EAST AFRICAN COMMUNITY CLIMATE CHANGE MASTER PLAN

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EXECUTIVE SUMMARY

The East African Community Climate Change Master Plan (EACCCMP) is an outcome of a consultative and participatory process for a unified regional approach to combat climate change. It was developed by the East African Community (EAC) Partner States (Republic of Burundi, Republic of Kenya, Republic of Rwanda, United Republic of Tanzania, and Republic of Uganda) with facilitation of the EAC Secretariat. The purpose of the Master Plan is to provide a long-term vision and a basis for Partner States to operationalise a comprehensive framework for adapting to and mitigating climate change in line with the EAC Protocol on Environment and Natural Resources Management and with international climate change agreements. The Master Plan's Vision is to ensure that: "*The People, the Economies and the Ecosystems of the EAC Partner States are climate resilient and adapt accordingly to Climate Change.*"
The Vision is aligned and consistent with EAC's mandate and development priorities as articulated in a number of relevant environmental and climate change documents such as the EAC Climate Change Policy, EAC Climate Change Strategy, the EAC Protocol on Environment and Natural Resources Management and the EAC Food Security Action Plan.
The overall objective of the Master-Plan is to strengthen regional cooperation to address climate change issues that concern regionally shared resources.

The main regional issues which have been identified and prioritised by the EAC Partner States, as being vulnerable to climate change are:

1. Agriculture (crops, livestock and fisheries) and Food Security;
2. Water Security;
3. Energy Security;
4. Ecosystems Services and Biodiversity;
5. Tourism;
6. Infrastructure (buildings, roads, railways, waterways and airways);
7. Human Health, Sanitation and Settlements;
8. Trade and Industry;
9. Education, Science and Technology;

A summary of the situational analyses of the climate, trends and projection of each of the five Partner States is given as a basis for understanding the vulnerabilities and sensitivities to climate change**.**

To ensure that the above sectors are climate proofed the Master Plan has established eight key Pillars:

Adaptation Interventions: EAC Partner States have a young and growing population distributed in all eco-regions including areas vulnerable to extreme climatic events such as floods and droughts. Adapting to or coping with climate change is of utmost importance in order to ensure socioeconomic and environmental systems function and development. Adaptation is crucial because climate change will occur regardless of future greenhouse gas emissions reduction measures.

Mitigation Interventions: The Master Plan identifies the three most polluting sectors in the region -- land use (including forestry and agriculture) energy and transport and recommends mitigation interventions. By undertaking mitigation interventions, EAC Partner States will be contributing towards the achievement of Objective II of the UNFCCC and also benefit through development of renewable energy resources such as geothermal, wind, solar

and biomass. Such development can benefit from the carbon markets under the Kyoto Protocol's CDM.

Technology Development and Transfer: Research is crucial for the understanding of climate change causes, manifestation and impact as well as developing appropriate responses in terms of policy, technology and innovation. The Master Plan provides an overview of current global climate change monitoring, detection, and attribution. There is poor and inadequate meteorological infrastructure in the region to undertake much needed coordinated and enhanced meteorological research and channel to where it is most needed. The Master Plan outlines recommendation measures to address this state. The Master Plan also recommends measures for international and regional cooperation to facilitate technology development and transfer. Technology transfer is one of the 'building blocks' of the Bali Action Plan (BAP), which calls for enhanced action on technology development and transfer to support action on mitigation and adaptation.

Capacity Building: Implementing adaptation and mitigation interventions require new knowledge, new skills, new expertise, new capacities and close cooperation of different sectors to effectively counter the challenges posed by climate change and explore opportunities associated with it. Capacity gaps identified regionally range from scenario modelling to the ability to assess and critically analyse climate change information needed to feed into adaptation and mitigation policy development and implementation. There is therefore need for climate change capacity building and training targeting government staff, pivotal in driving government policies, and other stakeholders such as researchers, who are the primary custodians of current scientific climate change knowledge and the private sector. The need to equip the young generation with climate change knowledge and skills necessary for adaptation and mitigation is crucial. Introduction and more integration of climate change into university curriculum is an area that the Master Plan emphasizes. The Master Plan focuses on capacity of the institutions in the region, primarily academic, research, governmental and non-governmental, to competently handle various aspects of climate change.

Education, Training and Public Awareness: The level of climate change awareness is generally low because climate change is a relatively new and developing concept in the general public domain. Similarly, there is a critical dearth of climate change content in the education curricula of most developing countries at nearly all levels of education, ranging from primary through to tertiary. This is true for the EAC Partner States where climate change education and training is limited to a few courses at some colleges and universities. These courses serve as an introduction to climate change in response to the interest of teachers, lecturers and professors teaching these courses, and make no deliberate attempt - at the higher level of colleges or universities' administration - to formally incorporate climate change into their curricula.

Gender, Youth and Marginalised Groups: Gender is important determinant of adaptive capacity. In most cases, women, the youth and children make up a large number of the poor in communities that are highly dependent on local natural resources for their livelihood and are disproportionately vulnerable to and affected by climate change. Women in rural areas have the major responsibility for household water supply, energy for cooking and heating, and food security. As a result, they are negatively affected by drought, uncertain rainfall and deforestation. Because of their roles, unequal access to resources and limited mobility, women in many contexts are disproportionately affected by natural disasters, such as floods, fires, and mudslides.

In addition, persons residing in marginalised areas like in drought and flood prone regions as well as the handicapped, elderly and other marginalised persons are also at greater risk of climate change and climate variability. The Master Plan has acknowledged this disproportionate

vulnerability of differentiated groups to climate change and recommended differentiated strategies for responding to the environmental and humanitarian crises caused by climate change.

Climate Risk Management and Disaster Risk Reduction: Climate risk management (CRM) and Disaster risk reduction (DRR) is a conceptual framework consisting of ways and means of minimising disaster risks by reducing the degree of vulnerability and increasing resilience capacity of the communities. DRR offers options for prevention, mitigation and preparedness to the adverse impacts of natural hazards with a sustainable development approach. The Master Plan aims at addressing community resilience against vagaries of weather and climate through application of stringent climate risk management principles. Some of the approaches involve strengthening regional Meteorological and Hydrological Services (NMHS); improve climate early warning systems to promote efficient management and utilisation of natural resources including protection of vulnerable ecosystems. DRR is therefore a good tool for climate change adaptation which should be integrated in the Climate Change Master Plan in line with the already developed EAC Climate Change Policy and Strategy.

Climate Finance: Achieving the Strategy's vision of *a Resilient People, Economy*, and *Ecosystem* requires substantial and additional financial resources to implement the proposed actions. Within the EAC, Climate Change activities are currently being supported through Partner States contributions, EAC Partnership Fund and other development partners. Recognising that existing funding mechanisms from the UNFCCC and other sources have inherent multiple challenges, the Master Plan recommends means through which such financing may be obtained.

The Master Plan's Implementation and Resource Mobilisation Plan has identified key activities that should be prioritized for implementation in the short, medium and long-term.

For EAC Secretariat and Partner States to implement urgent climate change activities proposed in the Master Plan, additional financial resources will be required. The total budget for EAC Secretariat in the short-term is estimated at **US$ 34,220,137.65.** This budget will cover climate change related running costs such as facilitation; meetings; pre-feasibility and scoping studies; demonstrations and pilots of best case projects; provide seed money for start-up replicable trans-boundary projects, etc. To initiate and accelerate the implementation of crucial priority trans-boundary and regional climate change measures including implementation of project profiles/proposals identified, the Secretariat shall need an approximate budget of **US$ 2,141,860,561.15** in the medium term. This amount is additional to the Partner States budget allocation for climate proofing and related issues.

The Master Plan recommends the immediate establishment of a **Climate Change Coordination Unit** to coordinate and facilitate implementation of the Master Plan and the Strategy.

The EAC Secretariat shall facilitate the design and development of a monitoring and evaluation plan to undertake a mid-term independent evaluation after two years to ascertain progress on implementation of the Master Plan. An evaluation after five year period is also recommended in order to review and develop a new five-year Strategic Plan.

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ACRONYMS

ARU	Ardhi University
AAS	African Academy of Sciences
ACCESA	Adaptation to Climate Change in Sustainable Development Policy Planning and Implementation in Eastern and Southern Africa
ACTS	African Centre for Technological Studies
AfDB	African Development Bank
AMSS	Automatic message switching system
AR4	Fourth Assessment Report
ASALs	Arid and Semi-Arid Lands
AWG-KP	Ad Hoc Working Group on Kyoto Protocol
BAP	Bali Action Plan
BCM	Billion Cubic Meters
BRT	Bus Rapid Transit
CA	Conservation Agriculture
CBD	Convention on Biological Diversity
CBOs	Community Based Organisations
CC	Climate Change
CCIAM	Climate Change Impacts, Adaptation and Mitigation Programme
CCIO	Climate Change and International Environmental Obligation
CDM	Clean Development Mechanism
CFL	Compact Fluorescent Lamp
CH_4	Methane
CLICOM	Climate Computing
CLIMSOFT	Climatological software
CO_2	Carbon Dioxide
COP	Conference of the Parties
CSR	Corporate Social Responsibility
DCP	Data collection package
DNA	Designated National Authority
DRR	Disaster Risk Reduction
EA	East Africa
EAC	East African Community
EACCCMP	East African Community Climate Change Master Plan
EC	European Community
ECVs	Essential Climate Variables
EDPRS	Economic Development and Poverty Reduction Strategy
EMA	Environmental Management Act
ENSO	El Niño/Southern Oscillation
EWS	Early-Warning System
FAPAR	Fraction of Absorbed Photosynthetically Active Radiation
FDI	Foreign Direct Investment
FGD	Focused Group Discussions

GCM	General Circulation Model
GCOS	Global Climate Observing Systems
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GHGs	Greenhouse Gases
GISS	Goddard Institute for Space Studies
GoK	Government of Kenya
GoR	Government of Rwanda
GoT	Government of Tanzania
GoU	Government of Uganda
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
GTS	global telecommunication system
GIZ	German Agency for Development Co-operation
HEP	Hydroelectric Power
ICPAC	IGAD Climate Prediction and Applications Centre
ICSU	International Council for Science
ICT	Information and Communication Technology
IGAD	Intergovernmental Authority on Development
IGEBU	Institut Géographique du Burundi (Burundi Geographic Institute)
IISD	International Institute for Sustainable Development
IMDWR	Integrated Management Document of Water Resources
IPCC	Intergovernmental Panel on Climate Change
IRA	Institute of Resource Assessment
ISP	Internet Service Provider
IWRM	Integrated Water Resources Management
JKIA	Jomo Kenyatta International Airport
Km	Kilometers
KMD	Kenya Meteorological Department
KNBS	Kenya National Bureau of Standards
KRB	Kenya Roads Board
LAI	Leaf Area Index
LDCs	Least Developed countries
LPG	Liquefied Petroleum Gas
MDGs	Millennium Development Goals
MEMR	Ministry of Environment and Mineral Resources
METAR	Aviation Routine Weather Report
MINAGRI	Ministry of Agriculture and Animal Resources
MINELA	Ministry of Lands and Environment
N_2O	Nitrous Oxide
NAMAs	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Programme of Action
NAPAs	National Adaptation Plans of Action
NASA	National Aeronautics and Space Administration

NCCRS	National Climate Change Response Strategy
NCCSC	National Climate Change Steering Committee
NCF	Nordic Climate Facility
NCs	National Communications (to the UNFCCC)
NCSA	National Capacity Needs Self-Assessment
NDF	Nordic Development Fund
NEMC	National Environment Management Council
NEP	National Environmental Policy
NGOs	Non-Governmental Organisations
NISR	National Institute of Statistics of Rwanda
NMC	National meteorological centre
NMHS	National meteorological and hydrological services
NMT	Non-Motorised Modes of Transport
NOAA	National Oceanic and Atmospheric Administration
NSIDC	National Snow and Ice Data Centre
NWP	Numerical Weather Prediction
PANA	Plan for Adaptation to the adverse effects due to Climate Change
REDD (+)	Reducing Emissions from Deforestation and Forest Degradation
REMA	Rwanda Environment Management Authority
SADIS	Internet and Satellite Distribution System
SBI	Subsidiary Body for the Implementation
SLR	Sea Level Rise
START	System for Analysis, Research and Training
SUA	Sokoine University of Agriculture
SWOT	Strengths, Weaknesses, Opportunities and Threats
SYNOP	Surface Synoptic Observations
TAF	Terminal Area Forecast
TANROADS	Tanzania National Roads Agency
TAZAMA	Tanzania Zambia Mafuta (pipeline)
TAZARA	Tanzania Zambia Railway Authority
TMA	Tanzania Meteorological Agency
TORs	Terms of Reference
TWG	Technical Working Group
UBOS	Uganda Bureau of Statistics
UDSM	University of Dar es Salaam
UMB	Norwegian University of Life Sciences
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNRA	Uganda National Roads Authority
VCM	Voluntary Carbon Market
VPO	Vice President's Office
WBCSD	World Business Council for Sustainable Development

DEFINITION OF TERMS

A1B Scenario: One of the greenhouse gas (GHG) emission scenarios of the IPCC under the family of SRES scenarios describing a future with rapid economic growth and population peaks in mid century with a balance of fossil fuel intensive and non-fossil energy sources.

A1T and A1F1 Scenarios: The A1 scenarios of the SRES are of a more integrated world. The A1 family of scenarios is characterised by rapid economic growth; a global population that reaches 9 billion in 2050 and then gradually declines; the quick spread of new and efficient technologies; a convergent world - income and way of life converge between regions; and extensive social and cultural interactions worldwide. With the AIT scenario, emphasis is on non-fossil sources of energy, while for the A1F1 scenario, emphasis is on fossil fuels (i.e. fossil intensive).

A2 Scenarios: One of the SRES family of scenarios which describe a more divided world. They are characterised by a world of independently operating, self-reliant nations; continuously increasing population; regionally oriented economic development; and slower and more fragmented technological changes and improvements to per capita income.

Adaptive Capacity: The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

B1 Scenarios: One of the SRES scenarios. B1 describes a world that is more integrated, and more ecologically friendly. The B1 scenarios are characterised by rapid economic growth as in A1, but with rapid changes towards a service and information economy; population rising to 9 billion in 2050 and then declining as in A1; reductions in material intensity and the introduction of clean and resource efficient technologies; an emphasis on global solutions to economic, social and environmental stability.

B2 Scenarios: One set of the SRES scenarios that describe a world that is more divided, but more ecologically friendly. They are characterized by continuously increasing population, but at a slower rate than in A2; emphasis on local rather than global solutions to economic, social and environmental stability; intermediate levels of economic development; and less rapid and more fragmented technological change than in A1 and B1.

Capacity Building: Capacity building and capacity development for climate change refers to the development or strengthening of personnel skills, expertise, and relevant institutions and organisations to reduce GHG emissions and/or to reduce vulnerability and adapt to climate-related impacts.

Carbon Markets/Trading: This is an international market regime in which carbon emission reductions allowances or credits are bought and sold.

The market is divided into two categories, namely regulatory (i.e., under the Kyoto Protocol), and voluntary (which emerged to fulfil the demand from organisations and businesses that wish to offset their carbon emissions voluntarily).

Carbon Sink: Any process, activity or mechanism that removes greenhouse gases, aerosols or precursors of GHGs from the atmosphere

Clean Development Mechanism (CDM): As defined in Article 12 of the Kyoto Protocol, allows countries with emission-reduction or emission-limitation commitments under the Kyoto Protocol (Annex B Party) to purchase certified emission reduction (CER) credits or units from projects

implemented in developing (non-Annex B) countries, each unit equivalent to one metric ton of CO2, which the former can use to meet a part of their emission reduction targets under the Protocol. It is one of the three flexible trading mechanisms under the Protocol (the others being Emissions Trading-ET, and Joint Implementation-JI), and was designed specifically to achieve the twin objectives of reducing emissions and fostering sustainable development. The CDM is primarily a market-based and private sector driven mechanism.

Climate Change Adaptation: Is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Such adjustment may be preventive or reactive, private or public, autonomous or planned.

Climate Change Mitigation: Human interventions to reduce the sources or enhance sinks of greenhouse gases.

Climate Change: Change of climate attributed directly or indirectly to human activity that alters the composition of global atmosphere which is in addition to natural climate variability observed over comparable period.

Climate Impact Assessment: The practice of identifying and evaluating the detrimental and beneficial consequences of climate change on natural and human systems.

Climate Variability: The seasonal shifts in mean climatic conditions such as temperature and precipitation.

Climate: The situation of a climate system, including the statistical description, taking into account averages and variations in temperature, rainfall, winds and other relevant meteorological factors in a given period.

Conference of the Parties (COP) : Is a meeting of countries, which are party to the United Nations Framework Convention on Climate Change (UNFCCC), and the supreme decision making body of the Convention.

Coping Capacity: The means by which people or organisations use available resources and abilities to deal with adverse consequences of disaster. The strengthening of coping capacities usually builds resilience to withstand the effects of natural and human-induced hazards.

Disaster Mitigation: Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards.

Disaster Risk Management: The systematic process of using administrative decisions, organizations, operational skills and capacities to implement policies, strategies and coping capacities of communities to lessen the impacts of natural hazards.

Disaster Risk Reduction: The conceptual framework of actions considered and taken with the possibilities of minimising social and economic vulnerabilities to hazards and disaster risks in a society, to avoid (prevention), or to limit the adverse impacts of hazards (mitigation), within the broad context of sustainable development.

Early Warning System: A functional system for the generation and provision of timely and effective information, through identified institutions, that allows individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response.

El Niño Southern Oscillation (ENSO): A complex interaction of the tropical Pacific Ocean and the global atmosphere that results in irregular episodes of changes in sea surface temperatures accompanied by either above or below average rainfall in the tropics and Pacific Rim countries resulting to La Nina and El Niño conditions associated with droughts and flooding respectively.

Emissions: This term is used interchangeably with GHGs in this document.

Global Warming: The intensifying greenhouse effect resulting from anthropogenic actions, where the consequence is an increase in the concentration of GHGs, aerosols or their predecessors in the atmosphere, which absorb part of the infrared radiation emitted by the Earth's surface, thus increasing the average temperature on the planet and causing adverse climatic phenomena.

Greenhouse Gases: Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation.

Intergovernmental Panel on Climate Change (IPCC): A body or institution formed jointly by the United Nations Environment Programme (UNEP) and the World Meteorological Organisation (WMO) in 1989 to provide broad and balanced information about climate change.

Kyoto Protocol: The Kyoto Protocol is an international binding agreement linked to the United Nations Framework Convention on Climate Change. It was adopted at the Third Conference of the Parties (COP3) to the UNFCCC in Kyoto, Japan. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialised countries including the European Union for reducing GHG emissions .These amount to an average of five per cent against 1990 levels over the five-year period 2008-2012.

Marginalised: As used in the document refers to handicapped persons, persons living in hardship areas (unproductive lands, conflict prone areas), internally displaced persons and persons living in climate disaster-prone areas.

Mitigation: Mitigation of climate change is defined as measures that seek to avert, reduce or limit GHG emissions as well as to enhance their sinks

National Adaptation Programmes of Action (**NAPA**): As defined in Article 4.9 of the UNFCCC, and further provided for by Decision 5/CP.7 of the COP to the UNFCCC, provide a process for Least Developed Countries (LDCs) to identify priority activities that respond to their urgent and immediate needs to adapt to climate change – those for which further delay would increase vulnerability and/or costs at a later stage.

Nationally Appropriate Mitigation Actions (NAMA): Refers to a set of policies and actions countries undertake to reduce GHG emissions. The term recognises that different countries may take different nationally appropriate action on the basis of equity and in accordance with common but differentiated responsibilities and respective capabilities. It also emphasises financial assistance from developed countries to developing countries to reduce emissions. NAMA was first used in the Bali Action Plan as part of the Bali Road Map agreed at the United Nations Climate Change Conference in Bali in December 2007, and is included in the Cancun Agreements, a result of COP 16.

Reducing Emissions from Deforestation and Forest Degradation Plus (REDD+): An incentive-based mechanism that seeks to reduce emissions of GHGs from deforestation and forest degradation as well as to enhance forest carbon stocks.

Resilience: The ability of a system to adapt to climate change, whether by taking advantage of the opportunities or by dealing with their consequences; the analysis of adaptation identifies and evaluates the different options, benefits and costs of the measures.

Risk Assessment: A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend on.

Special Report on Emission Scenarios (SRES): A report prepared by the Intergovernmental Panel on Climate Change (IPCC) that was published in the year 2000. The emissions scenarios described in the Report have been used to make projections of possible future climate change. The SRES scenarios, as they are often called, were used in the IPCC

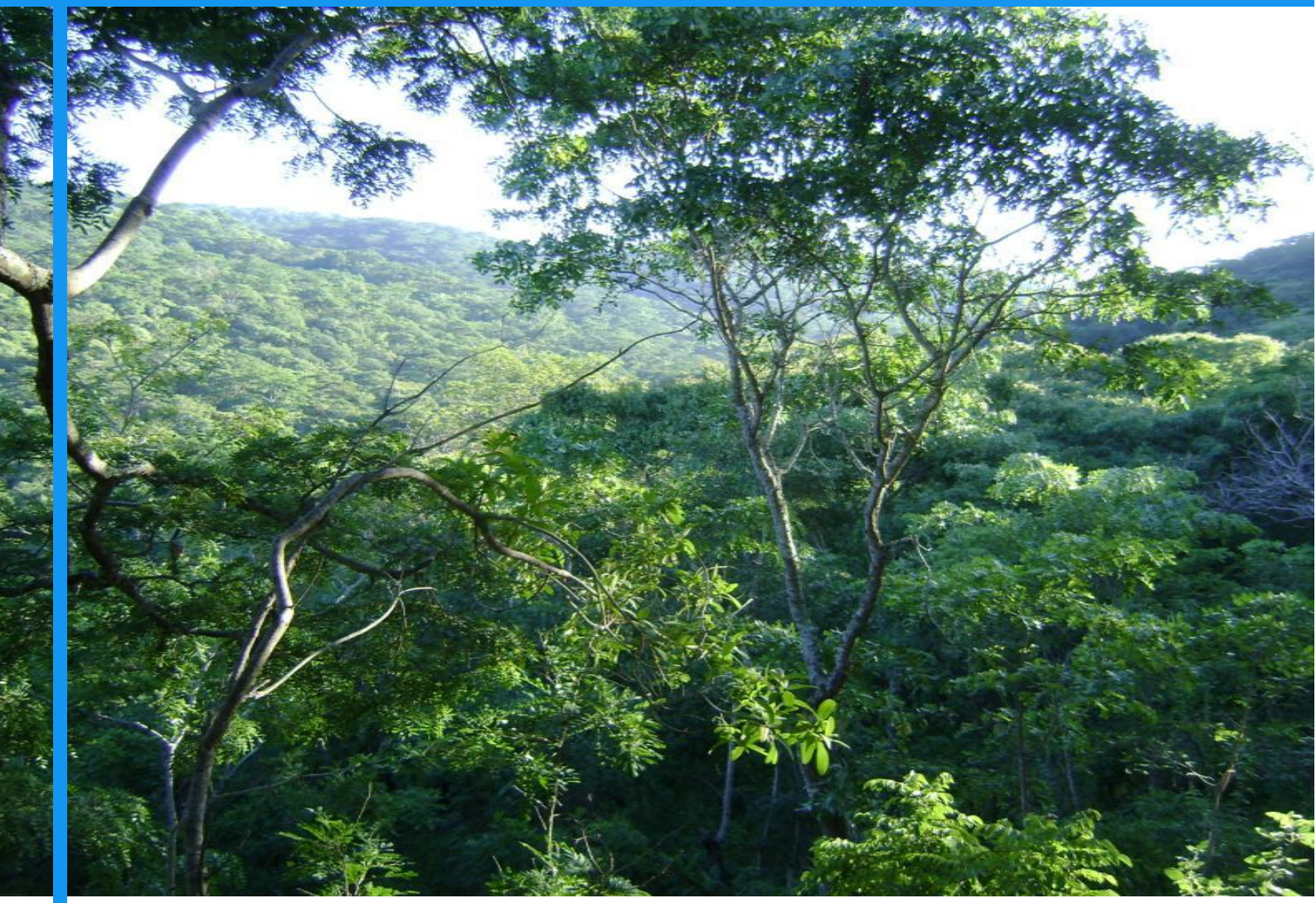
Third Assessment Report (TAR), published in 2001, and in the IPCC Fourth Assessment Report (AR4), published in 2007.

Sustainable Development: Development which meets the needs of the present without compromising the ability of future generations to meet their own needs.

Technology Transfer: A broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, non-governmental organisations and research/education institutions.

United Nations Framework Convention on Climate Change (UNFCCC): Is a non-binding global agreement on climate change, which sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognises that the climate system is a shared resource whose stability can be affected by industrial and other emissions of CO2 and other GHG. It was adopted in Rio de Janeiro, Brazil in June 1992.

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



1 Introduction

1.1 East African Community Climate Change Master Plan

The East African Community Climate Change Master Plan (EACCCMP) is an outcome of a consultative and participatory process for a unified regional approach to combat climate change. It was developed by the East African Community (EAC) Partner States (Republic of Burundi, Republic of Kenya, Republic of Rwanda, United Republic of Tanzania, and Republic of Uganda) with facilitation of the EAC Secretariat. This is partly in fulfilment of the EAC Sectoral Council on Transport, Communication and Meteorology, which in 2007, noted with concern the additional challenges climate change was posing to the socio-economic development of the EAC Partner States and called on the EAC Secretariat to develop a framework for responding to these challenges. This decision was later endorsed by the 11th Ordinary Summit of the EAC Heads of State in November 2009, which "directed the urgent development of a climate change policy and strategies to address the adverse impact of climate change….."[1].

Climate change is impacting negatively on the economies of the East African Community (EAC) Partner States. In recognition of this, and in order to deliver on its mandate and address the

[1] *Communiqué of the11th Ordinary Summit of the EAC Heads of State*

challenges emerging as a result of climate change, the EAC Secretariat spearheaded the development of this regional Climate Change Master Plan, which will supplement on-going efforts of the Partner States to cope with climate change. The purpose of the Master Plan is to provide and operationalise a comprehensive framework for adapting to and mitigating climate change in the EAC region in line with the EAC Protocol on Environment and Natural Resources Management and with international climate change agreements.

1.2 Justification for a Regional Climate Change Master Plan

There has so far not been a regional initiative of this kind to address climate change in East Africa. What exist are national initiatives on climate change such as the National Climate Change Response Strategy for Kenya; National Communications (NCs) to the United Nations Framework Convention on Climate Change (UNFCCC)[2], which all the EAC Partner States have developed; and the National Adaptation Plans of Action (NAPAs), which the four Partner States of Burundi, Rwanda, Tanzania and Uganda, all classified as least developed countries (LDCs), have developed. In addition, all of the five Partner States have ratified the Kyoto Protocol, with the dates of ratification as follows: Burundi (18th October 2001); Kenya (25th February 2005); Rwanda (22nd July 2004); Tanzania (26th August 2002); and Uganda (25th March 2002).

The lack of a regional initiative on climate change exists in spite of 1) climate change being noted as "one of the greatest challenges of our time", and 2) its additional constraints to poor developing countries of which the EAC Partner States all are. A problem of such magnitude requires a regional solution as advocated for, under Article 111 of the EAC Treaty, which calls on the Partner States to cooperate in the management of environment and natural resources; specifically, Article 111.1(a) of the Treaty obliges the Partner States to "take concerted measures to foster cooperation in the joint and efficient management and sustainable utilisation of natural resources within the Community", while Article 7.1(a) of the EAC Protocol on Environment and Natural Resources Management calls on the Partner States to "*co-operate in the development of a common policy on sound management of the environment and natural resources*". Climate change is at the core of sustainable development and therefore requires joint action by the EAC Partner States.

In addition, Article 10 of the Kyoto Protocol calls on Parties to "*formulate, implement, publish and regularly update national and, **where appropriate, regional programmes containing measures** to mitigate climate change and measures to facilitate adequate adaptation to climate change*". Thus, the development of this regional climate change master plan fulfils this requirement of the Kyoto Protocol.

The need for a regional climate change initiative is further bolstered by the need to have a unified approach to dealing with challenges such as poverty, weak and inadequate policies and institutions, poor infrastructure, lack of information, poor access to financial resources, which are common to the EAC Partner States. These factors are expounded on below:

Poverty: Based on the World Development Indicators report (the World Bank, 2010), the average poverty rate in the EAC region is about 47.5%. This average is derived from individual Partner States survey data carried out from as early as 1998 (Burundi) to 2006 (Kenya, Rwanda

[2] Burundi submitted its first NC on November 23rd 2001; Kenya, October 22nd 2002; Rwanda, September 6th 2005; URT, July 4th 2003; and Uganda, October 26th 2002. In addition, Burundi has submitted its second NC (28th June 2010), while the other four Partner States are at various stages in developing theirs.

and Uganda)[3]. This means that about 63.4 million people out of the region's total population of 133.5 million (EAC Facts and Figures 2010) live below the poverty line.

Thus, most of the limited resources at the disposal of the governments of the EAC Partner States would naturally be diverted to poverty eradication and wealth creation, as opposed to addressing climate change; a fact that the UNFCCC acknowledges when it asserts that "*economic and social development and poverty eradication are the first and overriding priorities of developing countries*" (Article 7 of the UNFCCC).

Weak and inadequate policies and institutions: Until the 1990s, much of the discussion on climate change was within the academic realm. It was only after the adoption in 1992 of the UNFCCC and subsequently the Kyoto Protocol in 1997 that the subject began to find itself in the policy arena. But even with the UNFCCC and Kyoto Protocol in existence, most developing countries did not make significant efforts towards creating policies, laws and institutions to address climate change because:

- They were yet to appreciate the magnitude of the problem, particularly at the high political level, and
- They were concerned with priority issues such as poverty eradication and could not make the link with climate change

None of the EAC Partner States has an explicit policy or law to address climate change. What exist are an array of policies and laws on natural resources, some of which have conflicting mandates in so far as climate change adaptation and mitigation are concerned. Similarly, none of the countries has so far established a dedicated climate change institution, except Kenya, which is in the process of setting up a National Climate Change Secretariat. For the rest of the EAC Partner States, climate change governance rests with the institution in charge of environmental affairs essentially the environment and natural resources ministries and/or their affiliated bodies, e.g. the national environment management authorities. This lack of dedicated climate institutions has rendered climate change response ineffective as:

- The institutions currently in charge of overseeing climate change are already over-burdened with other mandates, and
- Climate change was not a priority when these institutions were set up, and is therefore yet to be fully mainstreamed within their operations. What exist in most cases are mere climate change desks, which in some cases are not well resourced

Poor infrastructure: Economically-endowed countries can cope better with climate change impacts than poor countries. Infrastructure plays a key role in economic development, and is often touted as the "engine of growth". Thus, countries with poor, underdeveloped infrastructure such as the EAC Partner States suffer from low levels of development. They consequently suffer the greatest burden of climate change vagaries as they have little means to cope. Furthermore, climate change impacts such as floods often wreak havoc to this underdeveloped infrastructure as it is in most cases, not built to withstand such impacts.

Lack of information: Information on various aspects of climate change such as science (causes, vulnerabilities, impacts, climate projections, etc) and policy is crucial in responding to the problem. Currently, most developing countries have poor access to relevant climate information and insufficient resources to generate this information.

[3] The World Bank 2010, World Economic Indicators (Poverty levels-Burundi: 68.0%, 1998 estimates; Kenya: 46.6%, 2006 estimates; Rwanda: 56.9%, 2006 estimates; URT: 35.7%, 2001 estimates; and Uganda: 31.1%, 2006 estimates). Please note that the report is a compilation of data from available national sources.

Inadequate access to financial resources: Climate change response activities are huge financial undertakings, which most poor developing countries cannot afford as they are primarily concerned with issues such as food security, poverty eradication, economic growth, etc. Where funds may be available (from multilateral climate change funds), lack of information, poor governance, and inadequate capacity to access and use such funds impede their access.

The Climate Change Master Plan responds to all the above and provides a coordinated response to key climate change issues in the East Africa region including:

- A conducive and enabling policy framework and a concerted programme of action to address climate change;
- A coordinated approach and overall guidance to the implementation of climate change activities including climate change adaptation and mitigation programmes, awareness creation, education, capacity building, technology development and transfer, and financing, among others;
- Enhanced understanding of international agreements, policies and processes and the position the EAC needs to take in order to maximise beneficial outcomes of UNFCCC negotiations; and
- Harmonised EAC Partner States' participation in the global climate change negotiations.

1.3 Linkages between the Master Plan, the Strategy and Policy

In addition to the Master Plan, the EAC Secretariat has developed a Climate Change Policy and Strategy. These three documents are distinct but complimentary:

a. EAC Climate Change Policy is a purposeful statement by the Secretariat expressing recognition of a climate change problem and stating its commitment to address the problem through specified actions. Although not binding, the overall objective of the Policy is to guide Partner States and other stakeholders on the preparation and implementation of collective measures to address climate change in the short and medium-term. In view of the high vulnerability of the region's agriculture and food security, the Policy highlights adaptation to climate change as first priority to the EAC region. The focus is on an integrated, harmonised and multi-sectoral framework for responding to climate change in the EAC region.

b. The objective of the EAC Climate Change Strategy is the implementation of the EAC Climate Change Policy. The Strategy sets out a range of measures, taking into account those already in place in the Partner States, to ensure effective implementation of the Climate Change Policy at all levels. The Strategy gives the direction and scope of implementation of the Policy over a shorter time-frame, defining all the necessary actions and resources needed in order to achieve its goal.

c. The EAC Climate Change Master Plan is a blue-print and comprehensive document, encompassing a long term view of challenges, opportunities and priority actions to combat climate change. The Master Plan provides the overall picture and vision for the region in so far as climate change response is concerned giving estimates of all the resources needed in order for the EAC to be climate resilient. It is a twenty (20) year planning document covering the period 2011 to 2031.

Master Plan will provide the overall picture and vision linking all three documents. This vision will be operationalized by means of periodic climate change strategies developed in consideration of the prevailing circumstances, the first of which is the EAC Climate Change Strategy 2011-2015. The climate change policy will, on the other hand, direct the strategy. Both the Policy and Strategy will undergo review after 2015.

In view of the fact that these three climate change documents have been developed more or less in parallel, the Master Plan has tried as much as possible to align itself with the EAC Climate Change Strategy 2011-2015 and the EACCCP 2011-2015. This has been achieved by ensuring that all the provisions of the **Strategy** and the **Policy** are captured in the **Master Plan** since the latter is the broader planning document.

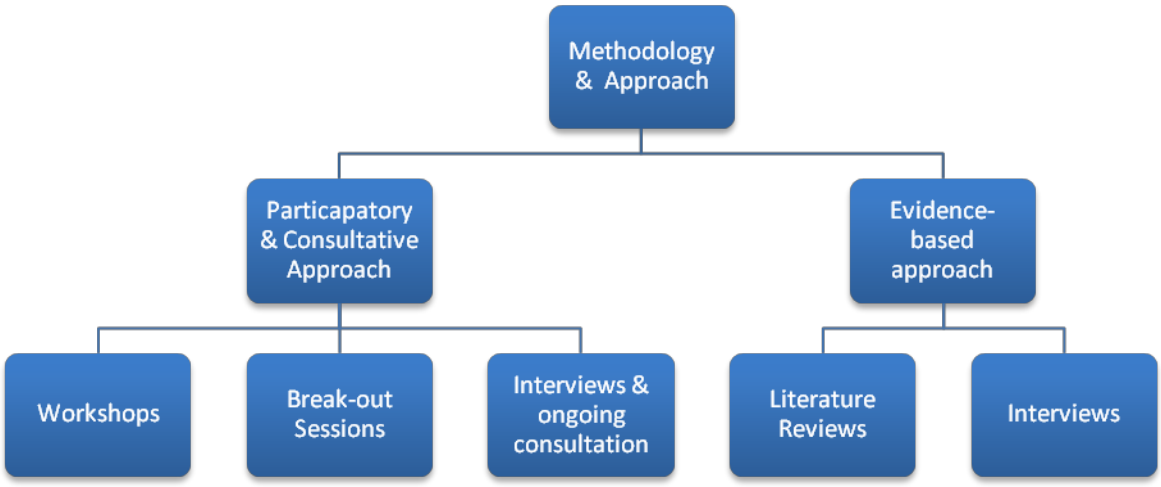
In addition, the Master Plan has captured the provisions and aspirations of other key important and related planning documents of the EAC such as the EAC Food Security Action Plan 2011-2015, the EAC environmental and natural resource governance instruments such as the EAC Treaty and Protocol on Environment and Natural Resources Management as well as international environmental and climate change governance instruments, principally, the UNFCCC, the Kyoto Protocol, the Convention on Biological Diversity (CBD), and the United Nations Convention to Combat Desertification (UNCCD), among others.

The Master Plan has taken cognizant of the dynamic nature of the geo-politics of climate change, capturing the spirit and provisions of an anticipated future climate change governance framework, that is, a post-Kyoto international agreement.

1.4 Approach and Methodology

The figure 1-1 below demonstrates a schematic overview of the methodology and approach used in the development of the Master Plan.

Figure 1-1 Overview of the methodology and approach used

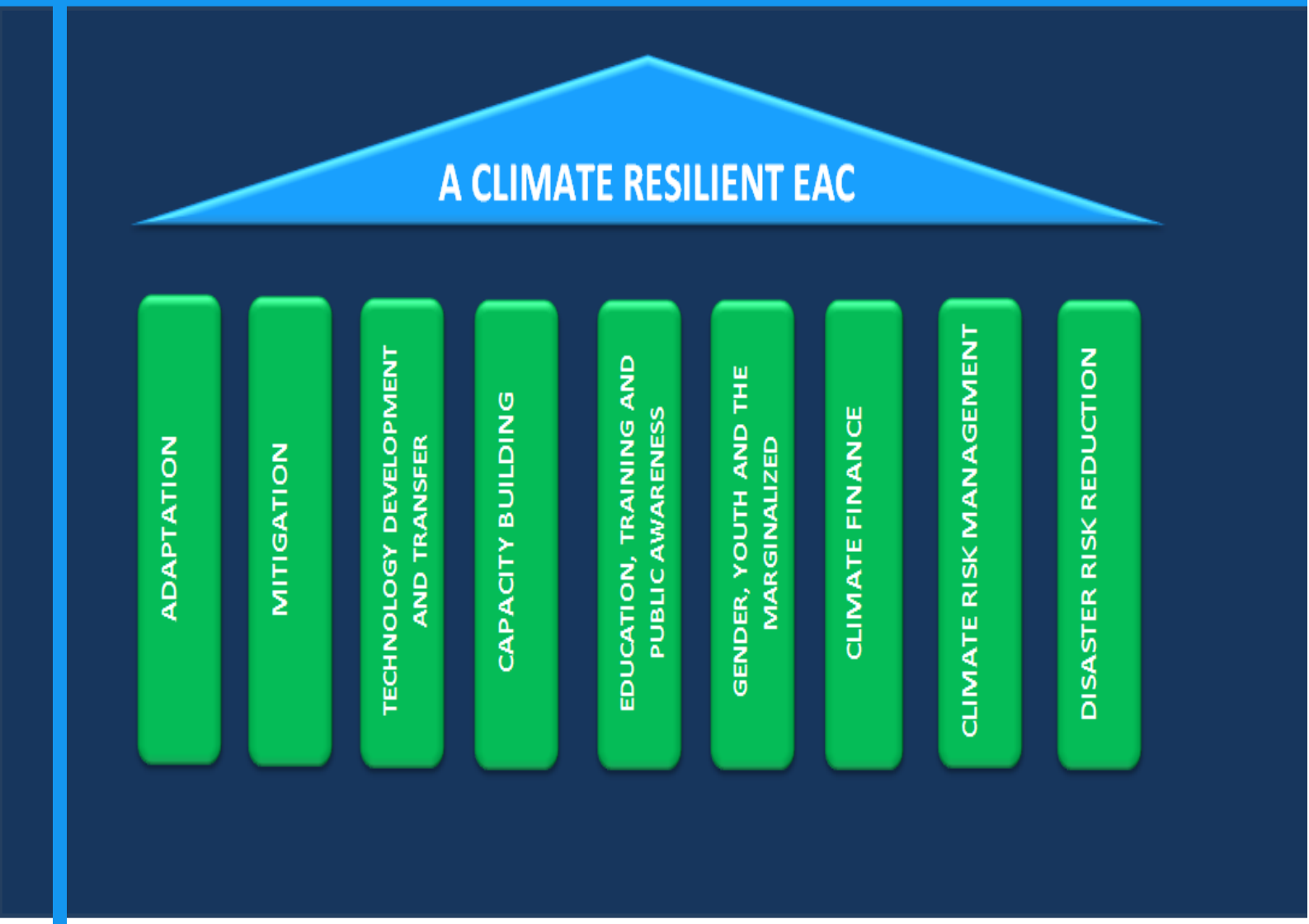


The two pronged approach involved two key components:

Participatory and consultative approach involved five national workshops, one in each of the EAC Partner States. The Workshops were designed to engage stakeholders within each of the Partner States to generate discussion and to identify the most important issues related to climate change impact, adaptation and mitigation response measures. Throughout the development of the Master Plan, various stakeholders were consulted and interviewed. These included EAC 'Working Group of Experts', experts within various governmental departments and allied institutions, the private sector, donor agencies and observers. Other stakeholders had the opportunity to comment on the Master Plan at various stages to further ensure that pertinent information was incorporated into the Master Plan. The consultative approach facilitated by the EAC Secretariat culminated into a validation workshop, which discussed and

validated draft versions of the Master Plan and ensured that the final version is harmonised with the existing reports and structure.

Evidence-based approach, which involved the identification and prioritisation of adaptation and mitigation related measures and actions based on literature review and an analysis of the linkages of climate change to the socio-economic development in the region. In addition comprehensive literature reviews were conducted to fully understand and appreciate the regional climate change situation; data sources included national documents, meteorological records and other national documents in addition to information drawn from international studies and bodies such as the IPCC, UNFCCC and UNEP. The evidence-based approach informed the high-level vulnerability and sensitivity analyses for each of the Partner States.



2 Vision, Objectives and Pillars of the Master Plan

The purpose of the Master Plan is to provide a long-term vision and a basis for Partner States to operationalize a comprehensive framework for adapting to and mitigating climate change in the EAC region in line with the EAC Protocol on Environment and Natural Resources Management and with international climate change agreements.

2.1 Vision

The People, the Economies and the Ecosystems of the EAC Partner States are climate resilient and adapt accordingly to Climate Change.

The Vision is aligned and consistent with EAC's mandate, development priorities as articulated in a number of relevant environmental and climate change documents such as the EAC Climate Change Policy (EACCCP), EAC Climate Change Strategy, the EAC Protocol on Environment and Natural Resources and the EAC Food Security Policy. The Vision is consistent with Article 111.1(a) of the EAC Treaty, which obliges the Partner States to "*take concerted measures to foster cooperation in the joint and efficient management and sustainable utilisation of natural resources within the Community*", and with Article 7.1(a) of the EAC Protocol on Environment and Natural Resources Management which calls on the Partner States to "*co-operate in the*

development of a common policy on sound management of the environment and natural resources".

2.2 Objectives

The overall objective of the Master Plan is to strengthen regional cooperation to address climate change issues that concern regionally shared resources. The Master Plan's specific objectives are:

- To provide an effective and integrated response to regional climate change adaptation;
- To enhance the mitigation potential of Partner States in the energy, infrastructure, agriculture and forestry sectors;
- To streamline and harmonise existing and on-going trans-boundary mitigation and adaptation projects or activities;
- To foster strong international cooperation to address issues related to climate change including enhancing the negotiating ability of the Partner States in the African Union and other forums including the UNFCCC;
- To mobilise financial and other resources to implement the above.

The main regional issues which have been identified and prioritised by the EAC Partner States are:

1. Agriculture (crops, livestock and fisheries) and Food Security: to improve sustainable land use systems that enhance agricultural production and ensure food security under the changing climate;
2. Water Security: to protect and ensure sustainable management and resilience of trans-boundary water resources under the changing climate;
3. Energy Security: to scale up the exploitation and development of less carbon-intensive and more climate change-resilient energy infrastructure in the region;
4. Biodiversity and Ecosystems Services: to ensure the conservation of the integrity of biodiversity and ecosystem services that they provide;
5. Tourism is one of the main foreign exchange earners of the Partner States, there is therefore need to put in place measures to ensure sustainability of the sector;
6. Physical Infrastructure: to ensure that buildings, roads, railways, waterways and airways, etc., are climate proofed and adapt to climate change;
7. Human Health, Sanitation and Settlements are highly vulnerable to climate change and as such appropriated adaptation measures need to be put in place;
8. Trade and Industry are increasingly important in the region and are affected indirectly by climate change;
9. Education, Science and Technology are key planks to development of innovative ideas that will assist in combating climate change.

2.3 Key Pillars of the Master Plan

To achieve the Vision and Objectives, the Master Plan calls for prioritisation and implementation of the following eight core pillars:-

2.3.1 Adaptation Interventions

Adaptation is crucial because climate change will occur regardless of future GHG reduction measures. Adapting to or coping with climate change is of utmost importance in order to ensure socioeconomic and environmental systems function and development. EAC Partner States have a young and growing population distributed in all eco-regions including those in areas vulnerable to extreme climatic events such as floods and droughts.

2.3.2 Mitigation Interventions

Mitigation of climate change is defined as measures that seek to avert and reduce/limit emission of GHGs as well as to enhance their sinks. By undertaking mitigation interventions, EAC Partner States will be contributing towards the achievement of Objective II of the UNFCCC and also benefit through development of renewable energy resources such as geothermal, wind, solar and biomass. Such development can benefit from the carbon markets under the Kyoto Protocol's Clean Development Mechanism (CDM). The Master Plan identifies the three most polluting sectors in the region as land use (forestry and agriculture), energy and transport and recommends mitigation interventions.

