabitants likely to be under threat as result of increasing incidence of climate hazards such as flooding and heat waves. It also indicates the magnitude of relief that will be expected from government and other donor agencies in response to major climate-related disasters. Attempts are now being made at urban renewal in several parts of Lagos as a long-term strategy to plan settlements and reduce climate risk.

3.11 Disaster Management

A number of factors predispose Lagos State to both natural and human-made disasters. These factors include:

- The State's coastal location, its generally low-lying topography and the high annual rainfall, all of which make it subject to coastal erosion and extensive flooding;
- The high level of poverty, which promotes human activities that expose people to disaster risk, such as the erection of buildings on flood plains; and
- Weak enforcement of development control and of the building code.

The prevalent disasters in the State are flooding, fire, traffic accidents, building collapse, coastal erosion, civil unrest, and destructive storms. Of these, flooding, coastal erosion and destructive storms may be expected to increase as a result of climate change.

Lagos has a State Emergency Management Authority (LASEMA) but it appears to be inadequately funded relative to the frequency and severity of the disasters that it has to manage. Going by the nature of disasters that occur in the State and the level of casualties, it could be said that there is need for more effective disaster response strategies. Moreover, in view of the threat posed by climate change, there is need for the adoption of disaster risk reduction strategies in the State.

4. EXPECTED CLIMATE CHANGE IN LAGOS STATE

4.1 Introduction

A Climate Change Adaptation Strategy for Lagos State must be informed by what the climate of the State is likely to be in the future. For this purpose, scientists build plausible pictures of future climate that are called climate scenarios. These scenarios are based on models that simulate the physical processes of atmospheric circulation that determine global climate. The models are then scaled down for particular regions of the world, such as West Africa or Nigeria.

Recently, the Climate Systems Analysis Group of the University of Cape Town developed two climate change scenarios for the Building Nigeria's Response to Climate Change (BNRCC) project. One of these scenarios, known as A2, is used in this document. It is based on a scenario that envisages higher global greenhouse gas (GHG) emissions than the other scenario, B1.

In 2010, Triple-E Systems Inc. of USA, in collaboration with the Pennsylvania State University, USA, and its Nigerian affiliate, Triple-E Systems Associates Limited, were contracted by the United Nations Industrial Development Organization (UNIDO) and the Lagos State Government to undertake a study on climate change scenarios for Lagos State.

4.2 Temperature

The A2 scenario developed for the BNRCC project suggests that Nigeria will experience a warmer climate in the future, with a temperature increase of 0.04 degrees Celsius per year from now until the 2046-2065 period. Areas near the coast are expected to warm up at a slower rate. Ikeja is projected to have a temperature increase of between 1.4 and 2.3 degrees Celsius by 2046-2065. The Triple-E Systems report indicates that climate change will result in a temperature rise of about 3° C by the end of the century, and a slight increase in climate variability.

4.3 Rainfall

The A2 scenario suggests that the climate will be wetter, with the annual rainfall increasing by about 15cm by 2046-2065. Furthermore, it is projected that the rainy season will start earlier and end later, resulting in a rainy season that will be longer by up to two weeks by the 2046-2065 period. The Triple-E Systems report indicates that climate change will bring a slight increase in precipitation, and a slight increase in climate variability.

4.4 Extreme Weather Events

Extreme weather events are important because they are prime cause of natural disasters. According to the A2 scenario, extreme weather events will increase both in frequency and magnitude. By 2046-2065, Lagos State may be expected to experience:

- Between 7 and 23 extreme heat days with the temperature reaching 38 degrees Celsius;
- A small increase in extreme rainfall days, meaning days with more than 50mm of rain; and
- More violent tropical storms.

4.5 Sea Level Rise

In addition to the above changes in temperature, rainfall, and extreme weather events, the Intergovernmental Panel on Climate Change (IPCC) has projected that sea level will rise as a result of increasing global temperatures, which among other things causes the melting of polar ice caps and thermal expansion of water. The global average rate of sea level rise of about 3.1mm per year that was recorded between 1993 and 2003 is expected to continue into the future. The IPCC has projected global sea level rise of between 18 and 59 cm by 2100 relative to 1980-1999 levels (IPCC, 2007). Triple-E Systems Inc. (2010) reported that the projected sea level rise in Lagos State coastal areas could reach more than 1m by 2100 and inundate substantial coastal areas.

5. EXPECTED IMPACTS OF CLIMATE CHANGE IN LAGOS

The projected changes in climate described above have the potential to impact the economy of Lagos State in significant ways. The impacts will be felt in every sector. It is necessary to understand the impacts for each sector in order to be able to design appropriate adaptation strategies and measures.

Table 2 on the following pages presents the key climate change impacts expected as a result of climate change - as well as the associated vulnerabilities - for the following sectors of the economy:

1. Agriculture and Food Security
2. Water Resources
3. Wetlands and Freshwater Ecosystems
4. Coastal Zone and Marine Ecosystems
5. Land Use, Forestry and Biodiversity
6. Energy
7. Transportation
8. Industry and Commerce
9. Financial Services
10. Human Settlements and Health
11. Disaster Management

Table 2 Expected Impacts of Climate Change in Lagos State

SECTOR 1: AGRICULTURE AND FOOD SECURITY
<p>TEMPERATURE Higher temperatures are expected to lead to:</p> <ol style="list-style-type: none">1. Increased water demand for agriculture;2. Increased pest infestation; and3. Increased food storage losses.
<p>RAINFALL Increased rainfall, unpredictable variability of rainfall and a longer rainy season resulting from earlier onset dates and later rainy season cessation dates could:</p> <ol style="list-style-type: none">1. Be beneficial to agriculture and food security through increased crop yields, depending on the crop;2. Result in increased flooding and damage to or destruction of crops;3. Result in increased soil erosion;4. Lead to higher incidence of crop and animal pests and diseases; and5. Reduce agricultural productivity by disrupting timing of farming operations.
<p>SEA LEVEL RISE Sea level rise will:</p> <ol style="list-style-type: none">1. Cause the loss, through submergence, of agricultural land as well as built-up areas on low-lying land near the sea;2. Result in increased flooding;3. Cause intrusion of salt water into soils, surface water and groundwater resources; and4. Result in the loss of mangrove and possibly some freshwater swamps.
<p>EXTREME WEATHER EVENTS Increases in the frequency and severity of violent storms will:</p> <ol style="list-style-type: none">1. Result in damage to or destruction of physical infrastructure, such as buildings; and2. Result in increased incidence and magnitude of flood disasters that will affect crops, buildings and infrastructure.
<p>Vulnerability Note: All rural areas of the State where agriculture is the main source of livelihood are vulnerable. Particularly vulnerable are:</p> <ul style="list-style-type: none">• All agricultural land as well as built-up areas on flood plains and low-lying land near the sea;• The people who live in these areas;• The water resources in areas near the sea; and• The fishing industry for which the mangrove swamps serve as a sanctuary for young fish to mature.
SECTOR 2: WATER RESOURCES
<p>TEMPERATURE Higher temperatures are expected to lead to:</p> <ol style="list-style-type: none">1. Higher rates of evaporation;2. Higher water demand for agricultural, industrial and domestic use, particularly during the dry season; and3. Algal blooms that could threaten water quality.
<p>RAINFALL Increased rainfall will result in:</p> <ol style="list-style-type: none">1. Greater amount of runoff into and from surface water resources;2. Increased risk of flash floods; and3. Increased risk of water-borne diseases.

SEA LEVEL RISE

Sea level rise is likely to result in:

1. Damage to water storage/supply systems;
2. Saltwater intrusion into the groundwater resources in the coastal region and in the estuaries; and
3. Salt water intrusion into farmlands.

EXTREME WEATHER EVENTS

More frequent or intense storms will result in:

1. Damage to water storage/supply systems;
2. Power outages causing disruption to public water supply;
3. Increased water pollution;
4. Crop damage; and
5. Increased risk of water-borne diseases.

Vulnerability Note:

- All dry season agriculture is vulnerable, as well as industries that use large volumes of water.
- People living in marginal environments are highly vulnerable.
- The public water supply system is highly vulnerable, as are private water supply schemes that depend on groundwater.
- Farming communities are also highly vulnerable.

SECTOR 3: WETLANDS AND FRESHWATER ECOSYSTEMS**SEA LEVEL RISE**

Sea level rise will result in:

1. The conversion of some wetlands into areas of open saltwater and freshwater, with loss of biodiversity;
2. Formation of new wetlands in areas that were formerly dry land; and
3. Erosion along the outer boundaries of the new wetlands.

EXTREME WEATHER EVENTS

More frequent or intense storms will result in:

1. Destruction of already compromised wetland and mangrove species and ecosystems; and
2. Threats to the important function of wetlands as regulating water quantity and quality.

Vulnerability Note:

The following are vulnerable:

- Wetlands and freshwater eco-systems near the sea;
- The mangrove swamps along the coast; and
- Fishing communities that depend on the freshwater ecosystems.

