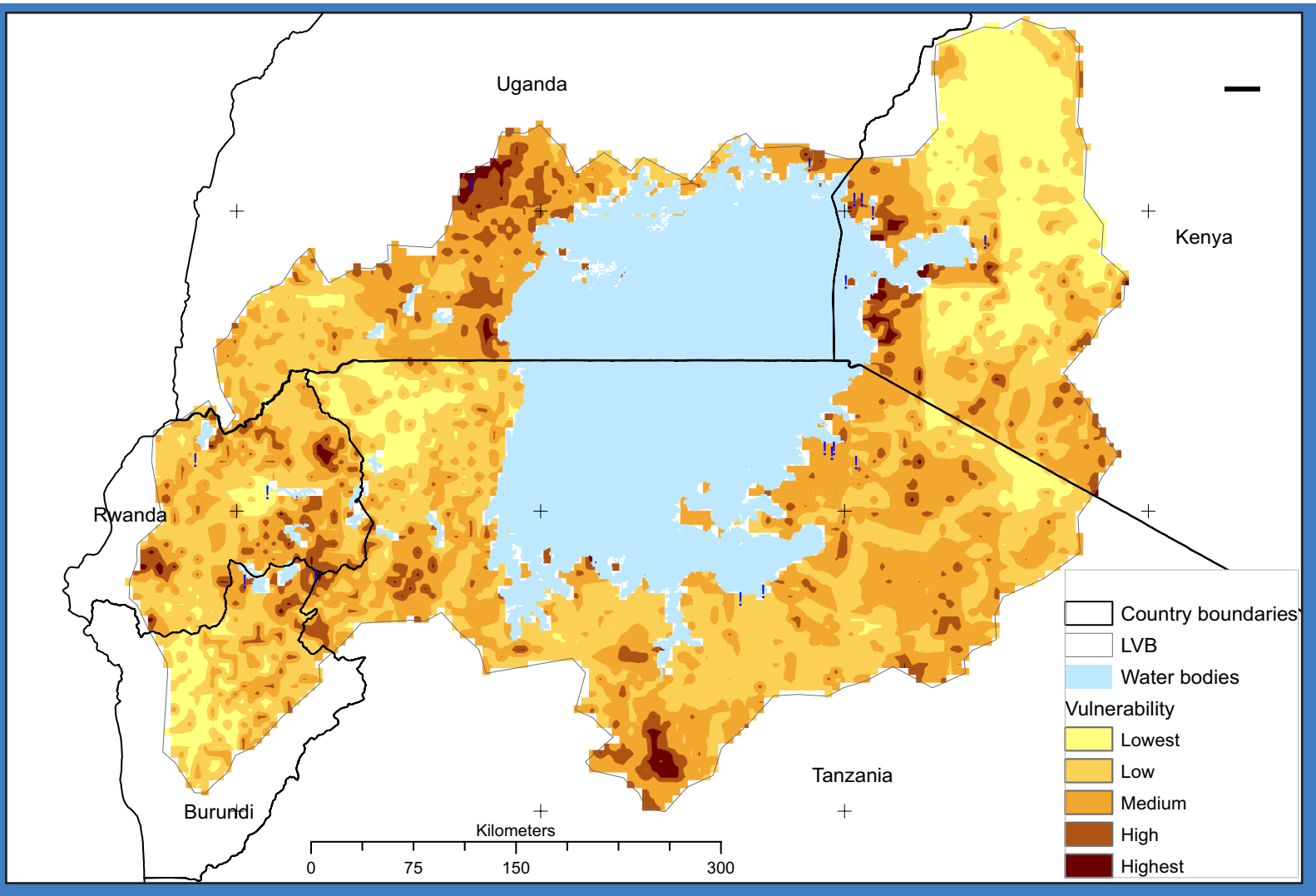
LAKE VICTORIA BASIN COMMISSION

LAKE VICTORIA BASIN

Climate Change Adaptation Strategy and Action Plan

2018–2023



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SUPPORTED BY

FOREWORD

From the local level to the global, climate change has become an economic, political, social, and environmental challenge and Africa is especially vulnerable to its adverse effects. This is because most of the continent's economies, including the Partner States of the East African Community (EAC), depend on climate-sensitive natural resources and have very low levels of adaptive capacity and extreme levels of poverty.