2.3.3 Research, Technology Development and Transfer

Research is crucial for the understanding climate change cause, manifestation and impact as well as developing appropriate responses in terms of policy, technology and innovation. The Master Plan provides an overview of current global climate change monitoring, detection, and attribution. Studies have shown that there is inadequate meteorological research in the region and as such there is need for enhanced meteorological research. Research needs to be coordinated and channelled to where it is most needed. Networking is an important component of optimising resources for maximum impact.

Technology transfer is one of the 'building blocks' of the Bali Action Plan (BAP), which calls for enhanced action on technology development and transfer to support action on mitigation and adaptation. The Master Plan calls for international and regional cooperation to facilitate technology development and transfer. This is in line with the EAC Treaty; Partner States are called upon to promote "*linkages among industries...in order to facilitate the transfer of technology*."

2.3.4 Capacity Building

The need for capacity-building to assist Parties to respond to climate change has long been recognised. Through its decisions 10/CP.5 and 11/CP.5, COP 5 launched a process to address capacity-building in an integrated manner, resulting in frameworks for capacity building being agreed at COP 7 (Marrakech, November/December 2001) for developing countries in decision 2/CP.7. These frameworks were intended to serve as a guide for the climate change capacity building activities of the Global Environment Facility (GEF) and other funding bodies.

2.3.5 Education, Training and Public Awareness

The level of climate change awareness among individuals in developing countries such as the EAC Partner States is comparatively low because climate change is a relatively new concept in the general public domain. Similarly, there is a critical dearth of climate change content in the education curricula of most developing countries at nearly all levels of education, ranging from primary through to tertiary. This is true for the EAC Partner States where climate change

education and training is limited to a few courses at some colleges and universities. These courses serve as an introduction to climate change however; there is no deliberate attempt - at the higher level of colleges or universities' administration - to formally incorporate climate change into their curricula.

2.3.6 Gender, Youth and Marginalized Groups

Gender is an important determinant of adaptive capacity. In most cases, women, the youth and children make up a large number of the poor in communities that are highly dependent on local natural resources for their livelihood and are disproportionately vulnerable to and affected by climate change. Women's limited access to resources and decision-making processes increases their vulnerability to climate change (Commission on the Status of Women, 2008; UNDP, 2009). Women and girls in rural areas have the major responsibility for household water supply and energy for cooking and heating, as well as for food security, and are negatively affected by drought, uncertain rainfall and deforestation. Because of their roles, unequal access to resources and limited mobility, women and girls in many contexts are disproportionately affected by natural disasters, such as floods, fires, and mudslides. It is important to identify gender-sensitive strategies for responding to the environmental and humanitarian crises caused by climate change (Commission on the Status of Women, 2008). In addition, persons residing in marginalised areas like in drought and flood prone regions as well as the handicapped, elderly and other marginalised persons are also at greater risk of climate change and climate variability. The Master Plan has acknowledged this disproportionate vulnerability of differentiated groups to climate change and recommended differentiated strategies for responding to the environmental and humanitarian crises caused by climate change.

2.3.7 Climate Risk Management and Disaster Risk Reduction

Disaster risk reduction (DRR) is a conceptual framework consisting of ways and means of minimising disaster risks by reducing the degree of vulnerability and increasing resilience capacity of the communities. DRR offers options for prevention, mitigation and preparedness to the adverse impacts of natural hazards with a sustainable development approach. In 2005, the global community, at the World Conference on Disaster Reduction (WCDR) agreed on *The Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters* to expand and strengthen actions at all levels to reduce disaster risks and build the resilience of nations and communities to disasters. Five priorities of action were set out as a global commitment to tackle disaster risks as follows:

1. Ensure that DRR is a national and local priority with a strong institutional basis for implementation;
2. Identify, assess and monitor disaster risks and enhance early warning;
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels;
4. Reduce the underlying risk factors;
5. Strengthen disaster preparedness for effective response at all levels.

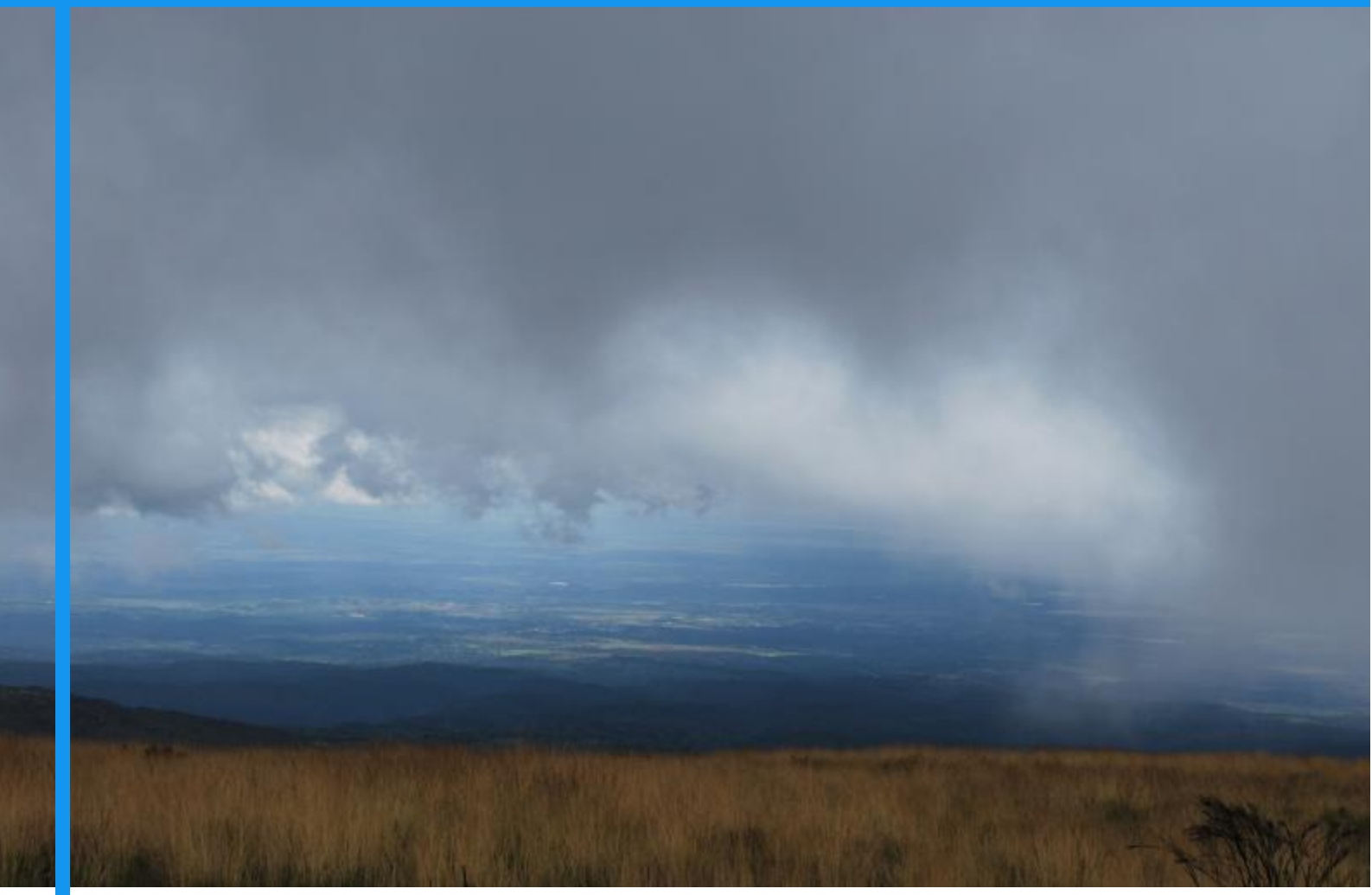
The EAC Climate Change Master Plan aims at addressing community resilience against vulgarizes of weather and climate through application of stringent climate risk management principles. Some of the approaches involve strengthening regional Meteorological and Hydrological Services (NMHS); improve climate early warning systems to promote efficient management and utilisation of natural resources including protection of vulnerable ecosystems. DRR is therefore a good tool for climate change adaptation which should be integrated in the

climate change master plan in line with the already developed EAC climate change policy and strategy.

2.3.8 Climate Finance

Achieving the Strategy's vision of *a Resilient People, Economy*, and *Ecosystem* requires substantial and additional financial resources to implement the proposed actions. Within the EAC, climate change activities are currently being supported through Partner States contributions, EAC Partnership Fund and other development partners. Recognising that existing funding mechanisms from the UNFCCC and other sources have inherent multiple challenges, the Master Plan recommends a means through which such financing may be obtained including:

- **Dedicated Climate Funding from Bilateral and Multilateral Sources**: A number of external sources of climate funding are available for climate change adaptation and mitigation activities. In Table 5-2 in chapter 5, a number of such funds are listed.
- **The Partner States' National Budgets:** The mainstreaming of climate change risks into the development agenda (e.g. medium term development plans) can influence budget allocation in a way that results in more funds being allocated for climate change activities. Through such measures, national budgets can provide leverage funding from external sources, especially in situations where governments can co-finance climate change projects.
- **Private Sector Finance and Foreign Direct Investments (FDI):** Investments in the energy sector and renewable energy, as well as the forestry sector, may largely come from the private sector. These funding sources can be supplemented by additional grants or soft loans from Multilateral Finance Institutions (MFIs). The involvement of the private sector may also be promoted through public-private partnerships.
- **Funding from Carbon Markets:** Funding can also be secured for mitigation from market-based mechanisms such as the CDM or its future successor, as well as voluntary carbon market schemes.
- **EAC Climate Change Fund:** Whose main purpose is to enhance the region's capacity to mobilise existing, new and additional climate change funds from both international and domestic sources, has been established. Once fully operationalised, the EAC Climate Change Fund will be able to tap into the available international Climate Funds, bilateral and multilateral and other local sources.



3 Climate Change in East Africa: Situational Analysis

This chapter gives a summary of the situational analysis of the climate, trends and projections of each of the five Partner States as a basis for understanding their vulnerabilities and sensitivities to climate change**.** Detailed Situational Analysis for each of the five Partner States is available at EAC Secretariat.

3.1 Climate, trends and projections per Partner State

3.1.1 Burundi

Climate

In general, Burundi has a humid, tropical climate that is strongly influenced by altitude and topology (MEEATU, 2010). Using the Köppen-Geiger climate classification, Burundi falls within the tropical savannah (AW) climate category, flanking tropical rainforests and monsoons areas (Peel *et al*. 2007). This climate group is characterised by abundant summer rainfall and little or no rain during winter period. The country is prone to winter drought and unpredictable weather conditions.

Burundi's climate is influenced by several weather systems, the most prominent of which are the Inter-Tropical Convergence Zone (ITCZ) and El-Niño /Southern Oscillation (ENSO) episodes

which govern precipitation. Other influencing factors include the Congolese air mass, the equatorial low pressure system, high pressure ridges in East Africa and the subtropical anticyclones such as the Mascarene Islands, Saint Helen and Azores. The Inter Tropical Convergence Zone controls the intensity and migration of the seasonal rainfall over the East African region.

Temperature and Rainfall[4]

There are two wet seasons, the first of which extends from September to December (growing season A), and the second from February to May (growing season B). A dry spell typically occurs between mid-January and mid–February.

Generally speaking rainfall ranges between 800 – 2,000 mm depending on the region. The Congo-Nile ridge, which has the highest altitude, has the highest average rainfall per year, ranging between 1,300 and 2,000 mm. The Mumirwa escarpments also have high average annual rainfall ranging between 1,100 and 1,900 mm. The Imbo Plains have the lowest annual rainfall ranging between 800 and 1,100 mm.

Average annual temperatures are highest on the Imbo Plains at typically over 23°C; the Mumirwa escarpments have the greatest range in temperature at 13°C to 28°C. The lowest temperatures occur on the Congo-Nile ridge ranging between 14°C and 15°C.

A summary of the region's climatic characteristics is summarised in Table 3-1.

Table 3-1 Burundi's eco-climatic regions

Eco-climatic zone	Proportion Land cover	Altitude (m a.s.l.)	Average annual temperature	Average rainfall (mm)
Imbo Plains	7%	800 – 1,100	≥ 23°C	800 – 1,100
Mumirwa escarpments	10%	1,000 – 1,700	13°C - 28°C	1,100 – 1,900
Congo-Nile ridge	15%	1,700 – 2,500	14°C - 15°C	1,300 – 2,000
Central plateaux	52%	1,350 – 2,000	17°C - 20°C	1,200 – 1,500
Eastern plains	16%	1,000 – 1,400.	20°C - 23°C	1,100 – 1,550

Source: IGEBU

Climate Trends

For the past five years, Burundi and the other countries of the sub-region have experienced unusual weather patterns and a gradual decline in rainfall (Koyo, 2004). This state of affair is often aggravated by population pressure, uncontrolled deforestation and wildfires. The area most affected, are those below 1,200 m altitude, especially north of Bugesera, east of Buyogoma and west of Imbo. In the areas most affected, there is a very significant correlation between the drop in rainfall levels and the decline in agricultural productivity.

[4] *Information regarding the temperature and rainfall are derived from the product on the study of vulnerability and adaptation (Bujumbura, August 2008), and the report on the baseline and climate projections (Bujumbura, November 2008), under the project "Empowerment of Burundi to formulate its second national communication under the UN Framework Convention on Climate Change. "*

Four main stations are used to monitor seasonal and annual climatic trends in the country. These include Bujumbura, Gisozi, Musasa and Kirundo. For some sectors, specific data at some stations are provided by IGEBU for analysis. At a meeting to commence work on the project component "*Vulnerability and Adaptation* ", meteorological experts agreed that four other regions, namely: Bugesera, Kumoso, Imbo and Mugamba, also needed to be monitored to detect changes in long term climate.

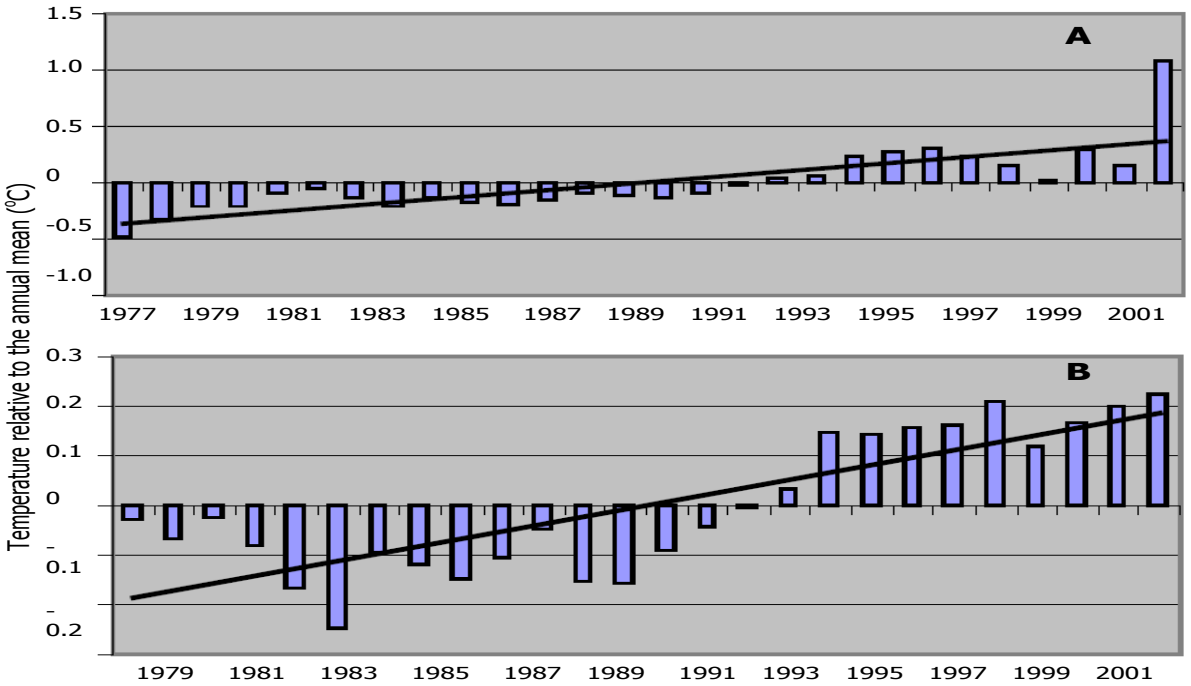
There is a general problem with data availability, specifically for Bugesera, Kumoso, Imbo and Mugamba. These areas have been prone to extreme weather events in the recent history of Burundi. The year 2050 was chosen as a reasonable projection horizon. This is justified by the long series of historical climate observation stations in these regions (30 years and more).

Temperature

The temperature analysis had focused on four major stations by ecological regions of Burundi during the preparation of the two National Communications on Climate Change in Burundi.

This analysis of the inter-annual temperature, maximum and minimum temperatures showed a general trend of increase; it is particularly marked for minimum temperatures at the station of Musasa (Figure 3-1).

Figure 3-1: Inter-annual temperature deviations from the annual mean



(Source: Shiramanga and Barakiza, UNDP/MINATTE, Final Report, November 2008) (A: Musasa, B: Gisozii)

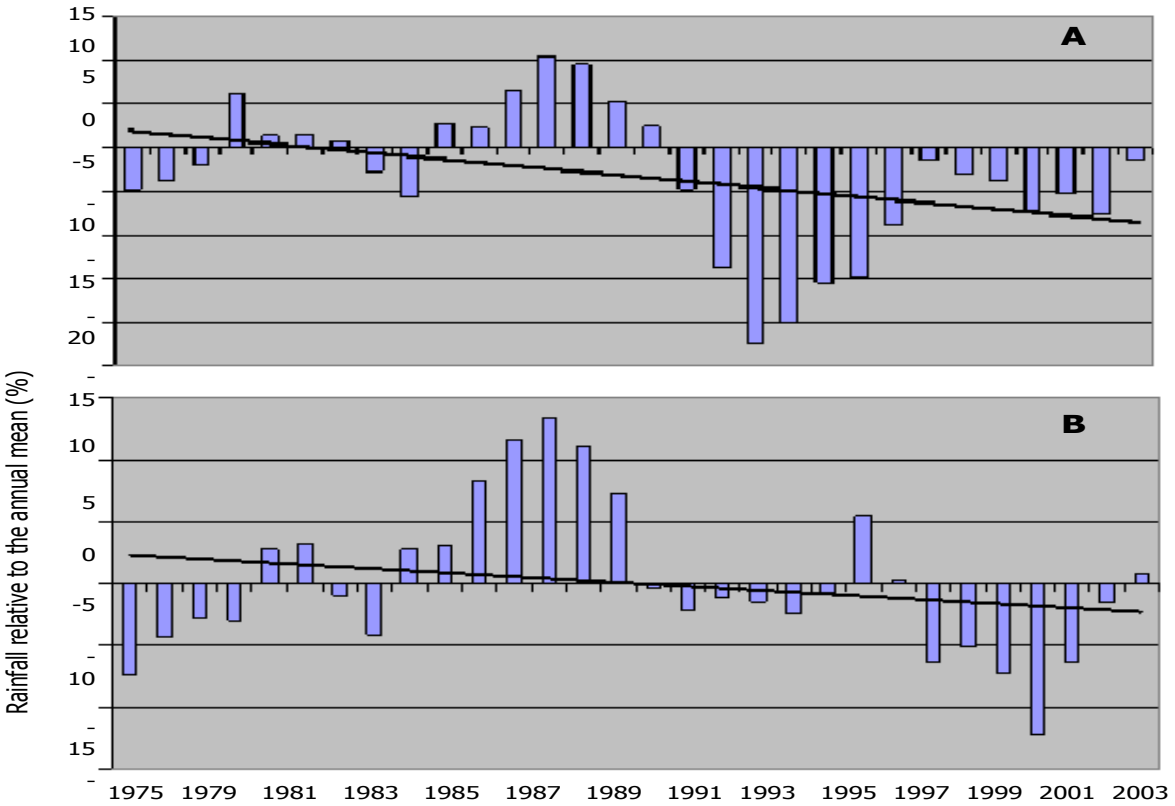
Rainfall

A baseline study of climate data and anomalies covering the period from 1974 to 2006 was undertaken by IGEBU (2008). A cyclic pattern of below-and above-average rainfall, since the mid 1970's, is evident. These cycles of alternating periods of above and below average rainfall

occur on a decadal scale. The same trend is observed at all four meteorological stations, The cyclical deviations from the mean are more pronounced in Bujumbura and Musasa, with a sharp downward trend.

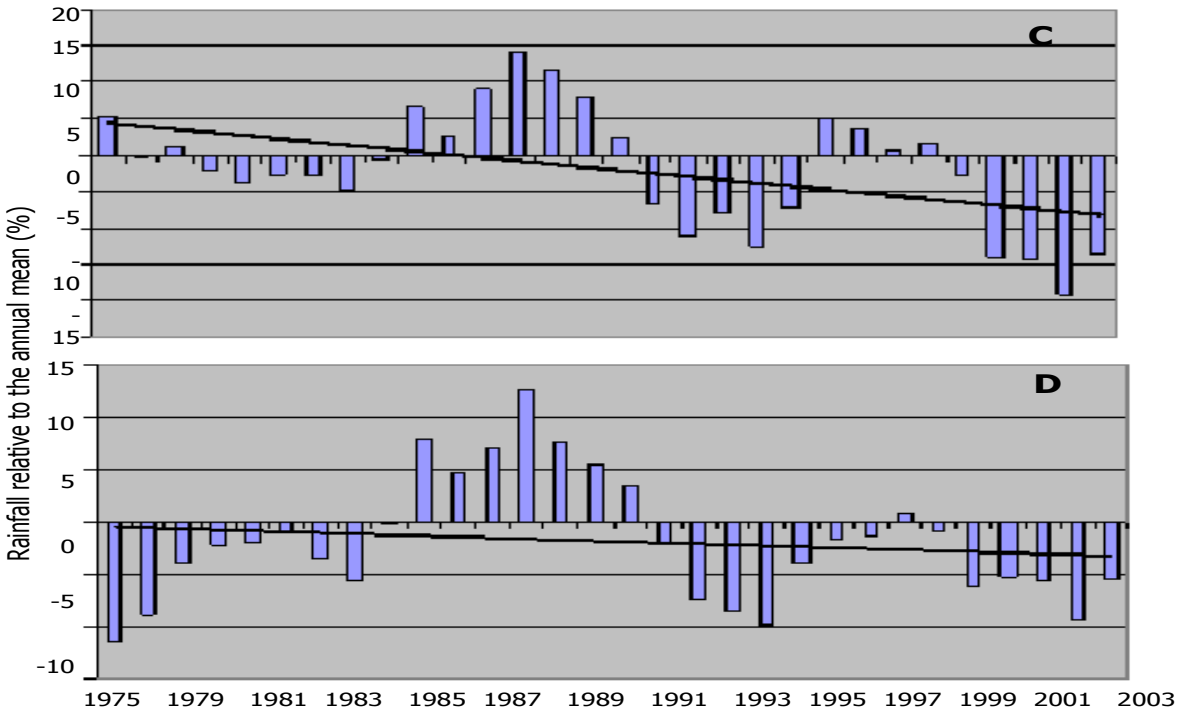
Figures 3-2 and 3-3 illustrate the percentage annual rainfall relative to the annual mean for Bujumbura, Gisozi, Musasa and Kirundo.

Figure 3-2 Inter-annual rainfall deviations from the annual mean



(Source: Shiramanga and Barakiza, UNDP/MINATTE, Final Report, November 2008) (A: Bujumbura, B: Kirundo)

Figure 3-3 Rainfall baseline and projections



(Source: Shiramanga and Barakiza, UNDP/MINATTE, Final Report, November 2008) (C: Musasa, D: Giozi)

The analysis of climatic data of the past 30 years shows that climate is marked by inter-annual and inter-decadal irregularities in the temporal and spatial distribution of rainfall; irregularities in early and late rainy seasons; high frequencies of extreme climatic events and more frequent dry episodes, particularly in Bugesera. A summary of changes in precipitation is provided in Table 3-2 below.

Table 3-2 Rainfall trends over the past 30 years (1974 to 2006)

Eco-climatic region	Station	Change in number of rain days and rainfall pattern			
		Number of rainy days	Cropping season A	Cropping season B	Annual average
Imbo Plains	Bujumbura	Decreasing	No significant trend	Sharply down	Sharply down
Congo-Nile crest and central highlands	Gisozi	Decreasing	Slightly higher	Slightly down	Slightly down
Kumoso depression	Musasa	Decreasing	Slightly down	Sharply down	Sharply down
Bugesera	Kirundo	Decreasing	No significant trend	Slightly down	Slightly down

Source: IGEBU 2008, report on the baseline and projected climate.

Climate Projections

Studies by IGEBU show that with climate change, extreme weather events are increasing in frequency and intensity and generally results in remarkable changes in socioeconomic systems.

The manifestations of these extreme events are characterized by erosion, the destruction of infrastructure and many other negative impacts on the environment and the quality of people's lives.

Among these extreme weather events are prolonged droughts in the agricultural regions of Burundi, as well as periods of heavy rains, which often result in catastrophic floods. These natural disasters greatly increase the vulnerability of natural systems. Variations in the spatial and temporal distribution of rainfall and temperature resulting from climate change will have negative socioeconomic impacts on the Burundian population.

The main sectors identified as most vulnerable to climate change are energy, agriculture and animal husbandry, forestry, water resources, natural ecosystems and health. Climate change projections as for 2000 – 2020 indicate the following (Study of Vulnerability and Adaptation to CC, 2006):

- Climate change will result in greater climate variability especially with regard to rainfall. Rainfall is projected to decrease by 3 to 10% for the high scenario; the period from May to October will have reduced rainfall of about 4-15 %.
- Temperatures are projected to rise by 0.4ºC every 10 years, and increase by 1.9^{o}C by the year 2050.

3.1.2 Kenya

Climate

In the Köppen climate classification, Kenya can be classified as predominantly arid and semi-arid (larger parts of eastern and northern Kenya) and tropical wet and dry (or savannah) (areas to the west of the country and the coastal strip) (Peel *et al.* 2007). Areas near water bodies such as the Lake Victoria are characterised by tropical rain forest climate, and receive significant rainfall throughout the year.

Temperature and Rainfall

Kenya, being located in the tropics shows clear diurnal range in mean air temperatures, with the maximum temperatures (T_{max}) occurring during the day and minimum temperatures (T_{min}) occurring at night/early morning. Furthermore, mean air temperatures are closely related to altitude. Thus, the highest temperatures are recorded along the coast, northern Kenya, lake shores and their surroundings, and can reach as high as 40-45°C (Wajir T_{max}), while the lowest temperatures are recorded at high mountain peaks. . Temperature ranges between maximum and minimum vary from 6°C at the coast to 16°C in the highlands

The seasonal northward and southward movements of the ITCZ have considerable influence on the country's climate. As a result, most parts of the country are characterised by two rainy seasons, March to May ("long rains") and October to November ("short rains"). According to a 2007 WRI/GoK/UNEP report, "*Nature's Benefits in Kenya: An Atlas of Ecosystems and Human Well-Being*", the country has a mean annual average rainfall of about 500 mm, which varies between 250 mm in the ASALs to 2,000 mm in the high mountain ecosystems. About 66% of the country receives less than 500 mm of rainfall annually.

Climate Trends

Temperature and Rainfall

From the early 1960s, Kenya has experienced generally increasing temperature trends over vast areas Christy *et al*. (2009). Over the inland areas, the trends in both minimum (night/early morning) and maximum (daytime) temperatures depict a ***general warming*** (increasing) trend with time. However, the increase in the minimum temperatures is steeper than in maximum temperatures. The result of the steeper increase in T_{min} and a less steep increase T_{max} is a reduction in the diurnal temperature range (difference between the maximum and minimum temperatures).

The change in the daily maximum temperature however, is minimal. Data records kept by the Kenya Meteorological Department (KMD) on temperatures across the country since the 1960s agree with this observation (Tables 3-3 and 3-4).

Table 3-3 Minimum temperature trend from 1960

Region	Trend	Magnitude (^{o}C)
Western	Increase	0.8-2.9
Northern & North-eastern	Increase	0.7-1.8
Central	Increase	0.8-2.0
South Eastern districts	Increase	0.7-1.0
Coastal strip	Decrease	0.3-1.0

Source: KMD

Table 3-4 Maximum temperature trends from 1960

Region	Trend	Magnitude (^{o}C)
Western	Increase	0.5-2.1
Northern & North-eastern	Increase	0.1-1.3
Central	Increase	0.1-0.7
South Eastern districts	Increase	0.2-0.6
Coastal strip	Increase	0.2-2.0

Source: KMD

An analysis of both minimum (T_{min}) and maximum temperatures (T_{max}) based on the standard seasons of December-January-February (DJF), March-April-May (MAM), June-July-August (JJA) and September-October-November (SON) reveals that the rise in temperatures over the northern parts of the country is relatively higher than in other parts especially from October to February period. Similarly, the decrease in minimum temperatures in the northern parts of the coastal strip is also relatively higher than in the southern parts of the coastal areas during the same period. Lamu in the north coast shows a drop of 1°C from a mean of 24.5°C in the early 1960s to 23.5°C in the recent ten years, whereas Mombasa in the south coast indicates a drop of about 0.3°C from 23°C in the early 1960s to 22.7°C in the recent ten years.

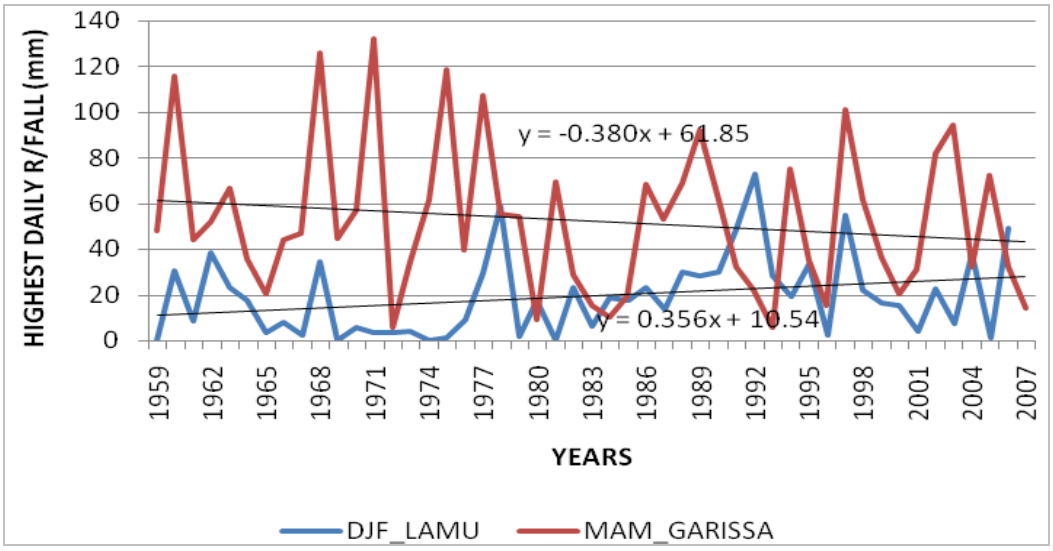
From the early 1960s, Kenya has experienced generally increasing temperature trends over vast areas. Over the inland areas, the trends in both minimum (night/early morning) and maximum

(daytime) temperatures depict a ***general warming*** (increasing) trend with time. However, the increase in the minimum temperatures is steeper than in maximum temperatures. The result of the steeper increase in T_{min} and a less steep increase T_{max} is a reduction in the diurnal temperature range (difference between the maximum and minimum temperatures).

With regard to precipitation, the KMD's data shows the following trends:

- Neutral to slightly decreasing trends in the annual rainfall series over most areas. This is mainly due to an associated general decline with time of rainfall in the main rainfall season of March-May (the "Long Rains") over most areas.
- There is a general positive trend (increase) in rainfall events of September to February period suggesting a tendency for the "short rains" (October-December) season to be extending into what is normally hot and dry period of January and February over most areas. This may be attributed to possibly more frequent occurrences of El-Niño events occasionally coupled with relatively warmer sea surface temperatures over the western Indian ocean (along the coast of east Africa) and relatively cooler than average sea surface temperatures (SSTs) to the east of the Indian Ocean. This sea surface temperature pattern is conducive for enhancing rainfall over the country. Even in the absence of El-Niño conditions, this pattern over the Indian Ocean results into heavy rainfall during the "short rains" season as was the case in 1961-62 and the recent 2006-07 rainfall events.
- In general, annual highest rainfall events indicate the 24-hour intense rainfall amounts observed in the recent years are relatively lower than those in the early 1960s. Effectively, these values have *been reducing (negative trend)* with time (Figure 3-4).

Figure 3-4 Rainfall trends over Lamu and Garissa over the last 50 years



Source: KMD (Input by the KMD to the National Climate Change Response Strategy (NCCRS) development process)

- These trends are also depicted in the time series of the "long rains" (MAM) season that contributes a significant amount of rainfall to the annual totals over most parts of the country. However, the changes (reductions) are not very significant. Most of the standard seasons also depict the same type of patterns in the highest daily rainfall values observed.

- There is an indication of relatively *more intense rainfall occurring more frequently over the coastal strip* and the northern parts of the country in the SON and DJF seasons.

Climate Projections

Results from the North Carolina State University enhanced version of the RegCM3 regional model (Anyah *et al*, 2006; In ICPAC/SEI 2009) which were run for both a control and one climate change (A2 scenario) simulation, have been analysed for Kenya. A domain resolution of 20 km forms the basis of these experiments. This class of models offers much higher resolution than the GCMs (general circulation models) and, as a result, are of relevance to complex terrain which characterizes Kenya. The regional model was forced by global fields from the FvGCM model. The results from this Regional GCM model indicate that Kenya is likely to experience the following climate changes between the late 2020s and 2100:

- Average annual temperature will rise by between 1°C and 5°C, typically 1°C by 2020s and 4°C by 2100
- Climate is likely to become wetter in both rainy seasons, but particularly in the "short rains" (October to December). Global Climate Models predict increases in northern Kenya (rainfall increases by 40% by the end of the century), while a regional model suggests that there may be greater rainfall in the West
- The rainfall seasonality i.e. "short and long rains" are likely to remain the same
- Rainfall events during the wet seasons will become more extreme by 2100. Consequently flood events are likely to increase in frequency and severity
- Droughts are likely to occur with similar frequency as at present but to increase in severity. This is linked to the increase in temperature

SCENGEN Scenario Projections of Kenya for 2030 and 2050

Realistic regional and local scale climate change scenarios are critical for an assessment of the impacts, and vulnerability for the specific socio-economic sectors and hence the development of appropriate adaptation strategies. In order to generate such regional climate change scenarios, high resolution Regional Climate Models (RCMs) are usually "nested" within GCMs to be able to represent the unique effects of smaller scale factors such as mountains, lakes, and land use among others (IPCC, 2001).

Several computer application software packages are now available for doing this, i.e. for downscaling regional climate change scenarios using Intergovernmental Panel on Climate Change (IPCC), Special Report on Emissions Scenarios (SRES). Downing *et al.* (2009); In ICPAC/SEI (2009) have applied such computer software, a MAGICC/SCENGEN[5] to six GCMs in order to generate downscaled future climate scenario for Kenya. The results show that, compared to the 1961-1990 average:

[5] *The Model for the Assessment of Greenhouse-gas Induced Climate Change (MAGICC) module consists of a suite of coupled gas-cycle, climate and ice-melt models integrated into a single software package that determines changes in greenhouse-gas concentrations, global-mean surface air temperature and sea-level resulting from anthropogenic emissions of greenhouse gases and aerosols. The SCENario GENerator (SCENGEN) uses the output from MAGICC to produce maps showing the regional details of future climate.*

- The mean annual temperature will increase by between 0.8 - 0.9 °C across the country by the year 2030 and from 1.5 to 1.6 °C by the year 2050 for the IPCC mid-range emission scenario (A1B), while annual precipitation will change from 7.0 - 9.7 % and 13.3 - 18.8 % for 2030 and 2050 respectively.

- The order of magnitude projected in mean seasonal temperature changes among the four seasons (DJF, MAM, JJA and SON) is more or less similar to the annual changes. It should be noted that the observed increase in temperature will enhance evapotranspiration, resulting in significant reduction in water resources availability. Areas that are projected to have increased rainfall (most parts of Kenya) may not necessarily have surplus water, as evapotranspiration rates and water conservation practices will be significant factors in the water balance of those areas and hence determine water availability.

- While the temperature variation was not significant among the seasons, it was noted that for rainfall, the December-February season showed significant increase compared to the baseline rainfall.

- Increases of mean annual rainfall of up to 10% in northern parts of Kenya for 2030 scenario, with corresponding values of 18% in northern Kenya for 2050. However, these regions are generally arid and semi-arid such that the percentage projected increase in rainfall may not result in significant amounts but may result in episodic flooding.

Projections on Sea Level Rise

- The IPCC which in its AR4, predicts a global sea level rise of about 18 to 59 cm by 2100 (IPCC, 2007).
- A study that suggests that 17% of Mombasa's area could be submerged by a sea-level rise of 30 cm (Awuor *et. al*, 2008).

3.1.3 Rwanda

Climate

Rwanda coordinates indicate that this country is entirely situated in the equatorial zone. Yet its higher altitude between 1000 and 4507m moderates its temperatures and accounts for its temperate climate (Köppen Cw) (Peel *et al.* 2007).

The observed average of 1961 to 1990 show that rains, like temperatures, are moderate; this is in fact the result of a combination of a certain number of factors whose explanation is in the general and regional atmospheric circulation. These factors are among others: the ITCZ, subtropical anticyclones, tropical cyclones, monsoons, east waves as well as the tile connections such as the temperatures of the surface of the oceans (SST) and ENSO.

Temperature and Rainfall

The principal factor that controls the rainy seasons in Rwanda is the ITCZ characterised by low pressures, the maximum of humidity and the convergence of winds. It crosses Rwanda twice a year and determines the two rainy periods:

- From mid-September to mid-December and from March to May, the ITCZ is at its turn, controlled by the position and intensity of subtropical anticyclones such as the Mascarene Islands, Saint Helen, Azores and the Arabian Dorsal.

- From mid-September to December, the dominating winds are from the Northeast and humidity come from masses humidified by the Indian Ocean and Lake Victoria.

The dry season that follows (mid-December to end February is characterised by the penetration in East Africa by masses of dry and cold airs from the Arabian Dorsal. However, the moderating effect of Lake Victoria and the diversity of the Rwandan relief maintains some rainfall in Rwanda.

- During the season from March to May, Rwanda is influenced by a front situated between the dry winds from Southeast and from Southwest, which carry the humidity from the South Atlantic passing through the Congolese Basin
- Lastly, during the dry season from June to mid-September, the air masses of winds from South–East which arrive in Rwanda are dried by the continental air crossing of Tanzania and present a divergence in the low layers resulting in low to little rainfall.

The annual mean rainfall totals varies westward from 700 mm to 1,600 mm following the topography of the country (Figure 4). The annual mean temperature varies eastward from 15°C to 21° in the western highland to eastern plains and hills respectively. The absolute minimum temperature recorded in Kinigi (Northern Province) is 0°C and the absolute maximum temperature recorded in Kigali is 35.4 C.

- The rainfall and temperature variability across Rwanda is influenced by topographical features such as the: t mountainous region of the Congo-Nile Crest which overlooks Lake Kivu (1,462 m) and rises to between 2,500 and 3,500 m. The temperature varies from 15 to 17°C; its annual average rainfall around 1,400mm with one dry month, July, and can reach or exceed 1,600 mm;
- The central plateau, a dissected landscape with hills culminating around 1,700-1,800 m, has temperatures with range from 19 to 20°C. The dry season lasts three months (June-August) and its annual rainfall varies around 1,200 mm;
- The Eastern low plateau is characterised by a wider flat topography around 1,500 m (1,200-1,600 m). The annual average temperature is in the range of 21 to 22°C, and less annual rainfall, generally around 950 mm; the dry season lasts three to four months (June-September);
- Finally, a small area in north Tanganyika is found in Bugarama where annual average temperature may reach 24°C, and rainfall about 800 mm. Its dry season is more severe, lasting five to six months (May-October).

Climate Trends

According to the analysis of observed rainfall at Kigali meteorological station (REMA, Second National Climate Change, 2010), the monthly and annual total rainfalls recorded during the last six years are generally lower than the average of 1961 to 1990. More particularly, April, the month with the highest rainfalls has been recorded as having the rainfall equivalent to 27%, 48%, 88%, 70% and 52% respectively in 2000, 2001, 2002, 2003 and 2005. However, the months of July, September, November and December have had higher rainfalls than normal with the percentages respectively of 1,441% (in 2001), 189% (in 2003), 165% (in 2006) and 153% (in 2006). These high rainfall levels are not equally distributed across months: they may take place in less than four days and sometimes in one day and often result in floods and landslides. For example heavy rains on the 3rd of May 2002 in Kigali city resulted in heavy flooding in the Nyabugogo valley. The Kanombe Airport meteorological station indicated 63,2mm of rainfall night of 2nd to 3rd May 2002. The heavy rainfall events occurred in

September 2007 which affected the Districts of Rubavu (Gisenyi station: 70.8mm) and Nyabihu (particularly Bigogwe Sector)

An analysis of the daily rainfall data for Kigali Airport station for the period 1971-2010 is provided in Table 3-5 below.

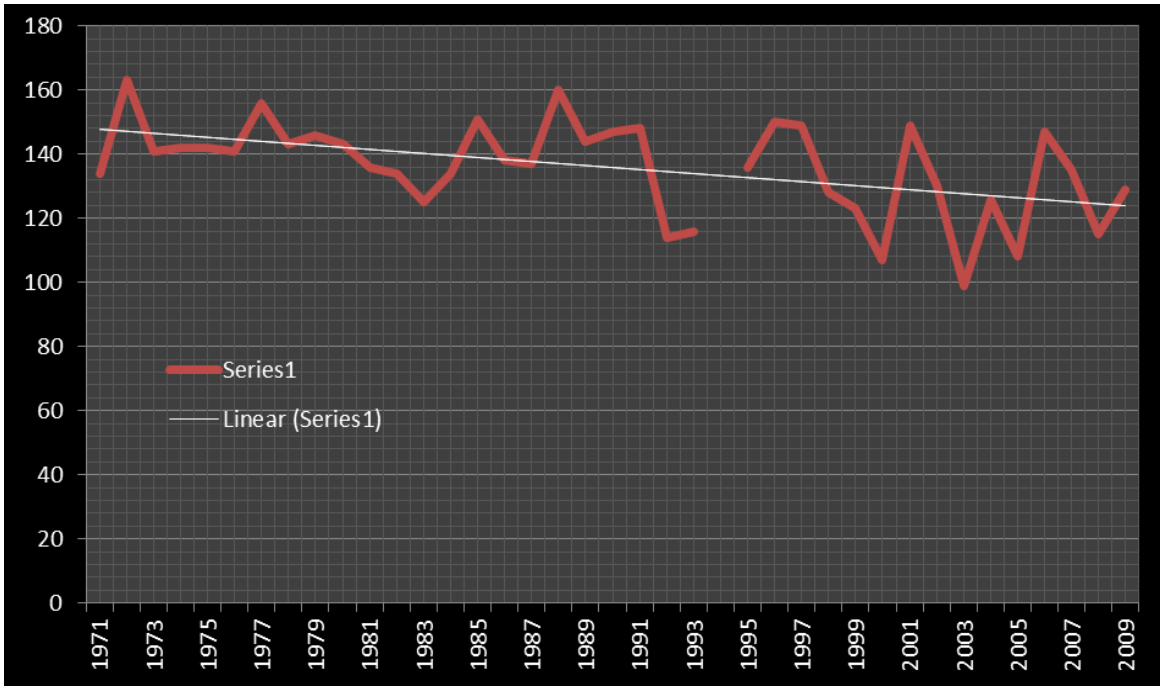
Table 3-5 Monthly average number of rain days Kigali

Month	Raindays (1971 - 1990)	Raindays (1971 - 2010)
1	11	11
2	13	11
3	15	16
4	20	17
5	14	12
6	3	3
7	2	2
8	6	4
9	12	10
10	17	17
11	19	16
12	15	13
Annual Total	147	132

Source: RMS

A comparison of 1971-1990 and 1991-2009 periods indicates that the monthly average number of rain days generally decreased for most of months including April and November which are the rainiest months of year. Figure 3-5 shows the trend of annual total number of rainfall days. On average, the annual total number of rainfall days decreased from 148 days to 124 days from 1971 to 2009.

Figure 3-5 Annual Number of rain days (days) at Kigali station



Source: RMS

The monthly average rainfall totals, generally decreased in the last years (1991-2009 period). This is also confirmed by the annual average rainfall totals which decreased from 1,020 mm to 920 mm. In other words, during the 1991-2009 periods, the lost average rainfall is about 100 mm per year compared to 1971-1990 period. In addition, the standard deviation has generally increased, meaning that the rainfall becomes less stable. This indicates that in the last period (1991-2009), the rainfall maxima are very high in some years and the rainfall minima are very low in other years.

Heavy daily rainfall is becoming more and more quantitatively significant. In addition, this heavy rainfall has been observed in what is usually a dry month. The illustrative case is 22nd July 2001 and 28th July 2007 with recorded rainfall of 106 mm and 57 mm respectively (Table 3-6). Thus, floods may be expected even during dry seasons.