SECTOR 4: COASTAL ZONE AND MARINE ECOSYSTEMS**SEA LEVEL RISE**

Sea level rise will result in:

1. Submergence of low-lying areas;
2. Increased coastal erosion, which is already a problem as a result of human activities; and
3. Increased salinization of both groundwater and surface water.

EXTREME WEATHER EVENTS

Increased frequency and intensity of storm surges will result in:

1. Increased coastal erosion; and
2. Damage to or destruction of coastal infrastructure.

Vulnerability Note:

The following are highly vulnerable:

- All coastal settlements;
- All coastal communities who depend on marine resources;
- All coastal infrastructure; and
- All coastal beaches, which are critical for much of the State's tourism industry.

SECTOR 5: LAND USE, FORESTRY AND BIODIVERSITY

TEMPERATURE

Higher temperatures are expected to lead to:

1. Higher net primary productivity; and
2. Possible displacement of heat-intolerant species.

RAINFALL

Increased rainfall will result in:

1. Flooding and water logging that may change habitat conditions for biodiversity, leading to changes in species composition in coastal ecosystems.

SEA LEVEL RISE

The greatest impact of climate change is likely to be due to sea level rise which will result in:

1. Permanent loss of large areas of land due to sea incursion;
2. Saltwater intrusion into freshwater swamp forest ecosystems, causing major changes in species composition;
3. Freshwater flooding of some areas of low-lying forest, causing major changes in species composition; and
4. Large-scale displacement of human populations, causing the conversion of large areas of forest into settlements and farmland.

EXTREME WEATHER EVENTS

More frequent and intense storms will result in:

1. Usually short-term disruptions in ecosystems leading to the loss of species and habitats.

SECTOR 6: ENERGY

TEMPERATURE

Higher temperature area expected to result in:

1. Greater demand for energy for cooling.

SEA LEVEL RISE

Sea level rise will result in:

1. Damage to or destruction of energy infrastructure, such as power plants and electricity transmission lines located along or near the coast; and
2. Destruction of mangrove ecosystems, used as a local supply of fuel wood for coastal communities.

EXTREME WEATHER EVENTS

Severe storms will:

1. Damage or destroy energy production facilities and transmission lines.

SECTOR 7: TRANSPORTATION

TEMPERATURE

Higher temperatures are expected to result in:

1. Road network problems due to softening of asphalt and buckling of concrete;
2. Warping of railroad rails;
3. Increasing mechanical failure in cars and trucks; and
4. Flight delays, cancellations and re-routing due to lack of lift in extremely hot conditions.

RAINFALL

Increased rainfall will result in:

1. Flooding, leading to disruptions in road transport.

SEA LEVEL RISE

Sea level rise will:

1. Damage port infrastructure;
2. Lead to the submergence or flooding of industrial and commercial infrastructure, such as industrial estates, factories and market places; and
3. Put communications infrastructure at risk of damage or destruction.

EXTREME WEATHER EVENTS

Severe storms will:

1. Damage or destroy port and other transportation infrastructure as well as communications infrastructure;
2. Cause disruptions in road, rail, air and water transportation; and
3. Create hazardous conditions for local people relying on small boats.

SECTOR 8: INDUSTRY AND COMMERCE

TEMPERATURE

Higher temperatures are expected to result in:

1. Higher energy bills for cooling in all workplace premises; and
2. Reduced productivity of workers because of heat stress.

RAINFALL

Increased rainfall will result in:

1. Disruption of production by climate change-induced reduction in the supply of raw materials e.g. agricultural produce.

SEA LEVEL RISE

Sea level rise will:

1. Lead to the submergence or flooding of industrial and commercial infrastructure, such as industrial estates, factories and market places; and
2. Put communications infrastructure at risk of damage or destruction.

EXTREME WEATHER EVENTS

Severe storms will:

1. Damage or destroy industrial and commercial as well as communications infrastructure; and
2. Cause disruptions in road, rail, air and water transportation.

SECTOR 9: FINANCIAL SERVICES

TEMPERATURE

Higher temperatures are expected to result in:

1. Higher energy for cooling of all buildings in the Financial Services sector in Lagos; and
2. Heat stress affecting productivity across all sectors supported by Financial Services sector.

RAINFALL

Increased rainfall will result in:

1. Flooding from excessive rainfall; insurance claims and premiums may rise.

SEA LEVEL RISE

Sea level rise will:

1. Result in the increased flooding, and eventually the submergence of the Sector's prime real estate assets in Lagos; and
2. Increased flooding and eventually the submergence of other real estate assets in which the Sector has substantial investments or interest in Lagos State.

EXTREME WEATHER EVENTS

Extreme weather events will:

1. Trigger disasters which will affect the Sector both directly and indirectly; and
2. Increase the need for insurance against disaster risks.

Vulnerability Note:

- The entire financial services sector, which is highly interdependent, will be at risk.

SECTOR 10: HUMAN SETTLEMENTS AND HEALTH

TEMPERATURE

Higher temperatures are expected to result in:

1. Heat stress and greater incidence of heat related diseases;
2. Worsening sanitation conditions in the slums; and
3. Out-migration to other areas, leaving women and children behind in settlements.

RAINFALL

Increased rainfall will result in:

1. Flooding from excessive rainfall; may lead to displacement of people and households and in increase in water-borne diseases.

SEA LEVEL RISE

The most serious impact of climate change on settlements and health in Lagos State is likely to be that of sea level rise and extreme weather events and will take the form of:

1. Large-scale displacement of coastal settlements and the people living in them as a result of flooding and coastal erosion;
2. Depreciation of the value of coastal real estate assets;
3. Damage to electricity transmission and communications infrastructure; and
4. Contamination of water with salt, sewage, industrial and domestic waste.

EXTREME WEATHER EVENTS

Severe storms will:

1. Increase damage to buildings and other infrastructure; and
2. Cause death and injury from disasters.

Vulnerability Note:

- Vulnerable physical assets will include land, private homes and businesses, and other real estate.
- All Lagosians are vulnerable, but to varying degrees. The most vulnerable people are the poor (most of who live in slums), women, children and the elderly.

SECTOR 11: DISASTER MANAGEMENT

TEMPERATURE

Higher temperatures are expected to result in:

1. Greater incidence of heat stress and thus more pressure on emergency response systems and hospitals.

RAINFALL

Increased rainfall will result in:

1. Flooding from excessive rainfall; leading to displacement of people and heightened pressure on emergency systems.

SEA LEVEL RISE

Sea level rise will:

1. Result in more frequent and more devastating flood disasters, which will cause destruction of and damage to lives and properties.

EXTREME WEATHER EVENTS

More frequent and severe storms and storm surges will result in:

1. Destruction and damage to lives and properties; and
2. Disruption of shipping.

Vulnerability Note:

Particularly vulnerable are:

- All low-lying areas;
- The poor, who live in marginal areas, in settlements along the coast, and in buildings that may not be able to withstand violent storms;
- Coastal shipping and port infrastructure;
- Electric power lines and communications infrastructure.

6. CLIMATE CHANGE RESPONSE ACTIONS BY LAGOS STATE

Lagos is arguably the most proactive state in Nigeria in terms of climate change response activities. In order to benefit from the experience of other cities around the world, Lagos has become a member of the C40 Large Cities Climate Summit, an organization dedicated to helping some of the world's largest cities to tackle the challenge of climate change.

In 2009, 2010 and 2011, the State organized a Climate Change Summit, bringing in experts from around the world to examine the threat that climate change poses to the State and how it should respond to it. Also in 2011, the State, in collaboration with the International Council for Local Environmental Initiatives (ICLEI), organized a congress on the theme, *Building Climate Change Resilient African Cities: Climate Proofing Africa on the Road to COP 17*. The Mayors and Local Government Chairmen present at the congress signed the *African Mayors Climate Change Declaration* that was drafted on the occasion of the *Local Climate Solutions for Africa 2011 Congress* held in February/March 2011 in Cape Town, South Africa.

The key elements of Lagos State's existing strategy to combat climate change are:

1. Launching a public awareness and sensitization programme to educate Lagosians about the threat of climate change and what needs to be done to address it. In an attempt to "catch them young and use them (i.e. school children) as agents of change in reaching out to the larger society", the State has launched a School Advocacy Programme in which climate change clubs have been established in 172 primary schools and 348 post-primary institutions in the State.
2. Launching a climate change mitigation and adaptation programme. Various measures have been put in place to mitigate climate change and its impacts and to adapt to them. These include:
 - A tree planting campaign and criminalization of indiscriminate tree felling;
 - Landscaping of virtually all open spaces, road verges and medians, and triangular lay-bys;
 - Introduction of a mass transportation system, including the BRT (Bus Rapid Transit) scheme, rail transport and water transport;
 - Establishment of a waste-to-wealth programme, including:
 - A nylon buy-back programme, to reduce the dumping of plastic wastes into waterways, blocking storm water run-off, leading to flooding;
 - A waste-to-compost facility at Ikorodu;
 - A waste-to-energy project at the Olusosun Dump site;
 - Rehabilitation of the drainage infrastructure in Lagos;
 - Shoreline protection, especially at the Bar Beach on Victoria Island;
 - Erosion control;
 - Urban renewal programme;
 - Engaging the mass media (radio, television and print) to deliver warnings and weather predictions to vulnerable communities;
 - Organization of quarterly meetings of Community Development Associations (CDAs) and Community Development Committees (CDCs) to inform and sensitize the public on climate change threats; and
 - Cultivating the use of social networking platforms to communicate real-time climate-related threats.