The effects of future climate change in the EAC Partner States will be most evident in the Lake Victoria Basin (LVB), where the changes will affect the locals whose livelihoods depend on the lake to support agriculture, fisheries, and livestock. The adverse effects of climate change in the LVB are expected to include eruptions of epidemic diseases such as malaria, which disrupt healthy systems, as well as impacts on important infrastructure across the region.

The Lake Victoria Basin Climate Change Adaptation Strategy and Action Plan (LVBCCASAP) is timely, presenting a comprehensive roadmap for addressing and adapting to climate change impacts. This strategy and action plan are based on analysis of the climate change impacts on five thematic sectors that have been the subject of a Vulnerability, Impacts, and Adaptation Assessment (VIA): agriculture and food security; water and aquatic ecosystems; terrestrial ecosystems; health and human settlements; and energy and infrastructure. The adaptation options analysis in this strategy identifies key measures to address effectively the vulnerabilities in those sectors and the projected climate change impacts on them.

This LVBCCASAP was prepared in a highly consultative and participatory manner by experts drawn from the six EAC Partner States-Republic of Burundi, Republic of Kenya, Republic of Rwanda, Republic of South Sudan, Republic of Uganda, and the United Republic of Tanzania-and facilitated by the EAC Secretariat, Lake Victoria Basin Commission (LVBC), and the PREPARED Project. The 5th Meeting of the Sectoral Council on Environment and Natural Resources held on 5th to 9th February 2018, in Arusha- United Republic of Tanzania approved the Lake Victoria Climate Adaptation Strategy and Action Plan (LVBCCASAP)

The effective implementation of the LVBCCASAP depends heavily on collaboration among all relevant actors and implementers. The overall goal is to mitigate the impacts of climate change in a manner that will ultimately lead to social and economic growth for the entire EAC region.

Thank you

Dr. Ali Said Matano
Executive Secretary
Lake Victoria Basin Commission

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ACRONYMS AND ABBREVIATIONS

AMCEN	African Ministerial Conference on the Environment
BEST	Biomass Energy Strategies
C3A2	Community-Based Climate Change Adaptation Assessment
CCASAP	Climate Change Adaptation Strategy and Action Plan
CCASAP	Climate Change Adaptation Strategy and Action Plan
CCCU	Climate Change Coordination Unit
CCIN	Climate Change Information Network
CCLCU	Climate Change Liaison and Coordination Unit
CCTWG	Climate Change Technical Working Group
CIP	Conservation Investment Plan
CORDEX	Coordinated Regional Climate Downscaling Experiment
CSA	Climate-smart agriculture
DSS	Decision support system
EAC	East African Community
ENSO	El Niño-Southern Oscillation
EWS	Early warning systems
FEWS NET	Famine Early Warning Systems Network
GDP	Gross domestic product
GEF	Global Environment Facility
GSME	Greater Serengeti-Mara Ecosystem
ICPAC	Climate Prediction and Applications Centre (Intergovernmental Authority for Development)
IKMS	Information and Knowledge Management System
ILRI	International Livestock Research Institute
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IWRM	Integrated water resource management
JJAS	June-July-August-September
JSC	Joint Steering Committee
KMD	Kenya Meteorological Department
LVB	Lake Victoria Basin
LVBC	Lake Victoria Basin Commission
LVEMP	Lake Victoria Environmental Management Programme
LVFO	Lake Victoria Fisheries Organization
MAI	Mean annual increment
MAM	March-April-May
MoU	Memorandum of understanding
MRCC	Maritime Rescue Communication Centre
NAPA	National Adaptation Programme of Action
NASAP	National Adaptation Strategy and Action Plan
NGO	Nongovernmental organization
NMHS	National Meteorological and Hydrological Service
OND	October-November-December
PES	Payment for ecosystem services
PHE	Population, health, and environment
PPP	Public-private partnership
PREPARED	Planning for Resilience in East Africa through Policy, Adaptation, Research, and Economic Development