Table 3-6 Rainfall exceeding 50mm in 24 hours (1971 – 2010)

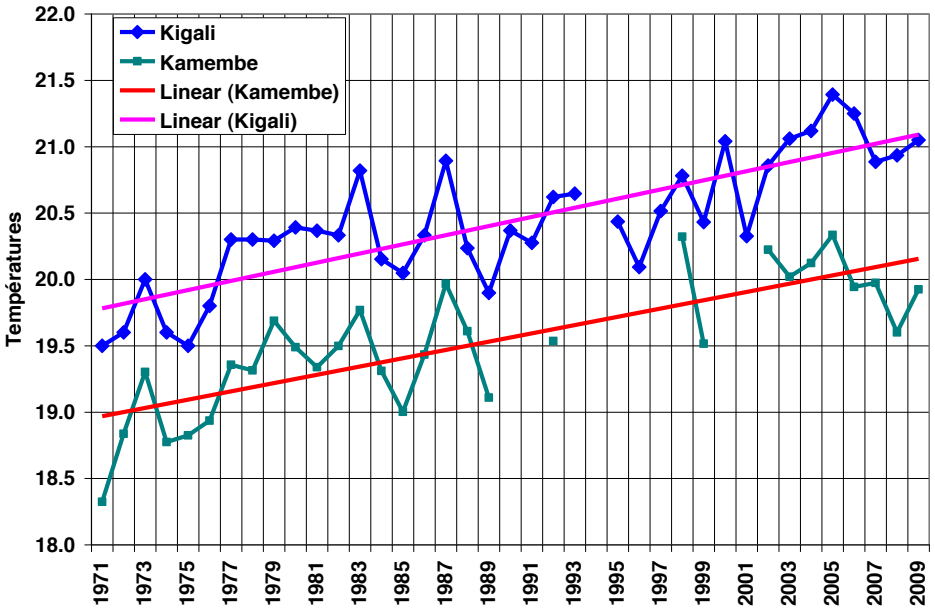
Year	Month	Rainfall (mm)
1977	4	72.7
1977	12	53.2
1979	3	61.5
1979	5	56.9
1980	2	89.9
1980	9	63.7
1981	1	57.3
1981	4	53.5
1981	8	66.8
1981	9	52.6
1982	4	91.9

1982	12	58.3
1983	6	60.1
1984	4	59.9
1985	4	58.8
1987	9	74.3
1987	11	52.7
1988	1	76.6
1988	5	61.7
1989	4	68.7
1990	9	52.5
1994	1	50.9
1998	2	54.8
1999	3	59.3
2000	10	52.6
2001	3	63.6
2001	7	106
2001	11	61.3
2002	1	79.9
2002	5	63.2
2002	12	58.2
2003	9	64.6
2007	7	57
2010	1	85.3

Source: RMS

The analysis of the average annual temperatures from the Kigali Airport Station (1971-2007) located in the centre of the country and of Kamembe station (south-West of Rwanda) shows a clear increasing tendency in rainfall levels. Figure 3-6 below confirm this. In fact, in the case of Kigali Airport the average temperature value was 19.8°C in 1971 and has now increased to 21.0°C in 2009, an increase of 1.2°C in 39 years (Figure 3-6).

Figure 3-6 Variation of the annual average temperature in °C (1971-2009) at Station de Kigali Airport (centre of the country) and Kamembe Airport (South West of the country) stations



Source: Data analysis provided by the Rwanda meteorological service

This temperature increase of 1.2°C in 39 years is remarkable in as much as it exceeds the one caused by global warming estimated at 0.8°C in 150 years. A similar trend has been detected at Kamembe Airport station (Figure 3-6) located in the south west of Rwanda. This seems to confirm the findings of the fourth IPCC report (IPCC, 4th Assessment Report, WG I, Ch.11: Regional projections; J.H. Christensen *et al.*, 2007) according to which the warming of the African continent could exceed that of the global warming of the planet.

Climate Projections

Using 12 different GCMs, there is high likelihood that rainfall quantity will increase by the end of 21st century in both Rwanda and Burundi. [6] While this rainfall increase is predicted to be between 10 and 20% of observed mean rainfall in 1961-1990, there is no indication whether the temporal rainfall distribution will be enough to meet future water requirements. According to rainfall observations in Rwanda since 1990s, there is a probability of having less rainfall days (impacting mostly on phonologic periods of crops) and more intense rainfall (daily) resulting in an increased amount of floods, landslides and associated impacts.

According to climate scenarios A1F1, A2, B1 and B2 the temperature is expected to increase gradually in Rwanda during the 21st century (Ruosteenoja et al., 2003) The increase expected is from 0.75 to 3.25°C during the shorter dry season (December to February) and from 1 to 3.25°C during the longer dry season (June-August).

3.1.4 Tanzania

Climate

Tanzania is comprised of four climatic zones: the Coastal strip, Highlands, Plateau and a semi-desert zone, a south-westerly strip dissecting the country. Using the Köppen-Geiger climate

[6] Mxolisi E. Shongwe , Projected changes in mean and extreme precipitation in Africa under global warming, Part II: East Africa" (Journal of Climate, November 22, 2010)

classification, the majority of Tanzania falls within the tropical savannah (AW) climate category (Peel *et al*. 2007). As with Burundi, this category is characterised by abundant summer rainfall and little or no rain during winter period.

Tanzania's climate is influenced by many of the same weather systems as the other Partner States. The ITCZ plays an important role in regulating the occurrence, frequency and timing of rainfall. Other important climate influences include ENSO episodes which govern precipitation patterns in the region.

Temperature and Rainfall

The climate of Tanzania varies from place to place in accordance with geographical location, altitude, relief and vegetation cover. The country can thus be roughly divided into four main climatic/topological zones:

The Lowland Coastal Zone can further be divided into three sub-zones: the wet sub-zone, between 0 to 500 m of elevation, with 1,800 mm of annual rainfall on average; humid sub-zone, elevation ranging from 500 m to 1000 m with a tropical climate, where it is hot and humid during the rainy season (March-May) and an annual rainfall of between 1000 and 1,800 mm, and the drier zone, about 1,000 metres in altitude, with less than 1,000 mm of rainfall per annum.

The Highlands Zone is comprised of the North-eastern Highlands, which include the Usambara Mountains, Mt. Kilimanjaro and Mt. Meru. The climate is semi-temperate in the mountains with the short rains (Vuli) coming in November - December and the long rains (Masika) falling between February and May. The Southern Highlands, which include Mt. Rungwe, Livingstone ranges, and Mt. Mbeya are, however, unimodal with the rain season taking place between November and May. As catchment areas, these are generally areas of high precipitation.

1. **The Plateau Zone** is a drier unimodal climate plateau region with considerable seasonal variations in temperature. Found around Lake Victoria and much of western Tanzania, this zone is occupied by what are generally referred to as miombo woodlands. These are, in the main, dry areas with an average rainfall of up to 1,000 mm.
2. **The Semi-Arid Zone** is found mainly in central, north and north-eastern Tanzania, especially around Dodoma, Shinyanga, Arusha, Manyara, Mwanza and Mara Regions. The zone has a rainfall of less than 600 mm per annum.

Temperatures in Tanzania also vary according to the geographical location, relief and altitude. In the Coastal Zone and the off-shore Islands the average temperatures range between 27^{o}C and 29^{o}C, while in the central, northern and western parts of the country temperatures range between 20^{o}C and 30^{o}C and higher between the months of December and March. In the northeast and southwest, where there are mountainous areas, and the Makonde Plateau in the south, the temperatures occasionally drop below 15^{o}C at night during the months of June and July. In some parts of the Southern Highlands temperatures can reach as low as 6^{o}C. This temperature variation has significant impacts on the agro-ecological zones and the adaptation strategies in the agriculture sector.

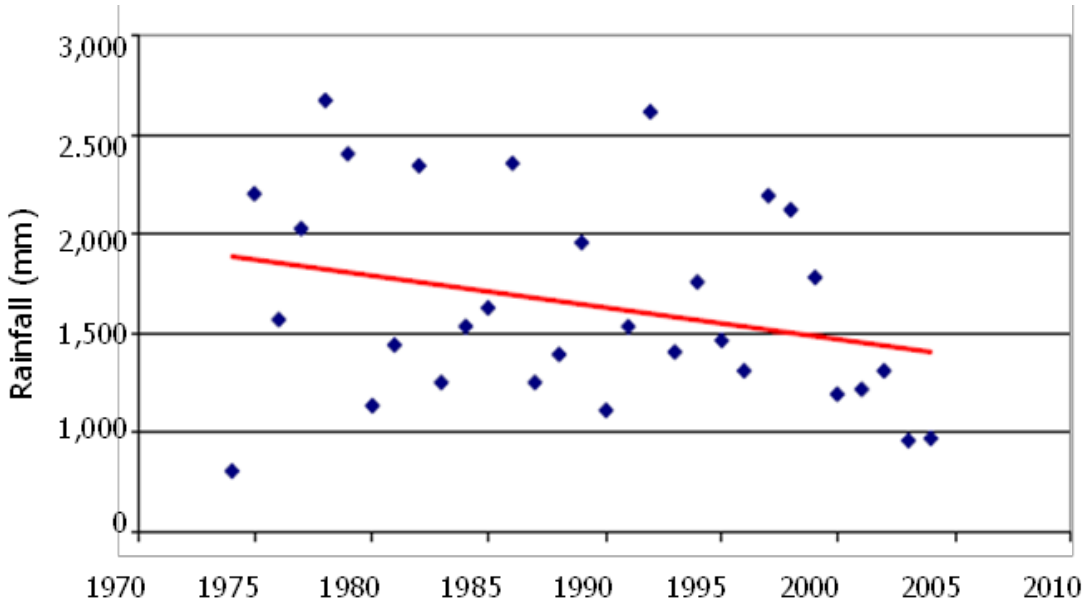
Climate trends

Country wide, the mean annual rainfall varies from 500 mm to 2,500 mm and above. Average annual precipitation over the entire nation is 1,042 mm. The average duration of the dry season is 5 to 6 months. However, recently, the rainfall pattern has become much more unpredictable with some areas/zones receiving extreme minima and maxima rainfall per year (Tanzania NAPA, 2006).

In addition to the findings above, an analysis of total annual rainfall for 21 meteorological stations in selected regions of the country shows a decreasing trend for over 61.9% while 33%

of the stations recorded increase in rainfall. The most affected stations were Pemba, Unguja, Moshi and Arusha (Figure 3-7). The observedrainfall trends attest to the increasing cyclical variability in rainfall pattern.

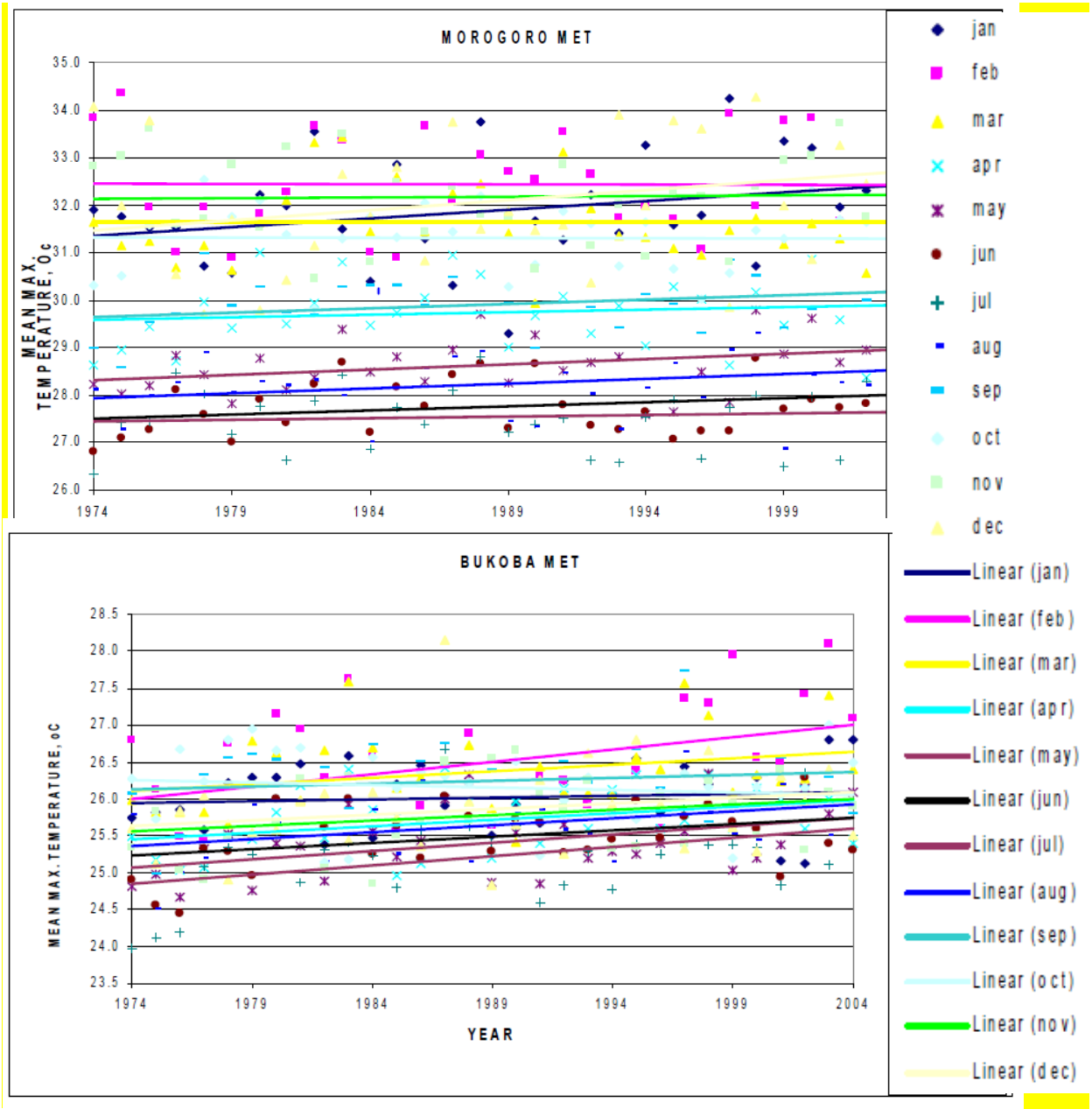
Figure 3-7 Rainfall Pattern at Pemba Meteorological station



Source: TMA

There has generally been a warming trend in the country. Temperature records for meteorological stations in Arusha, Bukoba, Dodoma, Iringa, Kilimanjaro, Mbeya, Morogoro, Mwanza, Songea, Tanga, Zanzibar and Shinyanga have shown an increase in minimum and maximum temperatures over a period of 30 years (1974 – 2004). The increasing trend was most prevalent in the months of January, July and December (Tanzania NAPA, 2006). Between 1922 and 2007, minimum and maximum temperatures in central Tanzania increased by 1.9^{o}C and 0.2^{o}C, respectively (A. L. Mary and A. E. Majule, 2009). Figure 3-8 shows the trend of increasing minimum and maximum temperatures at Morogoro and Bukoba.

Figure 3-8 Trend of monthly minimum temperatures at Morogoro and Bukoba Meteorological stations



Source: TMA

Climate projections

Climate change scenarios developed during the National Communications and NAPA processes indicate that the country is likely to undergo an increase in mean daily temperature as well as in the temperature of the warmest and coolest months. The results indicate that mean annual temperatures are projected to rise by 2.2°C by 2100, with somewhat higher increases (2.6°C) over June, July and August, and lower values (1.9°C) for December, January, February. Annual precipitation over the whole country is projected to increase by 10% by 2100, although seasonal declines of 6% are projected for June, July and August, and increases of 16.7% for December, January, and February. These overall increases are nuanced regionally, with some parts of Tanzania projected to experience increases in annual rainfall, while others are expected to experience decreases.

The National Vulnerability and Adaptation Assessment of Tanzania, under the National Communication, predict increased and modified climate variability. For example, northern and south-eastern sectors of the country would experience an increase in rainfall ranging from between 5% and 45%. The central, western, south-western, southern, and eastern parts of the country might experience a decrease in rainfall of 10% to 15%. The southern highlands might similarly experience a decrease of 10%, which could alter the suitability of this area for maize cultivation. These overall average figures also mask potentially more complex seasonal variability patterns. For instance, the north eastern sector might experience an increase of 25%-60% in the short rains and an increase of 20- 45% in the long rains, and the north coastal region might get an increase of 0-20% in the short rains and a decrease of 0-10% in the long rains.

Additionally, the timing of rains will become less predictable and their intensity is likely to become more volatile. While there are no precise predictions of sea level rise for Tanzania, the IPCC has predicted a global average sea level rise of between 18 and 89 cm by 2100. Impacts on the Indian Ocean are expected to be highly variable, and impacts on Tanzanian Coastline and islands are also uncertain, due to variables such as currents and modifications of tidal patterns and overall regional climatic patterns. Consequently, Tanzanian government estimates are based on a conservative and a worst-case scenario of 50cm and 1m sea-level rise, respectively.

Warming temperatures are projected to cause more frequent and more intense extreme weather events, such as heavy rain storms, flooding, fires, hurricanes, tropical storms and El Niño events (IPCC, 2001). Tropical storms can ravage coastal areas and intensify the impacts of sea-level rise by accelerating erosion in coastal areas and by removing protective natural buffer areas that absorb storm energy, such as wetlands and mangroves (Magadza, 2000). Extreme rainfall and subsequent heavy flooding damage will also have serious effects on agriculture including the erosion of topsoil, inundation of previously arid soils, and leaching nutrients from the soil. Regional fluctuations in lake levels are another impact of regional climate variations and are expected to worsen with projected climate change.

While uncertainties in climate change and impacts projections are a characteristic feature that poses a challenge for anticipatory adaptation for any country, Tanzania's case has several characteristics that might argue for a differentiated adaptation strategy. First, the climate change projections on which all national impact and vulnerability assessments are based (all the way to the Initial National Communication of 2003) rely on a limited number of older generation of climate models and scenarios, about early 1990s, which has several implications for assessment of impact and adaptation options. For example, an analysis based on more recent climate models concludes that the magnitudes of temperature increases projected for Tanzania might be somewhat lower (though the trends are broadly consistent) with the projections used in the National Assessment of Vulnerability and Adaptation. Thus, information on impacts might

need updating in Tanzania prior to the formulation of aggressive adaptation responses, more so than in other countries where projections might be based on more recent models.

3.1.5 Uganda

Climate

Temperature and Rainfall

Moderate temperatures are experienced throughout the year and the mean daily temperature is 28^0C. The highland area has cool temperatures; savannah tropical climate, including the lake basin has moderate average temperatures of 28^0C; and the semi-arid climate has relatively high average temperatures, ranging from 26.3^0C to 29.0^0C. Uganda experiences moderate temperatures throughout the year because of its location astride the equator and on a raised plateau with the highest temperatures of over 30ºC, experienced in the north and northeast of the country while temperatures as low as 4ºC experienced in the highlands of the southwest. Extreme temperatures of 33.3^0C and 35.6^0C have been recorded in the semi-arid climate[7]. Temperatures below 0^0C are registered on the high mountains of Rwenzori and Elgon[8].

Uganda has two rainy seasons, namely, March-June and October/November-December/January. Uganda's rainfall exhibits considerable spatial and temporal variability (500 to 2600mm/yr) partly due to a number of factors including complex topography, the existence of large inland lakes such as Lake Victoria and Kyoga, and the seasonal migration of the Inter-tropical Convergence Zone (ITCZ). Bukasa Islands in Lake Victoria receives in excess of 2200 mm per annum[9]. The average long term annual rainfall for Uganda (1960 to 1990) is 1318 mm[10] derived from the centres shown in Table 3-7.

[7] Ibid
[8] See NEMA 2009; Uganda: Atlas of Our Changing Environment, Kampala published at http://www.nemaug.org/atlas/Sensitivity_atlas_2010.pdf (accessed on 14 April 2011)
[9] See National Environment Management Authority (NEMA); State of Environment Report for Uganda 2008 published at http://www.nemaug.org/reports/n_s_o_e_r_2008.pdf (accessed on 8 April 2011) p.107
[10] See Uganda's Initial National Communication

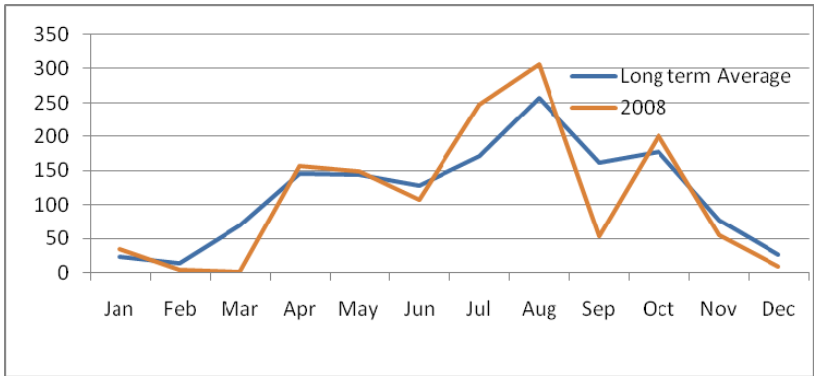
Table 3-7: Average long-term (1960 – 1990) annual Rainfall patterns in Uganda by regions and centres in millimetres (mm)

Region	Districts	Rainfall
EAST		**1365**
	Jinja	1321
	Tororo	1462
	Soroti	1312
	Moroto	745
WEST		**1043**
	Mbarara	905
	Kabale	994
	Kasese	970
	Masindi	1304
NORTH		**1464**
	Gulu	1555
	Lira	1430
	Arua	1406
CENTRAL		**1400**
	Kampala	1180
	Entebbe	1619
Average for all regions		**1318**

Source: Uganda Bureau of Statistics (Statistics Abstract 2000)

Figure 3-7 (a) shows Long Term Average and Monthly rainfall trends for the year 2008 for Gulu (northern Uganda). In the 1st and 2nd quarter of 2008, rainfall was generally below the long term average trend while in the 3rd quarter rainfall was above the long term average trend. In the 4th quarter however the rainfall figures fell slightly below the long term average trend. In 2008, the lowest rainfall was recorded in February.

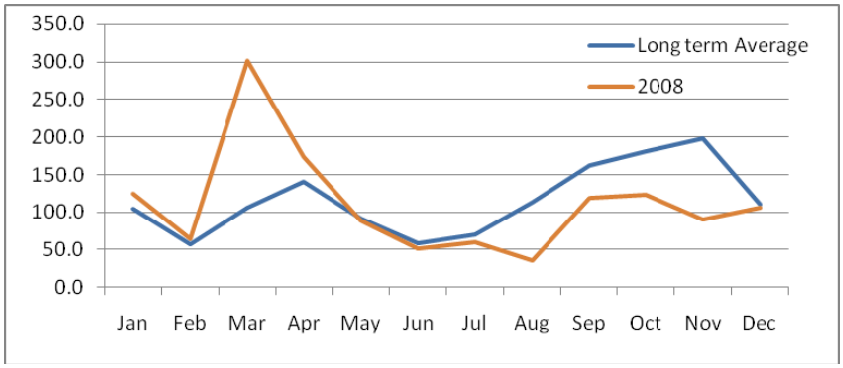
Figure 3-7 (a): Monthly Rainfall in Gulu (northern Uganda) in Millimetres



Source: Uganda Bureau of Statistics 2009

Figure 3-7 (b) shows the Long Term Average and Monthly rainfall trends for the year 2008 for Kampala centre (south central Uganda). During the 1st half of 2008 the rainfall level was higher for some months than the long term average. However, the long term average was higher than the rainfall received in the 2nd half of 2008. There was a drop in the December 2008 rainfall as compared to rainfall of the previous month of November 2008.

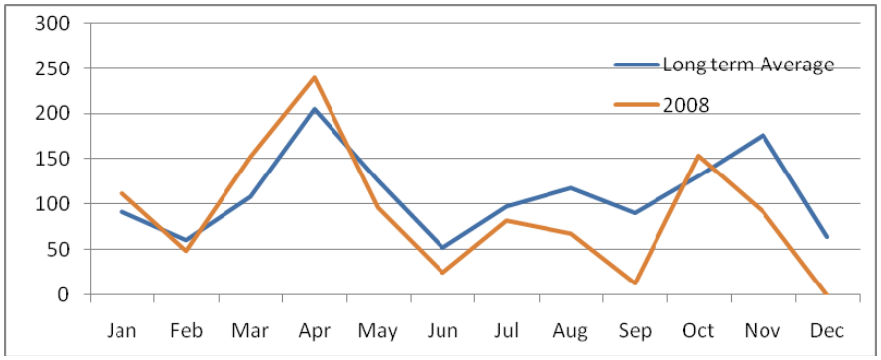
Figure 3-7 (b): Monthly Rainfall Kampala (south central Uganda) in millimetres



Source: Uganda Bureau of Statistics 2009

Figure 3-7 (c) shows the Long Term Average and Monthly rainfall trends for the year 2008 for Jinja. Most months showed minimal differences between the long term average and 2008 rainfall trends, except for September 2008 which recorded 90 mm of the long term average trend compared to 13 mm of the rainfall of the same month.

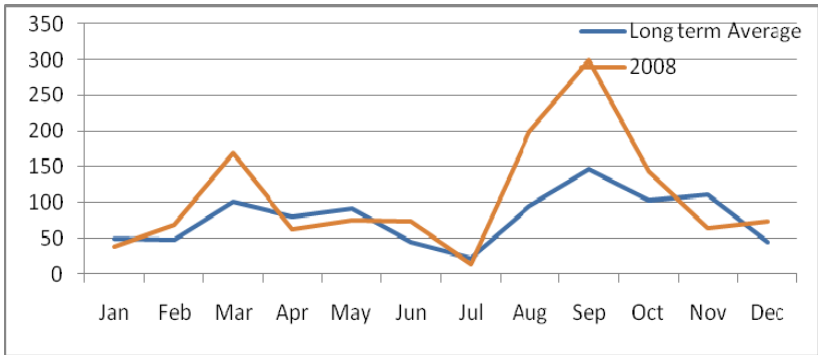
Figure 3-7 (c): Monthly Rainfall Jinja (mid eastern Uganda) in millimetres



Source: Uganda Bureau of Statistics 2009

Figure 3-7 (d) shows the Long Term Average and Monthly rainfall trends for the year 2008 for Mbarara. The rainfall movements for 2008 were similar to that of the long term average for most of the months, although the 2008 rainfall was generally higher than the long term average rainfall for the most months[11].

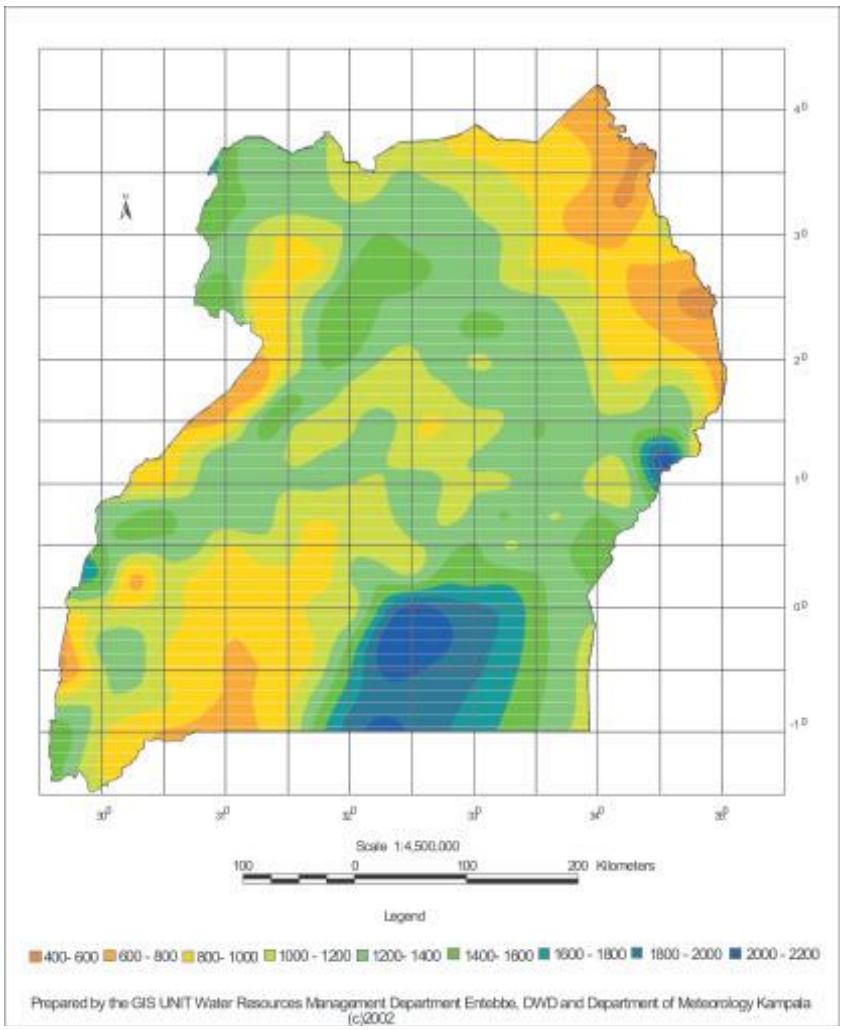
Figure 3-7 (d): Monthly Rainfall Mbarara (western Uganda) in Millimetres



Source: Uganda Bureau of Statistics 2009

[11] *See UBOS Statistical Abstract 2009, p.1-4*

Figure 3-8: Map of Uganda showing Mean Annual Rainfall



Source: Department of Meteorology

Climate Trends

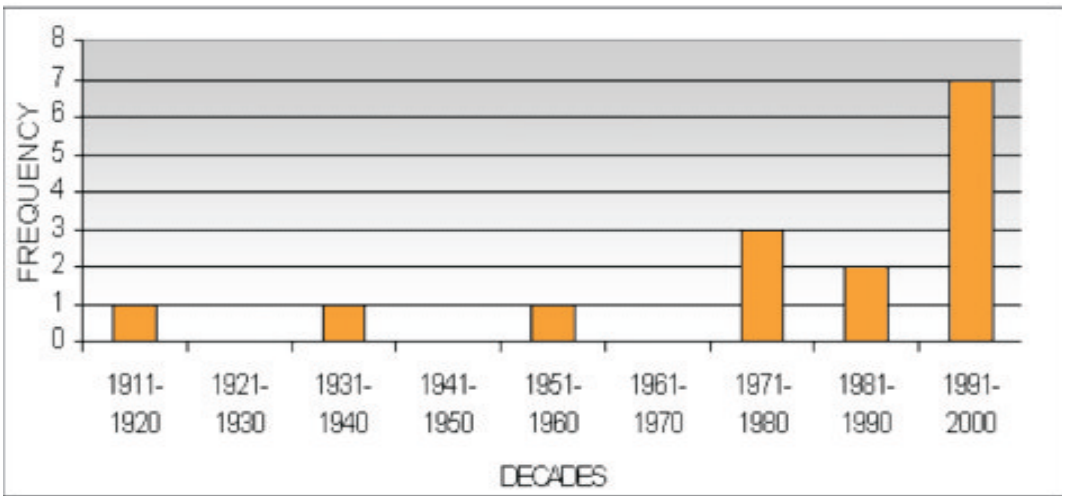
Uganda is experiencing increased levels of climate variability. Heightened rainfall variability has led to an increase droughts. Records of regional dry and wet years between 1943 and 1999 attest to the increase in rainfall variability in most regions of Uganda (Table 3-7 & Figure 3-9).

Table 3-8 Records of regional dry and wet years between 1943 -1999

Climatic Conditions	Region			
	South western	Central	Eastern	Central northern
Dry	6	4	8	9
Very dry	3	2	2	2
Wet	4	2	5	7
Very wet	2	4	4	3

Source: Department of Meteorology

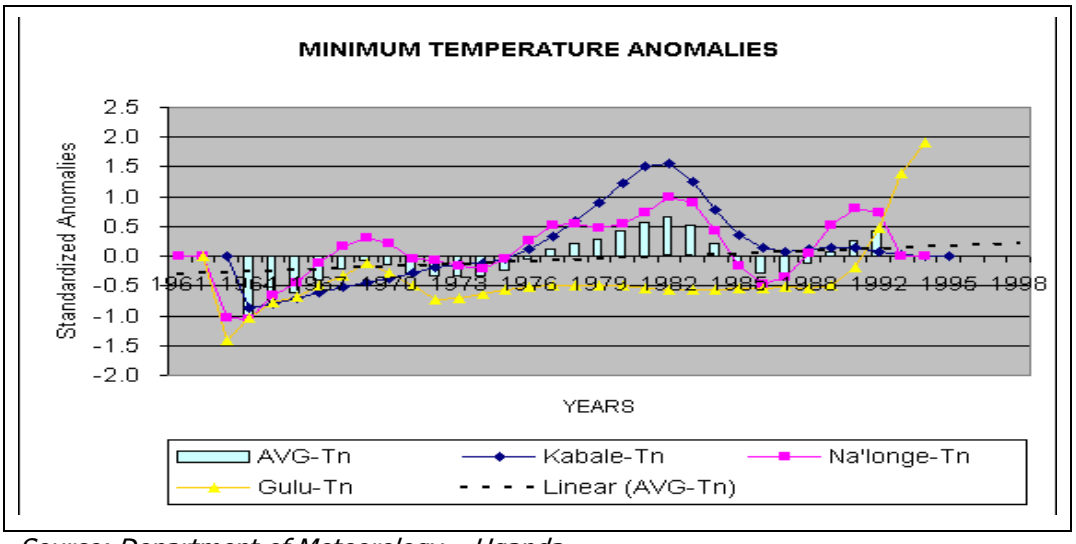
Figure 3-9 Drought Frequency in Uganda (1911-2000)



Source: Department of Meteorology

In terms of temperature variability and trend, there is sustained warming particularly over southern parts of Uganda. The fastest warming regions are in the south west of Uganda where the rate is of the order of 0.3^{0}C per decade. The minimum temperature is rising faster than the maximum temperature. The year-to-year variation in annual mean, maximum and minimum temperatures over selected stations in Uganda are shown in Figure 3-10.

Figure 3-10: Maximum and minimum Temperature Anomalies over selected regions of Uganda



Source: Department of Meteorology – Uganda

Climate Projections

Climate projections for Uganda point to an increase in temperature in the range of 0.7^{0}C to 1.5^{0}C by 2020[12]. The models predict a likely increase in the variability of rainfall with most areas

[12] *See National Development Plan 2010-1015*

getting higher rainfall. According to Uganda's 1st National Communication to the UNFCCC, a limited preliminary vulnerability and adaptation assessment was done under the US Climate Change Country Study Programme (1996), based on three climate scenarios derived from General Circulation Models (GCMs), namely; 1) the Canadian Climate Centre Model (CCCM); 2) the Geophysical Fluid Dynamics Laboratory's Model (GFDs); and 3) the United Kingdom Meteorological Office - 1989 Model (UK 89). Climate variables were used as inputs and simulations were run to provide baseline scenario and future climate scenarios were generated by doubling concentrations of $C0_2$ in the atmosphere by the year 2100. The results showed that all the models used predicted an increase in the temperatures of between 2^0C and 4^0C. There is variation in the precipitation results. The CCCM model gives an overall decrease in rainfall while the other two models gave a slight increase in rainfall.

Analysis of data on temperature variability shows sustained warming especially over the southern parts of the country. Warming temperatures are projected to cause more frequent and more intense extreme weather events, such as heavy rain storms, flooding, fires, hurricanes, tropical storms and El Niño events. Projections for Africa (including Uganda) indicate a 5-20 percent increase in precipitation from December-February (wet months); and 5-10 percent decrease in precipitation from June-August (dry months). These changes are expected not to be uniform and will occur in a sporadic and unpredictable manner. It is also projected that increased precipitation will come in a few heavy rainstorms during the already wet season leading to erosion and other water management problems. It is further projected that there will be less precipitation during the already dry season thus leading to severe droughts and desertification in the region. Evidence of increased variability in rainfall can be seen in the abnormal rainfall in 1998 and 2007 that resulted in extreme floods with serious negative impacts on several sectors including health and transport infrastructure.

3.2 Status of Meteorological Systems and Infrastructure

3.2.1 Overview

The East Africa meteorological services have a long history dating from 1929 (EAC 2004 and 2008). There are meteorological records dating as far back as 1921 (Tanzania NAPA, 2006) and thus provide a wealth of meteorological data which can inform climate assessments of the region. The historical EAC meteorological services have devolved into separate national entities that provide meteorological services for each of the five Partner States.

Table 3-9 provides a summary of the meteorological stations within each Partner State that are part of the Regional Climatological and Synoptic Networks of the World Meteorological Organisation (WMO)

Table 3-7 Meteorological stations

Country	Basic climatological Network	Basic Synoptic Network
Burundi	2	1
Kenya	18	17
Rwanda	1	3
Tanzania	16	18
Uganda	8	9

Source: EAC, 2008

3.2.2 Burundi

IGEBU is the main institution responsible for hydro-meteorological observations and services in Burundi. The synoptic network is made up of three stations at Bujumbura airport, Muyinga and Gitega airport. The Bujumbura station is the National Meteorological Centre and houses the meteorological database. The centre also analyses data and is capable of receiving and processing satellite data. The climatological network consists of about twenty stations in different regions of the country, there are about fifteen stations capable of taking temperature and precipitation measurements, an additional thirty stations are able to take rainfall readings out of a total of 167 stations.

Much of Burundi's meteorological network and infrastructure has been severely damaged by the war from 1993. Thus the much of the infrastructures has to be rebuilt at considerable cost to the country.

The hydrological network consists of about 152 stations located mainly around the lakes and other water bodies in the country. There is no real-time pre-processing of data mainly attributable to an absence of the necessary infrastructure even though core skilled staff is available. No NWP model is running. Daily activity of forecasting relies on NWP products from various international meteorological centres obtained through internet websites.

Archival of data is characterised by lack of data quality control due to insufficient specialized personnel. Archived data are not subjected to regular quality assurance leading to errors and mistakes in data. In addition, there is also a delay in archiving data in the database, resulting in data being kept on loose paper format for a long time. The data is then subjected to Data Management including data entry, quality control and archival as well as retrieval on request to serve clients. Thirty-six outstations have now been provided with PCs on which CLIMSOFT Database Management System (DBMS) is installed for data entry and some manipulations at the station level. Eighteen of these outstations have the General Packet Radio Service (GPRS) through which the near real-time data is transmitted to the data processing section of the department.

The meteorological service lacks communication facilities, such as:

- The link of the meteorological service with the global telecommunication system (GTS) does not exist;
- The service does not have a website;
- The service does not have a media television station;
- The service uses dial-up line connection through Internet Service Provider (ISP). This leads to the problems of downloading documents via internet, particularly big files;
- The NMC does not have fax and photocopier machines;
- Poor telecommunications for national and international data collection and exchange: The service lacks its own telecommunication facilities;
- All communication services are supplied through the aviation telecommunication section. This situation has several implications where there is lack of real time international data collection and exchange of meteorological information such as SYNOP, TEMP etc;
- Only aviation meteorological messages can be available through the existing telecommunication facilities.

Geographic Information Systems (GIS) is not yet being used in meteorological/climate activities. GIS is used mainly in hydrological service and in mapping section under some projects such as the Nile Basin Initiative.

3.2.3 Kenya

Kenya has one the most well-developed meteorological networks in the region (Kenya Meteorological Department, 2011). The KMD is responsible for providing meteorological services such as:

- Provision of meteorological and climatological services to agriculture, forestry, water resources management, civil aviation and the private sector including industry, commerce and public utilities for the better exploitation and utilisation of natural resources for national development;
- Provision of meteorological services to shipping in the western Indian Ocean including the issuing of cyclone warnings for the safety of merchant and other ships;
- Provision of meteorological services to military aviation for the safety of the Kenya Air Force aircraft for national defense;
- Organisation and administration of surface and upper air meteorological observations within its area of responsibility and the publication of climatological data;
- Maintenance of an efficient telecommunications system for rapid collection and dissemination of meteorological information required for national and international use in accordance with the WMO and the International Civil Aviation Organization (ICAO) procedures;
- Coordination of research in meteorology and climatology including cooperation with other authorities in all aspects of applied meteorological research, and the maintenance of the National Meteorological Library;
- Involvement of suitable training programmes in all fields of meteorology and other related scientific subjects which are relevant to the development of Kenya and other countries that participate in the Department's training activities.
- KMD houses three regional (write up to be provided)

Climate Data Collection and Management

In addition to the normal meteorological observatories, there are agro-meteorological stations, of which there are two types: Grade A and Grade B. Grade A stations are operated and manned by the KMD, while Grade B are run by other organisations e.g., the Ministry of Agriculture, universities and agricultural research institutions. Currently there are 13 agro-meteorological stations in the country (11 Grade A and 2 Grade B).

KMD also hosts three (3) WMO's regional institutions, namely: Regional Meteorological Training and Research Institute, Regional Telecommunications Hub, and Regional Instrumentation Workshop. The workshop has the capability of manufacturing basic meteorological instruments such as standard rain gauges, evaporation pans, Stephenson screens and basic mechanical spare parts for repair and maintenance of instruments. The Workshop has the capability of preparing materials for meteorological observatory such as sunshine pillars, optical pilot balloon pillars and fencing pillars for an observatory. In addition, the department has a well equipped Instrument Calibration Unit. The function of this unit is to repair and calibrate instruments namely, rain gauge, thermo-hygrographs, barometers etc. The unit maintains and calibrates instruments from other organizations including instruments from neighbouring countries. The IGAD Climate Prediction and Applications Centre (ICPAC) is also housed by KMD.

Data Processing and Forecasting Systems

On reception at the National Meteorological Centre, the data is verified for any errors and entered into computers. It is then verified for any errors that may have occurred during computer data entry. After the data has been certified to be a true record of the observations made, it is stored offline for future use. Whenever the stored data is required, there are computer programs available to extract the selected data and output it in the desired format.

The main data processing operations have been automated. Computers are involved in all stages of processing. Data entry, archival and retrieval are carried out through CLIMSOFT DBMS. There are plans to automate data processing right from the collection centres. The observatories will be equipped with computers into which data will be entered immediately after capture and then relayed to a central database at the National Meteorological Centre for verifications and archival.

With regard to forecasting systems in Kenya, the status is as follows:

1. Preparation of analyses of the three-dimensional structure of the atmosphere up to continental coverage is done manually. Weather data are plotted on the various charts, from the surface level up to 200 mb, and then hand analysed;
2. Preparation of fields of basic and derived atmospheric parameters, from national to regional level, for 1 to 3 days ahead are done for general weather. The general weather forecasts are done through weather discussion involving a broad section of meteorologists on duty using the analysed charts and satellite products and products from other weather prediction centers. A consensus is then reached on the final forecast product;
3. There are no operational ensemble forecasts systems available as the requisite infrastructure and human capacity was at its infancy and largely nonexistent;
4. Preparation of forecast products, including fields of basic and derived atmospheric parameters, up to national coverage for 1 to 3 days ahead are done for aviation forecast products such as SIGWX and en-route forecasts. Agro-meteorology and marine meteorology products are also prepared;
5. Numerical weather Prediction (NWP), critical for the production of timely and regular short and medium range weather forecasts, was established within the within the Forecasting Division of KMD in 2001. One of the purposes for which the NWP section was established was to adopt and customize a suitable Limited Area Model (LAM) that could be implemented for the country. By the end of year 2007, installation and operational use of various LAMs had been attempted. For example, the Regional Atmospheric Modeling System (RAMS) of the Colorado State University, the NCEP/ETA, the HRM/DWD developed from the EM/DM at Deutcher Weterdienst (DWD), Germany as well as the Weather Research and Forecasting (WRF) models have now been successfully installed and tested. The only handicap to these models is the enormous initialization data and advanced computing facilities required. Despite these handicaps, both the HRM and WRM model are now operational.

3.2.4 Rwanda

The Rwanda Meteorological Service (RMS), which was constituted in its current form in 1963, has a large amount of historical data dating as back as 1907. These data were collected from over 150 stations including 11 main stations (synoptic and agro-meteorological station) and stations dedicated for simple climate observation (stations for rainfall and rainfall & temperature). All these stations operated up to 1994. After that date, only a few stations were

put back into service between 1998 and 2000 for civil aviation purposes. Unfortunately, much of this data is not yet computerised and is still consulted from technical documents.

RMS is currently testing the CLIMSOFTsoftware. CLICOM and Excel software are used for data processing; graphic representation and mapping are processed by Excel and SURFER.

Rwanda Meteorological service have a data receiver for Meteosat Second Generation and a MESSIR processing system which allows it to receive continental climate data and satellite data on daily basis but these data are not archived for future needs.

Since the war in Rwanda, the meteorological service has operated very slowly due to lack of staff and facilities needed for collecting, entering and processing data. Since it resumed operations after the 1994 war, the service has not yet updated the climatologic and agro meteorological bulletin. Thus, updated data, necessary for different users in their routine activities is lacking. A summary of Rwanda's current meteorological network is provided in Table 3-10.

Table 3-8 presents Rwanda's current meteorological network (Rwanda Ministry of Infrastructure, 2011)

Synoptic Station	Agrometeorological Station	Climatological Stations
1. Kanombe	1. Kigali-Gitega	1. Bugarama
2. Kamembe	2. Gikongoro	2. Nyarubuye
3. Gisenyi	3. Busogo	3. Sake
4. Ruhengeri	4. Byumba	4. Rwesero
	5. Kibungo	5. Rubirizi
		6. Bicumbi-Nzige
		7. Zaza
		8. Nyagahanga
		9. Simbi (Huye)
		10. Nyamiyaga

Source: RMS

Currently, there is a 5 years meteorological strategic plan including rehabilitating the climatologic network system and recruiting staff. In addition, recent cabinet meetings approved autonomous status promoting Rwanda Meteorological Service. By the end of 2011, it is planned to have 225 observing stations including four subsystems (synoptic, agro-meteorology, climatology and automatic) which means that, for the first time since the war in 1990-1994, Rwanda will have in 2011 the minimum meteorological network restored.

The meteorological services have the following problems;

- Extra weather and climate information from outside is normally sourced only via satellite and Internet and Satellite Distribution System (SADIS) equipment;
- Global Telecommunication System (GTS) link is yet to be re-instated;
- No VSAT equipment installed and internet is slow.