Sea level rise is likely to be the most significant impact of climate change in Lagos State in the long term and this will have adverse impacts on virtually every sector of the economy. Therefore, it is recommended that the State, working with the Nigerian Institute for

Oceanography and Marine Research (NIOMR) and the Federal Ministry of Works, should conduct a statewide sea level rise vulnerability assessment as a matter of urgency. It is further recommended that the assessment be repeated every five years with each new assessment presenting the most recent knowledge about sea level rise and its impacts on ocean and coastal resources, an inventory of coastal natural and human-made assets, and an assessment of what is at risk (including an economic valuation). The data from these assessments should be periodically incorporated into Lagos State climate change adaptation plan updates.

7. RECOMMENDED ADAPTATION OPTIONS: STRATEGIES, POLICIES, PROGRAMMES AND MEASURES

The following pages present the elements of an Adaptation Strategy for consideration by Lagos State. The Strategy is presented by Sector, including the “Goal” of climate change adaptation for each sector, the “Overall Sectoral Strategy”, and “Recommended Options including Policies, Programmes and Other Measures” for consideration by Lagos State. These adaptation options may be grouped into five main categories (O’Donnell, 2008):

- Policy making and planning;
- Awareness raising, public education and capacity development;
- Information management (including early warning system);
- Design and decision-making for investments; and
- Specific practices in the areas of risk reduction, livelihood development and resource management.

It is recommended that a gender analysis be used throughout the preparation of adaptation responses to assess the implications of any climate change adaptation policy, programme or measure for men, women and other vulnerable groups and to make decisions in a way that promotes gender equality in line with the requirement of the National Gender Policy.

The “Recommended Options for Policies, Programmes and Other Measures” in Table 3, starting on the following page, are provided for consideration by Lagos State as it makes decisions on priority adaptation measures.

Table 3 Recommended Adaptation Goals and Strategies, with Recommended Options for Policies, Programmes and Other Measures

SECTOR 1: AGRICULTURE AND FOOD SECURITY
<p>SECTORAL GOALS</p> <ol style="list-style-type: none"> 1. To reduce the vulnerability of agriculture and food security in Lagos State to the adverse impacts of climate change; 2. To increase the resilience of agriculture and food security in Lagos State to the adverse impacts of climate change; and 3. To exploit expected higher rainfall to increase agricultural productivity.
<p>OVERALL SECTORAL STRATEGIES</p> <ol style="list-style-type: none"> 1. Develop short-term, farmer-targeted weather forecasting to assist the timing of agricultural operations; 2. Strengthen gender-sensitive agricultural research into the expected impacts of climate change and needed adaptation in the areas of crop and livestock agriculture and food security; 3. Put in place a community-based climate change adaptation support programme targeted at crop and livestock agriculture and food security in the state; and 4. Strengthen the state's agricultural extension services to be able to work with farming communities with particular reference to climate change adaptation.
<p>RECOMMENDED OPTIONS FOR POLICIES, PROGRAMMES AND OTHER MEASURES</p> <ol style="list-style-type: none"> 1. Provide short-term weather forecasting services to farmers to enable them adjust to and take advantage of changes in weather patterns; 2. Carry out a survey of agricultural areas that are at risk from flooding and sea level rise; 3. Develop a long-term plan for the relocation of farming communities that are most at risk from flooding and sea level rise; 4. Encourage communities to build flood defense structures such as ridges, bonds and drains; 5. Encourage the use of cover crops against soil erosion; 6. Encourage farmers to adopt salt-tolerant crops and farming systems that take advantage of a longer growing season; 7. Continue to promote irrigation farming that includes both women and men farmers; 8. Promote the breeding of livestock that is adapted to the 'new' climate regime; 9. Work with the financial services sector to develop innovative agricultural financing and insurance packages to empower small farmers to be able to adapt to climate change; 10. Promote climate-based insurance for farmers; 11. Enhance pest and disease control facilities; 12. Build on indigenous knowledge to promote food preservation and storage of agricultural produce; 13. Promote the establishment of a Lagos State strategic grain reserve to store surplus harvests; 14. Establish government policy to buy back surplus agricultural production to encourage farmers to continue to produce; 15. Improve road network for access to markets; 16. Promote diversification of livelihoods among the farming population; 17. Ensure gender equality in access to all climate change adaptation initiatives; and 18. Raise the awareness of and educate the farming population about the threat posed by climate change, its impacts, the need to adapt to it and how to do so.
SECTOR 2: WATER RESOURCES
<p>SECTORAL GOAL</p> <p>To ensure the availability of adequate quantity and quality of water for household use, agriculture, and industrial production.</p>

OVERALL SECTORAL STRATEGIES

1. Improve water use efficiency;
2. Protect quality of water sources; and
3. Protect water supply facilities.

RECOMMENDED OPTIONS FOR POLICIES, PROGRAMMES AND OTHER MEASURES

1. Introduce water efficiency and conservation measures;
2. Formulate and implement policy to regulate the sinking of boreholes;
3. Develop and enforce legislation to control the storage of petroleum products underground;
4. Design new water pipeline network in built-up areas taking into account projected sea level rise;
5. Consider the use of pumping stations to provide drainage during flooding;
6. Establish government policy on appropriate pricing of the extraction of groundwater by individuals and corporate bodies;
7. Apply stricter management of industrial effluent and the provision of industrial waste disposal facilities;
8. Enact new legislation and develop management structures to control the disposal of oily wastes.

SECTOR 3: WETLANDS AND FRESHWATER ECOSYSTEMS**SECTORAL GOAL**

To conserve and manage wetlands in such a way as to promote their capacity to continue to serve as habitats for aquatic life and to regulate water quality and flow.

OVERALL SECTORAL STRATEGIES

1. Improve the quality of information about the state's wetlands and freshwater ecosystems;
2. Support the implementation of the National Biodiversity Strategy and Action Plan with particular reference to recommendations that relate to climate change adaptation as they affect wetlands and freshwater ecosystems; and
3. Support the recommended adaptation policies and measures in other sectors that will be beneficial to biodiversity conservation, such as those in water resources, coastal zone and marine ecosystems, settlements and health, land use, forestry and biodiversity.

RECOMMENDED OPTIONS FOR POLICIES, PROGRAMMES AND OTHER MEASURES

1. Promote the sustainable management of upland wetlands and floodplains for the maintenance of water flow and quality and the prevention of flood disasters;
2. Promote community awareness and participation in the management of wetlands and freshwater ecosystems;
3. Take advantage of existing international assistance in wetlands conservation and management; and
4. Promote legislation geared at protecting wetlands.

SECTOR 4: COASTAL ZONE AND MARINE ECOSYSTEMS**SECTORAL GOALS**

1. To reduce the vulnerability of marine ecosystems, coastal infrastructure and communities to the impacts of climate change; and
2. To increase the capacity of marine ecosystems, coastal infrastructure, communities, and institutions to adapt to climate change.

OVERALL SECTORAL STRATEGIES

1. Adopt the principle of integrated coastal zone management in the State;
2. Maintain and restore mangroves and other coastal wetlands as a relatively cheap form of defense against coastal flooding and coastal erosion, and to promote livelihoods;
3. Create buffer zones in physical planning to accommodate anticipated sea level rise;
4. Develop a long-term plan for the relocation of vulnerable settlements and infrastructure; and
5. Reduce expansion of socio-economic development in areas at high risk from sea level rise.

RECOMMENDED OPTIONS FOR POLICIES, PROGRAMMES AND OTHER MEASURES

1. Conduct a state wide sea-level rise vulnerability assessment with a view to preparing an inventory of coastal natural and human-made assets that are at risk (including an economic valuation);
2. Develop a long-term physical plan for the coastal zone using the principle of integrated coastal zone management;
3. Strengthen policies prohibiting building on water courses;
4. Apply strict control over all new land reclamation along the coast, increasing the standard to a minimum of 4m above sea level with a requirement for sea defenses against storm surges;
5. Develop computer-based, flood early warning system for Lagos state;
6. Enhance capacity of early warning systems and the use of GIS and satellite imagery for coastal zone management;
7. Grow salt tolerant crops;
8. Invest in saltwater fish farming only in areas where mangroves will not be impacted;
9. Establish new protected areas;
10. Promote wide scale adoption of fuel efficient stoves in coastal communities to reduce cutting pressure on coastal forest ecosystems;
11. Relocate or modify infrastructure such as dams, treatment plants or reservoirs that are at risk.