QSIP	Quality Service Improvement Program
R&D	Research and development
RCM	Regional Climate Model
RCMRD	Regional Centre for Mapping of Resources for Development
RCP	Representative Concentration Pathway
REDD	Reducing Emissions from Deforestation and Degradation
REMA	Rwanda Environment Management Authority
SCENR	Sectoral Council for Environment and Natural Resources
SECOM	Sectoral Council of Ministers
SMART	Specific, Measurable, Achievable, Relevant, and Time-Bound
SPI	Standardized Precipitation Index
SWOT	Strengths, weaknesses, opportunities, and threats
TEV	Total Economic Valuation
TWRUA	Transboundary Water Resource User Association
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USGS	United States Geological Survey
VIA	Vulnerability, Impacts, and Adaptation Assessment
WAP	Water Allocation Plan

ACKNOWLEDGMENTS

The Lake Victoria Basin Climate Change Adaptation Strategy and Action Plan (LVB CCASAP) has been prepared by a team from the East African Community Secretariat led by the PREPARED Project in coordination with the Lake Victoria Basin Commission (LVBC).

This CCASAP is a culmination of diagnostic work and consultations done in close cooperation with representatives from all six EAC Partner States-Republic of Burundi, Republic of Kenya, Republic of Uganda, Republic of Rwanda, Republic of South Sudan, and United Republic of Tanzania-through country and regional consultations, including the Experts Meeting and Validation (October 2017).

The EAC Secretariat expresses its sincere appreciation to the many counterparts from the East Africa region who gave their time and expertise to this exercise. The authors particularly extend their thanks for their continued support and technical expertise and other guidance provided over the course of this diagnostic and consultative initiative. Their deep knowledge of the region and understanding of the EAC climate change dynamics was fundamental to the success of this endeavor.

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GLOSSARY

Adaptation
The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.

Adaptation assessment
The practice of identifying options to adapt to climate change and evaluating them based on criteria such as availability, benefits, costs, effectiveness, efficiency, and feasibility.

Adaptation constraint
Factors that make it harder to plan and implement adaptation actions or that restrict options.

Adaptation deficit
The gap between the current state of a system and a state that minimizes adverse impacts from existing climate conditions and variability.

Adaptation needs
The circumstances requiring action to ensure safety of populations and security of assets in response to climate impacts.

Adaptation opportunity
Factors that make it easier to plan and implement adaptation actions, which expand adaptation options, or provide ancillary co-benefits.

Adaptation options
The array of strategies and measures that are available and appropriate for addressing adaptation needs. They include a wide range of actions that can be categorized as structural, institutional, or social.

Adaptive capacity
The ability of systems, institutions, humans, and other organisms to adjust to potential damage, take advantage of opportunities, or respond to consequences.

Autonomous adaptation
Adaptation in response to experienced climate and its effects, without planning explicitly or consciously focused on addressing climate change. Also referred to as spontaneous adaptation.

Baseline/reference
The baseline (or reference) is the state against which change is measured. A baseline period is the period relative to which anomalies are computed. The baseline concentration of a trace gas is that measured at a location not influenced by local anthropogenic emissions.

Climate
Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in the mean and variability of relevant quantities over a period ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are often surface variables such as temperature and precipitation.

Climate change
Climate change is a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. The Framework Convention on Climate Change (UNFCCC), in Article 1, defines climate change as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." The UNFCCC thus makes a distinction between climate change attributable to human activities that alter the atmospheric composition, and climate variability attributable to natural causes.

Climate prediction
A climate prediction or climate forecast is the result of an attempt to produce (starting from a particular state of the climate system) an estimate of the evolution of the climate in the future, for example, at seasonal, inter-annual, or decadal time scales.

Climate projection
A climate projection is the simulated response of the climate system to a scenario of future emission or concentration of greenhouse gases and aerosols, generally derived using climate models. Climate projections are distinguished from climate predictions by their dependence on the emission/concentration/radiative-forcing scenario used, which is based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized.

Climate-resilient pathways
Iterative processes for managing change within complex systems to reduce disruptions and enhance opportunities associated with climate change.

Climate scenario
A plausible and often simplified representation of the future climate, based on an internally consistent set of climatological relationships that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change.

Community-based adaptation
Local, community-driven adaptation. Community-based adaptation focuses attention on empowering and promoting the adaptive capacity of communities. It is an approach that takes context, culture, knowledge, agency, and preferences of communities as strengths.

Coping
The use of available skills, resources, and opportunities to address, manage, and overcome adverse conditions, with the aim of achieving functioning of people, institutions, organizations, and systems in the short to medium term.