3.2.5 Tanzania

Tanzania Meteorological Agency (TMA) is a well-established meteorological agency offering a wide range of services including weather forecasting (public, marine and aeronautical), various technical services, research and applied services, as well as specific services for the Zanzibar and Pemba delivered by the Zanzibar Office Division (TMA, 2011). TMA is the designated National Meteorological Authority and is entrusted with the task of provision and regulation of weather and climate services in Tanzania. TMA is the only NMHS in the EAC that is established by an Act of parliament.

The following are the core functions of TMA:

- To provide meteorological services for international air navigation on behalf of the United Republic of Tanzania;
- To organise and administer efficient networks of surface and upper air stations necessary to capture accurate records of the weather and climatic conditions of the United Republic of Tanzania;
- To observe, collect, archive and disseminate meteorological and related information for the United Republic of Tanzania;
- To take part in global exchange of meteorological and related data and products for the safety of humankind and to enhance the understanding of the global atmosphere;
- To provide weather, climate services and warnings for the safety of life and property to the general public and to various users including aviation, agriculture and food security, water resources, disaster management, health and construction industry;
- To carry out research and training in meteorology and climatology and in other related fields, and cooperate with other institutions where appropriate, for use in socio-economic development planning;
- To participate in the activities of international organizations and programs, in particular the WMO;
- To cooperate with other institutions concerned with issues related to climate variability, climate change and environment.
- To participate in activities dealing with meteorology under Regional Organisations;
- To publish weather and climatological summaries, bulletins and other interpreted products;
- To collect fees and charges for data, products and services rendered;
- To carry out any other function as the Minister may direct.

As of 2008, the network included 28 meteorological stations and about 13 agrometeorological stations (TMA, 2008). National data collection is mainly through radio telephone, internet, GSM modems and DCP data collection platforms. An AMSS has also been installed at Dar es Salaam

for message switching within the national network. The challenges in the meteorological sector include:

- Rehabilitation of data collection and transmission facilities at the zonal centers and NMC and replace all analogue lines with digital links;
- Utilize advances in telecommunications technologies for automatic weather stations data collection;
- Support the implementation of broadband high-speed internet access at the NMC in support of Numerical Weather Prediction (NWP) and climate modeling and prediction services;
- Establishment of V-sat networking for exchange of meteorological data and products in the country and in the region.

Archiving of the date in TMA is done both on soft and hard copies. Soft copy archival is done using CLICOM software where most of the rainfall and temperature date has been computerized and the process of computerizing the other parameters is going on. In case of hard copy archival the main media are Cards, papers and tabular forms. The data is categorized according to the stations, type of parameters and duration then archived at TMA headquarters. In order to improve climate management the TMA plans to undertake the following:

- To scan all the data in hard copies and store them in soft copies as picture files;
- Microfilming the data;
- Duplications for the worn out papers;
- Archiving all the hard copy data for future use;
- Acquire a robust database management system which will ensure the safety of the data;
- Migration from CLICOM to CLIMSOFT;
- Archival of the data in other out stations for easy provision of services to the local clients of climatic and data services;
- Acquire external storage facilities;
- Install CLIMSOFT at all SYNOP stations to ensure a level of data management is done at regional level.

3.2.6 Uganda

Meteorology services are handled by the Department of Meteorology, located in the Ministry of Water and Environment. The Department carries out its responsibilities through the following four technical divisions; 1) Forecasting Division; 2) Station Networks Division; 3) Data Processing Division and Applied Meteorology; and 4) Training and Research Division[13]. In order to fulfil its mandate, the Department operates six categories of weather stations. These include; 1) Synoptic; 2) Agro; 3) Hydro; 4) Rain gauge; 5) Automatic; and 6) Upper Air.

[13] *Department of Meteorology, Ministry of Water and Environment*

Table 3-9 Status of Station Network in Uganda

Station Category	Established	Operational Stations	Operational Level (Percentage)
Synoptic	12	12	100
Agro	16	8	50
Hydro	14	5	35.7
Rain gauge	300	35	11.6
Automatic	41	6	14.6
Upper Air	1	0	0

Source: Department of Meteorology

Table 3-9 clearly demonstrates that all the station network categories (save synoptic station) are operating below their capacity. While some of the stations exist on the ground, they do not relay data to the National Meteorological Centre. The figures shown in the column "operational stations" refer to those stations that regularly send data to the National Meteorological Centre.

The bulk of data from the different categories of stations (save the rain gauge stations) has to be relayed to the National Meteorological Centre (NMC) for transfer into electronic mode and preliminary analysis. The current system being used is by Radio Telephones and landline communication. However, most of the Radio Telephones are not operational all the time and landline communication is also unreliable because of frequent disconnections. SYNOPS/METARS are fed into the Global Telecommunications System (GTS) hourly for the regional and World meteorological centre hubs[14].

The major constraints[15] of the meteorological sub-sector include:

- Obsolete and inadequate equipment which limits data collection, analysis, and provision of meteorological services;
- Acute shortage of skilled human resources;
- Weak institutional structures;
- Inadequate legal and policy framework to guide the provision of the required services;
- Inadequate funding; and
- Limited appreciation and use of climate data by other sectors of the economy.

The Government[16] has proposed a number of measures to improve the performance of the meteorological sub-sector and these include the following:

- Increase the type and number of automated weather and climate observations stations to meet national and international standards;
- Boost the provision of real time, short term, and long term forecasts to facilitate the performance of different sectors including agriculture, health, and water resources management;
- Recruitment and training of technical personnel to manage meteorological equipment;
- Develop and implement awareness programmes;

[14] *Ibid*
[15] *See National Development Plan*
[16] *Ibid*

- Dissemination of meteorological products;
- Formulation and implementation of meteorology policy;
- Formulation of a legal framework for meteorology (currently a Bill establishing the Uganda Meteorology Authority is being considered by Parliament); and
- Strengthening the institutional framework

3.3 Regional Climate Projections

Climate change is a global phenomenon even though it manifests itself differently in different parts of the world. The scenarios provide an indication of the various GHG emission scenarios, the scale of measures required to mitigate climate change as well the degree of adaptation that would be required to adequately respond to climate change. The IPCC Special Report Emissions Scenarios (SRES) provide a long-term context to inform atmosphere-ocean global circulation models and climate change policy.

The scenarios are categorised into a number of families representing a specific development pathway. Table 3-11 provides a summary of the SRES scenarios and association climate change impacts.

Table 3-10 IPCC Special Report Emissions Scenarios and Global Climate Projections

	Temperature change (^{o}C at 2090 – 2099 relative to 1980 - 1999)	Sea level Rises (m at 2090 – 2099 relative to 1980 - 1999)	
Case	Best estimate	Likely range	Model based range
Constant Year 2000 concentrations	0.6	0.3 - 0.9	NA
B1 Scenario	1.8	1.1 – 2.9	0.18 – 0.38
AIT Scenario	2.4	1.4 – 3.8	0.20 – 0.45
B2	2.4	1.4 – 38	0.20 – 0.43
A1B	2.8	1.7 – 4.4	0.21 – 0.48
A2	3.4	2.0 – 5.4	0.23 – 0.51
A1F1	4.0	2.4 – 6.4	0.26 – 0.59

Source: IPCC, 2001

3.4 Climate Regulating Systems and Projections in East Africa

Major climate regulating systems

The East African climate is strongly dependent on the African Hadley cell composed of the ITCZ, the monsoon wind systems; the sub-tropical high pressure systems; various jet systems (African Easterly Jet, Tropical Easterly Jet and the sub-tropical jet); the easterly and westerly wave systems. ENSO constitutes the most dominant source of inter-decadal variability in the region.

Climate Projections for East Africa

The IPCC global climate projects are based on various Atmosphere-Ocean General Circulation Models (AOGCM) or GCMs developed at research and academic institutions around the world.

The most recent IPCC climate projections were included in the AR4 and serve as the official source of climate projects for all UN sanctioned climate change policy and international negotiations. The IPCC projections are at the regional scale due to the difficulties and uncertainties associated with finer scale climate modelling. The GCMs offer climate projections based on regional scale due to the difficulty and uncertainty associated with modelling at finer scales. The various models used are already subject to some uncertainty, modelling at finer scales only serves to increase the uncertainty associated with projections and simultaneously lower confidence in projected results.

The climate projections presented in this section are taken from IPCC AR4 chapter 4 drafted by Christensen *et al* (2007). In general under all the scenarios discussed in Section 3.3, Africa is projected to warm at far higher rate than the global mean in all seasons. The drier subtropical regions are expected to warm at a faster rate than that of the moist tropics. The continent is also expected to get drier with the exception of some sections of East Africa where precipitation is expected to increase particularly for the December – February period. Small shifts in the position of tropical and subtropical rain belts are likely to result in large local changes in rainfall.

3.5 Status of Policy and Institutional Framework in East Africa

Below is an overview of the current climate change governance -- institutional and policy framework within each of the East African Community Partner States.

Burundi: The Environmental Management under the Ministry of Water, Environment, Land and Urban Planning created in 1988 is in charge of monitoring and implementing international conventions on environment and climate change. It has four General Directorates namely:

1. The General Directorate of Forestry and Environment;
2. Directorate General of Water Resources and Sanitation;
3. The Directorate General of Land Management;
4. Directorate General of Housing and Urban Development.

In addition there is a National Commission of the Environment provides assistance to the Minister for the Environment for the Evaluation of the National Strategy for the Environment, its Plan of Action and its update, the application code environment, regulation of environmental standards and the report's analysis of the state of the environment.

Specifically in terms of climate change, responsibilities are divided as follows:

- Environment Directorate was created in 1998 which is responsible for coordinating national activities of GHG inventories and preparation of national communications is the second focal point of UNFCCC;
- Geographic Institute of Burundi collects data on climate and is the operational focal point of the United Nations Framework Convention on Climate Change;
- The National Climate Change Committee.

Kenya: The Ministry of Environment and Mineral Resources (MEMR) established its Directorate of Environment (DOE) headed by an Environment Secretary. The DOE has 3 directorates covering: Policy Formulation, Interpretation and Implementation; Programmes, Projects and Strategic Initiatives, and Multilateral Agreements.

Within the DOE, MEMR also established in 2009 its National Climate Change Coordinating Office. This office now acts as the Secretariat for the National Climate Change Activities Coordinating Committee (NCCACC) established in 1992 as a requirement under the UNFCCC.

Membership of the NCCACC is drawn from line ministries, academia and research institutions, Non-Governmental Organisations (NGOs) as well as the private sector.

Further, under the oversight of MEMR, the National Environment Management Authority (NEMA) hosts the country's Designated National Authority (DNA), which is responsible for approving climate change mitigation -CDM projects under the Kyoto Protocol. The Kenya Meteorological Department (KMD), which falls under the MEMR, is mandated to provide meteorological and climatological services to the country for the benefit of all sectors and the public in general. Climate research and monitoring are also some of KMD's responsibilities.

In addition, there is a Climate Change Coordination Unit (CCCU) at the Office of the Prime Minister, whose aim is to provide high-level political support to climate change activities in Kenya.

The National Climate Change Response Strategy (NCCRS) adopted in April 2010 has noted the diffuse nature of the existing climate change institutional arrangement. Because the present arrangement does not support a coordinated approach to combating climate change, the NCCRS has proposed an alternative arrangement, i.e., the establishment of a Climate Change Secretariat within MEMR to oversee climate change activities in the country. At the moment, the Secretariat is being staffed. It is also in the process of drawing up an Action Plan for the implementation of the NCCRS in collaboration with other key stakeholders such as the PMO; the Ministry of State Planning, National Development and Vision 2030; and development partners, among others.

Rwanda: The Ministry of Natural Resources (MINIRENA) is the Ministry responsible for designing the state policy related to environment protection, conservation and management. Currently MINIRENA is coordinating the establishment of National Strategy on Climate Change and Low Carbon Development (NSCCLCD). Rwanda Environment Management Authority (REMA) is the official organ in charge of implementing this policy. A successful outcome of this policy requires the collaboration between REMA and all potential stakeholders: departments in ministries, public institutions, schools and research institutions, international bodies and nongovernment organizations.

REMA is the authority in Rwanda in charge of supervision, following up and ensuring that issues relating to environment and climate change receive attention in all national plans. REMA has responsibility to implement the Environment and climate change policy within Economic Development and Poverty Reduction Strategy (EDPRS) framework.

From 2009, a Department of Climate Change and International Environmental Obligation (CCIO) was created and from 2010, operational under REMA. The REMA developed a 5 year climate change strategic plan for CCIO. The main functions of CCIO Department include:

- Developing the capacity of REMA in clean development mechanism;
- Assuring the secretariat of the National Designated Authority under the Kyoto Protocols Clean Development Mechanism;
- Coordinating the preparation and implementation of policy, strategy and regulatory frameworks and instruments towards mitigation and adaptation of the country on climate change;
- Advising on opportunities and emerging issues related to climate change and climate change responses measures;
- Coordinating implementation of Multilateral Environment Agreements (MEAs) and other Regional and international Agreements in the field of environment;

- Provide technical input in negotiating and implementing regional and international conventions, protocols and treaties relating to environmental management;
- Initiate and coordinate the drafting of the national reports and assess convention decisions and recommendation to update the plan by integrating those that are relevant;
- Coordinate the work of the Conventions Focal Points;
- Provide technical advices related to GEF endorsement of projects;
- Ensure national compliance with international and regional agreements related to environment.

Tanzania:

Implementation of climate change issues in Tanzania is undertaken within the context of the National Environment Policy of 1997 and the Environment Management Act (EMA) Cap. 191 as well as other specific legislation developed in this context. There are also various sectoral policies that address climate change.

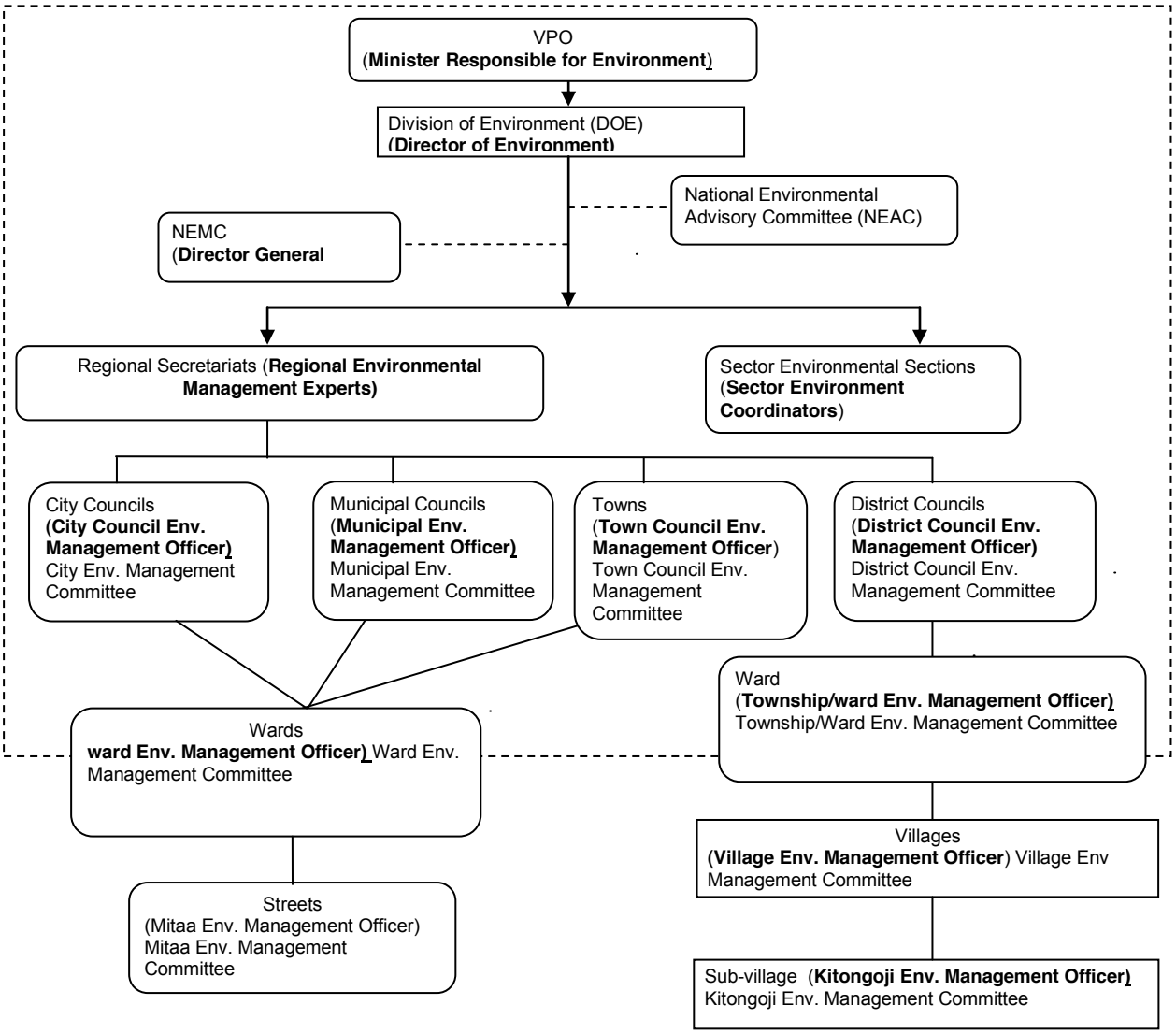
The overall responsibility for coordination in ensuring effective implementation of all environmental policies, laws and rules as well as all climate change and related issues belongs to the Vice President's Office. The Minister Responsible for Environment works under the Vice President and has overall responsibility for matters relating to environmental-management legislation and policy. The Division of Environment (DoE), through the section of Environmental Assessments within the Vice President's Office, is responsible for all climate change related activities. The DoE is both the National Climate Change Focal Point (NCCFP) for the UNFCCC as well as the CDM's Designated National Authority (DNA).

EMA Cap. 191 has facilitated establishment of various committees at both national and local levels. At the national level, there is an established National Climate Change Steering Committee (NCCSC) chaired by the Permanent Secretary in the VPO. All key sectors are members of this committee. Its function is to provide policy guidance to the NCCFP and to ensure coordinated actions and participation within various sectors and institutions. There is also the National Climate Change Technical Committee (NCCTC) chaired by the Director of Environment which is geared to provide technical advice to the NCCFP, stimulate more coordinated actions of actors and broaden the participation of various actors in addressing climate change. The members of the committee are all sector environmental coordinators and representatives of: Development Partners, CSOs, Private Sector, higher learning and research institutions and the media.

The Tanzania Meteorological Agency (TMA) is in charge of provision of meteorological services. It is also the national focal point for the Intergovernmental Panel on Climate Change (IPCC). In addition, a number of line or sector ministries and departments have made attempts at mainstreaming climate change into their operations and mandates.

A detailed diagrammatic representation of the institutional arrangement for environment and climate change as per the Environmental Management Act Cap. 191 is shown in the following figure 3-10

Figure 3-10 Institutional arrangement



Uganda:

In 2008, the Government of Uganda established the Climate Change Unit to coordinate all issues concerned with climate change in Uganda. The Unit is hosted by the Ministry of Water and Environment. In the same year, the Government also established the Climate Change Policy Committee (CCPC) that brings together various Government Ministries and departments and provides policy guidance to the Unit. In July 2010, a new body known as the Inter-Sectoral/Institutional Climate Change Technical Committee was established to provide technical advice to the Unit.

Some of the other relevant institutions include the following: 1) Ministry of Energy and Mineral Development; 2) Ministry of Finance, Planning and Economic Development; 3) Ministry of Local Government; 4) Ministry of Trade and Industry; 5) Ministry of Agriculture, Animal Industry and Fisheries; 6) National Environment Management Authority (NEMA); 7) Uganda Wildlife Authority

(UWA); 8) National Forest Authority (NFA); and 9) National Forestry Resources Research Institute (NaFORRI).

Uganda does not have a specific climate change policy. However, plans are underway to develop a national climate change policy for Uganda[17]. There are a number of other relevant policies and plans including the following: 1) The National Environment Management Policy (1994); 2) The Uganda Forestry Policy (2001); 3) National Policy for the Conservation and Management of Wetland Resources (1995); 4) The National Water Policy (1999); 5) Uganda Wildlife Policy (1995); 6) The Energy Policy for Uganda (2002); 7) Renewable Energy Policy for Uganda (2007); 8) The National Health Policy (1999); 9) National Population Policy for Sustainable Development (1995)); 10) The Disaster Management and Preparedness Policy (1999-revised in 2003); 11) The Draft National Land Policy (March 2011); 12) National Development Plan (NDP) (2010-2015); 13) Vision 2025; 14) Environment Natural Resources Sector Investment Plan (ENR-SIP) (2008/09 – 2017); 15) National Adaptation Programme of Action (NAPA) (2007); 16) Agriculture Sector Development Strategy and Investment Plan (DSIP) (2010/11- 2014-15); 17) Plan for Modernization of Agriculture (2000); 18) Rural Electrification Strategy and Plan (2001-2010); 19) National Biomass Energy Demand Strategy 2001 – 2010; and 20) The Integrated Tourism Development Master Plan (1992).

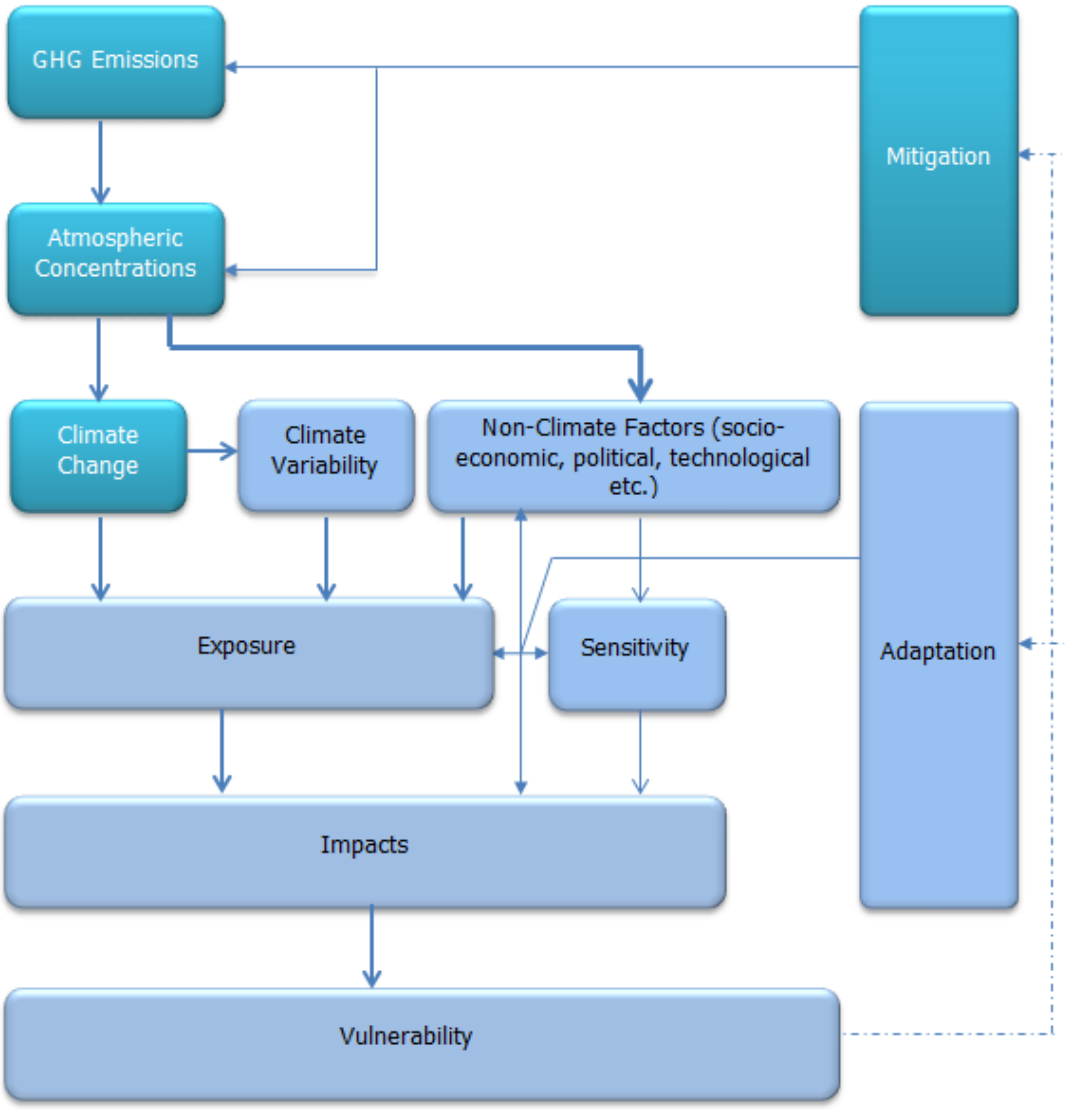
Uganda does not have specific climate change legislation. However, a number of other laws relevant to climate change are in place and they include the following: 1) The Constitution of the Republic of Uganda (1995); 2) The National Environment Act (1995); 3) The Land Act (1998); 4) The National Forestry and Tree Planting Act (2003); 5) The Water Act (1995); 6) The Electricity Act (1999); 7) National Environment (Wetlands, Riverbanks and Lakeshores Management) Regulations (2000); 8) The National Environment (Mountainous and Hilly Areas Management) Regulations (2000); 9) The National Environment (Standards for discharge of effluent into water or on land) Regulations (1999); and 10) Soil Conservation Measures and Guidelines (2000).

[17] *See National Development Plan p.316*

4 Vulnerability, Impacts and Interventions

This chapter assesses the vulnerabilities and sensitivity to climate change of nine key sectors that have been prioritised as the most important to the region. Potential climate change impacts on these sectors are also discussed. Adaptation and mitigation interventions are proposed based on the results of this assessment. Figure 4-1 below presents a conceptual flow of vulnerability assessment. From the figure, it is important to note that factors affecting vulnerability and sensitivity include non-climate factors such as socio-economic, political, technological and others. The method used to conduct the assessment is described as a second-generation vulnerability assessment by Füssel and Klein (2006). The second-generation vulnerability assessment estimates as realistically as possible the vulnerability of sectors or regions to climate change in the context of stress factors relevant to the sector/region, while being mindful of the potential feasible adaptation measures available to reduce the severity of climate change impacts. The assessment thus examined not only the adaptation options available but also the adaptive capacity of people, a function of their ability to implement effective adaption measures. The aim of the assessment was to enable the prioritisation of resource allocation for adaptation and other interventions.

Figure 4-1 Conceptual flow of vulnerability assessment showing factors affecting vulnerability



Source: Hans-Martin Fussel and Richard J.T. Klein 2006. Climate-Change Vulnerability Assessments: An Evolution of Conceptual Thinking. Climate Change Vol. 75 No. 3 pg 301- 329

4.1 Agriculture and Food Security

Key Climate Change Vulnerability. Agriculture, generally the main economic activity in East Africa, is mainly rain-fed and therefore particularly susceptible to drought, especially in areas that are recognised as drylands. The East Africa region is particularly vulnerable to low agricultural yields and productivity which lead to severe food shortages as a result of climate related impacts such as droughts. This vulnerability is exacerbated by the high degree of small-scale subsistence farming, where people are dependent on both the foodstuff cultivated as well as the income provided by sales of foodstuff. Any agriculture-related disaster or setback, robs farmers of the food as well as the income required to purchase food or gain access to services.

Crop Cultivation

Crop cultivation is an important component of the regional economy, a direct source of food as well as the primary source of livelihoods. It employs up to 93% of the Burundi labour force (DCNCC, 2010); 75% of the Kenyan labour force (Kenya National Bureau of Statistics Economic Survey 2010); 80% in Rwanda (MINITERRE, 2010); over 80% of the Tanzanian labour force (Tanzanian NAPA, 2006); and 73% of the Ugandan labour force (Uganda NAPA, 2007).

The majority of agricultural activity in the region is rain-fed both at small-holder and commercial levels. The sector is thus highly exposed to climate variability, at both annual and decadal scales, as well as recurrent natural disasters, with drought as a particular threat. Where rain-fed agriculture dominates, vulnerability to food insecurity is high. The level of vulnerability is heightened even further as the majority of agricultural activity is subsistence based and as such the main source of income and food. The combination of high rates of poverty and climate exposure makes the region highly susceptible to food insecurity. A case in point is the on-going food crisis in northern Kenya which is as a result of a combination of produce failure, drought, unavailability of food and/or inability to afford food due to rapidly rising food prices, etc.

Livestock Keeping

Both commercial and pastoral livestock keeping are a prominent and important part of agriculture in East Africa. Table 4-1 below presents livestock per head in 2009. Although poultry ranks higher than the other livestock per head, cattle have by far the greater market value. Goats are also an important component of livestock keeping particularly in areas with low rainfall.

Table 4-1 Livestock per Head in the EAC

Livestock	Livestock per head
Cattle	50 234 000
Sheep	25 248 000
Goats	59 657 000
Pigs	6 288 000
Poultry	109 826 000

Source: EAC Facts and Figures, 2010

The majority of livestock in these three States is found in arid and semi-arid lands (ASALs), where pastoralism is the dominant means of livestock keeping. In these lands, pastoralism is an essential livelihood strategy for an estimated 20 million people.

This sub-sector is highly vulnerable to adverse impacts of climate change and climate variability (especially drought) as most of the livestock is found in ASALs where rainfall is already quite low; this vulnerable is heightened by considerable rainfall variability. Drought leads to reduced forage availability, degradation of the environment and an increase in destitution of pastoralists. The mobile nature of livestock may exacerbate the transmission of livestock disease and pests within the region.

Fisheries

Fisheries are an important economic activity as well as a direct source of food in the region. Lake Victoria is the most important inland fisheries on the continent (Njiru et al. 2008). The Lake supports freshwater fishing with estimated annual fish yields of about 800,000 – 1,000,000 tonnes per year (LVFO, 2011). The value of the fisheries industry on the Lake is valued at more than USD650 million, of which USD250 million is revenue from fish export. The Lake provides a habitat for over 500 species of endemic species, the most important of which is the cichlid family (LVFO, 2011).

There are only three important freshwater fishery species, the Nile Perch (Lates niloticus) and Nile Tilapia (*Oreochromis niloticus*) and *Rastrineobola argentea*, commonly known as omena or dagaa, the latter being the only native species (Awiti, 2011). The Nile Perch is now the dominant commercial species of economic importance, in the region accounting for more than USD200 million per year in export earnings.

The 'Tanganyika Sardine' is the main fishery product for commercial and artisanal fishing. It accounts for 50 – 90% of the commercial fishery while artisanal are almost entirely dependent on this species (Jorgensen, 2006).

Marine fisheries production is one of the major activities along the Indian Ocean coastline. Kenya and Tanzania are the only two EAC Partner States that have coastal fisheries. Marine fisheries in Tanzania contribute about 15% of the total fish production in the country (Tanzania NAPA, 2006); and 6.5% of fisheries revenue in Kenya (GoK Economic Review of Agriculture, 2010). The main marine species consumed are snapper, Scombrides and mackerel, among others.

Rising ocean temperatures and ocean acidification (also linked to increasing global emissions of carbon-dioxide) are radically altering aquatic ecosystems. Climate change is modifying fish distribution and the productivity of marine and freshwater species. This has impacts on the sustainability of fisheries including aquaculture, on the livelihoods of the communities that depend on fisheries, and on the ability of the oceans to capture and store carbon (biological pump). The effect of sea level rise means that coastal fishing communities are in the front line of climate change, while changing rainfall patterns and water use impact on inland (freshwater) fisheries and aquaculture.

Declining water levels in Lake Victoria (45% attributable to recurrent droughts) (Kull, 2006, unpublished) and rising temperatures will likely lead to decline in fish stocks. Studies for instance show that Lake Tanganyika has warmed significantly over the past 90 years, leading to an increase in stratification and consequently, a decrease in primary productivity e.g. between 1975 and 2000, phytoplankton biomass reduced by over 70% (Verschuren, D. (2003) in Tierney *et al.* (2010).

Table 4-2 Impacts of Climate Change on Agriculture in East Africa

Phenomenon and direction of trend in weather and climate events	**Possible climate impacts**
Warmer and more frequent hot days and nights over most land areas (virtually certain)	Increased yields in colder environments; decreased yields in warmer environments; increased insect pest outbreaks
Warm spells and heat waves increasing in frequency over most land areas (very likely)	Reduced yields in warmer regions due to heat stress; increased danger of wildfire
Heavy precipitation events increasing in frequency over most areas (very likely)	Damage to crops Increased in soil erosion and degradation Inability to cultivate land due to waterlogging of soils Economic shocks from loss of income and livelihood options placing an increased burden on women and children
Drought-affected area increases (likely)	Land degradation and soil erosion lower yields from crop damage and failure; increased livestock deaths; increased risk of wildfire; loss of arable land Economic shocks from loss of income and livelihood options placing an increased burden on women and children
Intense tropical cyclone activity increases (likely)	Damage to crops on coastal regions Damage to fisheries and aquaculture infrastructure

Table 4-3 A SWOT analysis of the East African Agricultural Sector

Strength	**Weakness**
• Abundant rainfall (Burundi, Rwanda) • Access to considerable water resources – Lakes Tanganyika and Victoria • Fairly well developed agricultural infrastructure • Large export market in different sectors of agriculture • Strong contributor to GDP • Diversified cash crops for export markets • Low incidence of livestock diseases such as tsetse flies • High potential for commercial	• Extremely fragmented agricultural activity • Heavy reliance for livelihoods based on small-scale agricultural activities • Crop cultivation and stable foods are not diversified • Low productivity farming methods • Significant proportion of country is classified as arid or semi-arid • Exposure to livestock diseases like Rift Valley Fever • Intense competition for land-use • Extremely fragmented agricultural activity • Heavy reliance for livelihoods based on small-scale agricultural activities

freshwater and marine fisheries and artsinal fishing • Fisheries Policy that recognizes the importance of mangroves to the productivity of the fisheries • Large agricultural markets both horticulture and fisheries	• Crop cultivation and stable foods are not diversified • Low productivity farming methods • Structural constraints e.g. irrigation • Predominantly smallholder based • Heavy reliance on one staple crop - maize • Livestock production concentrated in ASALs • Highly dependent on natural cycles • Livestock forage highly unpredictable • Exposure to livestock diseases like Rift Valley Fever
Threats	**Opportunities**
• Natural disasters and crop failure • Increasing fragmentation of smallholdings • Increasing food prices • Recurrent drought (Kenya, Tanzania and Uganda) • Natural disasters and crop failure • Long dry season and drought • High seasonal temperature fluctuations in ASALS • Land-use pressure and competition	• Potentially food secure • Productivity of most food and cash crops could be increased from 50% to 150% • Increased commercial and artisanal fishing in the EEZ • Upscaling fisheries activities in both marine and freshwater systems

Adaptation in the Agricultural Sector

The following adaptation measures that have been identified in the agricultural sector:

1. Creation/provision of special livestock and crops insurance schemes using weather insurance index;
2. Promotion of water-efficient irrigation agriculture;
3. Creation of strategic grains reserves as a form of post-harvest management;
4. Investment in water capture and storage infrastructure to harvest and store rainwater for agricultural use;
5. Investing in research and development (R&D), e.g. in breeding and dissemination of crop and livestock varieties suited to different agro-ecological zones and changing climatic conditions;
6. Promotion of crops and livestock types and varieties able to withstand the changing climatic conditions such as early-maturing crops and livestock;
7. Promotion of suitable forms of conservation agriculture (CA) to conserve soil and water (moisture);
8. Provision of mobile grain driers to respond to unusual wet conditions during harvesting;
9. Promotion of agroforestry;
10. Creation of livestock feed conservation programmes;

11. Creation of seed conservation programmes;
12. Investment in pest and disease monitoring and control measures;
13. Creation of pest and disease free-zones [livestock];
14. Creation of a robust early-warning system (EWS) to provide extension, advisory & outreach services to farmers and other users;
15. Provision of agricultural inputs, e.g. fertilisers, "improved" seeds and other plant materials through subsidies and other financial tools; and
16. Incorporation of indigenous/traditional/local knowledge on adaptation into modern/scientific knowledge, e.g., traditional knowledge of food preservation and rainfall forecasting/prediction integrated with modern knowledge

Mitigation Interventions in Agricultural Sector

1. Promotion of agroforestry;
2. The use of biodigesters and related technologies to reduce methane emissions;
3. Increased fertiliser consumption efficiency, application technology and a greater investment in non-synthetic fertilisers;
4. Promotion of low-tillage regimes and other agricultural approaches that limit soil disturbance;
5. Avoidance of fumigants such as methyl bromide (covered under the Montréal Protocol). Although this fumigant is being phased out, it is still used extensively in Africa.

4.2 Water Security

Water is one the resources most sensitive to any changes in the climate. Climate change is expected to alter and hence bring changes to the hydrological cycle, temperature balance and rainfall pattern. This has wide-ranging implications since water is one of the most important of all natural resources for socioeconomic, cultural, political and environmental development. It is a commonly used resource and hence a fundamental economic asset for sustainable development. Given the proximity of the most Partner States to major water bodies, the main challenge regarding access to water is inadequate infrastructure as well as inefficient use of water resources. It is projected that there will be freshwater scarcity for the majority of the East African Community Partner States unless conservation and management measures are put in place at different levels.

Eastern Africa is home to some of the greatest water sources in the world. The three most notable of water bodies and systems and of relevance to the East Africa region include:

- Lake Tanganyika - the greatest single reservoir of fresh water on the continent and second deepest in the world (UNEP, 2006)
- Lake Victoria - Africa's largest lake the world's second-largest freshwater lake
- The Nile River Basin - source of the Nile, the longest river in the world

This being said, the distribution of water varies significantly within the region. The region has four major aridity zones: moist sub-humid mainly in Uganda, Rwanda and parts of Burundi, dry sub-humid (parts of Uganda, western Tanzania), semi- arid (parts of Tanzania) and arid, most of Kenya. The western component of East Africa, including Burundi, Rwanda and Uganda along with the central part of the continent are considered to have a rain surplus, while large parts of Kenya are considered to have a very large water deficit (UNEP, 2010)

Water security is a complex issue; it is a function quantity, quality and access. It is highly influenced by upstream activities which can be trans-boundary in nature; it is subject to competition among sectors within the same country, among different countries within a region; and the management of activities elsewhere can have a profound impact on water quantity, quality and access. Table 4-4 summaries water quantity and quality for Lake Victoria and Lake Tanganyika.

Table 4-4 Lake Victoria and Lake Tanganyika basic statistics

Parameter	Lake Victoria[18]	Lake Tanganyika[19]
Water quantity	2,750 km^3	18,800 km^3
Water quality	Serious decline	Declining
- *Sedimentation*	Excessive	Excessive: Lake shore deforestation and catchment erosion
- *Pollution*	Excessive (major concern) – low levels of trace metals – pesticides and untreated industrial wastewater	Excessive[20]: - urban pollution and boat discharges - untreated industrial wastewater
Eutrophication	Severe - Agricultural run-off - Domestic effluent and solid waste	Severe eutrophication and anoxia - Agricultural run-off - Domestic effluent and solid waste
Human Settlements	One of the most densely populated rural river basins in the world. Up to 250 people/km^2 (Population of 35 million people in catchment)[4]	Population density: 45 people/km^2 (10 million people in basin)[3]

Lake Victoria and the Nile River are inextricably connected along with all the major inflows into the Lake. All the EAC Partner States: Burundi, Rwanda, Kenya, Tanzania and Uganda contribute to the Nile Waters through the White Nile. Burundi, Rwanda and Uganda are almost completely integrated into the Nile Basin.

The control of the water levels in Lake Victoria is influenced by many factors both upstream and downstream of the lake. The upstream factors include the state of water towers and catchments, inflows and outflows en route to the Lake, and populations surrounding the lake. Twenty per cent of inlet of the water that feeds Lake Victoria originates from the Kagera, Mara, Simiyu, Nzoia, Grumeti, Yala, Nyando, Migori and Sondu-Miriu; while the rest (80%) is form direct rainfall (Awange et al. 2008).

Downstream impacts are closely related to the control of the White Nile flow in Jinga. Natural factors include temperature which controls the rate of evaporation of surface waters.

[18] *UNEP (2004)*
[19] *West (2002)*
[20] *Jorgensen et al. (2006)*

Water Towers

Both of the great lakes, Lakes Victoria and Tanganyika, and ultimately the White Nile depend on the regional catchments referred to as Water Towers of the region. The Water Towers of eastern Africa are a collection of mountain ecosystems and associated river basins. These areas have a major influence on regional hydrology and global climatic cycles.

The majority of the main water towers in the region are under very serious threat and several are severely degraded; the threats are anthropogenic in nature. Many of these forests have been cleared extensively mainly for agricultural purposes and human settlements and a face additional pressure from surrounding human settlements; this is particularly so in Burundi and Uganda (Blom and Bowie, 2001) as well as Rwanda (Ruzigandekwe, 2009).

Aquifers

Groundwater is an important but often overlooked source of freshwater, though water from these systems tends to be of high quality. As with the distribution of surface waters, groundwater sources are also distributed unevenly through the region; however these aquifers are a significant source of water. There are five trans-boundary aquifers and basins in the East Africa region including the Kagera Aquifers shared by Burundi, Rwanda, Uganda and Tanzania and the Kilimanjaro aquifer shared by Tanzania and Kenya. Kenya and Uganda share two other aquifers: the Rift Aquifers and the Mount Elgon Aquifer. The aquifers in the East Africa region tend to be shallow and fairly localised but they are still important sources of good quality freshwater (UNEP, 2010).

It is clear that the region has significant volumes of water and that these volumes could be enhanced by the preservation and restoration of the region's water towers. However to achiever water security, there is need to address important policy issues regionally including:

- Though water resources are available, they are not evenly distributed nationally and regionally.
- Access to water is critical; water storage and transportation is currently not sufficiently developed to deal with the scale of regional water availability, shortcomings are further emphasised during natural disasters such as drought.
- Water quality, is declining significantly mainly as a result of human activity in both the catchments and river basins.
- Sedimentation and siltation are exacerbated by increasing deforestation; pollution occurs as a result of untreated industrial, domestic wastewater and solid waste as well as boat discharges; high levels of eutrophication and anoxia occur as a result of agricultural run-off and domestic wastewater and solid waste discharge.
- Lake Victoria is relatively shallow with high rates of evaporation and almost completely reliant on rainfall (Kizza et al., 2009; Awange et al. 2008), thus pollution can be concentrated within the lake.
- Lake Tanganyika is already anoxic beyond a depth of 35m (UNEP 2004) and most importantly as a closed basin, water and pollution are long lived; it takes approximately 7,000 years for water to be flushed from the lake.

The main challenges to achieving water security are therefore:

- The destruction of the ecosystems underpinning the region's water towers;

- The lack of physical infrastructure to store and transport water from areas of high availability to those of low availability;
- High population density that continues to increase above the continent's average (UNEP, 2010);
- Poor waste management;
- High rates of evaporation particularly of Lake Victoria;
- Lack of systematic knowledge, data and monitoring of groundwater aquifers.

Table 4-5 Impacts of Climate Change on Water Security in East Africa

Phenomenon and direction of trend in weather and climate events	**Possible climate impacts**
Warmer and more frequent hot days and nights over most land areas (virtually certain)	Increased rates of evaporation and decrease in lake/river levels Increased biofouling of stored water Higher frequency of lake eutrophication Increased water demand for cooling
Warm spells and heat waves increasing in frequency over most land areas (very likely)	Highers rates of biofouling of stored water Increased water demand for cooling
Heavy precipitation events increasing in frequency over most areas (very likely)	Reduced water quality (heavy sedimentation and siltation)
Drought-affected area increases (likely)	Reduced recharge of aquifers Drying of lakes, springs and rivers
Intense tropical cyclone activity increases (likely)	Saltwater intrusion of aquifers and other water bodies

Table 4-6 A SWOT analysis of Water Security in the Region

Strength	**Weakness**
• Access to large water bodies including Victoria, Tanganyika and Nyasa • Major sectoral reform and resource management strategy • Nile Basin Cooperative Framework Agreement, which supersedes the older Nile Treaty	• Uneven geographic distribution of water sources • Poor water transportation infrastructure and general management • Lakes Cohaha and Rweru are vulnerable to climatic conditions and siltation and turbidity • High variability of groundwater distribution • High seasonality of specific some rivers • Underdevelopment infrastructure for the transportation of water • Groundwater recharge is mainly from rainfall • Groundwater monitoring is not systemically done for the entire country

	• High potential for localised water shortages • Highly variable water quality • Eutrophication of important water bodies
Threats	**Opportunities**
• Increasing population could push Tanzania into water stress • Decreased rainfall, high rainfall variability and temperatures threaten a few of the major rivers • Decreasing glaciers particularly so for Kilimanjaro • Saltwater intrusion in coastal areas	• The imminent creation of the Nile Basin Commission allowing Burundi even greater access to the Nile resources • Infrastructural development to transport waters from water-rich to water-stressed areas • Improvement of water quality particularly in important water bodies • artificial groundwater recharge, where harvested rainwater and or reclaimed water is routed to the subsurface.

Adaptation Measures in the Water Sector

Recommended adaptation measures in the water sector include:

1. Promotion of integrated water resources management as a primary tool of water resources management;
2. Catchment and watersheds protection and management, e.g. through afforestation to create protected forest areas;
3. Roof, rock and other forms of rain water harvesting for domestic use;
4. Investment in more water capture and storage facilities including state schemes as well small dams/pans;
5. Ground water is currently underutilised in spite of the fact that aquifers provide high quality water. The main obstacles to greater utilisation of these water sources include a lack of data that would inform more effective exploitation and management of these regional resources. Greater investment and in ground water exploration and abstraction as well as pollution control is required;
6. Early warning systems for floods and droughts;
7. Promotion of water resource economics focussing on water-use efficiency including water conservation and recycling;
8. Artificial recharge of dried-up aquifers;
9. Inter-basin transfers;
10. Investment in more water supply and sanitation infrastructure;
11. Sustainable use of wetlands;
12. Protecting coastal freshwater resources and supplies from saltwater intrusion; and
13. Desalination of sea-water in coastal regions (as an adaptation strategy for salt-water intrusion).