SECTOR 5: LAND USE, FORESTRY AND BIODIVERSITY

SECTORAL GOALS

1. To promote the development and maintenance of diverse and healthy ecosystems that can continue to perform their productive, protective, regulating and supporting functions in the face of climate change; and
2. To promote sustainable land use.

OVERALL SECTORAL STRATEGIES

1. Conduct periodic assessments of the status of land use, vegetation cover and biodiversity in the State;
2. Integrate biological diversity considerations into the state's regional planning, policy and decision making as a way of securing the future well-being of the people and ecosystems of Lagos State;
3. Conduct periodic reviews of the state's regional plan with a view to making necessary adjustments in the interest of conserving biodiversity; and
4. Implement and enforce biodiversity conservation programmes.

RECOMMENDED OPTIONS FOR POLICIES, PROGRAMMES AND OTHER MEASURES

1. Establish land use zoning and control to prevent development from encroaching on sensitive ecosystems, such as wetlands, forests and flood plains;
2. Promote healthy and diverse agroforestry systems to protect and enrich soils and to provide a wide range of economic benefits;
3. Promote afforestation with fast-growing, preferably native species;
4. Introduce a long-term plan for mandatory sourcing of all timber or timber products used in the state from sustainable sources;
5. Preserve existing and designate new forest reserves;
6. Integrate green or nature-based infrastructure and technology into hard engineering solutions to environmental problems wherever possible;
7. Promote widespread adoption of more energy-efficient fuel wood stoves; and
8. Introduce a long-term plan to replace fuel wood use with the use of renewable energy.

SECTOR 6: ENERGY

SECTORAL GOALS

1. To reduce the vulnerability of the energy sector to climate change impacts; and
2. To ensure the availability of energy to meet additional needs brought about by climate change.

OVERALL SECTORAL STRATEGIES

1. Draw up and implement a Lagos State energy policy, integrating climate change considerations;
2. Assess the vulnerability of the energy sector to climate change impacts and put in place risk reduction measures;
3. Promote energy use efficiency in the state;
4. Promote the use of renewable energy in the state to reduce dependence on electricity from the national grid; and
5. Decentralize electricity generation and transmission to reduce the vulnerability of energy sector to climate change impacts.

RECOMMENDED OPTIONS FOR POLICIES, PROGRAMMES AND OTHER MEASURES

1. Work with relevant agencies of the Federal Government to set standards for the construction and maintenance of energy infrastructure, bearing in mind the expected impacts of climate change;
2. Take climate change impacts into account in the location of new energy infrastructure;
3. Design and implement a contingency plan to meet the challenges posed by climate change for the energy sector, including the possible relocation of critical infrastructure;
4. Promote the reduction of electricity consumption in households through the use of efficient light bulbs and electrical appliances;
5. Encourage businesses to invest in energy efficiency and renewable energy facilities;
6. Promote the use of saw dust for cooking, electricity generation, etc.;
7. Expand the lead that the Lagos State government has taken in using solar energy for street lighting and traffic lights to public buildings, schools, hospitals, libraries and offices;
8. Design and implement a renewable energy master plan for the state with a view to satisfying the energy needs of the populace for water pumping, lighting, cooking and heating, food preservation, grain milling and small/micro enterprises for income generation;
9. Encourage the adoption of green architecture.

SECTOR 7: TRANSPORTATION

SECTORAL GOALS

1. To reduce the vulnerability of transportation to the expected impacts of climate change; and
2. To take advantage of economic opportunities that may be presented by climate change.

OVERALL SECTORAL STRATEGIES

1. Assess the vulnerability of transportation to the expected impacts of climate change;
2. Design and implement climate change risk reduction measures for transportation infrastructure.

RECOMMENDED OPTIONS FOR POLICIES, PROGRAMMES AND OTHER MEASURES

1. Identify transportation infrastructure that is at high risk from climate change impacts;
2. Strengthen or relocate existing transportation infrastructure that is at high risk, so that it is better able to withstand climate change impacts;
3. Develop a long-term plan for the relocation of transportation infrastructure within the context of the Lagos Megacity project;
4. Build increased protective margins into the design, placement and construction of transportation infrastructure; and
5. Ensure that rural coastal communities have safe and reliable road and water transportation systems.

SECTOR 8: INDUSTRY AND COMMERCE

SECTORAL GOALS

1. To reduce the vulnerability of industry and commerce to the expected impacts of climate change;
2. To take advantage of economic opportunities in the areas of industry and commerce that may be presented by climate change; and
3. To promote sustainable development of industry and commerce.

OVERALL SECTORAL STRATEGIES

1. Assess the vulnerability of industry and commerce to the expected impacts of climate change;
2. Design and implement climate change risk reduction measures for industrial and commercial infrastructure; and
3. Exploit opportunities created by climate change to develop new enterprises, e.g. energy efficiency and water saving gadgets and weather forecasting tools.

RECOMMENDED OPTIONS FOR POLICIES, PROGRAMMES AND OTHER MEASURES

1. Identify, industrial and commercial infrastructure that is at high risk from climate change impacts;
2. Encourage the private sector to strengthen or relocate existing industrial and commercial infrastructure that is at high risk, so that it is better able to withstand climate change impacts;
3. Encourage the private sector to develop long-term plans for the relocation of industrial and commercial infrastructure within the context of the Lagos Megacity project;
4. Encourage the private sector to build increased protective margins into the design, placement and construction of industrial and commercial infrastructure; and
5. Monitor the activities of businesses in the sector to ensure that they are in line with the state's objectives for climate change adaptation.

SECTOR 9: FINANCIAL SERVICES

SECTORAL GOALS

1. To reduce the vulnerability of the sector to the adverse impacts of climate change; and
2. To ensure that the sector takes advantage of financial opportunities offered by climate change adaptation.

OVERALL SECTORAL STRATEGIES

1. Create awareness in the financial sector through the Bankers Committee, the Chartered Institute of Bankers (CIBN), the Nigeria Insurance Association, the Chartered Insurance Institute of Nigeria and others, on the implications of climate change for their businesses;
2. Educate investors and shareholders in the sector on issues of climate change and the implications on trade, investments, transactions, policies, relationships, business strategy, returns, etc.; and
3. Work with stakeholders to assess the vulnerability of the sector to the impacts of climate change.

RECOMMENDED OPTIONS FOR POLICIES, PROGRAMMES AND OTHER MEASURES

1. Collaborate with stakeholders in the sector to facilitate the availability of financial services in terms of insurance, credit and investment in climate change adaptation activities;
2. Encourage participants in the sector to invest in climate change adaptation activities both for profit and as part of their corporate social responsibility; and
3. Work with the insurance sub-sector to promote the culture of insurance among businesses and the general public as a way of encouraging risk-sharing as a way of dealing with the impacts of climate change.

SECTOR 10: HUMAN SETTLEMENTS AND HEALTH

SECTORAL GOAL

To develop settlements that will:

1. Reduce the impacts of climate change;
2. Be more resilient to the impacts of climate change;
3. Promote adaptation to climate change; and
4. Promote healthy and sustainable livelihoods.

OVERALL SECTORAL STRATEGIES

1. Develop climate change adaptation action plans for urban settlements and other settlements that are most at risk from climate change, such as coastal settlements;
2. Engage communities in the participatory planning of their settlements in order to reduce their vulnerability to climate change;
3. Enforce land use zoning regulations that restrict building on high risk areas, such as the ocean front, flood plains and low-lying terrain; and
4. Promote rural development in order to reduce the rate of rural-urban migration.

RECOMMENDED OPTIONS FOR POLICIES, PROGRAMMES AND OTHER MEASURES

1. Commission research into the possible health impacts of climate change;
2. Promote environmental sanitation across the state;
3. Improve the basic health care system to be able to cope with health impacts of climate change;
4. Produce land-use maps of the main urban settlements in the State and periodically review them;
5. Prepare a master plan for urban settlements in the light of the challenge of climate change and implement them;
6. Integrate the various District and Model City Plans and ensure their implementation;
7. Complete and ensure regular review of all physical development plans in the state;
8. Encourage the use of soft landscaping (i.e., grass in external areas of buildings) rather than concrete;
9. Intensify the process of providing greened parks and open spaces in urban areas;
10. Develop a long-term plan for relocation of settlements that are most vulnerable to sea level rise.

SECTOR 11: DISASTER MANAGEMENT

SECTORAL GOALS

1. To reduce the occurrence of disasters caused by climate change;
2. To increase the level of preparedness of the state for disasters that might be caused by climate change;
3. To increase the capacity of the state to respond to disasters caused by climate change; and
4. To increase the resilience of the economy and the people of Lagos State to disasters caused by climate change.