Coping capacity
The ability of people, institutions, organizations, and systems, using available skills, values, beliefs, resources, and opportunities, to address, manage, and overcome adverse conditions in the short to medium term.

Exposure
The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.

Extreme weather event
An event that is rare at a particular place and time of year. The characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season).

Food security
A state that prevails when people have secure access to sufficient amounts of safe and nutritious food for normal growth, development, and an active and healthy life.

Planned adaptation
Anticipatory or proactive adaptation consists of measures taken to reduce potential risks of future climate change.

Resilience
The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.

Risk
The potential for consequences where something of value is at stake and where the outcome is uncertain. It is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard.

Runoff
That part of precipitation that does not evaporate and is not transpired but flows through the ground or over the ground surface and returns to bodies of water.

Scenario
A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships.

Sensitivity
The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).

Socioeconomic scenario
A scenario that describes a possible future in terms of population, gross domestic product, and other socioeconomic factors relevant to understanding the implications of climate change.

Sustainable development
Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED 1987).

Tipping point
A level of change in system properties beyond which a system reorganizes, often abruptly, and does not return to the initial state even if the drivers of the change are abated.

Uncertainty
A state of incomplete knowledge that can result from a lack of information or from disagreement about what is known or even knowable.

Vulnerability
The predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including exposure, sensitivity, or susceptibility to harm and lack of capacity to cope and adapt.

Vulnerability index
A metric characterizing the vulnerability of a system. A climate vulnerability index is typically derived by combining, with or without weighting, several indicators assumed to represent vulnerability.

EXECUTIVE SUMMARY

East Africa, and especially the Lake Victoria Basin (LVB), is among the regions most vulnerable to climate variability and change, a situation aggravated by the interaction of "multiple stressors," occurring at various levels as well as the low adaptive capacity of the population. This is partly because of human and socioeconomic factors, but climate also makes it one of the most vulnerable regions in the world.

Recent socioeconomic impacts of severe and prolonged droughts in the LVB states demonstrate the sensitivity and vulnerability of local populations. Over 10 percent of the basin's population is gradually becoming chronically food insecure, requiring support for both short-term emergency food relief and sustainable long-term development programs. Addressing the current challenges from recent and future climate change will be challenging.

Recognizing the potential adverse impacts of climate change and particularly their vulnerability, the Partner States of the East African Community became parties to the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, and the Paris Agreement, in effect stating their commitment to address global warming. They have in place national adaptation plans and strategies, and their commitment to act is demonstrated in their national reports to the UNFCCC, which includes their respective national communications and Nationally Determined Commitments.

At the regional level, the EAC Secretariat has focused on improving cooperation on climate change through the development of policy instruments, plans, and strategies. These include a regional Climate Change Policy, Climate Change Strategy, Climate Change Master Plan, Summit Declaration on Food Security and Climate, and Food Security Action Plan, which includes discussion of the relationship between climate change and food security. The EAC Treaty, in Article 100 on Meteorological Services, also provides for harmonization in the collection, management, and dissemination of meteorological information to facilitate early warning efforts.

The Lake Victoria Basin Commission (LVBC) Secretariat has just completed its Third Strategic Plan covering the period 2016–2021, which is anchored on the Protocol for Sustainable Development of December 2004. The plan adopts a programmatic approach aimed at implementing six program areas with an emphasis on management by results. The six program areas aim to:

- Enhance environmental and natural resources management;
- Promote and facilitate implementation of integrated water resource management (IWRM) and development;
- Enhance maritime transport safety and security on Lake Victoria;
- Promote social development services in the LVB;
- Improve investments and economic productivity in the LVB; and
- Strengthen the institutional and coordination capacity of the LVBC.

Lake Victoria is the world's second largest and Africa's largest freshwater lake and covers about 68,870 square kilometers. A relatively shallow water body, the lake is only 80 meters at its deepest point and has an average depth of about 40 meters. Over 80 percent of its water comes directly from rainfall, the rest comes from tributary runoff. High evapotranspiration affects water loss, and the lake has one major outlet through the Nile River in Uganda.

The socioeconomic importance of Lake Victoria to Eastern Africa is associated with its status as a fish and biodiversity sanctuary, transport link, water source, and climate modulator.