4.3 Energy Security

Vulnerability of the regional energy sector to climate change is primarily due to its lack of diversification. Of the region's total electricity installed capacity of 2661.17 MW (according to table 4-7 below), 62%, i.e. 1661.97 MW, is hydro-based. Hydro energy sources in the region are susceptible to the adverse effects of climate change and climate variability as recent experience shows (case studies 1). In addition, a large majority of the region's population depends on biomass, for their primary energy needs, a resource whose stock is reducing rapidly as a result of deforestation. Other threats include a reduction in the productivity of biomass sources due to an increase in temperature and rainfall decrease. It is widely reported in Kenya, as a result of reduced rainfall that has led to slow growth of trees, people have resorted to cutting down fruit and fodder trees for fuel!

The energy sector in the EAC is underdeveloped. In the power sub-sector, electricity prices are 5-10 times higher than in Egypt or South Africa (GTZ and EABC, 2007). The sub-sector is further pegged down by low quality of power supply systems. There is frequent power outage, due to a high dependency on large scale hydroelectric plants whenever there is low rainfall or long dry spell.

Over 81% of the population in the region, mainly in rural areas, do not have access to modern energy services (Kirai and Hankins, 2009). Average of national statistics on energy consumption shows that biomass meets 87.6% of the region's energy demand. Fuel-wood is the dominant form of biomass energy consumed in the region particularly in rural areas; while charcoal tends to be used by urban households. Current charcoal trends are expected to increase significantly in line with the fast growth rate of the urban population in the region.

Uptake of other sources of energy namely solar, liquefied petroleum gas (LPG), wind, geothermal, among others is very low due to the higher prices of these fuels in comparison to the traditional sources of energy and the ease of access to the traditional energy sources. The status of the energy sector across the five Partner States is provided in Table 4-7 below:

Table 4-7 The status of the energy sector in the EAC Partner States between 2007 and 2010

Factor		Partner State				
		BU	KE	RW	TZ	UG
Energy balance (%)	Biomass (mainly firewood, charcoal and agricultural residues)	94.97	67.65	94.1	90	91.5
	Electricity (mainly grid)	2.5	3.11	0.9	2	1.1
	Petroleum	2.5	28.57	4.9	8	7.4
	Peat	0.04	N/A	0.1	N/A	N/A
	Others	0.01[21]	0.67	N/A	N/A	N/A
Electricity/power sub-sector	Total installed capacity (MW)	56.67	1197	56.5	859	492
	Hydro (MW)	51.17[22]	677.3	44.5	561	328
	Thermal (MW)	5.5	385.7	12	251	150
	Others (geothermal, wind, bagasse, etc) (MW)	N/A	134	N/A	47	14
	Percentage of population with access to electricity	2	15	6	10	9
	Annual per capita consumption (KWh)	23	125	30	85	44

Source: The East African Community 2008; Ministry of Energy and Mineral Development, Uganda 2008; Kenya Institute for Public Policy Research and Analysis (KIPPRA) 2010; Ministry of Energy and Minerals 2011 (website); and GTZ 2007

[21] *Solar and biogas*

[22] *This figure includes 2.97 MW from small hydro plants (SHP) run by the Directorate General of Hydraulics and Rural Energies (DGHER) and non-profit organisations as well as 13.3 MW from 2 foreign SHP plants (one of SNEL-Congo with 4 MW, another of SINELACCEPGL 13.3 MW)*

Case Study 1: Drought, water levels of L. Burera and the consequences for electricity tariffs in Rwanda

Lake Burera is the source of water for the Ntaruka and Mukungwa power plants, whose combined installed capacity of 24.25 MW is more than half of the country's total installed hydro energy of 42.75 MW (which includes the regionally (DRC, Burundi, Rwanda) shared sources of Rusizi 1≈ 3.5 MW, and Rusizi 2 ≈ 12 MW).

Over the years, low river and lake levels occasioned by reduced rainfall have reduced the effective capacity of the hydro-power dams (see figure to the right). As a consequence, the Mukungwa power plant, capable of generating 12.5 MW, was at one time producing a mere 1 MW. In late 2004, the Government of Rwanda was forced to make stark choices: better expensive energy than none. Diesel generators were rented from private companies— and this during a time of unprecedented high world oil prices. Today, Rwanda imports 3 million litres of diesel every month to run and maintain the thermal generators, both rented and owned. Consequently, the electricity tariff has tripled from 42 to 112 Rwandan Francs per kilowatt per hour (22 Usc/kWh).

Source: REMA 2010. Second National Communication to the UNFCCC (cited in the Rwanda Situational Analysis Report for the EACCCMP) and GTZ 2007. Eastern Africa Energy Resource Base

Other threats of climate change on the energy sector include the destruction of energy infrastructure such as power transmission and distribution lines by storms and consequent power outages. This is a frequent occurrence in the region.

The following table gives a SWOT analysis of the regional energy sector:

Table 4-8 SWOT analysis of the regional energy sector

Strengths	Weaknesses
▪ Government policy of provision of clean energy services to all-e.g., ▪ Availability of devolved funds in some Partner States such as the Constituency Development Fund (CDF) in Kenya and Uganda, which can be used to deepen penetration of grid electricity ▪ Provision by World Bank to provide funds for strengthening electricity grid will ensure power reliability (e.g. approved for Tanzania in 2010) ▪ Expanding regional economy has increased energy demand and created a ready market ▪ Establishment of state-owned entities to spearhead the development and access of energy, e.g. the Geothermal Development Company in the case of Kenya, and the Rural Electrification Authorities in most of the Partner States ▪ Other policy reforms, e.g. establishment of renewable energy feed-in tariff policies (Kenya, Tanzania and Uganda) and EDPRS-Economic Development and Poverty Reduction Strategy for Rwanda)	▪ Lack of security, hence the fear of installing expensive energy systems like solar ▪ Inability of energy supplier to meet the real energy demand of the poor. ▪ Inability of many urban poor to pay market rates for energy services ▪ Lack of prepaid metering in some Partner States to cater for low income people with unstable incomes ▪ Expansion of human settlements with little regard to planning laws increases population without access to energy and inadequate infrastructure to increase the access ▪ Lack of legal and regulatory framework and institutional support to promote widespread use of solar energy and protect consumer interests ▪ High capital costs of energy systems relative to consumer incomes ▪ Over-dependence on two energy sources (hydro for electricity generation and biomass for domestic energy) ▪ Low quality electricity systems ▪
Opportunities	Threats
▪ Plans for regional power interconnection ▪ Feed-in-tariffs policies with lucrative return on investment for private sector investors ▪ Availability of loans at relatively low interest rates to foster electrification ▪ Abundant and varied energy sources, e.g. the combined hydro potential for the region is estimated at; that of geothermal is about ▪ Unbundling of energy sector players, e.g. into generation, transmission and distribution ▪ Increasing regional population implies a potential market ready to be exploited	▪ Lack of adequate national hydro generation capacity ▪ Changing rainfall patterns could impact negatively on the hydro power sources ▪ Theft and vandalism of power infrastructure equipment which could discourage private energy providers ▪ Unattractiveness of other energy sources ▪ Inadequate capacity to ensure proper adherence to set standards ▪ Insufficient government subsidies for renewable energy ▪ High upfront investment costs for most renewable energy ▪ The demand created by growing population could out-strip supply ▪ High level of poverty in the region, hence reduced purchasing power

Adaptation Interventions in the Energy Sector

The following adaptation strategies are recommended to deal with climate change threats to the energy sector:

1. In order to cushion the electricity sub-sector against potential shocks from reduced precipitation, and subsequent reduced water flow to hydro dams, the EAC Secretariat should promote energy diversification -- the exploitation of alternative renewable energy sources such as geothermal, wind , solar, biomass (including biomass waste) and biogas, which are abundant in the region. This should be done in line with "Regional Strategy on Scaling-up Access to Modern Energy Services in the East African Community", which gives a raft of measures for scaling up modern energy in EAC region.
2. As a way of reducing primary energy consumption and protecting natural resource base from depletion, EAC shall encourage Partner States to take the following measures:
    a. Promotion of energy conservation and efficiency in the household. The success of the Kenya Ceramics Jiko (KCJ) and a similar Improved Cooking Stove (ICS) initiative in Rwanda, have demonstrated the remarkable positive environmental and health effects of biomass energy efficiency programmes.
    b. Promotion of woodlots and agroforestry programmes for firewood and charcoal production.
    c. Improving access to liquefied petroleum gas (LPG) and other modern cooking energy forms by means of low or zero taxation and standardisation of supply equipment. It is reported that household LPG use in Kenya for instance, has been constrained by high costs and low supply rather than market (EAC, 2008).
    d. Review of electricity tariffs review to meet the demand of the poor, coupled with intensified rural electrification programmes.
3. In order to protecting energy facilities (infrastructure) against extreme weather events, the transmission and distribution utility must be modernised, e.g. automation of energy systems to enable energy utilities respond faster to emergency situations.

Mitigation Interventions in the Energy Sector

GHG emissions in the energy sector are primarily from two sources: unsustainable biomass energy (charcoal and fuel wood) consumption and petroleum products use, particularly in the transport and commercial sectors. The electricity sub-sector is generally associated with low levels of emissions; principally due to the fact hydro-electricity generation dominates. It is only during dry seasons when water levels in the dams falls and emergency thermal generation is commissioned that emissions rise. However, the region's energy sector GHG emissions could rise in future primarily for two reasons: (i) the discovery of oil in Uganda, which, theoretically means oil will be cheap in the region as compared to current prices, and (ii) the planned investment in thermal power plants in the region, e.g. the ongoing construction of a 300 MW coal power plant in the coastal city of Mombasa, Kenya. For these reasons, in addition to some of the above adaptation measures such as promotion of alternative energy sources and energy efficiency programmes, which also fall under mitigation, the region needs to pursue the following mitigation measures:

1. Harnessing the region's natural gas resource (e.g., Tanzania's proven reserve estimated at 45 billion cubic metres) to generate electricity as well as to supply domestic

consumers. Natural gas is environmentally cleaner than other fossil fuels such as coal and oil;

2. Promotion of waste to energy conversion programmes that make use of co-generation, for instance in the conversion of sugarcane bagasse to electricity, landfill (urban solid waste) to electricity/gas and molasses to ethanol for fuel blending. This has very high potential in the East African region and has been given as a project profile/proposal in the Master Plan;
3. Research and development (R&D) on alternative energy sources, especially targeting low-end renewable energy appliances of regional relevance, e.g. research on and production of low-cost bio-digesters;
4. Encourage innovative policy framework in the electricity sector such renewable energy feed in tariff, establishment of "net metering" programmes targeting domestic and commercial entities as well as suitable power purchase agreements;
5. The production of charcoal, which is a prominent source of energy, can be produced and utilised more efficiently using a number of well-established technologies. Such techniques help to ensure the sustainable management of trees and their conservation. A number of Sustainable charcoal projects are going on in Partner States such Rwanda, Tanzania and Uganda. Lessons learned from such projects can be replicated in EAC region;
6. The exploitation of alternative renewable energy sources such as geothermal, wind, solar, biomass (including biomass waste) and biogas to avoid over-dependency on hydro sources, which is particularly sensitive to climate, address both a need to mitigate emissions as well as adapt to the impacts of climate change. As mentioned in Section 4.1, agricultural residues and waste also offer an additional source of energy;
7. Energy conservation and efficiency is critical to ensuring energy security. A number of well-established technologies exist to enhance to efficient utilisation of electricity;
8. Energy (electricity) tariffs review to encourage domestic consumption coupled with intensified rural electrification programmes as a way of reducing over-reliance on biomass sources.
9. Small hydro development in the region
10. Clean Coal Technology development to develop the existing large reserves of Coal in the region

4.4 Human Health, Sanitation and Settlements

Vector borne diseases are highly dependent on climatic conditions. Expected changes in temperatures, precipitation, humidity and wind patterns due to climate change are likely to create favourable conditions for the development, reproduction, longevity and spread of vector species, and therefore vector borne diseases. For instance, it has been observed that Malaria, an infectious vector borne disease, has spread into new areas previously free of the disease. In Burundi, incidences of malaria have been reported in the central plateau, and in Kenya there are indications that malaria has spread to the highlands of Lake Victoria basin. This will aggravate the current situation where all the EAC partner states are struggling with the malaria

menace. Climate change is also going to affect water systems and encourage increase in water borne diseases such as cholera, typhoid and dysentery. Frequent and long lasting droughts, a result of climate change, are likely to affect food security and consequently, cases of malnutrition are expected to rise, especially among populations practising subsistence agriculture and livestock keeping. This is also likely to worsen the situation for other diseases such as HIV/AIDS, which are highly dependent on proper nutrition. All these put together are going to strain the already overstretched and underfunded health facilities in the region.

Health and sanitation have traditionally been a challenge for the region, although the health services and sanitation situation is generally improving. There is generally a significant disparity in access to health and sanitation in terms of access to health and sanitation services throughout the region: urban areas tend to have greater access to better resourced healthcare and sanitation in comparison with rural populations. The majority of the population in the region is rural, thus the majority of the population is not as well-serviced as it could be.

Access to healthcare and sanitation services is not evenly distributed within urban areas. Slums are an important feature of many of the urban areas in the region ranging from 54.8% in Kenya to 71.6% in Rwanda (UN DESA, 2008). Both rural areas and slums tend to have low income and this is an important factor limiting access to all the necessary health and sanitation facilities and services. The sector is in need of additional skilled human and financial resources, but particularly so for rural areas and slums. Over 50% of the region's urban population resides in slums, typified by extremely high population densities, living in poorly constructed accommodation, with little or no access to water and services, such as sanitation and waste management (UNDESA, 2010). Slums are currently some of the most rapidly expanding forms of human settlement in Africa. Settlements that occur in marginal land, slums and rural areas tend to have less access to basic services due to income levels in general in for rural areas in particular; the low population density in these regions often means that the distance to these services is often greater than that in urban areas.

The planning of settlements, both urban and rural, has an impact on the quality of life in these areas. Poor planning often means that the physical infrastructure required to keep and maintain good hygiene and sanitation is lacking or does not service the community adequately. The lack of physical infrastructure also exacerbates the impact of extreme weather events and natural disasters leading to the fatalities and destruction to property. Settlements where there is a high population density, of which slums are an example, increase the probability, speed and ease of which disease are spread.

Malaria and HIV/AIDS are the main disease of importance within the region. Although the HIV/AIDS in the region is of great importance; malaria is frequently the number one cause of morbidity/mortality in the region: for example, malaria is the primary cause of morbidity/death in both Burundi (Burundi DNCCC 2010), Kenya (GoK Ministry of Medical Services Facts and Figures 2008); Rwanda (particularly children under the age of five (NSIR 2010) and Uganda (GoU Ministry of Health Statistical Abstract 2010).

A significant proportion of people die from water-borne and sanitation-related diseases such as cholera, dysentery, typhoid and parasitic worms. Diseases associated with lack of clean water and sanitation and inadequate waste disposal, tend to occur more frequently in rural areas and urban slums simply because access to the necessary services. (GoT, Annual Health and Statistical Health Tables and Figures, 2008; GoU Ministry of Health Statistical Abstract 2010).

Of the Five Partner States, Burundi, Rwanda and Uganda have various challenges associated either high population density, Rwanda has the highest population density in the world with about 384 inhabitants/km² (NISR, 2010), closely followed Burundi with 289 hab./km (Burundi DNCCC 2010); while Uganda has one of the highest growth rates in the world at 3.2% per annum (GoU Ministry of Health Statistical Abstract 2010).

Impacts of Climate Change on Health, Sanitation and Human Settlments

Climate change will have a significant impact on the water supply and sanitation. In the face of competing resource requirements, high climate variability and insufficient infrastructure to harvest and store water, advances in both the management and distribution of water resources will be a key determinant of the vulnerability of the region to climate change.

Closely linked to the provision of services such as water and sanitation is a growing recognition of the rapid urbanisation occuring the region. Urban and rural planning or the lack thereof, has emerged as an important factor that can and often does worsen the impacts of extreme weather events. Poor urban planning, coupled with high population densities and geographic proximity to areas that are prone to extreme climate events as well as physically vulnerable to climate impacts considerably increases the risk of severe damage and disruption from single climate related events.

Table 4-9 Impacts of Climate Change on Human Health, Sanitation, Settlements and other Social Issues in East Africa

Phenomenon and direction of trend in weather and climate events	**Possible Climate impacts**
Warmer and more frequent hot days and nights over most land areas (virtually certain)	Shifts in areas/incidence of malaria and other insect-borne diseases Higher incidence of respiratory problems and illnesses Increased water demand, competition and conflict
Warm spells and heat waves increasing in frequency over most land areas (very likely)	Increased incidence of heat stress Increased burden on health services
Heavy precipitation events increasing in frequency over most areas (very likely)	Increased incidence of water-borne diseases due to disruption of sanitation systems Increased risk of landslides and floods and displacement of people Increased burden on health services Food shortage and famine risk Increasing social burden on women and children
Drought-affected area increases (likely)	Food shortage and famine risk Displacement and migration of people and increased potential for conflict Increasing social burden on women and children Increased water demand, competition and conflict
Intense tropical cyclone activity increases (likely)	Damage to property and disruption of sanitation services or access to freshwater

Table 4-10 A SWOT analysis of HHSS in the Region

Strength	Weakness
• Relatively developed healthcare system	• Weak land-use planning as well as water and sanitation management • Large and increasing urban slum population • Poor urban planning • High population density and high population growth rates • Uneven distribution of sanitation and health care services in urban and rural areas • Low income in a majority of the population is limiting access to sanitation, health and decent housing structures
Threats	**Opportunities**
• Natural disasters and outbreaks of water-borne diseases • Lack of maintenance of existing health care facilities • The lack of physical infrastructure	• Increasing regional stability • Housing developed • Expansion of city • Provide markets for goods • Suppliers of labour • Addition of skilled human and financial resources

Adaptation Interventions in the Health and Settlement Sector

From the above human health and settlements (environments) are closely linked and the type of an environment one resides in may determine the diseases or health problems he or she may face. Climate change will not necessarily cause new diseases and health problems, but may exacerbate existing ones. For this reason, current measures to deal with public health shortcomings may be considered adaptation measures although they may have to be applied at a larger scale to deal with expected climate change burden. They include:

1. Provision of adequate financial and human public health resources, including training, disease surveillance and emergency response as well as prevention and control programs;
2. Relocating humans from disaster prone areas e.g. from flood-prone areas to alternative safer areas;
3. Developing climate change awareness programmes involving all stakeholders;
4. Proper planning of urban settlements including ensuring that they have proper housing structures, and adequate waste disposal facilities and piped water infrastructure;
5. Establishing insurance schemes to compensate persons and communities affected by climatic disasters;
6. Diversifying economic activities to improve the resilience of rural communities dependent on climate-sensitive sectors such as agriculture and livestock rearing;
7. Encouraging the formation of 'satellite committees' that can respond to emergencies, and involving them in key decision making;

8. Developing empowerment programmes that enhance climate resilience[23]; and
9. Promotion of sustainable (environmental, social, and nutritional) public health interventions, e.g. urban tree planting to moderate temperature increases, safe biking instead of motorised transport, etc.

4.5 Physical Infrastructure

A good transport and communication infrastructure is critical for economic growth. It is often touted as "the engine of growth". Indeed, the resurgence of the regional economies in the recent past has been attributed to the growth in this sector. For instance, in 2009 in Kenya, the sector grew by 6.4%, mainly due to the expansion of the telecommunications sub-sector as well as improvement in the roads infrastructure (Kenya National Bureau of Statistics (KNBS), Economic Survey 2010). In Rwanda, transport and communication sector contributed about 8% to the GDP in 2009 (National Institute of Statistics of Rwanda (NISR), Statistical Yearbook 2010). In Tanzania, the sector's contribution to the GDP averaged around 5.3% per annum between 2000 and 2007 (Economic and Social Research Foundation, Tanzania, 2009), and it grew by 6.5% in 2007 (Tanzania National Bureau of Statistics, Economics Survey, 2008). In Uganda, the sector comprised about 6.2% of the GDP in 2009 (Uganda Bureau of Statistics (UBOS), 2010).

The main modes of transportation in the region are roads, railways, airways, waterways and pipeline.

Roads: The classified national road network in Burundi is about 12,338 kilometres (km) in length, and broken into the main network, is about 5,230 km (and further broken into national roads ≈ 1,963 km and provincial roads ≈ 2,522 km) and the "unclassified" network made up of community roads and urban highways (3,049 km), as well as agricultural feeder roads (4,059 km) (African Development Bank (AfDB), 2006). According to the Kenya Roads Board (KRB), the classified[24] road network stretches some 126,502 km, of which 14% is bitumen, 43% earth, and 43% gravel. The unclassified road network is about 133,800 km in length. This comprises urban road network, other unclassified roads in rural areas, roads in national reserves and parks, as well as forest roads In Rwanda, the road network is about 14,000 km of roads, and classified into national, district and gravel roads (Transport Sector Policy, 2008). In Tanzania, the network is about 33,012 km, comprised of 12,786 km of trunk roads (5,166 km paved and 7,620 km unpaved) and 20,226 km of regional roads (660 km paved and 19,466 km unpaved) (TANROADS, 2011), while in Uganda, the national road network is estimated to be 20,000 km in length (UNRA, 2011). A characteristic of the road sector common to all the Partner States is that it is the dominant mode of transport. In Burundi and Uganda, an estimated 90% of domestic passenger and freight transport is by road (AfDB, 2010). In Kenya, it is about 93% (Draft Integrated National Transport Policy, 2010). In Rwanda, estimates are not provided but the Transport Sector Policy 2008 states that roads are the main form of passenger and goods transportation, while in Tanzania, roads carry close to 70% of the country's freight and 90% of passengers (National Transport Policy, 2003).

Railways: Only three of the EAC Partner States, i.e., Kenya, Tanzania and Uganda have railway networks. These include the Kenya-Uganda Railway which was built in the late 19th Century by the British Government under the Foreign Office when Britain held colonial control

[23] *The Economic Stimulus Programme (ESP) of the Government of Kenya is a good example of such a programme*

[24] *The classes are International Trunk Roads (A), National Trunk Roads (B), Primary Roads (C), Secondary Roads (D), Minor Roads (E) and Special Purpose Roads*

of the region known then as the British East Africa. The line extends from Mombasa, Kenya to Kampala in Uganda. In Kenya, there is also a network that serves the City of Nairobi and its hinterland. Tanzania is served by two main networks: the Dar-es-Salaam-Mwanza-Tabora Railway, extending from Dar-es-Salaam to Tabora, where it splits into the Kigoma and Mwanza lines, respectively, and the Tanzania-Zambia Railway Authority (TAZARA), which extends from Dar-es-Salaam, Tanzania and to New Kapiri Mposhi in central Zambia. Up to and including the early 1980s, rail transport played a crucial role in the movement of bulky products to and from the ports of Mombasa and Dar-es-Salaam and the great lakes region, and thus made a major contribution to the development of the economies of the region. Deterioration of the systems coupled by insufficient investment over the recent years has seen this role diminish.

Airways: International airports include Bujumbura International Airport (Burundi); Jomo Kenyatta International Airport (JKIA), Moi International Airport, and Eldoret International Airport (Kenya); Kigali International Airport and Kamembe International Airport (Rwanda); Mwalimu Nyerere International Airport, Mwanza International Airport, Kilimanjaro International Airport, and Abeid Karume International Airport (Tanzania); and Entebbe International Airport (Uganda). Besides the international airports, there are a number of important local airports. These include Gitega and Kirundo in Burundi; Wilson, Kisumu, Wajir, and Lokichoggio in Kenya; Butare, Gabiro, Gisenyi, Nemba and Ruhengeri in Rwanda; Bukoba, Kigoma, Dodoma, Iringa, Lindi Kikwetu, Musoma, Pemba, Tabora and Tanga in Tanzania; and Arua, Gulu, Jinja, and Moyo in Uganda. Air transport is becoming an important mode of transport in the region. It is a crucial component of the region's thriving floricultural industry, where it facilitates the transportation of cut flowers and other horticultural products to Europe and overseas markets.

Waterways: The main sea-ports are Dar-es-Salaam, Tanga and Mtwara in Tanzania (Tanzania Ports Authority, 2011), and Mombasa in Kenya (Kenya Ports Authority, 2011). Of these, the largest and busiest are the ports of Mombasa and Dar es Salaam, which handle cargo ships, although cruise ships also frequently dock at the two ports. These ports serve the host countries, i.e. Kenya and Tanzania as well as countries of the interior such as Uganda, Rwanda, Burundi, Democratic Republic of the Congo and Sudan, linking them to the Indian Ocean, and to overseas markets. Most of the region's inland lakes and rivers are navigable, although only Lakes Victoria, Tanganyika, Nyasa and Kivu currently provide significant transport activities. Lake Victoria's ferries have been an important means of transport between Uganda, Tanzania and Kenya since the 1900s. The main ports on the lake are Kisumu, Mwanza, Bukoba, Entebbe, Port Bell and Jinja.

Pipelines: Major oil pipelines include the Kenya pipeline that starts from Mombasa to Nairobi from where it extends to the Kisumu and Eldoret depots (in Kenya) and the Tanzania-Zambia Mafuta (TAZAMA) pipeline, which runs from Dar es Salaam to Ndola in Zambia.

The **communication infrastructure** consists of landline and mobile telephone network, internet network, postal services, radio communication and television network, amongst other forms of communication. Technological leapfrogging has resulted in great expansion of the mobile telephone technology across the region in the past decade.

Climate Change Impacts on the Transport and Communication Infrastructure

Major threats to the region's infrastructure include damage of roads, bridges, railways and other infrastructure by floods, landslides, and mudslides; the likely submergence, inundation, erosion and destruction of low-lying, coastal zones including coastal cities and infrastructure by sea level rise (SLR); and the disruption of the water transport infrastructure by severe weather

events. Major benefits are in the form of response policies. The following bullet points exemplify these potential climate change risks and benefits.

Negative Impacts

- Damage to roads and bridges by floods, mudslides and landslides: This is already a frequent occurrence in the EAC, with the poor status of the roads being a sensitivity factor, i.e. it exacerbates the situation. In Burundi, economic loss due to infrastructural damage by landslides in the past two decades is estimated at more than 250 million U.S. dollars (USD) (Sabushimike J.M., 2010). The Mirwa Mountains and plains of Imbo are the regions that are most affected. In Kenya, the eight-month long 1997/1998 El-Niño rains caused one billion USD economic loss from infrastructural damage (Ngecu and Mathu, 1999), excluding flood-related casualties, which included the instant death of 36 passengers travelling in a bus that plunged into a deep river near the slopes of Mount Kenya following the destruction of 3 km of the Meru-Embu road (GoK, NCCRS, 2010). In Tanzania, the fertile regions in the north-west, the west and south often during the rainy season are cut off from the export outlets due to poor roads (Economic and Social Research Foundation, Tanzania, 2009). Similarly for Uganda, the 1997/1998 El-Niño floods destroyed the road infrastructure (Uganda NAPA, 2007). Photos in template 1 below clearly demonstrate the flood situation with regard to transport and communication infrastructure in the EAC region.

Photo 1: Landslides on Gikongoro-Cyangugu road in Nyungwe National Park (Rwanda)
Source: GoR, MINITERE 2005. Initial Communication to the UNFCCC

Photo 3: A flooded road section in Kenya

- Damage to railway lines: Projected high temperatures are likely to cause warping of rail tracks thereby exacerbating the chances of derailment of trains, while rainstorms accompanied by landslides could possibly wash away rail tracks and bridges. Such was the case in 1993 in Kenya when 114 people perished in a train that plunged into a river after floods washed away a bridge at Ngai Ndethya National Reserve near Voi (GoK, NCCRS, 2010).
- The likely submergence, inundation, erosion and destruction of low-lying, coastal zones including coastal cities and infrastructure by sea level rise (SLR), which is projected to rise by 17 cm to 59 cm (IPCC, 2007). For Kenya, a study shows that for an SLR of 0.3 m, 17% of Mombasa, which is located only 45 m above sea level, could be submerged (Awuor, Orindi and Adwera, 2008), with a larger area rendered unusable, thereby affecting the maritime transport system including the Mombasa Port facilities. A sensitivity analysis performed for Tanzania with regard to SLR gives the following results: for an SLR of between 0.5 and 1 m, 14,757 ha and 29,485 ha of Dar es Salaam and the Coast Region, respectively, could be inundated. In Tanga, between 2,022 ha and 4,045 ha could be submerged, while in Mtwara and Lindi, potential inundated areas are given as 7,922 ha and 15,855 ha, respectively. The total potential land loss is estimated to be 247 km^2 and 494 km^2 for SLR of 0.5 m and 1.0m, respectively. Economic loss from infrastructural damage for the Dar es Salaam coastline is estimated at between Tshs.49.83 billion and Tshs.85.9729 billion (Tanzania's First National Communication to the UNFCCC, 2003 and NAPA, 2007)
- In addition to SLR, stronger storm surges, winds and cyclones may also have impacts on coastal infrastructure, affect ship navigation and other port operations and increase coastal erosion. The probability and severity of such coastal storm events will increase with climate change given that temperatures, which influence them, are projected to rise.
- A rise in the coastal zone ground water table due to SLR would introduce a weakening in the underlying foundation upon which they are built. This could eventually lead to widespread structural instability, thereby affecting transportation of goods to and from the harbours.

- Changes in temperature would also affect air freight transport as the loading capacity is dependent on temperature – the higher the temperature, the lower the loading capacity. Therefore, for Sub-Saharan African countries such as the EAC Partner States for temperature rise will be expectedly higher than other regions as a result of climate change, it can be expected that flight operations would be frequently disrupted.

- Extreme and frequent drought episodes would also negatively affect inland water transport as they would cause recession of water levels.

- In addition, depending on their force, mudslides and landslides associated with rainstorms could cause great destruction to pipelines, therefore interrupting crude oil supply which would in turn have significant economic consequences.

- For the information and communication technology (ICT) sub-sector, potential negative climate change impacts include damage to telephone networks by storms, poor radio and TV signals and delay in the delivery of mails during adverse weather (e.g., storms).

Table 4-11 A summary of the impacts of climate change on physical infrastructure in East Africa

Phenomenon and direction of trend in weather and climate events	**Possible climate impacts**
Warmer and more frequent hot days and nights over most land areas (virtually certain)	Damage to rail and road networks Increased cooling costs
Warm spells and heat waves increasing in frequency over most land areas (very likely)	Damage to rail and road networks Increased cooling costs
Heavy precipitation events increasing in frequency over most areas (very likely)	Damage to rail and road networks and communications infrastructure
Drought-affected area increases (likely)	Significant impact on hydro-electric power capability and stability Economic losses and growth volatity
Intense tropical cyclone activity increases (likely)	Damage to coastal infrastructure

Beneficial Impacts

- Like the energy sector, the transport sector could be impacted upon negatively or positively by any mandatory mitigation measure(s) the Partner States may take on. This is because the sector is the major consumer of petroleum products in the region. GHG emissions as a result of petroleum products consumption in the region are rising in tandem with economic growth with those from the transport sector contributing significantly to this rise. Measures to climate-proof the transport sector must therefore include those that aim to reduce emissions from the sector. In this regard, proposals such as investment in non-motorised

means of, as well as efficient mass/public, transport ought to be implemented to avoid "locking in" the region in a high-emissions' path. They also present opportunities for the badly needed infrastructural development.

- Increasing demand for the "greening" of all sectors of the economy including transport may also present opportunities for the development of biofuels. Sustainability of biofuels must, however, be looked into on a case by case basis before embarking into such programmes.
- During rainstorms (projected to increase with climate change), access to quality and reliable internet and telephone systems could enable people to telecommute. Telecommuting has an added advantage of lowering transport-related GHG emissions.

Table 4-12 SWOT analysis of Physical Infrastructure in the Region

Strength	**Weakness**
• Well maintaind and busy international airports • Trans-boundary road network • Major transportation hub • Relatively developed road network • Well-developed telecommunications infrastructure (near universal cell-phone coverage) • Well-developed port facilities • Well-developed urban infrastructure • Good communications infrastructure Well maintained roads (paved and unpaved) • Has numerous international airports • Good telecommunications infrastructure	• Exceptionally prone to floods • Topography generally hilly/undulating • Development level and maintenance of major infrastructure generally poor • Uncontrolled settlement near water resources • Poor maintenance • Poor railway network • Topography generally hilly • Prone to flood • Underdeveloped particularly water and electricity infrastructure
Threats	**Opportunities**
Heavy rainfall and flooding • Landslides etc • Lack of maintenance • Direct impact of extreme weather events and natural disasters Rising sea levelsHeavy rainfall and flooding • Landslides etc	• Investment opportunities • Increased use of water ways (Lake Tanganyika) • Railway development and waterways • Investment opportunities • Air Transport • Investment in pipelines

Adaptation Intervention in the Physical Infrastructure Sector

With regard to adaptation the key issue is to climate-proof the infrastructure. This typically involves the following adaptation interventions:

1. Factoring in climate change into building codes and practice. This will help in ensuring that infrastructure is able to withstand extreme events associated with climate change;
2. Adopting the design and materials of construction of infrastructure that are able to withstand extreme weather events;
3. Continuing to use vulnerable areas or sites through innovative measures practicable under the new prevailing conditions; and
4. Factoring in potential impact of any future climate change mitigation action(s) on infrastructural service during its design stage.

Mitigation Interventions in the Physical Infrastructure Sector

The following mitigation measures have been recommended:

1. Investment in low carbon and low-cost public transport modes such as bus rapid transit (BRT) and other means of mass transport;
2. Investment in efficient rail transport system for long distance and low carbon transportation of freight and passengers;
3. Imposition of strict vehicular emissions standards in tandem with measures to phase out old and inefficient (high fuel-consuming) motor vehicles, while encouraging the importation of efficient ones;
4. Proper urban and transport planning to facilitate efficient and low GHG modes of transportation, e.g. decongestion of roads, non-motorised transport (NMT) by means of creating bikeways and pedestrian walkways, etc;
5. Creating transport demand management measures that encourage or favour public transport and NMT, e.g. ensuring that markets or workplaces are as close to residential areas as possible; and
6. Creating awareness on the importance of sustainable lifestyles such as car-pooling, and possibly using market incentives/disincentives such as punitive taxes and carbon tax (charges) to enforce such measures.

4.6 Ecosystems and Biodiversity

Competing land-use and land/ecosystem degradation has been identified as one the most important sensitivity factors in the persistence of biodiversity, ecosystems and ecosystem services. A significant proportion of populations in East Africa rely on ecosystems for the provision of goods such as fresh water, food (meat and fish), building materials and energy sources (timber, biomass etc). Areas with many resources, many of them derived directly from ecosystems tend to attract the populations utilising those particular resources.

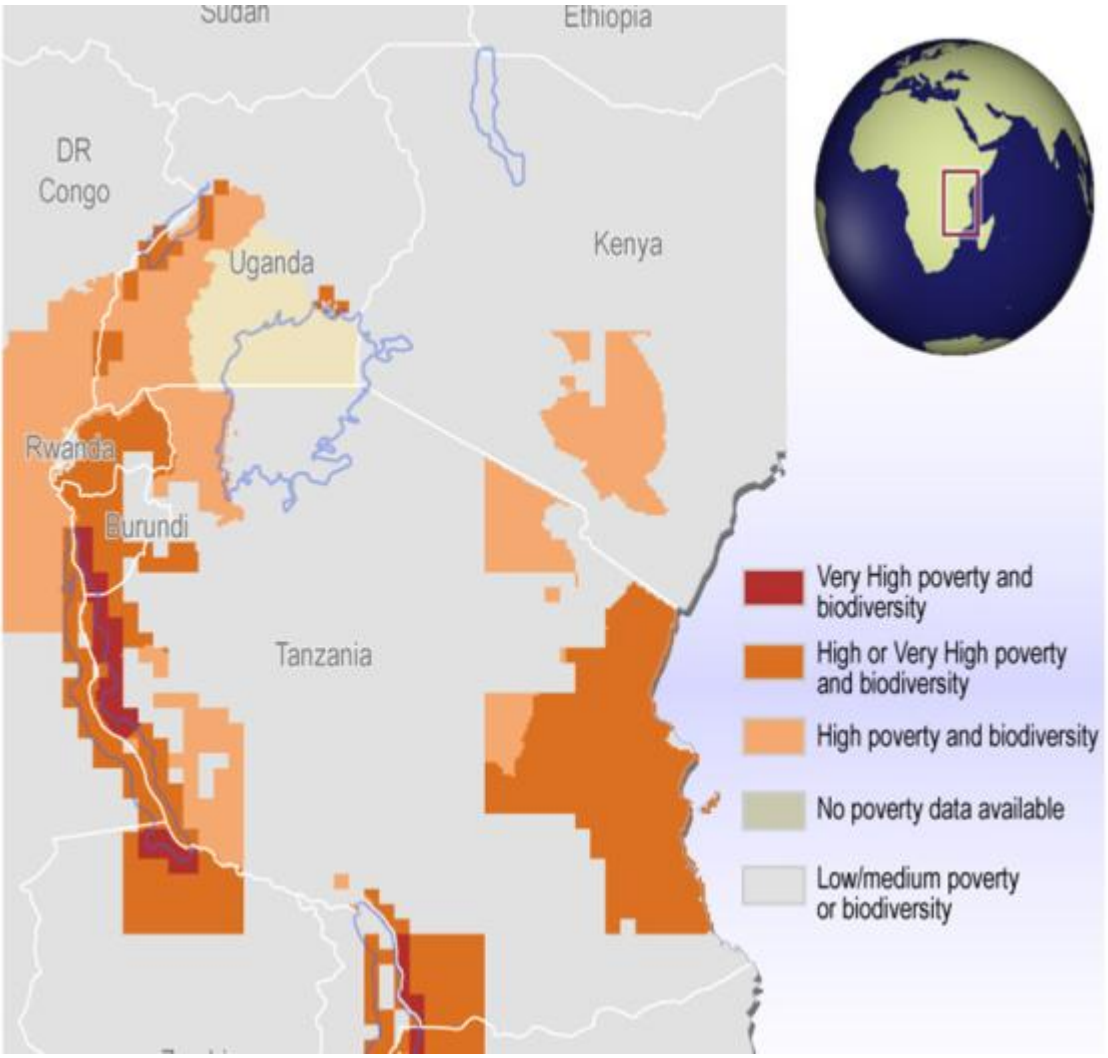
Competition for land and nature-based resources often results on the over-exploitation of the resource base, conflict and containment of migratory species and encroachment of human settlements, further exacerbating the over-exploitation of fixed resources.

According to the 2005 Millennium Ecosystem Assessment, 15 of the 24 ecosystems services upon which people directly rely are at risk of further degradation relative to current status. Climate change will have a strong negative impact on already degraded ecosystems. Figure 3-11 gives an indication of the proximity of biodiversity hotspots and areas of high poverty in East Africa.

Large and important biodiversity hotspots are located within very close proximity to human settlements (Figure 4-2) as well as in close proximity to national borders. The dynamics in such areas as depicted in Figure 4-2 are complex as they involve so many factors including tourism and cross-border tourism (shared resources) and its economic implications, livelihoods and access to essential resources for poor communities and the protection of sensitive ecosystems and species.

East Africa has experienced considerable loss in forest cover over the past few decades. Total forest area on the continent has decreased considerably relative to 1990. Forest cover in Kenya has decreased significantly and that of Tanzania is under serious threat on a number of fronts. Ugand has experienced considerable demands on forests for fuel wood. Rwanda and Burundi have already lost a considerable proportion of native montagne forests.

Figure 4-2 Biodiversity hotspots in relation to human settlements characterised by high levels of poverty



East Africa is well endowed with a variety of ecosystems that provide varied ecosystem services, as well as habitats for a wide range of species. Burundi, for example, is characterised by diverse ranges of ecoregions ecosystem comprising of the low Imbo flat country, the steep mountainous area of Mumirwa, the mountainous Congo-Nile watershed area, the central plateaux and the Kumoso and Bugesera depressions. The country has 13 protected areas covering 100,000 ha of land. About 172,000 ha (or 6.7%) of Burundi is forested. Of this, 69,000 ha (40.1%) is classified as primary forest - the most biodiverse and carbon-dense form of forest. Burundi also has 69,000 ha of planted forest. Together, these ecosystems harbour 2,500 higher plant species, 145 bird species, 107 mammal species, 79 reptile species, 18 amphibian species and 5 fish species.

Kenya has 3.467 million ha (or 5.9%) of the land area as forest cover. Of this, 1.417 million ha (or 2.4%) comprise indigenous closed canopy forests, and plantations on both public and private lands. The Kenyan coastline is characterised by a rich diversity of flora and fauna, including fish, coral reefs and mangrove forests. The rangelands are composed of a number of habitat structures ranging from open grasslands to closed woody and/or bushy vegetation with varying amounts and composition of grass cover and species.

Rwanda, on its part, has a remarkable variety of ecosystems and of flora and fauna. Its location at the heart of the Albertine Rift eco-region in the western arm of the Africa's Rift Valley is a

contributory factor. This region is one of Africa's most biologically diverse regions. It is home to some 40 % of the continent's mammal species (402 species), a huge diversity of birds (1,061 species), reptiles and amphibians (293 species), and higher plants (5,793 species) Forestry and biodiversity status

Tanzania has a diverse spectrum of fauna and flora, including a wide variety of endemic species and sub-species. The biological diversity and degree of endemism consist of primates, (20 species and 4 endemic), antelopes (34 species and 2 endemic), fish (with many endemic in Lake Victoria, Tanganyika and Nyasa and other small lakes and rivers), reptiles (290 species and 75 endemic), amphibians (40 endemic), invertebrates and plants (around 11,000 species including many endemic).

Tanzania is well endowed with forest resources such that by 2002, 38.8 million hectares, (35% of the total land) were covered by forests and woodlands. However, all forest areas and types are under major threat of deforestation. The deforestation rate was estimated to be 91, 276 hectares per year in 2002.

The main reasons for deforestation include clearing for agriculture and settlement, overgrazing, wildfires, charcoal burning and overexploitation of wood resources for commercial purposes.

Finally, Uganda has a rich array of natural resources which include water and wetlands, biodiversity, fisheries, forestry, land resources, wildlife, and minerals, among others. The country has more than 5,000 plant species along with 345 mammals, 1,015 birds, 165 reptiles, and 43 amphibians. Natural resources are the backbone of the Ugandan economy. Uganda's rich biodiversity offers the country a comparative advantage in bio-trade.

Climate Change Impacts on Ecosystems and Biodiversity

Climate change impacts will more or less be similar in all member countries as follows:

- Species sensitivity to large variations in temperature and rainfall leading to species extinction or heighten the risk of extinction;
- Changes in species composition and loss of traditional resources, ecosystems and services;
- Reduction in forest cover and associated benefit of GHG emissions mitigation and associated financing opportunities as well as loss of traditional resources and ecosystem services; and
- Possible reduction of important ecosystems such as wetlands.

Table 4-13 Impacts of Climate Change on Biodiversity and Ecosystems in East Africa

Phenomenon and direction of trend in weather and climate events	**Possible climate impacts**
Warmer and more frequent hot days and nights over most land areas (virtually certain)	Biodiversity loss as niches are closed out Changing ecosystem dynamics and production Increased occurrence and intensity of wildfires
Heavy precipitation events increasing in frequency over most areas (very likely)	Shifts in habitats and growing season
Drought-affected area increases (likely)	Additional pressure on natural resources (potential fallback on forests) Mass deaths of species Increased human-wildlife conflict
Intense tropical cyclone activity increases (likely)	Damage to corals Damage of coastal forests e.g. mangroves

Table 4-14 SWOT analysis of Ecosystem and Biodiversity

Strength	Weakness
• Good policies and institutions for wildlife management • High number of well-established protection (national parks and reserves) and conservancy areas • High levels of biodiversity within terrestrial, marine and freshwater systems and high species density • High levels of unique and endemic species.	• Population density and encroachment • Insufficient data and insufficient resources (financial, human and equipment) to collect the data • Forest cover and wetlands under pressure • The management of ASALs has been neglected • Population density and encroachment • Source of increased resource conflicts • Ecosystems under human pressure
Threats	**Opportunities**
• Extensive logging of montane forest • Very high human population pressure • Encroachment and over-stocking of livestock by communities surrounding ecologically sensitive areas • Drought, deforestation, encroachment and over-stocking and over grazing • Extensive logging of montane forest • Very high human population pressure • Increased human encroachment e.g. building of physical infrastructure within projected areas • Over exploitation of forest goods particularly fuelwood and charcoal • Disappearance/changes in ecosystems, species diversity, density and distribution • Saltwater intrusion and destruction of mangrove forests • Coastal erosion and coral bleaching and destruction • Extreme weather events and natural disasters • Land degradation associated impacts on biodiversity • Over exploitation of forest goods particularly fuelwood and charcoal • Increased human encroachment • Disappearance/changes in ecosystems, species diversity, density and distribution	• Ecosystem services eg tourism; fisheries resources • Orphan crops, medicine plants, gum and resins exploitation • REDD Opportunities • Eco-tourism: REDD Opportunities • Establishment of marine projected areas • Implementation of various programmes and projects for conservation and management of coastal areas • Current concerted international effort and support for the increased REDD(+) activity and project implementation – capacity building and finance opportunities • Establishment of projected areas • Implementation of various programmes and projects for conservation and management of coastal areas • Current concerted international effort and support for the increased REDD(+) activity and project implementation – capacity building and finance opportunities

Adaptation Intervention in the Ecosystem and Biodiversity

Key adaptation measures in these inter-connected sectors are:

1. Protection of sensitive ecosystems through measures such as community driven ecosystem management particularly as a way of addressing the drivers of over-exploitation and degradation of key ecosystems;
2. Establishment of more "protected" areas;
3. Increasing national forest covers through tree planting, agroforestry, participatory forest management, rehabilitation of degraded areas, and diversification of tree species (indigenous species) to enhance resilience to drought and other adverse weather conditions, etc;
4. Protecting and enhancing migration corridors and habitat connectivity (e.g., through avoiding habitat fragmentation especially with regard to privately owned land) to allow species to migrate as the climate changes;
5. Protection and management of rare plant and animal species, particularly those of important value, e.g., medicinal;
6. Rehabilitation and restoration of degraded habitats/ecosystems;
7. Collection and conservation of genetic resources of neglected indigenous species;
8. Research and active management of enclosed/protected/marginal areas specifically in relation to determining the carrying capacity and consequently the provision of water pans and other infrastructure to support wildlife in those areas;
9. Development of rapid response teams in order to respond to imminent and current destructive activities to limit damage to ecosystems;
10. Breeding new plant species that are more tolerant to changed climatic conditions;
11. Promoting fire suppression practices in the event of increased fire risk due to temperature increases; and
12. Controlling insect and disease outbreaks.