OVERALL SECTORAL STRATEGIES

1. Assess the disaster vulnerability of the state;
2. Increase funding for disaster management in the state;
3. Build a disaster avoidance policy into the state's land use planning and development control;
4. Put in place a comprehensive and participatory disaster response plan; and
5. Ensure that disaster planning and management in the state take into account the needs of women, children and other vulnerable groups.

RECOMMENDED OPTIONS FOR POLICIES, PROGRAMMES AND OTHER MEASURES

1. Put in place a comprehensive disaster response plan;
2. Build up the capacity of LASEMA as a disaster prevention and management agency;
3. Introduce a LASEMA charge as part of the fees payable by applicants for development permits in the State;
4. Create a Disaster Relief Fund and encourage corporate bodies and NGOs to donate to the fund;
5. Periodically carry out a disaster vulnerability assessment of the state that assesses differences in women and men's vulnerability;
6. Refine existing emergency preparedness plans and conduct exercises to augment preparedness for events likely to increase with climate change (e.g. heat waves, floods, coastal erosion);
7. Develop long-term plans for anticipated impacts such as sea level rise, saline intrusion into drinking water, etc.;
8. Relevant state agencies to consider project alternatives that avoid significant new development in areas that cannot be adequately protected from flooding or erosion due to climate change;
9. Protect vulnerable shoreline areas containing existing or planned development and regionally significant economic, cultural, or social value; in-fill development in these areas should be closely scrutinized in terms of costs and benefits;
10. Employ or encourage innovative engineering and design solutions so that structures that may be approved in hazard-prone zone are resilient to flooding or erosion;
11. Encourage research into all aspects of disaster occurrence and impacts in the State; and
12. Establish more disaster relief centers in various parts of the State, particularly in risk-prone areas.

8. GENDER CONSIDERATIONS

Because of the culturally determined roles and responsibilities that men and women play in Nigerian society, the Lagos State Climate Change Adaptation Strategy cannot hope to succeed unless it is gender-sensitive. The first expectation of such a strategy would be to recognize the different needs, roles and responsibilities of women and men, as well as their different vulnerabilities to the impacts of climate change. It will ensure that the objectives, expected output, methodology, planning and strategies for intervention all promote gender equality. The key to having a Climate Change Adaptation Strategy that promotes equitable development of men and women while also providing remediation of past discriminations is to take a gender mainstreaming approach.

8.1 Policy Recommendation

The Lagos State Government shall ensure that gender mainstreaming is an integral part of the planning and execution of all its climate change adaptation initiatives in order to take into account the implications of any course of action or intervention for both men and women.

8.2 Strategies

The State Government shall ensure:

1. That as much as possible, climate change adaptation initiatives in the State are based on gender-disaggregated needs;
2. That capacity building is provided for climate change adaptation policy makers, decision makers, planners, project implementation staff and project managers in developing attitudes, tools and methodologies for gender-sensitive policies;
3. That balance is achieved in the representation of men and women in decision-making bodies on climate change adaptation by encouraging more women to come into influential positions through awareness creation and capacity building;
4. That gender analysis is undertaken to assess the implications of any intervention in the area of climate change adaptation for men, women and other vulnerable groups; and
5. That a specific needs assessment for women is carried out prior to the introduction of climate change adaptation technologies in strategic areas that affect women, such as water use, lighting, cooking and heating, food preservation, grain-milling, small / micro enterprises for income generation, and agriculture.

9. IMPLEMENTATION: ROLES, RESPONSIBILITIES AND RELATIVE COSTS

Although there are frontline stakeholders, every Lagosian has a role to play in the successful implementation of the Lagos State Climate Change Adaptation Strategy. Table 4 below and on the following pages presents the Climate Change Adaptation Strategies, Policies and Measures previously presented in Table 3, along with the roles which the Federal Government or its agencies, the Lagos State Government or its agencies, the Local Governments, the Community Development Areas, members of the private sector, NGOs, CBOs, communities and individuals will be expected to play in the implementation of the strategy. These entities must work together in order to enable Lagos State to adapt to the threat of climate change. The table also includes an estimate of the relative costs of the recommended strategies, policies and measures.

An Inter-Ministerial Committee made up of all the key stakeholders, with the Honourable Commissioner of Environment as Chairman, shall coordinate the implementation of LAS-CCAS.

The Strategies, Policies, Programmes and Other Measures in Table 4, below, are provided for consideration by Lagos State as it makes decisions on priority adaptation measures.

Table 4 Implementing Adaptation Strategies, Policies, Programmes and Other Measures, with Roles, Responsibilities and Relative Costs

(VH - very high; H - high; L - low; M - moderate)

Adaptation Strategies, Policies, Programmes and Other Measures	Implementing Agencies ¹	Relative Cost
<u>Sector 1: Agriculture and Food Security</u>		
<i>At the Strategy Level:</i>		
1. Develop short-term, farmer-targeted weather forecasting to assist the timing of agricultural operations;	NIMET	L
2. Strengthen gender-sensitive agricultural research into the expected impacts of climate change and needed adaptation in the areas of crop and livestock agriculture and food security;	MAC	M
3. Put in place a community-based climate change adaptation support programme targeted at crop and livestock agriculture and food security in the State;	MAC, MLGCA, LGs, CSOs	M
4. Strengthen the State's agricultural extension services to be able to work with farming communities with particular reference to climate change adaptation.	MAC	M

¹ See Acronyms list at the start of this report for the full names of these government bodies.

Adaptation Strategies, Policies, Programmes and Other Measures	Implementing Agencies ¹	Relative Cost
<i>For Policies, Programs and Other Measures:</i>		
1. Provide short-term weather forecasting services to farmers to enable them adjust to and take advantage of changes in weather patterns;	NIMET	L
2. Carry out a survey of agricultural areas that are at risk from flooding and sea level rise;	MAC, MPPUD	M
3. Develop a long-term plan for the relocation of farming communities that are most at risk from flooding and sea level rise;	MAC, MLGCA, MPPUD, MEnv, LGs	M
4. Encourage communities to build flood defense structures such as ridges, bonds and drains;	MWI, MAC, LGs	L
5. Encourage the use of cover crops to prevent soil erosion;	MAC	L
6. Encourage farmers to adopt salt-tolerant crops and farming systems that take advantage of a longer growing season;	MAC	L
7. Continue to promote irrigation farming that includes both women and men farmers;	MAC	M
8. Promote the breeding of livestock that is adapted to the 'new' climate regime;	MAC	L
9. Work with the financial services sector to develop innovative agricultural financing and insurance packages to empower small farmers to be able to adapt to climate change;	MAC, NACRDB, Insurance companies	L
10. Promote climate-based insurance for farmers;	MAC, Insurance companies.	M
11. Enhance pest and disease control facilities;	MAC	M
12. Build on local and indigenous knowledge of women and men to promote food preservation and storage of agricultural produce;	MAC, LGs, CSOs	H
13. Promote the establishment of a Lagos State strategic grain reserve to store surplus harvests;	MAC, MEPB, MCI	H
14. Establish a government policy to buy back surplus agricultural production to encourage farmers to continue to produce;	MAC, MEPB, MF	H
15. Improve road network for access to markets;	MEPB, MAC	M
16. Promote diversification of livelihoods among the farming population;	MWI, MAC, MRD	L
17. Ensure gender equality in access to all climate change adaptation initiatives;	MAC, MYSSD, MRD	M
18. Raise the awareness of and educate the farming population about the threat posed by climate change, its impacts, the need to adapt to it and how to do so.	MAC, ME, MIS, MEnv, CSOs	M

Adaptation Strategies, Policies, Programmes and Other Measures	Implementing Agencies ¹	Relative Cost
<u>Sector 2: Water Resources</u>		
<i>At the Strategy Level:</i>		
1. Improve water use efficiency;	MWI	L
2. Protect quality of water sources;	MWI, MJ	L
3. Protect water supply facilities.	MWI	H
<i>For Policies, Programs and Other Measures:</i>		
1. Introduce water efficiency and conservation measures;	MWI	L
2. Formulate and implement government policy to regulate the sinking of boreholes;	MWI, MJ	L
3. Develop and enforce legislation to control the storage of petroleum products underground;	MJ	L
4. Design of new drainage network in built-up areas taking into account projected sea level rise;	MWI	L
5. Consider the use of pumping stations to provide drainage during times of flooding;	MWI	M
6. Establish government policy on appropriate pricing of the extraction of groundwater by individuals and corporate bodies;	MWI	H
7. Apply stricter management of industrial effluent and the provision of industrial waste disposal facilities;	MEnv, MCI, (NESREA)	H
8. Enact new legislation and develop management structure to control the disposal of oily wastes.	MJ, MEnv	L
<u>Sector 3: Wetlands and Freshwater Ecosystems</u>		
<i>At the Strategy Level:</i>		
1. Improve the quality of information about the State's wetlands and freshwater ecosystems;	MEnv, MPPUD	M
2. Support the implementation of the National Biodiversity Strategy and Action Plan with particular reference to recommendations that relate to climate change adaptation as they affect wetlands and freshwater ecosystems;	MEnv	H
3. Support the recommended adaptation policies and measures in other sectors that will be beneficial to biodiversity conservation, such as those in water resources, coastal zone and marine ecosystems, settlements and health, land use, forestry and biodiversity.	MEnv	H

Adaptation Strategies, Policies, Programmes and Other Measures	Implementing Agencies ¹	Relative Cost
<p><i>For Policies, Programs and Other Measures:</i></p> <ol style="list-style-type: none"> Promote the sustainable management of upland wetlands and floodplains for the maintenance of water flow and quality and the prevention of flood disasters; Promote community awareness and participation in the management of wetlands and freshwater ecosystems; Take advantage of existing international assistance in wetlands conservation and management; Promote legislation geared at protecting wetlands. 	<p>MPPUD, MEnv</p> <p>MEnv, LGs, CSOs, Communities</p> <p>MEnv, MTIR</p> <p>MEnv, MJ</p>	<p>M</p> <p>L</p> <p>L</p> <p>L</p>
<p><u>Sector 4: Coastal Zone and Marine Ecosystems</u></p> <p><i>At the Strategy Level:</i></p> <ol style="list-style-type: none"> Adopt the principle of integrated coastal zone management in the State; Maintain and restore mangroves and other coastal wetlands as a relatively cheap form of defense against coastal flooding and coastal erosion, and to promote livelihoods; Create buffer zones in physical planning to accommodate anticipated sea level rise; Develop a long-term plan for the relocation of vulnerable settlements and infrastructure; and Reduce the expansion of socio-economic development in areas at high risk from sea level rise. 	<p>(NIOMR) MPPUD, MWF, MEnv, MWI, MLGCA, MTIR</p> <p>MPPUD, MEnv</p> <p>MPPUD, MWI, MLGCA, MRD, MWF</p> <p>MPPUD</p> <p>MPPUD, MWF, MEnv</p>	<p>L</p> <p>L</p> <p>L</p> <p>L</p> <p>L</p>
<p><i>For Policies, Programs and Other Measures:</i></p> <ol style="list-style-type: none"> Conduct a statewide sea-level rise vulnerability assessment with a view to preparing an inventory of coastal natural and human-made assets that are at risk (including an economic valuation); Develop a long-term physical plan for the coastal zone using the principle of integrated coastal zone management; Strengthen policies prohibiting building on water courses; Apply strict control over all new land reclamation along the coast, increasing the standard to a minimum of 4m above sea level with a requirement for sea defenses against storm surges; 	<p>(NIOMR) MPPUD, MWF, MEnv, MWI, MLGCA, MTIR</p> <p>MPPUD, MEnv</p> <p>MPPUD</p> <p>MPPUD, MWF, MWI</p> <p>MPPUD, MWF</p>	<p>H</p> <p>L</p> <p>L</p> <p>L</p>

Adaptation Strategies, Policies, Programmes and Other Measures	Implementing Agencies ¹	Relative Cost
<ol style="list-style-type: none"> 5. Develop computer-based, flood early warning system, for Lagos State; 6. Enhance capacity of early warning systems and the use of GIS and satellite imagery for coastal zone management; 7. Grow salt tolerant crops; 8. Invest in saltwater fish farming only in areas where mangroves will not be impacted; 9. Establish new protected areas; 10. Promote wide-scale adoption of fuel efficient stoves in coastal communities to reduce cutting pressure on coastal forest ecosystems; 11. Relocate or modify infrastructure such as dams, treatment plants or reservoirs that are at risk. 	<p>MPPUD</p> <p>MPPUD, MEnv</p> <p>MEnv</p> <p>MEnv, (NIMET), LASEMA, MAC</p> <p>MEnv</p> <p>MAC, MEnv, MWI</p> <p>MPPUD, MEnv</p>	<p>H</p> <p>H</p> <p>VH</p> <p>VH</p> <p>VH</p> <p>VH</p> <p>VH</p>
<p><u>Sector 5: Land use, Forestry and Biodiversity</u></p>		
<p><i>At the Strategy Level:</i></p>		
<ol style="list-style-type: none"> 1. Conduct periodic assessments of the status of land use, vegetation cover and biodiversity in the State; 2. Integrate biological diversity considerations into the State's regional planning, policy and decision making as a way of securing the future well-being of the people and ecosystems of Lagos State; 3. Conduct periodic reviews of the State's regional plan with a view to making necessary adjustments in the interest of conserving biodiversity; 4. Implement and enforce biodiversity conservation programmes. 	<p>MEnv</p> <p>MPPUD, MEnv</p> <p>MPPUD</p> <p>MEnv</p>	<p>L</p> <p>L</p> <p>H</p> <p>H</p>
<p><i>For Policies, Programs and Other Measures:</i></p>		
<ol style="list-style-type: none"> 1. Establish land use zoning and control to prevent development from encroaching on sensitive ecosystems, such as wetlands, forests and flood plains; 2. Promote healthy and diverse agroforestry systems to protect and enrich soils and to provide a wide range of economic benefits; 3. Promote afforestation with fast-growing, preferably native species; 4. Introduce a long-term plan for mandatory sourcing of all timber or timber products used in the State from sustainable sources; 5. Preserve existing and designate new forest reserves; 	<p>MPPUD</p> <p>MAC</p> <p>MEnv</p> <p>MEnv</p> <p>MEnv, MPPUD</p>	<p>L</p> <p>L</p> <p>L</p> <p>L</p> <p>M</p>

Adaptation Strategies, Policies, Programmes and Other Measures	Implementing Agencies ¹	Relative Cost
<ul style="list-style-type: none"> 6. Integrate green or nature-based infrastructure and technology into hard engineering solutions to environmental problems wherever possible; 7. Promote widespread adoption of more energy-efficient fuel wood stoves; 8. Introduce a long-term plan to replace fuel wood use with the use of renewable energy. 	<ul style="list-style-type: none"> MWI, MH MEEnv, MCI MEEnv, MCI 	<ul style="list-style-type: none"> M M M
<p><u>Sector 6: Energy</u></p> <p><i>At the Strategy Level:</i></p> <ul style="list-style-type: none"> 1. Draw up and implement a Lagos State energy policy, integrating climate change considerations; 2. Assess the vulnerability of the energy sector to climate change impacts and put in place risk reduction measures; 3. Promote energy efficiency in the State; 4. Promote the use of renewable energy in the State to reduce dependence on electricity from the national grid; 5. Decentralize electricity generation and transmission to reduce the vulnerability of energy sector to climate change impacts. <p><i>For Policies, Programs and Other Measures:</i></p> <ul style="list-style-type: none"> 1. Work with relevant agencies of the Federal Government to set standards for the construction and maintenance of energy infrastructure, bearing in mind the expected impacts of climate change; 2. Take climate change impacts into account in the location of new energy infrastructure; 3. Design and implement a contingency plan to meet the challenges posed by climate change for the energy sector, including the possible relocation of critical infrastructure; 4. Promote the reduction of electricity consumption in households through the use of efficient light bulbs and electrical appliances; 5. Encourage businesses to invest in energy efficiency; 6. Promote the use of saw dust for cooking, electricity generation, etc.; 	<ul style="list-style-type: none"> MEPB MEPB MEPB MEEnv, MEPB, MCI MEPB MEPB MEPB, MPPUD MEPB MEPB, MCI MCI MCI, MEEnv 	<ul style="list-style-type: none"> H L L M H L L H L L L

Adaptation Strategies, Policies, Programmes and Other Measures	Implementing Agencies ¹	Relative Cost
<p>7. Expand the lead that the Lagos State government has taken in using solar energy for street lighting and traffic lights to public buildings, schools, hospitals, libraries and offices;</p> <p>8. Design and implement a renewable energy master plan for the State with a view to satisfying the energy needs of the populace for water pumping, lighting, cooking and heating, food preservation, grain milling and small /micro enterprises for income generation;</p> <p>9. Encourage the adoption of green architecture.</p>	<p>MEPB</p> <p>MEPB</p> <p>MEPB</p>	<p>M</p> <p>H</p> <p>H</p>
<p><u>Sector 7: Transportation</u></p> <p><i>At the Strategy Level:</i></p> <p>1. Assess the vulnerability of transportation to the expected impacts of climate change;</p> <p>2. Design and implement climate change risk reduction measures for transportation infrastructure.</p>	<p>MT, MWI</p> <p>MT, MWI</p>	<p>L</p> <p>H</p>
<p><i>For Policies, Programs and Other Measures:</i></p> <p>1. Identify transportation infrastructure that is at high risk from climate change impacts;</p> <p>2. Strengthen or relocate existing transportation infrastructure that is at high risk, so that it is better able to withstand climate change impacts;</p> <p>3. Develop a long-term plan for the relocation of transportation infrastructure within the context of the Lagos Megacity project;</p> <p>4. Build increased protective margins into the design, placement and construction of transportation infrastructure;</p> <p>5. Ensure that rural coastal communities have safe and reliable road and water transportation systems.</p>	<p>MT, MWI</p> <p>MT, MWI</p> <p>MT, MPPUD, MWI</p> <p>MT, MPPUD, MWI</p> <p>MPPUD, MT</p>	<p>L</p> <p>H</p> <p>L</p> <p>L</p> <p>H</p>