Adaptation Intervention in Coastal Area

Adaptation measures include the following:

1. Developing county-scale maps depicting which areas will require shore protection (e.g. dikes, bulkheads, beach nourishment) and which areas will be allowed to adapt naturally;
2. Analysing the environmental consequences of shore protection;
3. Promoting shore protection techniques that do not destroy all habitat;
4. Identifying land use measures to ensure that wetlands migrate as sea level rises in some areas;
5. Engaging state and local governments in defining responses to sea level rise; and
6. Improving early warning systems and flood hazard mapping for storms.

4.7 Tourism

Tourism is an important component of economies of the region. Tourism contributes an estimated 2.1% of total GDP (WTTC, 2011). In 2009, tourism was the third largest foreign exchange earner in Kenya (KNBS Economic Survey, 2010); the industry contributes up to 12% of Tanzania's GDP as a whole and considerably more for Zanzibar, 9.2% in Uganda (Uganda National Development Plan, 2010). The region as a whole hosted almost 4 million tourists in 2009 (EAC Tourism Indicators accessed 2011)

The tourism sector in the region is primarily nature based. East Africa's rich biodiversity is one of the most important tourist attractions and the Partner States together have a considerable number of conservation area, games reserves and other protected areas of environmental importance. Good infrastructure is a vital component of tourism. The region is well- placed to benefit from increased tourism and associated investments in infrastructure.

As a nature based industry, tourism is highly vulnerable to climate change for a number of reasons:

1. Changes in temperature and rainfall are important determinants of ecosystem types and associated biodiversity, and will thus have an impact on prime tourist destinations within the region.
2. There is a significant risk of pushing endangered species into extinction as well as increasing the number of endangered species in the region.
3. The range and habitats of species is likely to change in response to changes in climate;
4. Declining water volumes is of particular concern as water sustains both terrestrial and aquatic biodiversity which forms an important part of tourism attractions. Iconic phenomena such as the game migration between the Serengeti National Park and the Masaai Mara are negatively impacted by the reduction in the volume of the Mara River due to climatic variations and the destruction of the Mau "catchment".
5. Coral bleaching is of special significance to the region and Kenya and Tanzania in particular. Beginning in the 1980s, the frequency and widespread distribution of reported coral reef bleaching events increased. This has been attributed to global warming and consequent rising seawater temperatures (P.W. Glynn and L. D'Croz, 1990).
6. Climate change and rising temperatures in particular have already resulted in decreased glacial cover on Mount Kilimanjaro and Mount Kenya and on Rwenzori Mountains. Further increase in temperature and reduced rainfall is likely to result in further decline in the snow caps of both mountains, impacting on tourism.
7. Extreme weather events and natural disasters are likely to have considerable impact on diversity, ecosystems and physical infrastructure.
8. Coastal tourism is at particular risk both to extreme weather events as well as rising sea levels. Sea levels are already rising (IPCC, 2007); with the implication that some of the popular beaches will eventually disappear through. The case of rising sea-levels is of extreme importance for major tourism destinations such a Zanzibar and Mombasa.

Table 4-15 A SWOT analysis of Tourism in the Region

Strength	Weakness
• Unique and virgin tourist attraction destinations • Tourism is a significant contributor to GDP • Home to some of the most endangered primates in Africa • Spectacular and diverse landscape • Well known tourism attractions • National tourism policy in place • Home to some of the most endangered primates in Africa • High species richness and endemism	• Overdependence to wildlife as tourist attraction • Poorly maintained tourist road infrastructure • Tourism is predominantly nature based and subject to natural calamities • Not very diversified tourist attraction • Low private sector participation
Threats	**Opportunities**
• Clearing of forests for agriculture and logging • Encroachment • High population pressure • Escalating wildlife human conflicts • Increased international competition • Melting of Kilimanjaro as tourist attraction itself but also downstream impacts on surrounding montane forests • Clearing of forests for agriculture and logging Uganda • Armed conflicts and displaced populations • Clearing of forests for agriculture and logging	• Aggressive marketing of tourism in alternative markets (middle east, china and other African countries • Very well developed immigration laws • Aggressive marketing of tourism in alternative markets (middle east, china and other African countries • Increased investment in physical infrastructure particularly from private sector • High potential from industry-based poverty alleviation • Promotional of ecology friendly and sustainable tourism • Good immigration laws • Traditionally beautiful countries

Adaptation Intervention in the Tourism Sector

The tourism sector in East Africa is mostly nature-based. This therefore means that potential negative impacts of climate change on biodiversity (wildlife resources) and the adaptation measures to deal with such impacts as highlighted under Forestry, Ecosystems and Biodiversity above also apply to the tourism sector. In addition to the above listed adaptation measures, the following apply specifically to the tourism sector (Simpson, M.C., et al., 2008) and should be adopted:

1. **Managerial measures**; developing the domestic and regional tourism market to cushion the tourism industry against spill over effects of possible mitigation measures in the international aviation industry; initiation of resource (e.g. water) conservation plans as well as redirecting tourists away from vulnerable areas;

2. **Technical measures**; protection of coastal tourist resorts through construction of sea walls or naturally vegetated coastal dunes, designing buildings to be cyclone-proof, provision of early warning systems, etc;
3. **Behavioural measures**; creation of GHG emissions offset programmes, energy and water conservation initiatives, and other good practices;
4. **Policy interventions**, regulation of for instance building codes, compliance, coastal management plans, coordinated political lobbying for GHG emission reductions and adaptation mainstreaming, etc; and
5. **Research interventions**, e.g. assessing the level of awareness among businesses and tourists on climate change impacts, deducing knowledge gaps, and providing remedial measures. Other research interventions include predicting climate change impacts on ecosystems that form popular tourist attractions such as coral reefs to inform policy interventions.

4.8 Trade and Industry

Intra-regional trade has expanded with the coming into force of the EAC Customs Union Protocol on 1st January 2005. In 2006, Burundi's external trade with the EAC (excluding Rwanda) was US$ 65.2 million; Kenya's was US$ 717.7 million (excluding Burundi and Rwanda); Rwanda's was US$ 172.0 million (excluding Burundi); Tanzania's was US$ 368.0 million (excluding Burundi and Rwanda); and Uganda's was US$ 327.9 million (excluding Burundi and Rwanda). In terms of international trade, the total EAC trade volume with the rest of the world stood at US$ 20,663.0 million (excluding Burundi and Rwanda) (EAC, 2008).

Energy and transport infrastructure is crucial in facilitating trade and industry. Thus, climate change and variability impacts on the transport and energy infrastructure cascade to the trade and industry sector. In all the EAC Partner States, a large percentage of electricity is met by hydro sources. Whenever the generation capacity of hydropower dams reduces as a result of droughts and flood-induced siltation, industry is one of the biggest casualties as manufacturing industries are forced to switch to expensive fossil fuels (oil) to meet their peak demand of electricity (EAC, 2008). Since most consumers are unable or unwilling to absorb the extra energy cost, it often leads to a deficit in industrial output, which has to be met by imports from e.g., the Southern African Development Community (SADC) (mainly South Africa), further tilting the region's balance of trade in favour of these "advanced" economies.

Other climate change impacts on trade and industry include rising temperatures, which are expected to strengthen coastal winds and storms, which will in turn affect ship navigation and other port operations, and consequently hamper on international trade. Adverse weather events have already been observed to impact negatively on local and regional trade, particularly through the damage to roads and other forms of land transportation infrastructure. In Kenya, the damage to roads and other physical infrastructure by the 1997/1998 El-Niño rains caused one billion US Dollars economic loss (Ngecu and Mathu, 1999). Since Kenya's road network links with roads of the other Partner States to form international highways (e.g. the "International Trunk Roads A" in Kenya measure 3755 km long according to the Kenya Roads Board), such impacts have ramifications on the economies of at least three other Partner States — Burundi, Rwanda and Uganda — which are all landlocked and linked to the major regional ports (Mombasa and Dar es Salaam) through these roads.

Furthermore, the loading capacity of aeroplanes is dependent on temperature, the higher the temperature, the lower the loading capacity. This means that projected higher temperatures will likely cause a reduction in the volume of airfreight cargo.

Last but not least, the desire by some European consumers of horticulture to reduce their carbon footprints could deal a blow to the EAC Partner States' horticultural industry since Europe is a major export market of the region's cut flowers.

Table 4-16 A SWOT analysis of Trade and Industry in the Region

Strength	**Weakness**
• Relatively developed agro-processing industries • Progressive regulatory framework • Open/private sector-driven market • Strong human resource • Endowment with diverse natural resources ranging from minerals (including oil) to extensive and agriculturally rich land • Expanding democratic space	• Slow industrial growth and low manufacturing base • Lack of specialised skills in some areas • Low levels of innovation • Lack of linkages between centres of innovation (universities and research institutions) and industry • Heavy reliant on one industry: agriculture • Volatile market prices for products • Over-concentration of manufacturing industries in one area, often the capital city of a Partner State
Threats	**Opportunities**
• Rising international prices of petroleum products, which increases the cost of production • Cheap imports, which makes locally manufactured products less competitive • High political temperatures during electioneering process • Rising cost of essential commodities, which reduce the demand for some products considered • Rising wage bill to meet the rising cost of living	• Large population, which provides ready market • Increasing demand for agricultural products in the region and internationally • Strong bilateral and multilateral ties • Large reserve of natural resources, e.g. minerals • Higher commodity prices for high value products such as gold

Adaptation Intervention in the Trade and Industry Sector

The impacts of climate change on trade and industry range from direct impacts such as destruction of transport infrastructure by floods which affect the flow of goods and services to indirect impacts such as reduced hydro-electricity generation capacity resulting from drought-induced low water levels in hydro-power dams, which cascades down to industrial production. Adaptation strategies in the sector should therefore be formulated along these issues, and may include:

1. Developing strategies to deal with the impacts of climate change on other operators in the trade and industry value chain (for example, energy and transport);
2. Developing strategies to deal with current and future climate change regulations and industry standards, e.g. measures to respond to possible mitigation legislation/regulation in the industry;

3. Evaluating the potential impacts (including economic/financial) of climate change in the sector, and developing appropriate measures to deal with such;
4. Ensuring that the management approach taken by a firm is based on robust climate change information and assumptions; and
5. Developing strategies for taking advantage of the opportunities that may arise e.g. how does the regional industrial sector ensure that it benefits from mitigation measures being imposed on the industry elsewhere?

5 Cross-Cutting Interventions

5.1 Education, Training and Public Awareness

Education and Training

Access to climate change information and technology is one of the key elements necessary to effectively respond to climate change regionally. Learning and research institution play an important role in developing climate change knowledge, preparation and presentation of climate change information in a way that benefits local communities, partner sates and the region. The EAC has already established the Inter-University Council for East Africa (IUCEA) – which is an autonomous institution of the EAC. The Council's mission is to encourage and develop mutually beneficial collaboration among universities in East Africa, and between them and governments and other organizations, both public and private. The EAC has also enjoyed collaboration in science and technology for decades and is striving to establish the East African Science and Technology Commission (EASTECO). The establishment of such a significant platform should be accelerated. In addition, individual Partner States of the EAC boast of a number of well-established research bodies and industrial development institutes. Some of these institutions offer a few courses on climate change integrated among natural and environmental sciences. However, given that climate change stands out as one of the greatest challenge that mankind has ever faced, more is needed from institutions of higher learning.

Burundi: In Burundi, a number of institutions including universities offer courses in various disciplines that are climate change relevant, e.g., agriculture, livestock, forestry and agroforestry. Some of the most important are the Faculty of Agricultural Sciences of Burundi University which offers a five-year non-specialised agricultural engineering course, the Department of Geography at University of Burundi which provides four years in Geography include Geophysics and Environmental sciences courses, and the Agricultural Institute (ISA) which provides a number of four-year multipurpose courses geared to the rural economy, including animal husbandry, agriculture, rural engineering and water and forests (Mbazumutima, 2010). Primary school curricular also contains environmental issues, including climate change.

Kenya: Nearly all major public and private universities in Kenya, such as Nairobi University, Moi University, Egerton University, Kenyatta University, USIU, Jomo Kenyatta University of Agriculture and Technology (JKUAT) and Maseno University offer the traditional courses of geography, meteorology, geology, agriculture, environmental and natural resources management, etc, all which are climate change related.

At the postgraduate level, a number of these institutions have attempted to introduce climate change as a specific discipline:

- Tegemeo Institute of Egerton University has recently incorporated climate change research into its research agenda.
- The Department of Meteorology of the University of Nairobi offers an executive course on climate change adaptation and mitigation, specific courses called Climate Change and Renewable Energies, besides the traditional courses on climatology and climate dynamics.
- At the University of Nairobi, Institute for Climate Change and Adaptation (ICCA), a research institution to focus but not solely on climate change adaptation research, is in its formative stages. The University also hosts a Global Change System for Analysis, Research and Training (START) Research Node (see the section below on Tanzania for more information on START).

In addition, some collaboration on climate change work between these institutions and regional as well as global institutions takes place.

Rwanda: The National University of Rwanda's Geography has a geography department that offers courses in geography which has components of global warming and climate change covered in undergraduate curriculum. The Kigali Institute of Science and technology (KIST) and the National University of Rwanda (NUR), in collaboration with the with the Common Market for Eastern and Southern Africa (COMESA), are planning to establish geoscience courses and a climate observatory station on Mount Karisimbi. The station will monitor regional atmospheric GHG and constitute part of the global GHG monitoring network. The Ministry of Disaster Management and Refugee Affairs (MIDIMAR), Rwanda Meteorological Services (RMS) and the Ministry of Local Government and Social Affairs (MINALOC) are planning on developing early warning systems (EWS). The REMA Climate Change Unit performs the assessment of climate sensitivities and adaptation and mitigation policy options.

Tanzania: The country has many universities which offer various courses in environment and natural resources notable among them are: University of Dar es Salaam and Sokoine University of Agriculture and Ardhi University. Since April 2007, the Institute of Resource Assessment (IRA) of the University of Dar es Salaam has been hosting the Pan African START Secretariat (PASS). The PASS hosts the African Climate Change Fellowship Program, which is jointly coordinated by the START, the IRA of the University of Dar es Salaam and the African Academy of Sciences (AAS). This programme supports African professionals, researchers, teachers and students to undertake research, training, teaching and policy analysis to increase their knowledge, capabilities and

experience for advancing and applying knowledge for climate change adaptation in Africa. Institutions can participate by hosting a Fellow ("host institutions") and/or having its members apply for Fellowships ("home institutions"). The programme is intended to benefit and create stronger linkages between the host and home institutions of participating Fellows. Host and home institutions may include, but are not limited to, government agencies, non-government organisations, community-based organisations, private sector organizations, scientific research organizations and educational institutions. Home institutions must be located in Africa, while host institutions may be located in or outside of Africa, with preference given first to African institutions and secondly to institutions outside of Africa that demonstrate a commitment to enabling Fellows to pursue careers in Africa. Other African START Research Nodes are the University of Cape Town, University of Ghana and University of Nairobi.

Sokoine University of Agriculture (SUA) in collaboration with the University of Dar es Salaam (UDSM), Ardhi University (ARU), Tanzania Meteorological Agency (TMA), and several Norwegian institutions coordinated by Norwegian University of Life Sciences (UMB) are jointly implementing the "Climate Change Impacts , Adaptation and Mitigation Programme (CCIAM)" in response to the challenges and impacts of climate change in the country. The main objective of the programme is to develop and sustain adequacy in national capacity to participate in climate change initiatives and address the effects and challenges of climate change with particular emphasis on the REDD initiatives. PhD and Masters Students are undertaking research in REDD and livelihood related issues at various partner Universities.

Uganda: Makerere University through a number of schools offer courses on agriculture, environment and geography. For instance, the College of Agricultural and Environmental Sciences offer numerous courses across different departments touching on environmental and natural resources and is considering entrenching climate change adaptation courses through a programme supported by the Rockefeller Foundation titled "*Strengthening East African Resilience and Climate Change Adaptation capacity through training, research and policy intervention*".

The Department of Geography at Makerere also has meteorology unit which is involved in training and conducting research, regional climate modelling, recording and monitoring of the weather and running a GEONETCAST facility.

Table 5-1 A SWOT analysis of Education and Training in the region

Strengths	**Weaknesses**
• Existence of the IUCEA • Historical collaboration in science and technology • Established research bodies in EAC partner states	• Lack of adequate and appropriate research facilities • Minimal number of trained personnel in climate change (Teachers, lecturers and professors) • Overreliance on foreign aid to fund research • Absence of established centres of excellence in education, science and technology. • Weak links between industrial development institutes and this affects transfer and sharing of technology
Threats	**Opportunities**
• Losing well educated and trained human resources to more advance countries	• Integration of research bodies and institutes of the partner states into well

(Brain drain) • Invasion of EAC with cheap technology can greatly impair the development of local research and development of indigenous knowledge, human resources and consequently local industries. • Over importation of education greatly affect development of local institutions and technologies and therefore affect growth of local industries	harmonised research centres of excellence • Creating linkages with international research institutes and centres. • Creating standards in education, science and technology for the region • Learning institutions to create new areas of specialization (Such as climate change adaptation, climate change policy, climate change mitigation etc.)

Strategies to respond to climate change

The EAC should pursue the following measures in response to climate change education, science and technology.

1. Integrating climate change into the educational curricula of the Partner States, starting from primary level to tertiary level through current endeavours to harmonize education and training curricula;
2. Curriculum review to incorporate climate change and other environmental issues in classroom instructional materials, capturing locally relevant and culturally appropriate content that takes into account specific conditions and contexts and is geared towards local needs and perceptions;
3. Carrying out a technology needs assessment for the region;
4. Developing, strengthening and harmonising research programmes on issues regarding the impacts of, adaptation to and mitigation against climate change through such institution as IUCEA and EASTECO. This in turn should lead to the development of technological capacity in various climate change fields;
5. Creating linkages with international research centres and institutions to benefit from skills and research facilities. Some international institutes and centres have headquarters in the region and have been pursuing research related to climate change mainly on adaption measures;
6. Individual member states of the EAC have well established research bodies and industrial development institutes. The EAC should integrate these bodies and institutes into well harmonised research centres of excellence;
7. Encouraging Partner States to set aside funds equivalent to a certain portion of their GDP to fund research;
8. Involvement of development workers, local authorities, community leaders in education and training on climate change to achieve committed mutual understanding and concerted action against climate change; and
9. Developing and disseminating climate change literature in local languages for the benefit of marginalised populations and the general public, thereby encouraging their involvement in adaptation and mitigations programmes. Scientific data and terminologies should be well explained and simplified in literature, which could be in the form of brochures, illustrated pamphlets, billboards and journals.

Public Awareness
There are efforts in all the EAC Partner States to enhance climate change awareness.

Burundi: The Ministry of Water, Environment and Urban Planning uses annual multilateral environmental agreements (MEAs) as well as national holidays as platforms for passing environmental information in general and climate change information in particular to the general public. These days and events include the 2nd February which is the RAMSAR day; 22nd February, which marks the Nile Basin Cooperative Framework Agreement; 22nd March that marks the World Water Day; and 5th June, the World Environment Day, among others. Others include 22nd July, the National Day of Lake Tanganyika, and in December when the country holds the National Week of Environment as well as the National Day of Forests. Civil society organisations such as the Green Belt Movement and Association of Women in the Environment are quite active in climate change advocacy and public awareness. Print and broadcast media also provide an avenue for passing climate change information. These include RTNB, Isanganiro, Radio Public Africaine, Radio Maria, etc.

Kenya: The Ministry of Environment and Mineral Resources (MEMR) and other related ministries such as Forestry and Water organise environmental awareness events and days during which climate change information is passed to the general public. MEMR is in particular currently implementing the National Environmental Education and Awareness Initiative (EEAI) with a sub-theme on climate change. The initiative aims to raise awareness on environmental challenges to all citizens and to encourage the participation of all stakeholders in environmental conservation and management through outreach and education, public awareness campaigns, tree planting events, environmental clean-up events, as well as mass and folk media, among other channels. In addition to the efforts by the government is the work done by the civil society under the umbrella of the Kenya Climate Change Working Group (KCCWG). For instance, between 2009 and 2010, KCCWG in partnership with Oxfam GB and the Norwegian Church Aid organised an ad hoc group called the "Road to COP Taskforce", which played a key role in sensitizing the general public and key stakeholders such as the private sector, the legislature, youth especially in tertiary learning institutions, etc, particularly leading to and after COP 15 in Copenhagen, Denmark.

Rwanda: The Rwanda Environment Management Authority (REMA) has a department in charge of environmental education, climate change mainstreaming and multilateral environmental agreements. The department promotes the integration of climate change issues in both formal and non-formal education materials. During national and international celebration days such as International Environment Day, International Water Day, National Tree Planting Day, etc, REMA and Ministry of Natural Resources regularly organize climate change sensitization campaigns. REMA also carries out TV shows and radio broadcast on climate change sensitization. Recently, REMA started an initiative to mainstream climate change into District Development Plans through capacity building of District Environmental Officers and planners.

Tanzania: The Division of Environment (DoE) in the Vice President's Office (VPO) carries out climate change awareness raising through training of sector and district environmental staff, annual exhibitions of green initiatives and products such as on biogas, solar, and efficient cook stoves, and tree planting, environment clean up, etc on the World Environment Day, the World Water Day, etc. The civil society is also active in climate change public awareness and advocacy. Notable examples of the civil society's involvement in climate change advocacy and public awareness is the work of the Tanzania Natural Resource Forum (TNRF), which in early

2011, teamed up with community members in Simanjiro, the UCRT and Resource Africa UK to produce a film about climate change in Tanzania. Another civil society group active in climate change awareness is Tanzania Civil Society Forum on Climate Change (Forum CC), a civil society platform for climate change awareness. It collaborates with the government in raising public awareness on climate change.

Uganda: The Ministry of Water and Environment (MWE) has adopted a three-pronged approach to the process of carrying out public awareness and information dissemination campaigns. This involves preparation of a film documentary; preparation of print and audio products and actual dissemination of these two to the public through seminars. In addition, a Climate Change Communication Strategy is in place. Its purpose is to strengthen the level of understanding and awareness on the issues of climate change, the related threats and Article 6 of the UNFCCC through the effective usage of media and public information activities.

Despite these efforts by the Partner States, the level of climate change awareness by the general public is low because it (climate change) is a relatively new concept in the general public domain. For this reason, there should be a deliberate effort to enhance awareness through:

1. Developing climate change training material and programmes for specific target groups i.e. women, men, children, youth, people with disabilities, religious groups, etc through Eco-tournaments, Edutainment (education-based entertainment), Individual voluntarism and graphical images, print and electronic media to pass climate change information;
2. Documenting climate change impacts and linking them to community livelihoods;
3. Formation of youth, women and men's groups, CBOs, as forums for outreach, and including existing youth groups and initiatives in on-going climate change and decision making activities;
4. Involving the corporate sector to raise awareness on climate change issues and response measures as part of their corporate social responsibility (CSR);
5. Online blogging on social websites such as Facebook, Twitter, Google Groups, and Yahoo Groups through which various topics on climate change could be discussed;
6. Promotional activities and sponsorship of events with climate change themes, e.g. a reward scheme for pupils or individuals who participate in various green initiatives such as tree planting, waste recycling, etc;
7. School or college competitions where students perform drama, poetry, essays and music with climate change themes, and possible coverage of such events in the mass media.

5.2 Technology Development and Transfer

Technology transfer is one of the 'building blocks' of the Bali Action Plan (BAP), which calls for enhanced action on technology development and transfer to support action on mitigation and adaptation, including, inter alia, consideration of:

- Effective mechanisms and enhanced means for the removal of obstacles to, and provision of financial and other incentives for scaling up the development and transfer of technology to developing country Parties, to promote access to affordable environmentally sound technologies;
- Ways to accelerate deployment, diffusion and transfer of affordable environmentally sound technologies;

- Cooperation on research and development of current, new and innovative technology that facilitate win-win solutions;
- the effectiveness of mechanisms and tools for technology cooperation in specific sectors.

Possible ways of enhancing technology development and transfer in the region include:

1. Through the UN framework, essentially through the UNFCCC's (Kyoto Protocol's) CDM or its future successor; the envisaged Technology Mechanism within the UNFCCC ,as conceived in the Copenhagen Accord and Cancun Agreements, (UNFCCC, 2009, 2010); and through the United Nations Industrial Development Organisation (UNIDO) (UN, 2008).

2. South-South technology transfer, essential for the transfer of "adaptation technologies", particularly agricultural technologies. This is according to the UNFCCC (2006, which states that "*crop and animal varieties are sensitive to local conditions and therefore much of the technology transfer in this area is expected to take place between regions with similar agro-climatic conditions*." Essentially, this means that agricultural technology transfer is expected to flow between and among countries in the southern part of the globe because of their "similarities" in agro-climatic conditions.

3. North-South technology transfer through Foreign Direct Investment (FDI) including taking advantage of 'free-patent' technologies[25].

4. Through other multilateral and bilateral channels: to help developing countries meet their sustainable development needs, certain developed countries have established funding facilities to facilitate the transfer of their advanced technologies to low-income economies. An example is the Nordic Climate Facility (NCF), which was created within the Nordic Development Fund (NDF) of the five Scandinavian countries – Norway, Denmark, Finland, Sweden and Iceland. The NCF finances projects that have a potential to combat climate change and reduce poverty in low-income countries.

5. Through the establishment and capacity enhancement of local technological innovation centres to help strengthen institutional technology generation and transfer through a learning-by-doing approach. The core aim of technology transfer is to help facilitate sustainable development in developing countries, and this can only be achieved by developing indigenous innovation capabilities in developing countries, i.e. the capabilities to adapt, develop, deploy and operate clean technologies effectively within specific developing country contexts. Empirical evidence suggests that incremental and adaptive innovation processes within developing countries facilitate the diffusion and development of technologies (Ockwell*et al.*, 2009). This requires sufficient innovation capabilities amongst developing country firms, universities and research institutes, and appropriate links with public sector actors including production sectors (Juma., 2006). Furthermore, this enhancement of local institutional capacity to generate, adopt and

[25]For instance, in 2008, the World Business Council for Sustainable Development (WBCSD) formed the Eco-Patent Commons initiative to encourage the sharing of patents that provide environmental benefit but do not represent an essential source of business advantage. This sharing of environmental patents 'can promote environmental sustainability including eco-efficiency, enabling technology innovation to meet social innovation' (WBCSD, 2008).

diffuse technologies will fulfil the provisions of Article 80.1(b) of EAC Treaty, which calls on the Partner States to "*promote linkages among industries within the Community through diversification, specialization and complementarity, in order to enhance the spread of industrial growth and to facilitate the transfer of technology*" and Article 102.1(b) on "*strengthening of existing and where necessary establishment of new common research and training institutions*".

5.3 Climate Risk Management and Disaster Risk Reduction

The EAC, as part of Sub-Sahara Africa, is most prone to many climate change induced disasters including floods, landslide and famine. These often have severe socioeconomic impacts that include; food and energy shortages as well as shortages of many other basic resources and services. Additional impacts may also induce famine, mass migration of families and animals, loss of life and property and damage to infrastructure. . DRR programmes which aim at increasing the national disaster preparedness and response capacity should therefore be incorporated in the Master Plan as a priority.

Disaster Risk Reduction aims to minimise the effects of natural and human made hazards such as floods, landslides, industrial hazards and pollution, terrorism and famine on communities by reducing their vulnerability to loss of life and livelihoods within a broad context of sustainable development. This may include protecting and diversifying livelihoods, e.g. through crop diversification as well as tackling chronic food insecurity.

Incorporation of disaster risk management in the national development programmes and processes, including climate change adaptation action plans is on the agenda of the EAC Secretariat. This is recognized in the Hyogo Framework for Action of 2005 to which EAC Partner States are a signatory.

It is acknowledged internationally that disaster risk reduction efforts must be systemically integrated into policies, plans and programmes for sustainable development and poverty reduction. These efforts should be supported through bilateral, regional and international co-operation and partnerships. The importance of promoting disaster risk reduction efforts on the international and regional levels as well as national and local levels has been recognised in the past few years in a number of key multilateral frameworks and declarations including the Yokohama Strategy (ISDR, 2005).

The main challenges experienced in EAC with regard to Disaster Risk Management (DRM) which require urgent attention within the framework of the Climate Change Master Plan are:

1. Inadequate data provision for risk assessments over different timescales. There is need to improve the application of advanced technology and identification and evaluation of risk:
    - Invest in user specific models and application products
    - Invest in services that will have to take a lead e.g. ICPAC
    - Improve meteorological networks as well as the collection, quality and management of data
    - Improve downscaling of climate models
    - Build forums for data integration and exchange (extensive regional networks, National Communication preparation)
    - Invest in climate information systems
    - Improve community & family preparedness information tools

2. People centred early warning systems on climate. There is need for improved networks for information exchange and capacity building at local level to provide accurate information for risk assessment. Lack of trust in science by users, both at community level and by policy makers, partly resulting from poor communication further emphasises the need for awareness raising. Increase communication between scientists, decision makers, NGOs and communities is thus necessary and can be achieved through the approaches outlined below:

    - Build on existing national and regional structures to raise awareness
    - Build on existing forums and centres to bring together expertise (e.g. UN-ISDR hosted workshops, ICPAC training forums, invest in 'translators' working manuals, media, technical committees) and regional links
    - Engage grassroots communities to build on existing coping/adaptation responses (applied science by Ministries of Agriculture, Livestock and Water and NGOs)

5.4 Capacity Building

The need for capacity building to assist Parties, especially developing countries, to respond to climate change has long been recognised in the Convention's work on such issues as technology transfer, national communications and funding. Under the Convention, the Subsidiary Body for the Implementation (SBI) of the Convention is charged with providing advice on "*ways and means of supporting endogenous capacity-building in developing countries*" (Article 9), while the Kyoto Protocol commits Parties to cooperating in, and promoting, "…*the strengthening of national capacity-building*…" (Article 10). In line with the requirements of the UNFCCC, all the EAC Partner States have undertaken climate change capacity building needs assessment either as separate assessments or as part of the National Communication to the UNFCCC or the National Adaptation Programmes of Action (for the LDC Partner States of Burundi, Rwanda, Tanzania and Uganda).

Burundi: The Burundi NAPA has identified financial constrained as well as weak inadequate human resource and institutional framework as the main barriers to climate change response. Low levels of climate change awareness and general low adaptive capacity further constraint Burundi's ability to effectively respond to climate change.

Kenya: Between 2004 and 2005, Kenya undertook a climate change technology needs assessment as well as capacity building needs assessment to undertake article 6 of the UNFCCC. Capacity building gaps identified included inadequate capacity to prepare GHG inventories for National Communications and to undertake vulnerability assessment as well as low awareness of climate change issues by the general public and insufficient resources to implement climate change response activities.

Rwanda: According to the Rwandan NAPA, one critical capacity gap for Rwanda is inadequate human resource particularly the weak capacity of observation, description and evaluation of climate/ hydro meteorological stimuli at national, regional and local levels and their impact on ecological, social and economic systems does not allow for the production of sufficient data. Others include inadequate human resource in key climate change response areas as well as insufficient financial resources.

Tanzania: Similar to the other Partner States, capacity gaps for Tanzania include inadequate human resource in key climate change response areas, weak institutional framework as well as insufficient financial resources to implement climate change activities.

Uganda: According to the Ugandan NAPA, climate change capacity gaps include inadequate understanding of climate change and its impacts, thus creating a barrier to resource allocation; inadequate technical capacity; inadequate financial resources; and weak institutional and coordinating mechanisms.

The above capacity caps in the EAC Partner States and the following reasons justify the need for climate change capacity building and training:

- Adaptation to and mitigation of climate change, like for many developing countries, are emerging important issues for the EAC Partner States. They require new knowledge, capacities and close cooperation of different sectors to effectively counter the challenges posed by climate change and explore opportunities associated with it.

- There are numerous challenges that exist in effectively combating climate change. A major one is the uncertainties associated with gauging the impacts of climate change on various sectors of the economy. The need for more capacity to deal with such uncertainties in climate change science and policy is therefore critical. Necessary capacities in this area include the ability to assess and critically analyse climate change impacts on different sectors of the economy and at different scales; scenario modelling to inform adaptation and mitigation policy development and implementation; and skills enhancement to undertake research in other aspects of climate change adaptation and mitigation such as climate change resilient agricultural and energy systems and products.

- There is a high degree of complexity in climate change policy making. Climate change is a multi and cross-sectoral issue. As such, deliberation on ways to effectively engage in climate change adaptation and mitigation is quite often complex. Finding common solutions requires different stakeholders to come together in a joint learning exercise to pursue constructive dialogue informed by current scientific knowledge. There is therefore need for climate change capacity building and training targeting government staff (who are pivotal in driving government policies, i.e., policy formulation and institutions set up), and other stakeholders such as researchers (primary custodians of current scientific climate change knowledge) the private sector (who are often affected directly or indirectly by policies, e.g. a policy on emissions trading would affect the private sector). Training forums bringing these different stakeholders together as well as introduction of training programmes in government departments are some of the channels that could be used to enhance the capacity of policy makers.

- The need to equip the young generations with climate change knowledge and skills necessary for adaptation and mitigation. In this regard, introduction and more integration of climate change into university curriculum is an area that member states should focus attention on.

Capacity Building Needs Entry Points

All the EAC Partner States have in place designated government ministries and departments, and other institutions (both governmental and non-governmental) that deal with environmental issues and climate change.

In addition to national research and academic institutions, the EAC region also hosts some regional institutions that carry out climate change work, and can serve as entry points for capacity building and training. These include:

a) IGAD Climate Prediction and Applications Centre (ICPAC)

Intergovernmental Authority on Development (IGAD) established a drought monitoring centre in 2003 known as IGAD Climate Prediction and Applications Centre (ICPAC) which is responsible for seven member countries namely: Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan and Uganda as well as Burundi, Rwanda and Tanzania. The centre core objectives are mainly to provide timely climate early warning information and support specific sector applications for the mitigation of the impacts of climate variability and change for poverty alleviation, management of environment and sustainable development and to improve the technical capacity of producers and users of climatic information, in order to enhance the use of climate monitoring and forecasting products in climate risk management and environment management.

b) African Centre for Technological Studies (ACTS)

The centre conducts research and formulates projects and programmes which enable communities to adapt to climate change. Some of the projects include: community based adaptation to climate change, capacity strengthening in Least Developed Countries (LDCs) for adaptation to climate change, integrating vulnerability and Adaptation to Climate Change in Sustainable Development Policy Planning and Implementation in Eastern and Southern Africa (ACCESA).

c) Consultative Group on International Agricultural Research (CGIAR)

This is a global partnership of organizations engaged in research for sustainable development in the agricultural sector. It is a strategic partnership of diverse donors that support 15 international centres, working in collaboration with many hundreds of government and civil society organizations as well as private businesses around the world. CGIAR donors include both developing and industrialized countries, international and regional organisations and private foundations. CGIAR centres in the region are the International Livestock Research Institute (ILRI) and the World Agroforestry Centre (ICRAF).

Capacity Building and Training Needs for the EAC Region

In response to the above capacity gaps, the following are the capacity needs of the EAC:

1. Training on climate change competencies and strengthening of institutions through:

    a. Support to regional and sub-regional preparatory workshops for climate change negotiators on the UNFCCC negotiation process;

b. Technical support in the preparation of National Communications to the UNFCCC;
c. Support in the implementation of the UNFCCC decisions and provisions through country and regional-driven approaches;
d. Awareness-raising, development of communication tools, training and planning workshops at local, national, regional and global levels;
e. Mobilising and enhancing the capacity of governments, employers and workers' organisations to contribute to coherent policies and effective programmes leading to greening economies with green jobs;
f. Training in the use of relevant technologies for adaptation and mitigation such as geo-referenced demographic and socioeconomic data, GHG monitoring, etc; and
g. Strengthening the CDM Designated National Authorities (DNAs), meteorological departments, and the relevant institutions.

2. Capacity Building in Adaptation through:

h. Providing advisory services on how to mainstream climate change considerations into development decision-making e.g. for the achievement of the millennium development goals (MDGs);
i. Supporting city and other local governments to mainstream climate change adaptation into their programmes; and
j. Strengthening planning and capacity development initiatives to reduce risk, prepare and recover from disasters including strengthening institutions in charge of Disaster Risk Reduction).

3. Capacity Building in Finance through:
   k. Creating awareness in and enhancing capacity in climate change finance negotiation; and
   l. Enhancing the capacity of relevant institutions to access and effectively use climate change funds from various sources.

4. Capacity Building in Mitigation and Carbon Markets through:
   m. Assisting developing countries to improve their level of participation in the CDM;
   n. Supporting the identification of policy options that enable the rural poor to engage in climate change mitigation by building the foundation for pro-poor payment for ecosystem service markets;
   o. Capturing opportunities offered by the UN-REDD Programme, the Forest Carbon Partnership Facility as well as the REDD+ initiatives including the proposed REDD+ Mechanism to prepare developing countries to effectively participate in and benefit from REDD+.

5. Capacity Building in technology transfer and application through:
   p. Capacity building in the development and transfer of climate-friendly and resilient technologies; and
   q. Capacity building seminars/workshops in different regions to assist promote implementation of new standards aiming at the reduction of GHG emissions through radio and ICT devices.

6. Capacity Building of Meteorological Systems

Meteorological systems have a unique and important role in climate change, and therefore deserve special attention. As highlighted in chapter 3, the capacity of the meteorological systems in all the Partner States to handle climate change is inadequate, with insufficient equipment and lack of specialised skills being the major obstacles. The following capacity building areas have been identified:

a. **Climate change research and observation (Monitoring, detection, attribution and prediction)**

The role and operation of the National Meteorological Services (NMSs) in Partner States of the EAC is to provide information incorporated into early warning systems based on observed and projected meteorological conditions that may lead to natural disasters such as floods and droughts for the safety of life, protection of property and conservation of the natural environment. This role can only be effectively achieved through systematic observations to monitor the prevailing climate conditions, fast exchange of data and products, generation of useful information for decision making and timely dissemination of the information to end users.

The Meteorological Services have a crucial role to play in generating climate change scenarios for the region that would not only contribute to the global assessments but also be used as a tool for adaptation, vulnerability assessment and mitigation of climate change and climate variability at the regional and national levels/information.

Some key challenges in the provision of weather and climate services include:

1. Insufficient meteorological infrastructure to support research and systematic observation systems and tools;
2. Limited hydrological and meteorological data collection stations;
3. Poor data processing and dissemination through real-time communication;
4. Limited and unreliable hydro-meteorological early warning products;
5. Inadequate human capacities with sufficient technical skills;
6. Inadequate early warning information for severe (extreme) weather;
7. Inadequate research and development in the meteorology.

In order to enhance the role of Meteorology in adaptation and mitigation of climate change, the following actions are necessary:

Immediate/Short Term Actions include the establishment of an EAC Centre for Weather Forecasting, Applications, Research and Development

The proposed Centre will utilise modern methods of forecasting including Numerical Weather Prediction and ensemble forecasting. The Centre will run models and have access to other global models which will be utilised to issue early warning information on severe (extreme) weather events which are expected as the climate continues to change. The Centre will also develop climate change scenarios for our region and this will assist in planning for the future.
The Centre will also support the downscaling of global climate model outputs to regional and national levels to address climate variability and change at Partner State level; The Centre will also utilize synergies with the World Meteorological Organization's on-going Severe Weather Forecasting Demonstration Project for Eastern Africa. In addition the centre will be charged with the following responsibilities:

a. Develop numerical and statistical methods for Short, medium and long range forecasting;
b. Prepare, on a regular basis short, medium and long range forecasts for distribution to the meteorological services of the Partner States;
c. Scientific and technical research directed at the improvement of these forecasts;
d. Extend the skill of medium and long range forecasts;
e. improve timeliness and reliability of product dissemination, and availability of the computer facilities to the Partner States;
f. Provide good forecasts of severe weather 4 or 5 days ahead;
g. Calibration of satellite derived weather, climate and atmospheric constituent records;
h. Data processing including development of basic weather and climatological statistics;
i. Timely acquisition of near real time weather and climate and remotely sensed data;
j. Monitoring space-time evolutions of weather and climate extremes over the region.
k. Generation of Early warning products;
l. Delineation of risk zones of the extreme climate events;
m. Networking with the National Meteorological Services in the Partner States and other regional and international centres for data and information exchange;
n. Timely dissemination of early warning products;
o. Public awareness and education of sectoral users of meteorological products;
p. Development of sector specific weather and climate information and prediction products;
q. Interactions with users through regional and national user workshops and pilot application projects, etc.;
r. Climate change monitoring, detection and attribution;
s. Assessment of Adaptation and mitigation to climate change;
t. Research in weather and climate and related fields.

Medium Term Actions

EAC Partner States shall strengthen climate change research through monitoring, detection, attribution and prediction through inter alia:

i. Support modernisation of meteorological infrastructure in the Partner States as there is inadequate weather observing stations, communication, processing systems, training as well as dissemination facilities for communicating weather and climate information for adaptation measures in all the climate sensitive socio economic sectors;
ii. Promote digitisation and historical climate data rescue;
iii. Strengthen hydro-meteorological early warning systems for monitoring, detection, attribution and prediction of extreme weather and climate events;
iv. Support development of joint research programs on drought, floods, pests and disease resistant crops and livestock, and foster cooperation with regional organizations to facilitate transfer of research developments from other regions;
v. Strengthen Weather and Climate Monitoring Systems;
vi. Improve weather/climate Observing System;
vii. Enhance Meteorological Telecommunications for Data Exchange;
viii. Improve Data Processing and Forecasting Systems;
ix. Enhance Meteorological Application and Public Weather Services;
x. Improve Meteorological Data Management Systems for the National Meteorological Services;
xi. Strengthen early warning systems in the sub-region;

xii. Strengthen Meteorological Services in support of Maritime and Air Navigation over Lake Victoria and the Indian Ocean.

Long Term Actions

i. Strengthen research and promote data and information exchange for all sectors impacted on by climate change including forests and wetlands in the community;
ii. Promote periodic climate change related research and exchange of information in conservation and sustainable use of wildlife;
iii. Promote research on coastal and marine systems;
iv. Promote research in the area of climate change and human health;
v. Promote implementation of research findings and its linkages with policy formulation and practice research that Promote modern agriculture technology;
vi. Develop modalities of disseminating and sharing research findings with an emphasis on research into use to inform policy and practice.

7. Mechanisms for exchange and sharing of knowledge

In addition to the above mentioned capacities and initiatives in the region parts of the population have already started to inculcate coping strategies. Some member states have in place national climate change response strategies to support and facilitate a coordinated response to climate change issues in the respective country hence exchange of experiences, challenges and lessons learned should be shared among the member states to improve on ways of preparing a better climate change response strategies for members states that are planning to develop their strategies.

Other mechanism that can be explored in fostering exchange of experience and knowledge across the member state is organising regional workshop by sectors which offer a platform to discuss vulnerability and adaptation options. Sector-based climate change workshops if properly structured can lead to regional sector working group composed of sector experts from the member states who can give guidance on ways of tackling climate change hazards and capitalise on the positive issues that can emanate from the climate change phenomenon in the region. Like any other regions in Africa there is low scientific capacity for working with climate models in East Africa but different member states are at different levels of capacity endowment especially with regards to the universities prowess in the climate projections and use of the models hence building stronger linkages among East African universities in the area of sharing climate science knowledge is needed.

5.5 Gender, Youth and Marginalised Groups

Women make up a large number of the poor in communities that are highly dependent on local natural resources for their livelihood and are disproportionately vulnerable to and affected by climate change. Women's limited access to resources and decision-making processes increases their vulnerability to climate change (Commission on the Status of Women, 2008; UNDP, 2009). Women in rural areas have the major responsibility for household water supply and energy for cooking and heating, as well as for food security, and are negatively affected by drought, uncertain rainfall and deforestation. Because of their roles, unequal access to resources and limited mobility, women in many contexts are disproportionately affected by natural disasters, such as floods, fires and mudslides. It is important to identify gender-sensitive strategies for responding to

the environmental and humanitarian crises caused by climate change (Commission on the Status of Women, 2008). Some of these gender-sensitive strategies include:

1. Mainstreaming gender perspectives into the climate change efforts at the national, regional and international levels – including in policies, strategies, action plans and programmes. For instance, governments' efforts in poverty eradication (e.g., through the provision of farm inputs) should be deliberately targeted at women and the most vulnerable in the society.
2. Access to credit by women and other marginalised groups: Access to credit becomes very important in instances where women do not meet their basic needs. However, the prerequisites and processes for accessing these credit initiatives sometimes exclude certain members of society, particularly women, from accessing them. There should be a deliberate effort to review such credit programmes to allow for equitable access particularly by women and other marginalised groups.
3. Skills improvement and market access: There is need for skills' acquisition and improvement by women to enable them engage in economically productive activities such as basket weaving, commercial fishing, bee-keeping, etc. Programmes geared at training and capacity building in these areas as well as other areas of business such as marketing and book-keeping should be promoted. Reliable markets - be they local, national or international - for such produce should be developed to make such skills economically viable. Support for women's groups to share experiences and exchange lessons in what they engage in should also be promoted.
4. Provision of basic amenities: Women still have to travel long distances to collect water and firewood. Water supply services need to be improved to provide reliable access to clean, potable water for basic needs that can also be used for productive purposes. Provision of affordable alternative energy, e.g. liquefied petroleum gas (LPG) could reduce their vulnerability to climate change-induced energy shocks.