Adaptation Strategies, Policies, Programmes and Other Measures	Implementing Agencies ¹	Relative Cost
<u>Sector 8: Industry and Commerce</u>		
<i>At the Strategy Level:</i>		
1. Assess the vulnerability of industry and commerce to the expected impacts of climate change;	MCI	L
2. Design and implement climate change risk reduction measures for industrial and commercial infrastructure;	MCI	H
3. Exploit opportunities created by climate change to develop new enterprises, related to energy efficiency, water saving gadgets and weather forecasting.	MCI	H
<i>For Policies, Programs and Other Measures:</i>		
1. Identify, industrial and commercial infrastructure that is at high risk from climate change impacts;	MCI	L
2. Encourage the private sector to strengthen or relocate existing industrial and commercial infrastructure that is at high risk, so that it is better able to withstand climate change impacts;	MCI, NACCIMA	L
3. Encourage the private sector to develop long-term plans for the relocation of industrial and commercial infrastructure within the context of the Lagos Megacity project;	MCI, NACCIMA	L
4. Encourage the private sector to build increased protective margins into the design, placement and construction of industrial and commercial infrastructure;	MCI, NACCIMA	L
5. Monitor the activities of businesses in the sector to ensure that they are in line with the State's objectives for climate change adaptation.	MCI, NACCIMA	L

Adaptation Strategies, Policies, Programmes and Other Measures	Implementing Agencies ¹	Relative Cost
<u>Sector 9: Financial Services</u>		
<i>At the Strategy Level:</i>		
1. Create awareness in the financial sector through the Bankers Committee, the Chartered Institute of Bankers (CIBN), the Nigeria Insurance Association, the Chartered Insurance Institute of Nigeria and others on the implications of climate change for their businesses;	MCI, CBN, CIBN, CIIN	L
2. Educate investors, shareholders in the sector on issues of climate change and the implications on trade, investments, transactions, policies, relationship, business strategy, returns, etc.;	MCI, NACCIMA	L
3. Work with stakeholders to assess the vulnerability of the sector to the impacts of climate change.	MCI, NACCIMA	L
<i>For Policies, Programs and Other Measures:</i>		
1. Collaborate with stakeholders in the sector to facilitate the availability of financial services in terms of insurance, credit and investment in climate change adaptation activities;	MCI, CBN, CIBN, CIIN	L
2. Encourage participants in the sector to invest in climate change adaptation activities both for profit and as part of their corporate social responsibility;	MCI, CIIN	L
3. Work with the insurance sub-sector to promote the culture of insurance among businesses and the general public as a way of encouraging risk sharing as a way of dealing with the impacts of climate change.	LASEMA, CIIN	L

Adaptation Strategies, Policies, Programmes and Other Measures	Implementing Agencies ¹	Relative Cost
<u>Sector 10: Human Settlement and Health</u>		
<i>At the Strategy Level:</i>		
1. Develop climate change adaptation action plans for urban settlements and other settlements that are most at risk from climate change, such as coastal settlements;	MPPUD, MEnv, MRD, MLGCA, MWF, MH	L
2. Engage communities in the participatory planning of their settlements in order to reduce their vulnerability to climate change;	MPPUD, MLGCA, Communities, CSOs	M
3. Enforce land use zoning regulations that restrict building on high risk areas, such as flood plains and low-lying terrain;	MPPUD, MEnv	L
4. Promote rural development in order to reduce the rate of rural to urban migration.	MRD, MAC, MEPB, MLGAC, CSOs	VH
<i>For Policies, Programs and Other Measures:</i>		
1. Commission research into the possible health impacts of climate change;	MH	L
2. Promote environmental sanitation across the State;	MEnv	L
3. Improve the basic health care system to be able to cope with health impacts of climate change;	MEPB, MH	M
4. Produce land use maps of the main urban settlements in the State and periodically review them;	MPPUD	M
5. Prepare a master plan for urban settlements in the light of the challenge of climate change and implement them;	MPPUD	L
6. Integrate the various District and Model City Plans and ensure their implementation;	MPPUD	L
7. Complete and ensure regular review of all physical development plans in the State;	MPPUD	L
8. Encourage the use of soft landscaping (i.e. grass in external areas of buildings) rather than concrete paving;	MEnv, MPPUD	M
9. Intensify the process of providing greened parks and open spaces in urban areas;	MEnv	L
10. Develop a long-term plan for relocating those settlements most vulnerable to sea level rise.	MWF, MPPUD	L

Adaptation Strategies, Policies, Programmes and Other Measures	Implementing Agencies ¹	Relative Cost
<u>Sector 11: Disaster Management</u>		
<i>At the Strategy Level:</i>		
1. Assess the disaster vulnerability of the State;	LASEMA, All Ministries	M
2. Increase funding for disaster management in the State;	MEPB	H
3. Build a disaster avoidance policy into the State's land use planning and development control system;	MPPUD	L
4. Put in place a comprehensive and participatory disaster response plan;	LASEMA, All Ministries	L
5. Ensure that disaster planning and management in the State take into account the needs of women, children and other vulnerable groups.	LASEMA, All Ministries	L
<i>For Policies, Programs and Other Measures:</i>		
1. Put in place a comprehensive disaster response plan;	LASEMA,	M
2. Build the capacity of LASEMA as a disaster prevention and management agency;	MEPB	H
3. Introduce a LASEMA charge as part of the fees payable by applicants for development permits in the State;	MEPB	L
4. Create a Disaster Relief Fund and encourage corporate bodies and NGOs to donate to the fund;	MEPB, LASEMA	M
5. Periodically carry out a disaster vulnerability assessment of the State that assesses differences in women's and men's vulnerability;	LASEMA, All Ministries	L
6. Refine existing emergency preparedness plans and conduct exercises to augment preparedness for events likely to increase with climate change (e.g. heat waves, floods, coastal erosion);	LASEMA, All Ministries	L
7. Develop long-term plans for anticipated impacts, such as sea level rise, saline intrusion into drinking water, etc.;	All Ministries, LASEMA	L
8. Relevant State agencies to consider project alternatives that avoid significant new development in areas that cannot be adequately protected from flooding or erosion due to climate change;	All Ministries	L
9. Protect vulnerable shoreline areas containing existing or planned development and regionally significant economic, cultural, or social value; in-fill development in these areas should be closely scrutinized in terms of costs and benefits;	MWF, MWI	VH

Adaptation Strategies, Policies, Programmes and Other Measures	Implementing Agencies ¹	Relative Cost
<p>10. Employ and encourage innovative engineering and design solutions so that structures requiring approval in hazard-prone zone are resilient to flooding, erosion;</p> <p>11. Encourage research into all aspects of disaster occurrence and impacts in the State;</p> <p>12. Establish more disaster relief centers/camps in various parts of the State, particularly in risk-prone areas.</p>	<p>MWI</p> <p>LASEMA, MEPB, All other Ministries</p> <p>MEPB, LASEMA</p>	<p>VH</p> <p>M</p> <p>VH</p>
<p><u>Gender Considerations</u></p> <p>1. Base climate change adaptation initiatives in the State on gender-disaggregated analysis of needs;</p> <p>2. Provide capacity building for climate change adaptation policy makers, decision makers, planners, project implementation staff and project managers in developing attitudes, tools and methodologies for gender- sensitive policies;</p> <p>3. Ensure balance in the representation of men and women in decision-making bodies on climate change adaptation by encouraging more women to come into influential positions through awareness creation and capacity building;</p> <p>4. Undertake gender analysis to assess the implications of any course of intervention in the area of climate change adaptation for men, women and other vulnerable groups;</p> <p>5. Carry out a women’s needs assessment prior to the introduction of climate change adaptation technologies in such strategic areas that affect women as:</p> <ul style="list-style-type: none"> • Water use • Lighting • Cooking and heating • Food preservation • Grain milling • Small/micro enterprises for income generation • Agriculture. 	<p>All Ministries</p> <p>All Ministries</p> <p>All Ministries</p> <p>All Ministries</p> <p>All Ministries</p>	<p>L</p> <p>M</p> <p>L</p> <p>L</p> <p>L</p>

10. KEY RECOMMENDED ADAPTATION ACTIONS

The following is a selection of the key recommended adaptation actions taken from the longer set of recommendations in the preceding section:

Vulnerability Assessment

1. Conduct a statewide vulnerability assessment of sea level rise with a view to preparing an inventory of coastal natural and human-made assets that are at risk (including an economic valuation).
2. Carry out a disaster vulnerability assessment of the state.