Increasing the participation of women in decision-making and information sharing on climate change at different levels is thus a major long-term climate change response.

Youth Perspectives

Some youth-focused strategies that should be mainstreamed into the climate change agenda include:

1. Empowering the youth with knowledge and information that can enable them live sustainable consumption patterns and lifestyles, devoid of Western-style consumerism perverse in the world today;
2. Creation of green jobs for and by the youth, providing them with the much-needed employment opportunities, while enabling them to contribute directly to the fight against climate change; and
3. Promoting youth participation in decision-making, information sharing and capacity building on climate change at different levels.

5.6 Climate Finance

The implementation of the above recommendations requires additional and substantial financial resources. The following illustrates means through which such financing may be obtained:

1. **Dedicated climate funding from bilateral and multilateral sources**: A number of external sources of climate funding (Table 5-2) are available for climate change adaptation and mitigation activities.
2. **The Partner States' national budgets:** The mainstreaming of climate change risks into the development agenda (e.g. medium term development plans) can influence budget allocation in a way that results in more funds being allocated for climate change activities. Through such measures, national budgets can provide leverage funding from external sources, especially in situations where governments can co-finance climate change projects.
3. **Private sector finance and Foreign Direct Investments (FDI):** Investments in the energy sector and renewable energy, as well as the forestry sector, may largely come from the private sector. These funding sources can be supplemented by additional grants or soft loans from Multilateral Finance Institutions (MFIs). The involvement of the private sector may also be promoted through public-private partnerships.
4. **Funding from carbon markets:** Funding can also be secured for mitigation from market-based mechanisms such as the CDM (or its future successor), REDD+ Mechanism as well as voluntary carbon market schemes.

Table 5-2 below provides a summary of potential financing sources

Table 5-2 Summary of potential climate funds

Funding Mechanism	Funding Mechanism's Sub-Group	Contributors	Eligibility Criteria	Regional opportunities/comments
Climate Investment Funds (CIFs) of the World Bank	Pilot Programme for Climate Resilience (PPCR)	Australia, Canada, Denmark, Germany, Japan, Norway, UK & USA	Bangladesh, Bolivia Cambodia, Mozambique, Nepal, Niger, Tajikistan, Yemen & Zambia selected as pilot countries in 2009	Targeting mainstreaming of climate change into national development planning
	Scaling up Renewable Energy in low income countries Programme(SREP)	Japan, the Netherlands, Norway, Switzerland, UK & USA	Low income countries, first pilots to be selected in 2010	SREP is country-led and builds on national policies and the activities of other existing energy initiatives
	Clean Technology Fund (CTF)	Unspecified	ODA eligible countries, and must have an active Multilateral Development Bank (MDB) project	Financing of scaled-up, low carbon activities in a country
World Bank's Carbon Funds and Facilities	The BioCarbon Fund; FCPF; CDCF; Netherlands CDM Facility; Danish Carbon Fund; Italian Carbon Fund; etc	Contributed by governments and companies in OECD countries to purchase project-based greenhouse gas emission reductions in developing countries and countries with economies in transition	All developing countries and countries with economies in transition	Viable emission reduction projects in both the compliance (CDM) and voluntary markets
UN-REDD Programme of the FAO, the UNDP & the UNEP	N/A	Denmark, Norway & Spain	9 "quick start" pilot countries were selected in 2009 (Bolivia, DRC, Indonesia, Panama, Paraguay, PNG, Tanzania, Vietnam & Zambia). A further 16 countries are joining in 2010	REDD+ Readiness projects qualify for funding

Funding Mechanism	Funding Mechanism's Sub-Group	Contributors	Eligibility Criteria	Regional opportunities/comments
Least Developed Countries Fund (LDCF) of the UNFCCC/GEF	N/A	20 major donors	All 50 least developed countries that have prepared National Adaptation Programmes of Action (NAPAs) are eligible for project grants	A number of projects in the LDCs have been funded
Special Climate Change Fund (SCCF) of the UNFCCC/GEF	N/A	Unspecified	Developing countries	For adaptation; technology transfer and capacity building; energy, transport, industry, agriculture, forestry and waste management; and economic diversification; set up in 2001
Adaptation Fund (AF) of the Kyoto Protocol, with the GEF providing secretariat for the Fund, while the World Bank acting as the Trustee	N/A	The share of proceeds amounting to 2% of certified emission reductions (CERs) issued for a CDM project activity	Developing country Parties to the Kyoto Protocol that are particularly vulnerable to the adverse effects of climate change	Opportunities to obtain adaptation funding
The proposed Green Climate Fund under the UNFCCC	Adaptation, REDD+, NAMA Mechanism, Technology Transfer Mechanism, etc	All developed countries	All developing countries with priority on least developed countries, small-island developing states and Africa	The EU has already committed USD 7.5 billion towards the fast-track fund
Development Bank Of Southern Africa (DBSA)	The Energy and Environment Partnership Programme with Southern and East Africa (EEP-S&EA)	Finland and Austria	Kenya, Tanzania, Mozambique, Namibia, Swaziland, South Africa, Botswana and Zambia	Provides support for pre-feasibility and feasibility studies to the value of Euro 200,000 per project

Funding Mechanism	Funding Mechanism's Sub-Group	Contributors	Eligibility Criteria	Regional opportunities/comments
COMESA Carbon Fund	N/A	Unspecified	26 Member States of COMESA, the East African Community (EAC) as well as the South African Development Community (SADC) member states	For investment into, and transaction with, project developments that are or will be registered under the Clean Development Mechanism (CDM) under the Kyoto Protocol as well as other select voluntary carbon credit registries

6 Maximising Benefits from International Processes

6.1 Common positions for global negotiations

Most Parties to the UNFCCC belong to political negotiating groups, formed on the basis of their common interests. There is no formal process for establishing these groups. Parties decide to form them, and inform the COP Bureau or the Secretariat. They meet informally during sessions of the COP or the Subsidiary Bodies (SBs). Their purpose is to exchange information and, quite often, to share information on common issues, and, in some instances, develop and agree on common positions.[26]

The political negotiating groups include, among others: The "G77 and China", the largest coalition in the UN to which all of the five EAC Partner States belong. The G-77 was founded in 1964 in the context of the United Nations Conference on Trade and Development (UNCTAD) and now functions throughout the United Nations system. It comprises 132 members. It consists of small island countries, oil-exporting countries, LDCs, industrialising countries, and middle-income countries. The African Group is the only regional group working as an active negotiating group. It consists of 53 members. They have various common concerns, including

[26] *http://www.nature-ic.am/en/unfccc_negotiation*

lack of resources and vulnerability to extreme weather. The group often makes common statements on various issues, such as capacity-building and technology transfer.

Other groups include the Alliance of Small Island States (AOSIS) and Least Developed Countries (LDCs), officially designated as "least developed" by the General Assembly of the UN, to which Burundi, Rwanda, Uganda and Tanzania belong. The LDC Group was formed to respond to the particular needs (special circumstances) of least developed countries, which have also been recognised by the Convention (Articles 4.9 and 12.5). The LDCs are increasingly active in the climate change process, often working together to defend their particular interests, in, for example, vulnerability and adaptation to climate change.

The existence of these many groupings within the UN system means that presenting a common position to the UNFCCC is a daunting task because of the diversity of interests of Parties in the groupings. Thus, any position that the EAC forges must be in line with the AU process and position. Thus, in order to enhance the EAC's participation in the UNFCCC processes and the benefits it could derive from such processes, the following approaches are recommended:

1. The EAC Secretariat could support a series of meetings of the Sectoral Council on Environment and Natural Resources Management involving "high-level regional experts on climate change" to provide technical support to the development of a common position for negotiations based on an understanding of regional climate change challenges and the interventions needed. Such technical support should include training of EAC negotiators.
2. Sectoral Council on Environment and Natural Resources Management will work closely with and influence the position of the African Ministerial Conference on the Environment (AMCEN), which is an influential organ in the AU.
3. In addition, the EAC could apply to the Conference of the Parties (COP) to become an Observer to the Conference of the Parties serving as the meeting of the Parties to the Protocol (COP/MOP). This is legislated under Article 13.8 of the Kyoto Protocol.

6.2 Opportunities in International Climate Change Instruments

Climate change presents both challenges and opportunities. Some of the opportunities include creation of "green" jobs in all areas that respond to the problem (climate change) such as science and policy. The following are some of the opportunities that climate change presents.

6.2.1 Carbon Markets

Carbon markets refer to the buying and selling of "carbon savings" from GHG-neutral projects. Essentially, a project that results in net GHG emission avoidance or reduction qualifies to earn sellable credits equivalent to the emissions it avoids or reduces. Of relevance to African countries are the following two types of markets:

Compliance Markets: Clean Development Mechanism: Currently, the only carbon trading mechanism within the compliance markets of relevance to the EAC region is the Clean Development Mechanism (CDM). It is one of three flexible carbon trading mechanisms of the Kyoto Protocol. The CDM was created under Article 12 of the Kyoto Protocol with the twin aim of helping developed countries reduce their emissions and fostering sustainable development in the developing world.

Africa's participation in the CDM has so far been insignificant (UNFCCC, Nairobi Framework, 2006). Information from the UNFCCC's CDM website shows that only about 2% of all the 2826

currently registered projects are from Africa. Furthermore, most of the Africa-based projects are in South Africa and Egypt. The distribution of CDM projects in the EAC Partner States is as follows: Burundi (Nil); Kenya (Three); Rwanda (Nil); Uganda (Two) and United Republic of Tanzania (Two) for a total of seven projects[27].

There are many and varied reasons for Africa's poor participation in the CDM. These include, among others:

1. The original design of the CDM that favours what are called "low-hanging-fruits" projects. These are projects with typically large volumes of emission reductions at low transaction costs, and are mostly industrial (e.g., nitrous oxide reduction or elimination) or fuel switch (e.g., coal to renewables such as wind, biomass, etc) projects. The complication for Africa has been that the economy of most of its states, particularly in what is geopolitically defined as Sub-Saharan Africa (SSA), is mainly agriculture-based, with little manufacturing taking place;
2. Lack of basic information related to legal and institutional arrangements (e.g. of the Kyoto Protocol and its provisions and opportunities such as the CDM itself);
3. Lack of knowledge on the CDM concept and its implementation, e.g. the financial sector in most African countries is not versed with the CDM, yet the CDM and other carbon markets are essentially financial markets;
4. Low levels of technical expertise in the CDM projects development; and
5. Inability of African countries/Parties to the UNFCCC to articulate their position at the COP meetings regarding how the CDM can be re-structured to work best for Africa.

Overcoming the above challenges with either national or regional strategies will enhance the EAC Partner States' participation in the CDM. The following are recommended strategies:

1. Development of policies and laws that encourage investment in GHG-neutral or limiting projects[28]. Such policies and laws include for example, renewable energy feed-in tariffs (Refit) policies, which Kenya and Uganda have. These offer private sector players a premium price and market guarantee for investing in renewable energy. Other policy measures include provision of tax incentives and favourable import tariffs on technology for projects that reduce emissions;
2. Calculation of the baseline GHG Grid Emission Factor (GEF) for the national electricity grids[29] to facilitate CDM projects in the power sector and assist carbon project developers and proponents. Baseline GEFs can also be determined at a regional scale;

[27] These figures are accurate as of April 28th 2011

[28] Such policies and laws must however, be designed in a manner that ensures that they do not affect additionality, the act of proving that the emissions a project reduces or avoids are additional, i.e., not those that would have occurred even without the CDM. Additionality test is a key component for all CDM projects. Projects implementing national policies that promote zero- or low-carbon emission technologies (e.g. South Africa's renewable energy target) can still go through the CDM process as they do meet the additionality requirement. However, where there are local regulations, e.g. on air emissions as pertains to local safety, health and environmental standards, projects such as landfill gas capture would not be ruled out entirely, but would receive credit for the difference between actual methane capture and that needed to meet these standards (Winkler H., 2004).

[29] With the support of the UNDP, Kenya has just implemented a similar project. A GEF calculation tool (software) has been developed and will be uploaded on the website of the Kenya Power Lighting and Company Ltd. (KPLC) to ease the work of project proponents and developers

3. Targeted capacity building for the private sector and investors to increase their knowledge of the CDM and other forms of carbon markets, e.g. developing a handbook for CDM Project activities detailing the role of government and the UNFCCC, CDM cycle, types of projects, eligibility criteria, CDM transaction costs and how to sell certified emission reductions (CERs);
4. Need for a government-fronted manual that guides CDM implementation; this can be placed on a public website, as has been done by a number of countries including Tanzania;
5. Strengthening relevant institutions such as the Designated National Authority (DNA)[30].
6. Training in the technical aspects of the CDM, e.g. baseline, methodologies and procedures development and identification. This could form part of the climate change education and training as proposed under *Education, Training and Awareness* in chapter 6;
7. Exploring ways of integrating carbon markets into the main economy and opening it to conventional legal and banking systems[31]; and
8. Developing a clear regional strategy and action plan on accessing of funding sources like the MDG Carbon Facility and Africa Carbon Asset Development (ACAD).

Voluntary Carbon Market: Voluntary Carbon Market (VCM) emerged to fulfill the demand from organisations and businesses that wished to offset their carbon emissions voluntarily. Business dominates demand principally to offset operational activities but also through a growing trend to offset products and services. In nearly all instances individuals are important, generating some primary demand in offsetting their own lifestyles' emissions and purchasing 'neutral' products and services and by inspiring companies to offset operational activities, presenting a positive corporate image (Harris E., 2006).

An example of a VCM mechanism is the Agriculture, Forestry and Other Land Use (AFOLU), of which REDD (from which REDD+ evolved), Improved Forest Management (IFM), etc, all form project categories. Like REDD+, AFOLU projects are land-use projects, and therefore the conditions applicable to REDD+ and the strategies for enhancing REDD+ (as provided below) apply.

6.2.2 Reducing Emissions from Deforestation and forest Degradation

The Reducing Emissions from Deforestation and forest Degradation plus (REDD+) is still at formative stage. Negotiations under the UNFCCC COPs, in particular at COP 15 in Copenhagen, Denmark and COP 16 in Cancun, México, have seen REDD+ take centre stage at the

[30] *In Kenya, a climate change policy is being developed. One of the proposed provisions of this law is the strengthening of the DNA through making the office an "Authority", to be chaired by the Permanent Secretary (P.S), Ministry of Environment, with P.S's of Ministries of Foreign Affairs, Planning, Energy, Agriculture, Trade and Tourism as Members, and the Director General of the National Environment Management Authority (NEMA) as the Secretary.*

[31] *An informed financial sector is an avenue for achieving this goal. Across the region, there are a number of carbon exchanges coming up courtesy of an informed financial sector. Examples include the African Carbon Credit Exchange (Lusaka, Zambia) and the Global Carbon Exchange (Cape Town, South Africa).*

international level. It is not yet clear what form (i.e. fund or market mechanism) REDD+ will eventually take.

REDD+ is important because scientific evidence reveals that forests act as natural carbon sink when they are not cleared or altered but when cut down or poorly managed, they are responsible for about 12-17% of global GHG emissions. Fighting deforestation, promoting sustainable forest management (SFM) and conservation, therefore become key elements of the climate negotiations. These negotiations are conducted in the framework of REDD+ mechanism. What REDD+ aims to achieve is to offer viable alternatives to activities causing deforestation or a fair compensation for preserving natural ecosystems (including forests) to forest-dependent communities.

The following is the status of REDD+ readiness implementation in the Partner States. The information is sourced from the REDD+ Partnership database. The REDD+ Partnership is a forum open to all countries willing to support or undertake REDD+ actions. It was launched at the Oslo Climate and Forest Conference hosted by Norway in May 2010, formalizing the call of ministers for such a Partnership at the International Conference on the Major Forest Basins in Paris in March 2010. As of 12 June 2011, it included 72 Partner countries and over 100 affiliated institutions. The REDD+ partnership maintains a database known as the Voluntary REDD+ Database, which provides access to information on REDD+ financing, actions and results that has been reported to it. The database relies solely on information voluntarily submitted by countries and institutions including a report on individual arrangements: agreements to undertake REDD+ related actions, involving funders and recipients. However, so far, only 36 countries report regularly.

Burundi: Burundi has 0.18 million ha of forest which is 7% of the country's total land cover. According to the REDD+ Partnership database, Burundi so far has not reported receiving any funding for REDD+ related activities in the country[32].

Kenya: Kenya has 3.52 million ha of forests or 6% of the total land-cover. Kenya has also not reported any funding or actions although other sources in the database indicate it has received 19.9 million USD for REDD+ activities for the period 2005 - 2014. However, it is on record that Kenya has initiated activities to implement a REDD-Readiness plan with support from the World Bank through the Forest Carbon Partnership Facility (FCPF). In 2010, a 0.2 million USD Formulation Grant was signed and disbursed towards this goal. Activities proposed under the REDD-Readiness phase include among others the development of a national REDD Implementation Strategy, development of a national carbon emission reference scenario and an emission reduction monitoring system. Kenya is in the process of recruiting a National REDD Coordinator. Activities already implemented or undergoing implementation include developing National REDD Readiness Management Arrangements, REDD Strategy Preparation, piloting of Implementation Framework, Strategic Environmental and Social Assessment (SESA), Development of a Reference Scenario, and development of a Monitoring, Reporting and Verification (MRV) framework.

Rwanda: Rwanda has approximately 0.39 million ha of forest corresponding to 18% of the country's total land area. According to the REDD+ Partnership database, the country has reported zero funding for REDD+ activities. However, the Congo Basin Forest Partnership has provided funding for REDD+ activities for the period 2008 – 2014.

Tanzania: Tanzania has 35.45 million ha of forest which is 38% of the country's total land area. The country has not reported receiving any funding for REDD+ activities according to the REDD+ Partnership, although Tanzania has received up to 108.28 million USD for the period 2005 – 2014 from the Norwegian Government and UNDP and other development partners. In

[32] http://reddplusdatabase.org/

July 2011 Forest Trends, an International Non-Governmental Organization, released a brief titled "REDD Opportunities Scoping Exercise (ROSE)". ROSE is a tool for classifying and prioritizing potential REDD+ sub-national activities, and for assessing critical constraints to project development, especially those associated with the legal, political, and institutional framework for terrestrial carbon finance. It involved case studies in Tanzania and Uganda among other countries[33]. The report concluded that although there are many opportunities for REDD+ in Tanzania, there is need to clear legal, policy, and institutional hurdles first, as well as undertake capacity building. A number of REDD+ pilots are currently ongoing in Tanzania in spite of these hurdles. With the exception of Kenya, Tanzania is relatively ahead of its counterparts in the region in implementing REDD_+ activities. The UN-REDD Programme in Tanzania is assisting the government of Tanzania with the establishment of a national forest carbon Measuring, Reporting and Verification (MRV) as well as achieve REDD-Readiness.

Uganda: Uganda has 3.43 M ha of forest area which corresponds to 15% of the country's land area. The REDD+ Partnership database shows that Uganda has received USD 0.2 million towards funding REDD+ activities for the period 2008 - 2015. However, the same database shows that reports by sources outside Uganda indicate incoming funding of 2million USD for the same period. The ROSE report concluded that Uganda too has vast opportunities for REDD+ although there is need to address legal, policy and institutional hurdles first. Uganda too has a number of REDD+ pilots currently.

Given that the economies of most African countries including those of the EAC Partner States are based primarily on land resources the REDD+ Mechanism is of immense importance to the region. Thus, the regional participation in the mechanism should be enhanced through the following measures:

1. Joint action involving both the public and private sectors in order to mobilise the necessary finance and accelerate REDD+ actions;
2. Awareness and capacity building especially among forest-dependent communities and generally members of the public;
3. Technical assistance and training on methodologies, baseline determination including filling of historical data gaps on forest covers throughout each of the Partner States, etc; and
4. Developing national REDD+ implementation frameworks including robust monitoring, reporting and verification (MRV), clear institutional arrangements (clear credible national forest monitoring baselines and guidelines), and means of addressing issues such as the risk of non-permanence and leakage, which are necessary conditions for participating in the mechanism.

6.2.3 Nationally Appropriate Mitigation Actions

Nationally Appropriate Mitigation Actions (NAMAs) of developing countries are voluntary actions or activities that a developing country undertakes to mitigate climate change, i.e. to reduce its emissions of GHGs. The concept was first introduced at COP 13 in Bali under the Bali Action Plan (BAP). The definition provided by the BAP, and which has since been adopted e.g., in the Copenhagen Accord and the Cancun Agreements, is that NAMAs are voluntary mitigation activities by developing countries, "*supported and enabled by technology, financing and*

[33] http://www.forest-trends.org/~foresttr/publication_details.php?publicationID=2431

capacity-building by developed countries", and "*in a measurable, reportable and verifiable manner*".

The main challenges in the implementation of NAMAs involve the identification of appropriate programmes/projects including developing funding proposals, estimation of emission reductions as well as reporting of the progress on actions being undertaken. The latter requires a strict monitoring, reporting and verification (MRV) system for all developing countries, with flexibility for the least developed countries (Articles 60, 62, 63 of the Cancun Agreements) as a condition for receiving support (financial, technological and technical) for NAMAs from developed countries. Joint collaboration by the EAC Partner States on these issues is therefore critical. The following strategies could be adopted:

1. Regional technical trainings on GHG monitoring and reporting;

2. Capacity building in technology transfer, e.g. training in the use of advanced GHG reduction/green energy technologies, etc; and

3. Technical capacity in NAMAs' development with funding proposals as well as GHG emission reduction estimation.

7 Policies, Legal and Institutional Framework

An overview of the status of policy and institutional framework of Partner States climate change governance has been outlined earlier in the document. In all Partner States climate change initiatives are dealt with by a number of different ministries, departments and agencies of the national government. There is no single institution that deal with climate change. From the overview, it can be concluded that there is no single institution that has a clear mandate for coordinating climate change activities in each of the EAC Partner States. All the Partner States are grappling with the need to ensure that climate change activities are well coordinated and harmonised to avoid duplication of resources.

The situation in the Partner States, is not dissimilar to the EAC Secretariat. According to the EAC Climate Change Policy, climate change activities and related initiatives are currenlty undertaken in un-coordinated and piece-meal manner by various departments, institutions and organs of EAC, a state that could lead to disharmony between departments and undermine EAC effectiveness and efficiency. EAC Climate Change Policy calls for the establishment of an institutional framework for climate change to work jointly with relevant government agencies, organs of the Community, EAC Insitutitions including Lake Victoria Basin Commission, Lake Victoria Fisheries Organization, Inter-University Council of East Africa and others that will be established, backed by relevant Sectoral Committees, a Coordination Committee and finally the Sectoral Council of Ministers for Environment and Natural Resources.

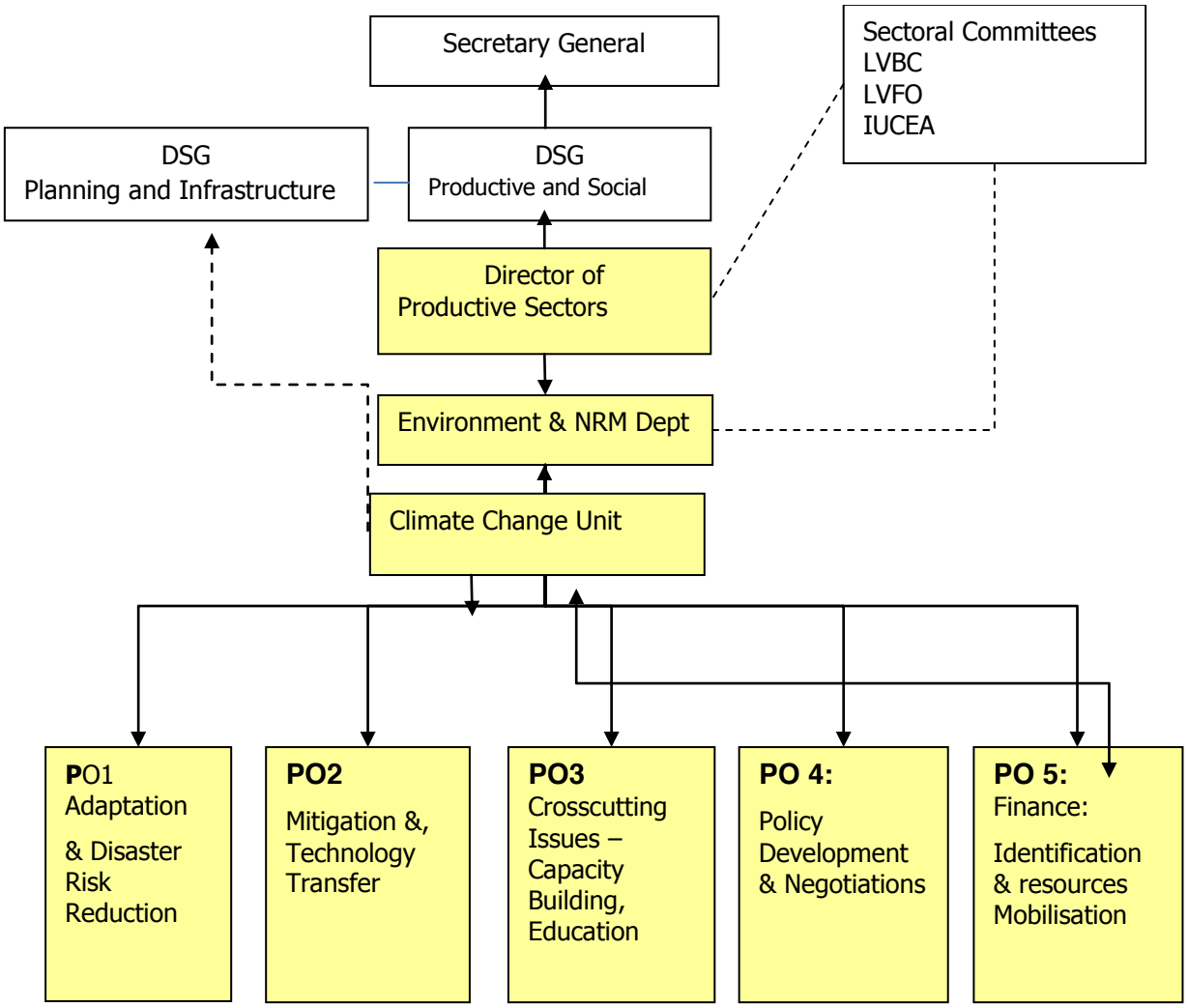
The Master Plan recommends the establishment of a defined coordination and management unit in order to enhance synergy and minimise duplication. This is consistent with the EACCC Policy which further clarifies the mandates of the climate change institution as follows:

- Designing of climate change policies, strategies and plans and designing relevant projects;
- Promoting the introduction of climate change in education curriculum
- Building the capacity of research institutions involved in climate change related issues

Given the above background, a **Climate Change Coordinating Unit (CCCU)** to be based in the Environment and Natural Resource Management department and under the directorate of productive sectors is proposed. In addition to the function stated above, the CCCU other functions shall include to:

1. Identify priority cross-border and trans-boundary adaptation and mitigation areas as contained in the EAC Master Plan and EAC Strategy, and work with Partner States to implement intervention measures, and periodically report on the progress and status of regional measures to promote climate change adaptation and mitigation to the Secretariat.
2. Develop and implement a programme for communication of information on climate change, with plans and appropriate procedures for communication using efficient tools for effective outreach, training and awareness building on climate change;
3. Collaborate with institutions of learning, training institutions and civil society organizations to disseminate climate change information as necessary;
4. Monitor and Evaluate the implementation of climate change activities in collaboration with the respective offices and the Secretariat; evaluate in collaboration with experts, each programme activity at completion and provide balanced decisions and views on success, failures (if any) and opportunities for improvement; and prepare, assess and review the viability, methodology and outcomes of all climate change programmes; and support the development of relevant policies, laws, rules, regulations and standards in relation to regional climate change activities; and present periodic reports on the activities to the respective programme offices, as well as to the Secretariat.

Figure 7-1 Institutional arrangement



8 Implementation and Resource Mobilization Plan

Detailed Implementation Plan (Annex III) has identified key activities that should be achieved during short, medium and long-term implementation of the Master Plan. The table below is an overview of the Implementation Plan based on priority sectors. It gives estimated costs for adaptation, mitigation, capacity building and other climate proofing measures detailed in the Master Plan.

The climate change budget for the EAC Secretariat is calculated using a factor of 0.1% to 0.15% of the total budget of priority sectors of the combined five Partner states' budget for that sector for the period 2011/2012. This budget will cover climate change related running costs such as facilitation; meetings; pre-feasibility and scoping studies; demonstrations and pilots of best case projects as well as provide seed money for start-up replicable trans-boundary projects. The budget for meteorological services have taken cognizance of the fact that there is need for investment in state of the art equipment to enhance meteorological infrastructure to support research and systematic observation systems and tools; increase and standardize regional hydrological meteorological data collection stations; upgrade hydro-meteorological early warning products and information, capacity building of human personnel, etc.

The climate change budget for the five Partner States is calculated based on a climate change urgent factor which assigns sectors a factor of 5% to 15% of the total sectoral budget depending on their vulnerability to climate change. In the Master Plan Education is assigned a 5% factor and includes social protection, capacity building in marginalized groups, training network, curricula, awareness, translation, women groups. Health is assigned 10% for infrastructure to meet MDG density of services, disaster risk reduction related to mortality, air

pollution and co-benefits, disease control. ICT which in this case includes CRM and DRR is assigned 5% for knowledge management, early warning monitoring systems on climate and climate impacts, harmonization and access. Physical Infrastructure is assigned 15% for roads, ports, dams, energy production, water harvesting, flood defences, coastal protection and industrial plan. Productive sector is assigned 15% and includes agriculture, fisheries, forestry, ecosystem services, water, wildlife, tourism, livestock, processing industry. Manpower is assigned 5% in lost labour productivity, manufacturing and services, livelihoods and social security, sectoral training of professional managers, standards. It is on this basis that the Partner States budget below is arrived at.

For EAC Secretariat and Partner States to implement urgent climate change activities proposed in the Strategy and Master Plan, additional financial resources will be required. The total budget for EAC Secretariat in the short-term (1 to 2 years) is estimated at **US$ 34,220,137.65** whilst for climate proofing Partner States development is US$ **2,141,860,561.15**. Note that this amount is meant for climate proofing crucial priority trans-boundary and regional climate change issues identified.

Potential sources of finance are indicated in section 5.5 and includes Partner States contribution, international climate finance sources (both bilateral and multi-lateral), private sector financing, carbon market and other sources (see table 5.2)

Table 8-1 CLIMATE PROOFING BUDGETS (Note: See Appendix III for a detailed table)

SECTOR STRATEGY	Time Frame	Estimated Costs EAC Secretariat US $	PARTNER STATES US $
AGRICULTURE & IRRIGATION	ST	3,300,918.22	330,091,821.68
WATER SECURITY	ST	461,655.22	46,165,521.78
ENERGY SECURITY	ST	3,652,540.78	365,254,078.24
HUMAN HEALTH, SANITATION AND SETTLEMENT	ST	3,370,955.07	337,095,507.56
PHYSICAL INFRUSTRUCTURE	ST	7,888,130.64	788,813,064.41
ECOSYSTEMS AND BIODIVESITY - Forestry - Wildlife - Coastal and Marine Ecosystems	ST	856,722.12	85,672,211.71
TOURISM	ST	101,260.43	5,063,021.70
TRADE AND INDUSTRY	ST	233,068.32	11,653,416.03
SCIENCE & TECHNOLOGY DEVT.	ST		23,278,750.06
EDUCATION & RELATED CROSS CUTTING ISSUES Technology Development and Transfer; Capacity building; Education, training and public Awareness; Gender, Youth and marginalized	ST	2,631,477.65	143,213,257.48
Upgrading Meteorological Systems including Capacity Building	ST	11,119,971.00	3,706,657.00
CRM & DRR	ST	370,650.00	1,853,253.50
TOTAL	ST	**34,220,137.65**	**2,141,860,561.15**

9 Monitoring and Evaluation

The EAC Secretariat shall be responsible for tracking, coordinating and overseeing the implementation of this Master Plan in collaboration with the five Partner States, and other agencies in the private sector, civil society or as may be assigned.

Monitoring Plan

While EAC Secretariat is expected to use an in-house monitoring and evaluation plan, if available, monitoring and evaluation should be designed to ensure that the newly established **Climate Change Coordinating Unit (CCCU)** foresees the collection of information for use by the Secretariat and related organizations and agencies; Partner States and their coordinating agencies, NGOs and key stakeholders. Monitoring is a management process, which will systematically supply information to the Partner States on the progress of implementation of the activities to facilitate timely decision making and to generate **evidence and arguments** that will **influence mainstreaming** of climate change into development programmes. The main goal of the Master Plan is to give an overall picture and enhance a coordinated regional response to climate change. The Information shall be collected through reports submitted to the Climate Change Coordinating Unit periodically. CCCU shall seek other ways of monitoring including stakeholder analysis, documentation review, biophysical measurements, direct observation, cost benefit analysis, semi-structured interviews, questionnaires and surveys.

Evaluation Plan

It is recommended that EAC Secretariat undertake a mid-term independent evaluation after two years to ascertain progress on implementation of the Strategy and the Master Plan. A terminal evaluation just before the end of the strategic plan period is also recommended in order to review and develop a new five year Strategic Plan.

ANNEX I: DETAILED APPROACH AND METHODOLOGY

I. Overview

The methodology and approach to the development of the Master Plan rests on two key components:

1. Participatory and consultative approach
2. Evidence-based approach to the identification and prioritisation of adaptation and mitigation related measures and actions based on literature review as well as the identification and analysis of the linkage of climate change to the socio-economic development in the region

Figure I-1 provides an overview of the approach and methodology used in the development of the Master Plan. These are further discussed in the sections below.

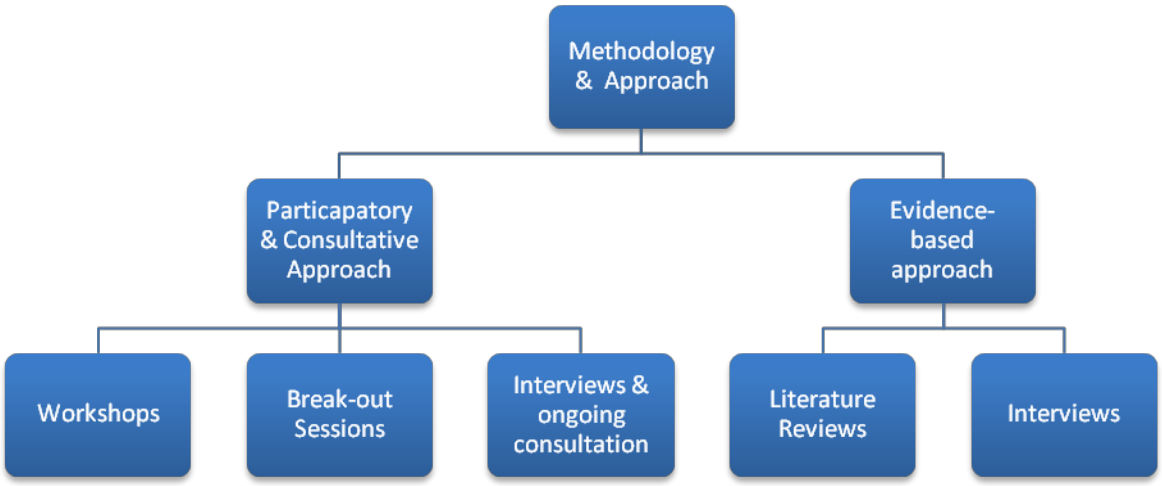


Figure I-1 provides an overview of the approach used in the development of the Master Plan

II. Participatory and Consultative Approach

National Workshops

As part of the participatory approach to the preparation of the Master Plan, five National Workshops, one in each of the EAC Partner States, took place from the 7th to 22nd March 2011 (Table X-1) . The Workshops were designed to engage stakeholders within each of the Partner States to generate discussion on climate change issues in each of the Partner States, to identify the most important issues related to climate change and to gauge their relevance as well as impact on both regional climate change adaptation and mitigation response measures.

The National Workshops were organised and led by each of the Partner States with facilitation/support from the EAC Secretariat. Camco provided the necessary support to ensure that quality information was generated by: orienteering participants as to the workshops' programme and objectives, presenting the draft Master Plan, providing the materials for discussion in the break-out sessions and facilitating the discussions during the break-out sessions.

Table I-1 below presents the dates of the National Works held in each of the Partners States.

Table I-1 Schedule of National Workshops

Date	Country
7 -8th March 2011	Bujumbura, Burundi
10-11th March 2011	Kigali, Rwanda
14-15th March 2011	Kampala, Uganda
17-18th March 2011	Dar es Salaam, Tanzania
21-22nd March 2011	Nairobi, Kenya

Objectives of the Workshops

The main objective of the National Workshops was to collect climate change related information from key stakeholders in each of the Partner States to inform the development of the Climate Change Master Plan. The three specific objectives of the workshop were:

i. To identify the main climate change issues within each of the Partner States with specific regional importance. These included risks, challenges and opportunities;
ii. To propose ways of improving both the EAC Secretariat's response and responsiveness to climate change at the regional and national level;
iii. To generate information on existing sources of climate change funding at Partner State level to complement EAC's climate change funding.

The key climate change issues initially identified as the basis for discussion at each of the workshops included agriculture/food security, water security, energy security as well as physical and social infrastructure.

Format and procedure

The workshops took place over two days in each of the Partner States. The original workshop format proposed by Camco (see Workshop programme and the materials used in the break sessions included in Annex I) was amended at the Burundi workshop and maintained for the subsequent National Workshops.

The workshop proceedings were broadly divided into three main parts: general introductions, including the draft Master Plan presentation, break-out sessions and several plenary sessions.

Determining the Climate Change Master Plan Priority Areas and Sectors

The sectors and areas initially identified at the Inception Meeting in February 2011 recognised as the key areas affected by climate change were expanded as the National Workshops took place. The final list of key sectors as identified by the participants included:

1. Agriculture (including livestock, fisheries and crop production) and food security
2. Water security
3. Energy security
4. Physical infrastructure (roads, good urban planning and infrastructure to transport resources such as water)

5. Health, human settlements and other aspects of social infrastructure
6. Biodiversity, ecosystems and ecosystem services
7. Trade and Industry
8. Tourism
9. Science and technology

Biodiversity and Ecosystems emerged as a priority area both national and regional climate change discussions at the Burundi National workshop participants. In line with the main priority sectors already identified, the participants stressed that water security is the key issue affected by climate change. Participants at the Rwanda National Workshop identified Human Health a key stand-alone sector that should receive more attention in the Master Plan. The key focus areas identified at the Uganda National Workshop included Human Health, Agriculture and Food Security emerged as particularly the role and impacts of pests and diseases on agriculture. As with the previous workshops, participants at the Tanzanian National Workshop identified agriculture and food security as the first priority in addressing climate change. The issue of climate change related sea level rise came to fore as a key issue for both the mainland coastal areas as well as offshore islands such as Zanzibar. In keeping with the identification of the Tanzanian coastline as a priority area, participants emphasised that the coastal and marine ecosystems and associated industries such as fisheries should feature prominently in the Master Plan. Forestry was identified as an especially important area and tool that can be used to respond to climate mitigation and adaptation measures. Although livestock and animal husbandry are an important issue for several of the EAC Partner States, the participants in the Kenyan national workshop raised it as an integral part of climate adaptation and mitigation measures in Kenya and regionally. As was with the workshop held in Dar es Salaam, the issues of sea level rise, coastal infrastructure as well as coastal and marine ecosystems were identified as especially vulnerable to climate change and therefore warranted particular attention in the Master Plan. Forestry was also highlighted as a priority area in responding to climate change. Table I-2 Provides a summary of the priority areas and sectors as they were identified at the National Workshops.

Table I-2 A summary of the Evolution of Priority Areas and sectors identified the EAC Partner States

Priority Area/Sector	Burundi	Rwanda	Uganda	Tanzania	Kenya
Agriculture and Food Security	✓	✓	✓	✓	✓
Water Security	✓	✓	✓	✓	✓
Energy Security	✓	✓	✓	✓	✓
Health and Human Settlements	✓	✓	✓	✓	✓
Physical Infrastructure			✓	✓	✓
Biodiversity, Ecosystems and Ecosystem Activities	✓	✓	✓	✓	✓
Tourism	X	X	X	✓	✓
Trade and Industry	X	X	X	X	✓
Education and Technology	X	X	X	X	✓

Expanded New

III. Continuous engagement with Experts and other Stakeholders

Throughout the development of the Master Plan, various stakeholders were consulted and interviewed. These included Working Group of Experts members, experts within various governmental departments and allied institutions, the private sector, donor agencies and observers. Stakeholders had the opportunity to comment on the Master Plan at various stages to further ensure that pertinent information was incorporated into the Master Plan.

The consultative approach facilitated by the EAC Secretariat also ensured that the various EAC Climate Change related documents and activities were coordinated and harmonised.

IV. Validation Workshop

As with the National Workshops the Validation Workshop provided another opportunity for the stakeholders within all the of the Partner States in various sectors to comment open, discuss and validate draft versions of the Master Plan prior to its finalisation.

V. Evidence –based Approach

In addition to the participatory and consultative approach used to gather relevant reference data and materials data and documents as part of the Master Plan development process; comprehensive literature reviews were conducted to fully understand and appreciate the regional climate change situation; data sources included national documents, meteorological records and other national documents in addition to information drawn from international studies an bodies such as the ICC, UNFCCC and UNEP

The evidence-based approach informed the high-level vulnerability and sensitivity analyses for each of the Partner States. The method used to conduct the assessment is described as a second-generation vulnerability assessment by Füssel and Klein (2006). The second-generation vulnerability assessment estimates as realistically as possible the vulnerability of sectors or regions to climate change in the context of stress factors relevant to the sector/region and while being mindful of the potential of feasible adaptation measures available to reduce the severity of climate change impacts. The assessment thus examined bout the adaptation options available but also the adaptive capacity of people, a function of their ability to implement effective adaption measures. The aim of the assessment was to enable the prioritisation of resource allocation for adaptation measures.

ANNNEX II: PROJECT PROFILES AND PROPOSALS

Project profiles have been prepared for the priority sectors for the region that the Master Plan has identified:

I. Agriculture and Food Security: Enhancing regional food security within the CAADP framework

Challenges

According to the EAC Food Security Action Plan 2011-2015, the region is frequently affected by food shortages and pockets of hunger. This is happening despite the fact that the region as a whole has a huge potential and capacity to produce enough food for regional consumption and a large surplus for export to the world market. There are many factors leading to this state of affairs but the most critical are: (i) inadequate food exchange/trade between times and/or places of abundant harvest on one hand, and those with deficit on the other; and (ii) high variability in production caused by high variability of weather which is becoming worse due to climate change.

Opportunities

The Comprehensive Africa Agriculture Development Programme (CAADP) is an agricultural programme of the New Partnership for Africa's Development (NEPAD), which in turn is a programme of the African Union (AU). Established by the AU assembly in 2003, CAADP focuses on improving food security, nutrition, and increasing incomes in Africa's largely farming based economies. It aims to do this by raising agricultural productivity by at least 6% per year and increasing public investment in agriculture to 10% of national budgets per year. All the five EAC Partner States have signed the CAADP pact, signalling their intention to increase budgetary allocation to the agricultural sector's development.

CAADP's work falls under 4 pillars of Land and Water Management (Pillar 1); Market Access (Pillar 2); Food Supply and Hunger (Pillar 3); and Agricultural Research (Pillar 4). The EAC could integrate its Food Security and Nutrition Action Plan within the CAADP framework, with focus on Pillars 2 and 3. This is because poor market access and reducing small-holder food production have been identified by the Food Security Action Plan as the main challenges to the region's food self-sufficiency and security.

II. Energy: Cogeneration in the sugar industry in East Africa

Cogeneration, also known as combined heat and power (CHP), refers to the simultaneous production of heat and power, both of which are used. Conventional power generation, on average, is only 35% efficient; therefore up to 65% of energy potential is lost, mostly as heat. However with cogeneration the energy loss is reduced by using the heat for industrial, commercial or domestic purposes. Cogeneration is applicable to many industries where heat and power are needed

Biomass cogeneration

Biomass co-generation refers to the use of biological material as feedstock for co-generation plants. Biomass can be in solid form such as agricultural residues, wood wastes from forestry and industry, residues from food and paper industries, green municipal solid waste (MSW), dedicated energy crops and reclaimed wood. It can also be in gas form including in the form of

landfill gas, manure biogas and wastewater treatment biogas. Alternatively, it can also be fed indirectly to generating plants through gasification of solid biomass or production of liquid biofuel.

Cogeneration is a fairly new technology in Africa, and only a few countries have venture in the technology. Currently Mauritius is leader in cogeneration in Africa. Mauritius meets close to 40% of its electricity needs from cogeneration, of which 25% is from bagasse. This success can be replicated in EAC.

Opportunities and benefits of cogeneration

Sugar Factories, Tea-Processors and Forest Industries

The EAC is majorly an agricultural region. There are a number of agro-processing industries including tea processing, sugar milling, paper industry and timber industry. Traditionally, all these industries have been depending on one revenue stream. By adopting efficient cogeneration technology, agro-industries such as sugar factories as well as forest industries can minimize the risks associated with declining commodity prices by selling surplus electricity to the national grid thus realizing a lucrative and, often, more stable revenue stream. For smallholder farmers such as those growing sugar cane, sale of electricity to the national grid by the sugar factory can also provide an additional source of revenue through a benefit sharing mechanism. For instance, an innovative revenue sharing system in the sugar industry of Mauritius has even the smallest sugar farmer to benefit from sale by sugar factories of surplus electricity to the grid.

For instance over 50 000 small scale farmers in Kenya benefit directly, by supplying raw material to Mumias sugar company (which is leading in cogeneration in the country). It is also estimated that cogeneration plants can create between 3 to 5 jobs per GWh.

Increase in oil prices and power supply shortfalls

Electricity generation in the EAC is majorly hydro based this has led to major power supply shortfalls especially during drought seasons. This has been compounded by the high cost of oil which dramatically increases the cost of procuring emergency oil-fired power plants. Cogeneration in agro-industries and forest industries can contribute to addressing the on-going power supply shortfalls in the EAC, by bringing on a new stream of power generation capacity that is of significantly lower cost than many of the oil-fired emergency power plants that are currently being used. Many of these potential cogeneration plants are located at the edges of national grids and would thus assist in reducing transmission losses as well as improved power grid stability.

Local investors and financing institutions

Cogeneration power plants required by most agro-industries and forest industries in the region are generally small to medium scale in size - ranging from 5MW to 50MW. Consequently, the investment needed is often within the capability of both local investors and local banks.

Opportunity for rural electrification

As most agro-based and forest industries with cogeneration potential are located in remote rural areas, they provide a good opportunity for expanding rural electrification. This would enable the rural communities to enjoy the benefits of electricity such as improvements to health care facilities and schools as well as enhancing potential for agro-processing facilities such as milk coolers and maize mills. In addition, cogeneration can help reduce vulnerability of the rural population by reducing poverty through job creation both at the cogeneration plants and at the source of raw materials for the industries such as at the sugar cane plantation level.

Possibility of foreign support

At a time when greening the world's economies and industries is high on the agenda, there is potential for foreign backing for cogeneration projects. Cogeneration provides an opportunity to reduce GHG emissions, and will therefore attract support through the GEF, CDM and other mechanisms under the Kyoto Protocol

Currently there is an initiative to promote cogeneration in Africa. The initiative dubbed "cogeneration for Africa" is a clean energy initiative funded by the GEF. The initiative is complemented by UNEP and AfDB and is executed by AFREPREN/FWD. The initiative aims to build on the success of cogeneration in Mauritius. It seeks to significantly scale up the use of efficient cogeneration systems; initially in seven eastern and southern African countries (With Kenya, Tanzania and Uganda being among the beneficiaries).
Current milestone: An equivalent of 20.8MW (3.8 MW Electric and 17 MW Thermal) of Efficient Cogeneration Systems has been constructed and commissioned. There is an expected follow-up of USD 133.5 Million Cogen Investment for up to 220 MW (74 MW Electric & 146 MW Thermal) in the Tea sector in Kenya and Sugar sector in Uganda as of July 2011

Viability of cogeneration in EAC

Sugar cane is a major commercially grown agricultural crop in the EAC. It is one of the plants having the highest bioconversion efficiency of captured sunlight through photosynthesis. Under current practice, 50% of this dry matter is harvested in the form of cane stalk for sugar recovery with the fibrous fraction in the form of bagasse gathering, providing energy requirements for the process, through combustion. This means fuel for cogeneration especially bagasse a readily available in many African countries.

The table below shows the potential of cogeneration in the sugar industry in East Africa.

Table II-1Cogeneration potential in the sugar industry in EAC

Country	Sugar ($x\ 10^3$t)	Sugar Cane[34] ($x\ 10^3$t)	Cogeneration Potential (GWh)	
			@ 44 bars[35]	@ 82 bars[36]
Burundi	21	191	13	21
Kenya	423	3,845	269	423
Rwanda[37]	-	-	-	-
Tanzania	190	1727	121	190
Uganda	244	2218	155	244

Source: Sugar Cane Bagasse Energy Cogeneration – Lessons from Mauritius by Dr Kassiap DEEPCHAND

[34] *Estimated at sugar recovered % cane of 11%*
[35] *Based on 70 kWh/tonne cane*
[36] *Based on 110 kWh/tonne cane*
[37] *Information not available*

The EAC boast of a vibrant Tea industry with all the EAC partner states engaging in tea processing. Heat is a key constituent of tea processing and provides a great opportunity to introduce cogeneration in the tea sector.

Investment cost
Thought the initial investment cost can be relatively high, the payback period is relatively short, estimated at about 3 to 5 years. Moreover, just like other renewable energy technologies, cogeneration can be implemented in modules, such that a large project is broken down into smaller units which can be implemented in phases. This makes financing of cogeneration projects easier.

Environmental assessment
Cogeneration have lower GHG emissions especially CO2. It is therefore an environment friendly technology and a less likely to receive opposition from environmentalists. This means that countries are likely to receive external funding for cogeneration projects.

Challenges to cogeneration in EAC

- Lack of proper and accurate information to support cogeneration.
- Poor supporting infrastructure especially in the distribution of energy to the users.
- Lack of incentives to encourage key player particularly in the private sector.
- Regulatory barriers such as the sale of surplus electricity to consumers and unattractive prices.
- Vested interests.
- Inability to pay. Majority of the people in the developing countries, especially those in the rural areas are poor, with irregular income flow, and though they have need for energy (electricity), sometimes they are not able to pay for it.

III. Energy: Expanding and accelerating the East African power pool

Developing climate-resilient indigenous renewable energy sources in the East Africa should be a priority in the EAC. This should build upon the on-going efforts under the East Africa Power Pool Project (EAPP). Eastern Africa is not short of indigenous renewable energy. Effort to address the barriers to RE development including a lack of bankable resource data, disconnected power demand, lack of an enabling regional policy environment and access to finance are required. Addressing these needs could define the objectives of one of the flagship projects. The energy sector in the greater EAC is characterized by low generation capacity, poorly maintained and managed transmission-distribution systems, inconsistent supply, vulnerability to geo-political and climatic shocks, marginal penetration of renewable energy (outside of large hydro) and accelerated use of fossil fuels.

Less than 20% of the 133 million people in the East Africa Community (EAC – composed of Burundi, Kenya, Rwanda, Tanzania and Uganda) are connected to a national electricity grid (EAC, 2009; EAC, 2010). Connectivity in rural areas where the majority reside is estimated at 3%. Total installed electricity capacity in these five countries is less than 3 GW - comparable to

one large hydro dam in China (CHINCOLD, 2010). Mexico, which has a comparable population size to the EAC, has an installed capacity of 58 GW for example (World Bank, 2005). Unreliable electricity supply significantly impacts socio-economic development within the EAC. In Kenya, inconsistent power supply is estimated to reduce GDP growth by up to 1.5% per year (WB, 2010) and electricity demand has continued to grow. Additional capacity to meet the existing and growing needs is necessary.

The proposal to develop an East Africa Power Pool has been an on-going discussion. In February 2005, seven African countries (Congo DRC, Egypt, Ethiopia, Kenya, Rwanda, Burundi and Sudan) signed an MOU outlining members' obligations, organizational structure and other foundational issues, setting the stage for such a project (EAPP, 2011). Tanzania and Libya joined the project in 2010 and 2011 respectively. Since then a regional master plan and grid code study has been funded by the African Union and technical assistance provided by the European Union. Other activities in progress include a strategic road map to 2025 and preparation of a cross-border treaty. Several interconnection projects are already on-going including the Kenya-Ethiopia line (400 KV), Ethiopia-Sudan (220 KV), Ethiopia-Djibouti (220 KV), Kenya-Tanzania (400 KV), Uganda-Rwanda (220 KV).

Developing opportunities, especially for private sector participation in feeding climate resilient indigenous renewable energy resources into the EAPP provides the region with the best option to cushion against the projected climate change threats. Currently, the region is heavily dependent on rain-fed hydro-electric sources leading to recurrent power rationing programmes in several countries in the region. This has led to an accelerated switch to fossil-fuel powered thermal stations which rely on imported oil vulnerable to geopolitical shifts. An expanded power pool with robust renewable energy sources is a first step in adapting to the impacts of climate change.

IV. Water: Trans-boundary underground water management

Groundwater is water located beneath the ground surface in soil pore spaces and in the fractures of rock formations. A unit of rock or an unconsolidated deposit is called an aquifer when it can yield a usable quantity of water. Although groundwater sources are distributed unevenly through the East African region, they form a significant source of water. There are five transboundary aquifers and basins in the East Africa region including the Kagera Aquifers shared by Burundi, Rwanda, Uganda and Tanzania and the Kilimanjaro aquifer shared by Tanzania and Kenya. Kenya and Uganda share two other aquifers: the Rift Aquifers and the Mount Elgon Aquifer. The aquifers in the East Africa region tend to be shallow and fairly localised but they are still important sources of good quality freshwater (UNEP, 2010). Despite this, groundwater resources are threatened by human activity and the unveiling climatic changes.

Water security and water quality, is declining significantly mainly as a result of human activity in both the catchments and river basins. In view of the fact that surface water is being stressed as it is, exploring underground water is the best alternative that will relieve the stress on surface water resources.

OPPORTUNITIES FOR USING UNDERGROUND WATER

It is clear that the EAC region has significant volumes of groundwater and these volumes could be enhanced by the exploitation of this region's water resource. The following opportunities can be used to ensure that groundwater is exploited:

- Using underground water for up scaling agriculture and livelihood enhancement. Groundwater is accessible to a large number of users and is generally less-capital intensive to develop. Agriculture makes major contributions to GDP in the five countries in East Africa. This can help ensure that the MDG goals are met by the partner states.
- Irrigation with groundwater is generally more productive compared to surface water irrigation because groundwater is produced at the point of use needing little transport. This will help ensure food security in the region especially in view of the fact that there is food insecurity in the region.
- Using underground water for domestic and industrial purposes to maximise hydro power generation from natural surface resources. Hydro power production has been reducing due to decreasing levels in water in rivers which has been caused by the ever increasing demand for water.

Agricultural production under irrigation in South Africa retrieves water from groundwater sources which irrigates 24% of the irrigable area, while surface water irrigates 76% of the irrigable area. (Center for Agricultural management, Faculty of Natural and Agricultural Sciences, University of Free State, Republic of South Africa)

CHALLENGES IN GROUND WATER MANAGEMENT

- Lack of adequate policies and weak legal framework to guide ground water resources management.
- Water supply is given clear priority over allocations to promote holistic water governance and management in the region.
- Inadequate information on ground water resources within the different East African countries and particularly transboundary aquifers. Very few studies have been carried out and hence limited information is available for the sustainable management of ground water resources in the region.
- Limited human capacity in the region with regard to professionals on water resources and particularly on groundwater.
- Although some of the countries in the East African region have good laws and policies, the lack of enforcement, monitoring and implementation have resulted in their ineffectiveness.

In order to realise the opportunities mentioned above, the following are proposed:

- Joint/collaborative management of transboundary aquifers.
- Managing groundwater resources as a shared responsibility between all the partner states.
- Establishment of abstraction and pollution control measures.
- Periodic review of water laws and policies to address dynamics of water resources.

- Groundwater resources planning.
- Institutional reforms and participatory management.

V. Transport, Trade and Industry: A modern East Africa's railways and harbours system-efficient transport system for business competitiveness and low carbon development

Challenges

The transport sector is a strategic sector for the EAC region as recognized by the Treaty. Article 89 of the Treaty calls upon the Partner States to "improve and expand the existing transport and communication links; and establish new ones as a means of furthering the physical cohesion of the Partner States, so as to facilitate and promote the movement of traffic within the Community".

The underdeveloped transport system in the region is a major obstacle to development. At present, the Community depends primarily on road transport, which accounts for over 90% of passenger and freight traffic. For long distance transportation, road transport is inefficient, besides being highly carbon intensive in comparison to other modes such as rail. It is estimated for instance, that transportation costs constitute up to 40% of the costs of goods and services produced in the region, as opposed to 6.5% to 11% in developed countries. To illustrate this point further, consider this scenario: at present, an individual wishing to travel from Kampala, Uganda to Mwanza, Tanzania has to take the longer through Kenya, and take at the very minimum a day for a journey that would take under 3 hours with a speed boat across Lake Victoria!

Proposal

A modern regional railway and harbour system will leverage these challenges. In this regard, it is proposed that an **East Africa Railways and Harbours Corporation (EARHC)** be created to undertake the development of a regional railways and harbours system.

1. A modern railway system will facilitate efficient and low carbon transportation of bulk goods within the region. Possible routes that have been identified in other initiatives, e.g. the East African Corridors/Transit Project (http://www.eastafricancorridors.org/projects) include the Northern Corridor, Southern Corridor, and Central Corridor.
2. Modern inland water transport (harbours) in all major navigable inland lakes and rivers (L. Victoria, L. Tanganyika, L. Kyoga, L. Nyasa, L. Albert, L. Kyoga, R. Victoria Nile, R. Albert Nile, etc)

VI. Human Health, Sanitation and Settlements: The role of ICT in curbing the spread of climate sensitive vector-borne diseases

Challenges

Projected temperature increases and changing precipitation patterns are expected to cause a shift in the spread of vector-borne diseases such as malaria and dengue fever. In the case of malaria, observational data shows an increasing frequency in its epidemics in the highlands of

Eastern Africa, with climate variability and change being one of the primary drivers behind the reported incidences. The communities in the highlands that have had less exposure to malaria are more vulnerable to malaria than their counterparts in the lowlands due to lack of clinical immunity. This has placed additional stress to already stretched health care system in the EAC Partner States particularly in rural areas where healthcare is often delivered by a lone nurse/medical practitioner serving as many as 10,000 people. In addition, the practitioners frequently lack access to electricity or running water, let alone medical information, a telephone, or the Internet.

Opportunities

With medical staff stretched so thin and working under challenging circumstances, access to wireless-enabled health care information becomes a critical lifeline just when it is needed—at the point of care. Academy for Educational Development (AED)-Satellife, a U.S.-based nonprofit organization, has implemented projects in more than a dozen countries including Uganda where health professionals working in resource-poor areas use handheld personal digital assistants (PDAs) to transmit and receive vital data via a wireless or mobile network. AED-Satellife uses hand-held computers to deliver medical information at the point of care. It delivers medical information including disease treatment guidelines, continuing education materials, newsletters, and essential drug lists and databases. Nurses also receive national and international news articles on their devices.

These types of low-cost ICT projects could be replicated across the EAC Partner States to tackle diseases such as malaria, yellow fever, dengue fever, cholera, etc, whose incidences are expected to increase with the changing climate.

VII. Biodiversity, Ecosystem Services and Tourism: Regional Livelihood Enhancement and Adaptation Programme

Under Biodiversity and Ecosystem Services which also includes nature-based tourism, the Master Plan proposes the implementation of a programme called Regional Livelihood Enhancement and Adaptation Programme (Re-LEAP). Its main aim will be to enhance livelihood in marginalised regions of East Africa (arid and semi-arid areas where pastoralism and tourism are the main economic activities) by implementation of the following seven project's components:

1. Trans-boundary natural resource management initiatives/projects to reduce conflict over diminishing resources (particularly pastureland whose productivity reduces during dry spells) (climate change adaptation)
2. Climate smart agriculture: up scaling existing agroforestry or initiating new ones by use of multipurpose trees (e.g. to provide fruits as source of food and nutrient fixing properties to boost crop productivity) (climate change adaptation and mitigation)
3. Proper natural resource management to boost food productivity and enhance food security. The project in this category will assess the role of the ecosystem services in aiding the agricultural production and how it can be enhanced especially in the context of changing conditions both environmental and socio-economic (climate change adaptation)

4. Support to pastoralists who are in the process of livelihood transformation or change, e.g., those shifting to the rearing of small herds like goat and sheep instead of cattle; those inculcating crop cultivation in their livelihood strategies as a result of sedentarization (settling down) and emergence of small towns and centres; etc. Support could be in the form of irrigation subsidies and training; training on modern cultivation practices; value addition and marketing (climate change adaptation)
5. Support for existing or start-up bio-enterprises such as gums and resins production and trade; bee-keeping; etc. These projects play a key role in livelihood enhancement while protecting the natural environment, e.g. it would be in the interest of the community to protect their forest if it provides an economic output such as gums, resins, honey, etc to them (climate change adaptation)
6. Provision of refrigeration facilities to facilitate the storage and trade of livestock products like meat and milk
7. REDD+ in areas where there is considerable forest cover as well as current and anticipated/possible threats in the future (climate change mitigation and adaptation)

VIII. Education, Science and Technology: Establishing Climate Change Development and Adaptation Institutes (RCCDAI)

Challenges

In the EAC, similar to other regions in the developing world, there are very few climate change specialists in the areas of science, policy, adaptation, mitigation, and carbon markets. Moreover, most universities in all the five Partner States do not currently offer courses on climate change other than the traditional courses on natural and physical sciences. Furthermore, climate change is yet to be integrated into these subjects. This is in spite of the region's high vulnerability to climate change. Building human capacity necessary to address the unique climate change adaptation needs of vulnerable communities through teaching, action-oriented research, development of innovative technologies and community participation should therefore be of high priority.

Proposal

In order to build the human capacity needed to address climate change adaptation that meets the region's unique needs, it is proposed that regional climate change development and adaptation institutions, similar to the Institute for Climate Change and Adaptation (ICCA) at the University of Nairobi, be established in at least one strategic university in all the five Partner States. The institutes will provide and/or conduct:

1. Formal training on climate change adaptation at both undergraduate and postgraduate level;
2. Professional "short courses" for various climate change adaptation actors and stakeholders in the public and private sectors including NGOs;

3. Climate change adaptation research and knowledge exchange;
4. Action-oriented community outreach programmes for implementation of practical climate change adaptation options; and
5. Policy advice on climate change adaptation.

ANNEX III. PRIORITY SECTOR AND CLIMATE PROOFING BUDGETS

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
AGRICULTURE			**2,200,612,145.53**	**TOTAL BUDGET**
Adaptation			**3,300,918.22**	**CLIMATE BUDGET**
1.2 Develop adaptation framework for agriculture to improve agricultural productivity and enhance food security.	a) Promote sustainable land management practices systems;	MT to LT		
	*Promotion of agroforestry; *Conservation agriculture (CA)*Incorporation of indigenous/traditional/local knowledge on adaptation into modern/scientific knowledge,			
	(b) Promote development and implementation of irrigated agriculture	MT to LT		
	*water-efficient irrigation techynology identified*Policies developed*Piloting and replication of best case practices			
	(c) Promote water availability and sustainable use practices and technologies in agriculture, livestock and aquaculture for efficient utilization of water especially in arid and semi-arid lands (ASALs);	MT to LT		
	*Investment in water capture and storage infrastructure to capture and store rainwater for agricultural use;			
	(d) Promote agro processing and enhance food storage facilities;	MT to LT		
	*Creation of strategic grains reserves as a form of post-harvest management; *Provision of mobile grain driers to respond to unusual wet conditions during harvesting			
	(e) Promote efficient livestock and aquaculture production systems.	MT to LT		
	*Creation of pest and disease free-zones [livestock];*Research and development*Fodder and pasture storage and availability;(R&D), e.g. in breeding and dissemination of livestock species			

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	(f) Increase use of integrated crop and livestock pests and disease management in the region;	MT to LT		
	(h) To improve on the food management and distribution systems to ensure access and affordability;	MT to LT		
	(i) Strengthen agro-meteorological information generation for improved early warning systems for food security;	MT to LT		
	(j) Promote harmonization of policies, strategies and standards of Partner States agricultural, livestock and fisheries research institutions and organizations.	MT to LT		
	(k) Facilitate Creation/provision of special livestock and crops insurance schemes using weather insurance index	MT to LT		
	(l) Promotion of crops and livestock types and varieties able to withstand the changing climatic conditions such as early-maturing crops and livestock;	MT to LT		
	(m) Facilitate Creation of seed conservation programmes;	MT to LT		
Mitigation				
2.4 To promote sustainable agricultural practices with agricultural based emission reduction through land management, planning and optimal utilization of agricultural resources.	(a) Enhance research programs and facilitate exchanges	MT to LT		
	(b)Promote development projects in agriculture for international carbon markets	MT to LT		
1.5 To improve sustainable land use, land use change and soil management practices as an adaptation strategy.	(a) Promote sustainable land use and land use change management practices;	MT to LT		
	(b) Promote improved land productivity and soil fertility, inter alia, through; integrated nutrient management, improving soil quality, enhancing soil and water conservation measures to enhance physical, chemical, biological or economic properties	MT to LT		

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	(c) Promote programmes to reduce land degradation and soil erosion especially in the fragile ecosystems such as mountainous areas, lake shores and riverbanks; and	MT to LT		
	(d) Facilitate formulation of integrated sustainable land management investment frameworks and land use policies and plans.	ST to MT		
WATER			**1,154,138,044.49**	**TOTAL BUDGET**
1.1 To improve water conservation, efficiency and sustainable use and exploitation of regional water resources in view of the changing climate.	(a) Enhance development and transfer of water- and climate- information and technology.	MT to LT	**1,154,138.04**	**CLIMATE BUDGET**
	*Support water conservation through natural resource planning, technology innovation and transfer, partnerships and joint ventures*Early warning systems for floods and droughts			
	(b)Promote regional and international cooperation for better water management and conflict prevention.	ST to LT		
	*Strengthen initiatives for conservation and management of lake and river basins *Promote participation of the private sector, civil societies and women in management of water resources*Promote Public Private Sector partnership in regulated abstraction and distribution of water for domestic, industrial, agricultural production & energy			
	(c) Promote water resource economics, transfer and dissemination of efficient water technologies	MT to LT		
	*promote recycling of waste water*Promote artificial recharge of dried-up aquifers*Sustainable use of wetlands			
	(d) Promote water conservatrain and efficiency.	ST to LT		

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	*Promote water harvesting, protection of water wells and springs, and other water sources*Promote actions that reduce water pollution, including protection of water quality and aquatic habitats.*Catchment and watersheds protection and management*Encourage investment in more water capture and storage facilities including state schemes as well small dams/pans,roof, rock and other forms of rain water harvesting for domestic use			
	(e) Promote bulky water supply to area with low volumes to ensure adequate and reliable water for production	MT to LT		
ENERGY			**2,435,027,188.24**	**TOTAL BUDGET**
Adaptation			3652540.78	**CLIMATE BUDGET**
1.12 To cushion the region's socioeconomic development from conventional sources of energy that are highly susceptible to climatic variability and change such as hydropower.	(a) Promote diversification of sources of energy;	MT to LT		
	*Facilitate exploitation of alternative renewable energy sources such as geothermal, wind , solar, biomass (including biomass waste) and biogas, which are abundant in the region. This should be done in line with "Regional Strategy on Scaling-up Access to Modern Energy Services in the East African Community", which gives a raft of measures for scaling up modern energy in EAC region.*Promotion of woodlots and agroforestry programmes for firewood and charcoal production. *Facilitate programmes that improve access to liquefied petroleum gas (LPG) and other modern cooking energy forms by means of low or zero taxation and standardisation of supply equipment. It is reported that household LPG use in Kenya for instance, has been constrained by high costs and low supply rather than market (EAC, 2008).			
	(b) Ecourage programmes that introduce economic and financial incentives in the energy sector	MT to LT		
	*Such as zero-rating of taxes and other financial measures on some renewable energy*Review of electricity tariffs review to meet the demand of the poor, coupled with intensified rural electrification programmes.			
	(d) Enhance the develop energy infrastructure	MT to LT		

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	*In order to protecting energy facilities (infrastructure) against extreme weather events, the transmission and distribution utility must be modernised, e.g. automation of energy systems to enable energy utilities respond faster to emergency situations.			
	(e) Protect watersheds that supply major hydroelectricity generating water sources through afforestation and reafforestaion measures;			
	(f) Enhance energy efficiency and saving;	ST to MT		
	*Promotion of energy conservation and efficiency in the household. The success of the Kenya Ceramics Jiko (KCJ) and a similar Improved Cooking Stove (ICS) initiative in Rwanda, have demonstrated the remarkable positive environmental and health effects of biomass energy efficiency programmes.			
Mitigation				
2.1 Increase availability and accessibility of sustainable, reliable and affordable renewable energy resources.	(a) Facilitate the Identification and development of renewable energy sources	MT to LT		
	*Harnessing the region's natural gas resource (e.g., Tanzania's proven reserve estimated at 45 billion cubic metres) to generate electricity as well as to supply domestic consumers. Natural gas is environmentally cleaner than other fossil fuels such as coal and oil. *The exploitation of alternative renewable energy sources such as geothermal, wind, olar, biomass (including biomass waste) and biogas to avoid over-dependency on hydro sources, which is particularly sensitive to climate, address both a need to mitigate emissions as well as adapt to the impacts of climate change. Agricultural residues and waste also offer an additional source of energy.			
	(b) Promote initiatives to apply subsidies and other tax incentives	MT to LT		
	*Energy (electricity) tariffs review to encourage domestic consumption coupled with intensified rural electrification programmes as a way of reducing over-reliance on biomass sources;			
	(c) Promote energy conservation and energy efficient	ST to MT		

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	*Research on and production of low-cost bio-digesters. *The production of charcoal, which is a prominent source of energy, can be produced and utilised more efficiently using a number of well-established technologies. Such techniques help to ensure the sustainable management of trees and their conservation. A number of Sustainable charcoal projects are going on in Partner States such Rwanda, Tanzania and Uganda. Lessons learned from such projects can be replicated in EAC region*Promote the use of energy saving bulbs			
	(f) Undertake awareness creation	MT		
	(g) Facilitate the formulation appropriate alternative energy sources policies and strategies	ST to MT		
	*Encourage innovative policy framework in the electricity sector such renewable energy feed in tariff, establishment of “net metering” programmes targeting domestic and commercial entities as well as suitable power purchase agreements			
	(h) Facilitate EIA/SEA	ST,MT, LT		
	(i) Facilitate the preparation of land use plans	MT to LT		
	(j) Mobilize funds	MT to LT		
	(k) Facilitate the development of solar, wind, geothermal sources of energy	MT to LT		
2.5 Promote waste management for improved air and water quality; soil and mitigation of greenhouse gases.	(a) Encourage development of environmentally- friendly solid and liquid waste management facilities	MT to LT		
	*Promotion of waste to energy conversion programmes that make use of co-generation, for instance in the conversion of sugarcane bagasse to electricity, landfill (urban solid waste) to electricity/gas and molasses to ethanol for fuel blending. This has very high potential in the East African region and has been given as a project profile/proposal in the Master Plan			
	(b) Undertake awareness creation	ST to MT		
	(c) Encourage the enforcement of standards and regulations	ST to MT		

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	(d) Facilitate the development of CDM projects in the waste sector	ST to MT		
	(e) Promote adoption of cleaner production technologies	ST,MT, LT		
HUMAN HEALTH, SANITATION AND SETTLEMENT			**3,370,955,075.58**	**TOTAL BUDGET**
1.7 To reduce the vulnerability of populations to climatic sensitive diseases and enhance adaptive capacities within the health services	(a) Develop effective early warning systems and emergency health measures for climate change related diseases		**3,370,955.07**	**CLIMATE BUDGET**
	*Formation of 'satellite committees' that can respond to emergencies*Formation of disease surveillance and emergency response as well as prevention and control programs			
	(b) Facilitate availability of health facilities to assist in early diagnosis and treatment in climate change related diseases			
	(c) Enhance capacity of medical personnel on climate change, including traditional/indigenous knowledge			
	*Provision of adequate financial and human public health resources			
	(d) Promote awareness among populations on climate change related diseases.			
	*Developing climate change awareness programmes involving all stakeholders*Developing empowerment programmes that enhance climate resilience*Promoting sustainable (environmental, social, and nutritional) public health interventions e.g urban tree planting			
	(e) Promote access to healthcare services to vulnerable groups.			
	*Establishment of insurance schemes to compensate persons and communities affected by climatic disasters			
	(f) Promote measures for preventing the spread and mitigating impacts of HIV/AIDS on climate vulnerable populations			

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	(g) Promote proper planning of urban settlements			
PHYSICAL INFRUSTRUCTURE			**5,258,753,762.73**	
Adaptation			**7,888,130.64**	**CLIMATE BUDGET**
1.9 To climate- proof infrastructure through ensuring that climate change concerns is factored in the development of social infrastructure to allow the infrastructure to withstand extreme weather conditions in the region.	(a) Promote climate change integration in all planning and design of infrastructure;			
	*Adopting the design and materials of construction of infrastructure that are able to withstand extreme weather events; *Factoring in potential impact of any future climate change mitigation action(s) on infrastructural service during its design stage.*Continuing to use vulnerable areas or sites through innovative measures practicable under the new prevailing conditions; and			
	(b) Build awareness and capacity of the architects and engineers to take into account Climate Change in their professional deliveries;			
	(c) Revise and harmonize structural/building codes and standards taking into account the expected changes in climate.			
	*Factoring in climate change into building codes and practice. This will help in ensuring that infrastructure is able to withstand extreme events associated with climate change;			
Mitigation				
2.2 To reduce greenhouse emissions from the transport sector	(a) Develop plans and strategies to improve public transport and infrastructure			
	*Creating transport demand management measures that encourage or favour public transport and NMT, e.g. ensuring that markets or workplaces are as close to residential areas as possible; and			
	(b) Facilitate the development of low-carbon transport modes eg bus rapid transit and light rail			
	*Investment in low carbon and low-cost public transport modes such as bus rapid transit (BRT) and other means of mass transport;			

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	(c) Improve existing railway system			
	*Investment in efficient rail transport system for long distance and low carbon transportation of freight and passengers;			
	(d) Faciliate the development of non-motorized modes of transport			
	*Proper urban and transport planning to facilitate efficient and low GHG modes of transportation, e.g. decongestion of roads, non-motorised transport (NMT) by means of creating bikeways and pedestrian walkways, etc;			
	(e) Formulate and enhance programmes to phase out old and inefficient motor vehicles			
	(f) Enforce vehicle rules to ensure emission reduction			
	*Imposition of strict vehicular emissions standards in tandem with measures to phase out old and inefficient (high fuel-consuming) motor vehicles, while encouraging the importation of efficient ones; *Creating awareness on the importance of sustainable lifestyles such as car-pooling, and possibly using market incentives/disincentives such as punitive taxes and carbon tax (charges) to enforce such measures.			
ECOSYSTEMS AND BIODIVESITY			**856,722,117.06**	**TOTAL BUDGET**
FORESTRY				**CLIMATE BUDGET**
Adaptation in Forestry			**856722.12**	
1.6 To promote sustainable management of forestry and wetlands as part of ecosystem based adaptation	(a) Strengthen capacity to monitor and manage forests and forest-related activities;			
	(b) Promote alternative energy sources in order to reduce dependency on biomass for energy needs in both urban and rural areas;			
	(c) Increasing regional forest covers			

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	*Promote reforestation, afforestation and agroforestry practices;*Promote collaborative forest management practices;*Promote the diversification of tree species (indigenous species) to enhance resilience to drought and other adverse weather conditions, etc;*Facilitate the rehabilitation of degraded areas			
	(d) Strengthen enforcement of laws and good governance of forests and wetlands;			
	(f) Promote improvement of agricultural productivity so as to avoid deforestation and encroachment on gazetted wetlands for agricultural expansion;			
	(h) Promote and strengthen community based management practices;			
	(i) Promote non-timber forest products;			
	(j) Promote biomass energy-efficiency technologies; and			
	(k) Promote participatory, integrated watershed management practices.			
Mitigation oppotunity in Forestry				
2.3 To ensure that the forest sector continues providing global services in mitigation of climate change while supporting sustainable development needs of the Partner States.	(a) Increase public awareness on opportunities and development of guidelines for accessing carbon financing facilities			
	(b) Promote alternative energy sources and efficient biomass energy			
	(c) Promote Afforestation and reforestation with appropriate tree species, including agroforestry and incentive measures			
	(d) Promote research and information exchange			
WILDLIFE				
1.3 To develop, harmonize and adopt common policies, laws and	(a) Promote measures that preserve the ecosystem integrity of critical wildlife habitats and endangered species;			

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
strategies for the conservation and sustainable utilization of wildlife resources in and outside protected areas in the region as part of ecosystem based adaptation	*Establishment of more “protected” areas;*Collection and conservation of genetic resources of neglected indigenous species*Protection and management of rare plant and animal species, particularly those of important value, e.g., medicinal; *Research and active management of enclosed/protected/marginal areas specifically in relation to determining the carrying capacity and consequently the provision of water pans and other infrastructure to support wildlife in those areas;*Breeding new plant species that are more tolerant to changed climatic conditions;			
	(b) Protecting and enhancing migration corridors and habitat connectivity (e.g., through avoiding habitat fragmentation especially with regard to privately owned land) to allow species to migrate as the climate changes;			
	(c) Facilitate the diversification of livelihood for local communities in order to reduce their dependency on wildlife.			
	*Protection of sensitive ecosystems through measures such as community driven ecosystem management particularly as a way of addressing the drivers of over-exploitation and degradation of key ecosystems;			
	(d) Facilitate the development of rapid response teams in order to respond to imminent and current destructive activities to limit damage to ecosystems;			
	(e)Promoting fire suppression practices in the event of increased fire risk due to temperature increases; and			
	(f) Controlling insect and disease outbreaks.			
	(e) Facilitate the rehabilitation and restoration of degraded habitats/ecosystems;			
COASTAL AND MARINE ECOSYSTEMS				
1.4 To enhance the adaptive capacity and resilience of the coastal and marine ecosystems, coastal communities and infrastructure to the impacts of	(a) Promote Integrated Coastal Zone Management (ICZM);			
	(b) Support measures to control coastal erosion as result of rising sea water;			
	*Identifying land use measures to ensure that wetlands migrate as sea level rises in			

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
climate change as part of ecosystem based adaptation.	some areas;			
	*Analysing the environmental consequences of shore protection;			
	(c) Promoting shore protection techniques that do not destroy all habitat;			
	*Mobilize funds to construct walls at vulnerable points to minimize adverse impacts of sea level rise;			
	(d) Conserve coastal and marine habitats to promote development of protected area management systems; and			
	(e) Establish coastal ecosystem monitoring and surveillance systems			
	*Improving early warning systems and flood hazard mapping for storms*Developing county-scale maps depicting which areas will require shore protection (e.g. dikes, bulkheads, beach nourishment) and which areas will be allowed to adapt naturally;*Engaging state and local governments in defining responses to sea level rise			
TOURISM			**101,260,434.05**	**TOTAL BUDGET**
1.8 To ensure resilience of tourism infrastructure through factoring climate change into their planning, as well as enhancing climate proofing of wildlife habitats to minimize environmental migrations of endangered species.	(a) Facilitate the develop all-weather infrastructure to support tourism in the region while ensuring minimal damage to wildlife habitats		**101260.45**	**CLIMATE BUDGET**
	(b) Encourage and facilitate the diversification of tourism			
	*To products less sensitive to climate change, as an adaptation and substitute for the many natural ones currently disappearing very fast;*Developing the domestic and regional tourism market to cushion the tourism industry against spill over effects of possible mitigation measures in the international aviation industry; initiation of resource (e.g. water) conservation plans as well as redirecting clients (tourists) away from vulnerable areas;			
	(c) Devise mechanisms of improving local vulnerable population livelihoods from revenues generated from tourism industry;			

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	(d) Develop park management practices to enable wildlife to adapt to the changing climate.			
	(e) Protecting of coastal tourist resorts through construction of sea walls or naturally vegetated coastal dunes, designing buildings to be cyclone-proof, provision of early warning systems, etc;			
	(f) Creating GHG offset programmes, water conservation initiatives, and other good practices;			
	(g) Policy interventions, regulation of for instance building codes, compliance, coastal management plans, coordinated political lobbying for GHG emission reductions and adaptation mainstreaming, etc; and			
	(h) Research interventions, e.g. assessing the level of awareness among businesses and tourists on climate change impacts, deducing knowledge gaps, and providing remedial measures. Other research interventions include predicting climate change impacts on ecosystems that form popular tourist attractions such as coral reefs to inform policy interventions.			
TRADE AND INDUSTRY			**233,068,320.65**	**TOTAL BUDGET**
	(a) Developing strategies to deal with the impacts of climate change on other operators in the trade and industry value chain (for example, energy and transport)		**233,068.32**	**CLIMATE BUDGET**
	(b) Developing strategies to deal with current and future climate change regulations and industry standards, e.g. measures to respond to possible mitigation legislation/regulation in the industry;			
	(c) Evaluating the potential impacts (including economic/financial) of climate change in the sector, and developing appropriate measures to deal with such;			
	(d) Ensuring that the management approach taken by a firm is based on robust climate change information and assumptions; and			

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	(f) Developing strategies for taking advantage of the opportunities that may arise e.g. how does the regional industrial sector ensure that it benefits from mitigation measures being imposed on the industry elsewhere?			
CROSS CUTTING ISSUES			**2,864,265,149.54**	**TOTAL BUDGET**
(a.) Technology Development and Transfer				
5.2 To promote development of climate change tools, methods and technologies and support their application;	*Through the UN framework, (Kyoto Protocol's) Clean Development Mechanism (CDM) or its future successor; *South-South technology transfer, essential for the transfer of "adaptation technologies", *North-South technology transfer through FDI including taking advantage of 'free-patent' technologies *Establish funding facilities to facilitate the transfer of their advanced technologies to low-income economies eg the Nordic Climate Facility (NCF)			
5.4 To support the designing and development of integrated climate change knowledge sharing and management tools such as databanks, regional network for sharing lessons, experiences and best practices amongst Partner States and other countries				
5.5 To promote harnessing and integration of indigenous technical knowledge in modern knowledge;	*Identify and integrate indigenous technical knowledge in modern knowledge			
(b) Capacity building				
3.1 To enhance the capacity of NMSs to effectively monitor, detect and predict climate change scenarios in the region to	(a) Modernize meteorological infrastructure in the Partner States by increasing weather observing stations, communication, processing systems, training and dissemination facilities for communicating weather and climate information for adaptation measures in all the climate sensitive socio- economic sectors;			

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
contribute to global assessments and development of adaptation options at the regional and national levels.	(b) Promote digitization and historical climate data rescue;			
	(c) Strengthen early warning systems for monitoring, detection, attribution and prediction of extreme weather and climate events;			
	(d) Support development of joint research programs on drought, floods, pests and disease resistant crops and livestock, and fostercooperation with regional organizations to facilitate transfer ofresearch developments from other regions;			
	(e) Strengthen research and promote data and information exchange for all sectors impacted on by climate change including forests and wetlands in the community;			
	(f) Promote periodic climate change related research and exchange of information in conservation and sustainable use of wildlife;			
	(g) Promote research on coastal and marine systems;			
	(h) Promote research in the area of Climate Change and human health;			
	(i) Undertake in-depth vulnerability assessments for identified priority sectors in the region.			
	(j) Promote implementation of research findings and its linkages with policy formulation and practice research that promote modern agriculture technology;			
	(j) Support the downscaling of global climate model outputs to regional and national levels to address climate variability and change at Partner State level; and			
	(k) Develop modalities of disseminating and sharing research findings with an emphasis on research into use to inform policy and practice			
5.9 To Support the establishment of a regional climate change negotiation platform;	*Build common positions around global climate issues of key relevance for the region, including for the post-2012 global agreement on climate change.			

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
5.10To Support capacity building on carbon financing mechanisms in order to take advantage of the existing global funding mechanisms	*Develop capacity for carbon market and carbon management for CDM, NAMAs, REDD+ and other facilities/mechanisms.			
5.11 To Encourage and strengthen participatory and integrated approaches in planning and decision making including meanigful participation of all stakeholders including the civil society;	*Undertake participatory and integrated approaches in planning and decision-making			
Capacity Building of Meteorological Systems in the EAC Region			74,133,140.00	
	*(a) Climate change research and observation (Monitoring, detection, attribution and prediction)			
	*Establishment of an EAC Centre for Weather Forecasting, Applications, Research and Development	ST		
	*Strengthening climate change research through monitoring, detection, attribution and prediction	MT		
	*Strengthen research and promote data and information exchange for all sectors impacted on by climate change including forests and wetlands in the community, *Promote periodic climate change related research and exchange of information in conservation and sustainable use of wildlife, *Promote research on coastal and marine systems,*Promote research in the area of climate change and human health, *Promote implementation of research findings and its linkages with policy formulation practice research that Promote modern agriculture technology, *Develop modalities of disseminating and sharing research findings	LT		

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	*(b) Mechanisms for exchange and sharing of knowledge		11,119,971.00	
(c) Education, training and public Awareness				
4. 3 To enhance Information and Knowledge Management Systems	Develop a database for repository of research findings, and sectoral information sharing including knowledge management in the region.			
5.1 To Enhance capacity of regional institutions to carry out climate change related research including climate change monitoring, detection, forecasting and the requisite response of interventions;	Strengthen capacity of regional institutions to carry out climate change related research and the requisite response of interventions; *Integrating climate change into the educational curricula of the partner states, * Developing, strengthening and harmonising research programmes on CC impacts, adaptation and mitigation in institution such as IUCEA and EASTECO			
5.6 Establish and support relevant climate change national and regional institutions and centres of excellence;	Establish coordination mechanisms for joint or coordinated programming of climate change activities in the region. *Creating linkages with international research centres and institutions to benefit from skills and research facilities.			
5.7 To Collaborate in institutional assessments with an aim of strengthing and mobilizing the capacities of existing relevant facilities and institutions in the region and Africa;	Assess institutional capacities of facilities and institutions in the and Africa. *Establishment of Climate change research centres of excellence.			

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
5.8 To Support development of human and technical resource and skills in climate change adaptation and mitiagtion (mainly negotiation skills, CDM project design and development, carbon trading, REDD etc) through focused training, mentoring and learning by doing approaches, scholarships and fellowships among other measures;	Undertake policy analysis of global climate change issues and mechanisms in relation to the priorities of the region. *Encouraging partner states to set aside funds equivalent to a certain portion of their GDP to fund research. *Involvement of development workers, local authorities, community leaders in education and training on climate change. * Developing and disseminating climate change literature in local languages for the benefit of marginalised populations and the general public			
* 5.9 **Enhance Public Awareness** in the EAC Partner States relatively low because it (climate change) is a relatively new concept in the general public domain	* Training material and programmes for specific target groups i.e. women, men, children, youth, people with disabilities, etc., *Documenting climate change impacts and linking them to community livelihoods; * Formation of youth, women and men's groups, CBOs, as forums for outreach, * Involving the corporate sector to raise awareness on climate change issues; *Online blogging on social websites such as FaceBook, Twitter, Google etc; *Promotional activities and sponsorship of events with climate change themes,			
(d) Gender, Youth and marginalized			2,631,477.65	
4.4 To promote gender considerations in climate change issues	(a) Integrate gender considerations in assessing vulnerability, impacts and risks of climate change at local, national and regional levels;	ST to MT		
	*Support empowering women, youth and the marginalized at different levels.	ST to MT		
	(b) Promote involvement of women in climate change monitoring, adaptation and decision-making processes;	MT to LT		

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	*Promote mainstreaming of gender, youth, and marginalized group perspectives into the climate change efforts at the national, regional and international levels.*Promote access to credit by women, youth, and other marginalised groups Reviewing credit programs to ensure equitable access to credit, *Promote skills improvement and market access, *Skills acquisition to enable them engage in commercially productive activities such as basket weaving, bee keeping, commercial fishing among others. *Support provision of basic amenities,*Improved water supply services for all,*Providing affordable alternative energy,*Promoting youth, gender and marginalized participation in decision-making, information sharing and capacity building on climate change at different levels.*Creation of green jobs for and by the youth	ST to MT & LT		
	(c) Promote social protection programmes for vulnerable communities, households and individuals including women, children, youth and others	MT to LT	263,147.00	
(e) Climate Risk Management and Disaster Risk Reduction			37,065,070.00	
1.11 To reduce the vulnerability of socioeconomic systems to climatic related disasters through employing disaster risk reduction as tool for climate change adaptation	(a) Promote community-based approach to disaster risk reduction and Community-based adaptation	MT		
	*People centred early warning systems on climate change*Increase communication between scientists, decision makers, NGOs and communities* awareness raising	LT		
	(b) Support development and implementation of climate related disaster risk reduction and management as a tool for adaptation;	MT		
	*Build on existing structures to raise awareness (e.g.) within NEMA, climate change department and Inter-Ministerial Committee for climate Change). * Engage grassroots to build on existing coping/adaptation responses (applied science by Ministries of Agriculture, Livestock and Water and NGOs)	MT		
	(c) Promote climatic risk assessment and monitoring through vulnerability assessment, risk and hazard mapping in all sectors including social and economic impacts of climate change;	MT		

SECTOR STRATEGY	Strategic Interventions	Time Frame	Estimated Costs	
	*Build on existing forums and centres to bring together expertise (e.g. UN-ISDR hosted workshops, ICPAC training forums, invest in 'translators' working manuals, media, technical committees) and regional links. *Improve application of advanced technology and identification and evaluation of risk through Investment in user specific models and application products, Investment in services that will have to take a lead e.g. KMD/ICPAC, Improve meteorological networks and ground-truthing aggregate other types of accurate data from monitoring for integrated (EWS), Improve downscaling of climate models, Invest in climate information system, Improve community & family preparedness information tools, build forums for data integration and exchange (extensive regional networks, National Communication preparation)	MT		
	(d) Enhance disaster risk preparedness through inter alia: production, acquisition and dissemination of weather and climate information services for improved early warning systems (EWS), and emergency response and post disaster recovery to avert or minimize the adverse impacts of climatic related disasters;	MT to LT		
	(e) Promote management of cross-border natural resource based conflict as result of stress on water and pasture for pastoral communities;	MT		
	(f) Promote the Disaster Risk Reduction (DRR) concept through the five priorities areas of the Hyogo Framework for Action (HFA),	MT		
	(g) Promote the implementation of the Africa Regional DRR Strategy and Programme of Action;	ST		
	(h) Prioritize the special needs of vulnerable groups such as children, women, youth, elderly and other specific groups	ST		

KEY:

ST – Short Term

MT – Medium Term

LT – Long Term

✳ - Refers to Strategic Interventions in the MasterPlan

Strategic Interventions in the EAC CC Strategy are labelled alphabetically

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