Planning and Preparedness

1. Develop a long-term physical plan for the coastal zone, using the principle of integrated coastal zone management.
2. Develop a long-term plan for the relocation of settlements and transportation and energy infrastructure within the context of the Lagos Megacity project.
3. Develop a long-term plan for the relocation of farming communities that are most at risk from flooding and sea level rise.
4. Integrate a disaster avoidance policy into the state's land use planning and development control.
5. Place strict control over all new land reclamation along the coast, increasing the standard to 4 metres above sea level with a requirement for sea defenses against storm surges.
6. Develop a computer-based, flood early warning system for Lagos State.
7. Put in place a comprehensive disaster response plan.

Agriculture

1. Strengthen gender sensitive agricultural research into the expected impacts of climate change and needed adaptation in the areas of crop and livestock agriculture and food security.
2. Put in place a community-based climate change adaptation support programme targeted at crop and livestock agriculture and food security in the state.
3. Promote diversification of livelihoods among the farming population.
4. Raise the awareness of and educate the farming population about the threat posed by climate change, its impacts, the need to adapt to it and how to do so.

Wetlands and Freshwater Ecosystems

1. Support the implementation of the National Biodiversity Strategy and Action Plan with particular reference to recommendations that relate to climate change adaptation as they affect wetlands and freshwater ecosystems.

Gender Analysis and Equality

1. Undertake gender analysis to assess the implications of any course of intervention in the area of climate change adaptation for men, women and other vulnerable groups.
2. Ensure gender equality in access to all climate change adaptation initiatives.

11. STRATEGY REVIEW

LAS-CCAS must be viewed as a living document. This means that it will be reviewed and improved upon periodically as knowledge of climate change and its impact on Lagos State increases and as strategies to respond to it evolve. Its implementation shall be subjected to evaluation three years after the Lagos State Executive Council approves it. This evaluation, which shall be carried out by the Inter-Ministerial Committee, shall form the basis of a comprehensive review of the strategy. The evaluation shall be concerned primarily with whether or not the recommended adaptation policies, programmes and other measures have been put in place or are being implemented. It shall be designed with a view to answering the following questions:

- Have the recommended climate change risk and vulnerability assessments been carried out?
- Have the recommended policies, laws and regulations been put in place and are they being implemented?
- Have the recommended physical planning measures been put in place and are the plans being implemented?
- Are the recommended awareness raising, public education and capacity development measures being carried out?
- Are the recommended information management measures being implemented?
- Are the specific practices in the areas of risk reduction, livelihoods development and enhancement, and resource use and conservation being implemented?

Any implementation lags and deficits shall be noted and explained for purposes of review of LAS-CCAS and further entrenchment of climate change adaptation in the state.

Table 5, on the following page, provides an initial list of evaluation indicators focused on the overall sectoral strategies presented in Table 3. These indicators (further developed and updated as required) shall be used during the review of the LAS-CCAS.

Table 5 Initial LAS-CCAS Evaluation Indicators (Strategic Level)

<p>Sector 1: Agriculture and Food Security Indicators:</p> <ul style="list-style-type: none"> • Commissioned research reports on climate change, its impacts on agriculture, and needed adaptation. • Existence of a community-based adaptation support programme for agriculture and food security. • A revamped agricultural extension services unit working with farming communities to facilitate adaptation to climate change. • Regular dissemination of short-term weather forecasts to farmers in the State.
<p>Sector 2: Water Resources Indicators:</p> <ul style="list-style-type: none"> • Existence of a new drainage network plan for areas at risk from sea level rise. • A feasibility study report on the use of pumping stations during times of flooding. • Existence of enforceable water efficiency and water conservation measures. • Existence of a government policy on appropriate pricing of the extraction of groundwater in the State.
<p>Sector 3: Wetlands and Freshwater Ecosystems Indicators:</p> <ul style="list-style-type: none"> • Commissioned study of the status of the State’s wetlands and freshwater ecosystems. • Active participation of the State in the implementation of the National Biodiversity Strategy and Action Plan, especially recommendations about climate change adaptation concerning wetlands and freshwater ecosystems. • Active participation of the Ministry of Environment in implementing adaptation measures related to wetlands and freshwater ecosystems.
<p>Sector 4: Coastal Zone and Marine Ecosystems Indicators:</p> <ul style="list-style-type: none"> • A sea-level rise vulnerability assessment report for Lagos State and an inventory of coastal natural and man-made assets that are at risk (including an economic valuation). • Existence of a long-term physical plan for the coastal zone using the principle of integrated coastal zone management. • Existence of a plan for restoration and maintenance of mangroves and coastal wetlands; the commencement of implementation of the plan. • Existence of buffer zones in physical plans to accommodate anticipated sea level rise.
<p>Sector 5: Land use, Forestry and Biodiversity Indicators:</p> <ul style="list-style-type: none"> • Existence of an up-to-date land use, vegetation and biodiversity assessment report. • Existence of land use zoning regulations across the State and enforcement of land use zoning across the State. • Adoption of healthy and diverse agro-forestry systems by farmers. • Substantial increase in the use of energy-efficient fuel wood stoves; the existence of a long-term plan to replace fuel wood use as part of a renewable energy policy.

Sector 6: Energy Indicators:

- Existence of a State climate change-proofed energy policy; and commencement of implementation of the policy.
- Existence of an energy sector climate change vulnerability research report and climate change risk reduction measures; and commencement of implementation of the measures.
- Implementation of the measures encouraging robust energy efficiency measures.

Sector 7: Transportation Indicators:

- Climate change vulnerability assessment report on the transportation sector.
- A design of climate change risk reduction measures for transportation infrastructure.
- And commencement of implementation of these measures.

Sector 8: Industry and Commerce Indicators:

- Climate change vulnerability assessment report for industry and commerce in the State.
- Climate change risk reduction measures for industrial and commercial infrastructure designed; commencement of implementation of these measures.

Sector 9: Financial Services Indicators:

- Increased knowledge among investors/shareholders of the implications of climate change for business.
- Assessment reports on the vulnerability of the business sector to the impacts of climate change.

Sector 10: Human Settlement and Health Indicators:

- Existence of adaptation action plans for urban settlements and other settlements that are most at risk from climate change.
- Research report available on the possible health impacts of climate change.

Sector 11: Disaster Management Indicators:

- Existence of a State disaster vulnerability assessment report.
- Increase in the budget of LASEMA.
- All land use plans have disaster avoidance considerations built into them; disaster avoidance is a major consideration in development control.

Gender Considerations Indicators:

- All climate change adaptation initiatives in the State are based on gender-disaggregated needs, assessments and analysis.

REFERENCES

Beachland Resources Limited. (2011). *Lagos State Adaptation Strategy – Draft Final Report*. Lagos State Ministry of Environment, Ikeja, Lagos.

CARE (2009). *Climate Vulnerability and Capacity Analysis Handbook*; accessed at http://www.careclimatechange.org/files/adaptation/CARE_CVCA_Handbook.pdf

Concern Universal, FARM-Africa, Find Your Feet, Self Help Africa and Utviklingsfondet/The Development Fund. (2009). *Climate Frontline: African Communities Adapting to Survive*.

FDALR (1995). *Reconnaissance Soil Survey of Nigeria*. Federal Department of Agriculture and Land Resources, Abuja

Heda Resource Centre. (2011). *Climate Change Adaptation, Mitigation and Governance Strategies for Lagos State (Recommendations for Policy Framework)*.

IPCC (2001). *Synthesis Report*. Contribution of Working Groups I, II & III to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK; accessed at <http://www.ipcc.ch/pdf/climate-changes-2001/synthesis-syr/english/front.pdf>

IPCC (2007). *Climate Change 2007. Climate Change – Impacts, Adaptation and Vulnerability: Contributions of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. UK: Cambridge University Press, Cambridge, UK; accessed at <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2-spm-pdf>

Iwugo, K.O., D'Arcy B. & Andoh R (2003). *Aspects of Land-based Pollution of an African Coastal Megacity of Lagos*. Poster Paper 14 -122. Diffuse Pollution Conference, Dublin, 2003

Justice Research Institute. (2011). *Technical Report Towards the Development of a Climate Change Adaptation Strategy and Action Plan for Lagos State*. Lagos State Ministry of Environment, Ikeja, Lagos

O'Donnell, J. (2008). Considerations for Developing Monitoring and Evaluation Approaches for Climate Change Adaptation. (<http://www.globalcollab.org/partners/qci>; accessed on October 3, 2011).

Speranza, Chinwe Ifejika. (2010). *Resilient Adaptation to Climate Change in African Agriculture*. Studies/Deutsches Institut fur Entwicklungspolitik (DIE); 54, ISSN 1860-0468

Triple “E” Systems Inc. in collaboration with Pennsylvania State University and Triple “E” Systems Associates Ltd. (2010). *Climate Change Scenarios, Sea Level Rise Impacts and Adaptation Strategy for Lagos State*.

UNFCCC (2006). United Nations Framework Convention on Climate Change Regional Workshop on Adaptation, 21- 23, Accra, Ghana, 2006.