The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability as "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and weather extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity." Vulnerability is considered to have three dimensions: exposure, sensitivity, and resilience/adaptive capacity.

Many of the potential adverse impacts of climate change can be avoided by improving risk management and implementing integrated adaptive strategies that build resilience across sectors. A critical first step in this process is conducting a Vulnerability, Impacts, and Adaptation Assessment (VIA)-an analysis of expected impacts, risks, and the adaptive capacity of a region or sector to the effects of climate change. The purpose of a VIA is to determine which populations and sectors are most vulnerable or at risk to the adverse effects of climate change; identify

weaknesses and gaps in existing adaptation strategies and policies; and put in place adaptation measures to respond to these impacts and build resilience. VIAs can also improve the understanding of inter-sectoral linkages, establish a baseline against which system changes and protective measures can be monitored, and provide the opportunity for building capacity, while strengthening the case for investment in these sectors.

The VIA that was completed for the East Africa region, and more specifically for the LVB, used an approach that promotes implementation of the VIA by appropriate regional and national institutions that can be regionally endorsed, replicated, and institutionalized. Specifically, the VIA team:

- Built regional capacity for conducting science-based vulnerability assessments;
- Determined current and future vulnerability due to climate change and the potential impacts on key sectors, activities, ecosystems, communities, and the region;
- Developed a climate hotspots map for the basin and identified spatial climate risks and impacts; and
- Prepared a climate change adaptation strategy and action plan for the LVBC.

Although the VIA covers the entire region, it has a strong focus on the LVB due to the socioeconomic importance of Lake Victoria. The lake is the region's largest inland fishing sanctuary; an inland water transport link; a source of water for domestic, industrial, and commercial purposes; a major reservoir for hydroelectric power generation; a major climate modulator; and a rich biodiversity sanctuary. The basin has also been declared a Regional Economic Growth Zone and an Area of Common Economic Interest to optimize its economic and social benefits while addressing any environmental concerns and issues. Climate change has been identified as a serious threat to the basin's economic prosperity and livelihoods.

In recent years, the LVB has been characterized by frequent episodes of either excessive or deficient rainfall, which has had a negative impact on the economy. In general, results indicate average annual rainfall variability of between 6 percent and 50 percent across the LVB countries for the 1981–2010 period. Annual precipitation trends for 1981–2016 for the basin show significant areas with declining rainfall. Drier periods are getting longer and more pronounced during the March–June (MAMJ) rains. Precipitation patterns for these long rains exhibit decreasing rainfall trends (20–100 millimeters per decade) over Burundi and Rwanda, northern and eastern parts of Kenya, and Uganda's LVB region. Increased rainfall trends have also been experienced in the southern and eastern portions of the Tanzania LVB region.

Generally, it appears that rainfall will increase over the LVB in the future. However, rainfall events will become more extreme, episodic, and intense, making it difficult to capitalize on increased precipitation in most areas. Maximum daily temperatures are expected to increase 2.5°C to 3.5°C by 2050 and even by 2°C to 2.5°C by 2020 under the worst-case scenario.

IMPACTS ON AGRICULTURE AND FOOD SECURITY

Rain-fed agriculture accounts for approximately 80 percent of subsistence food production, yet it is dominated by smallholder farmers. These farmers have limited or no resources to improve their agricultural production systems, making them extremely sensitive to climatic variability. High inter-seasonal rainfall variability, reduction of arable land, shifts in agro-ecological zones, and increasing natural resources–based conflicts can be expected in the future.

Overall vulnerability in agriculture will increase and under the most extreme emission scenario, when maximum and minimum temperatures are projected to increase by 3.5°C to 4°C, more than half of the area will become extremely vulnerable. A 1.5°C warming by the 2030s could lead to about 40 percent of present maize cropping areas being no longer suitable for current cultivars. Under warming of less than 2°C by the 2050s, total crop production could be reduced by 10 percent. For higher levels of warming there are indications that yields may decrease by 15–20 percent across all crops and regions. Heat and drought would also result in severe losses of livestock and associated impacts on rural communities.

Climate change–related loss of pasture and unfavorable breeding temperatures will affect livestock and fish. Current warming trends of more than +2°C above optimal levels (10–30°C) are expected to adversely affect both milk and beef production. The current warming and drying trends already have negatively affected the quantity and quality of pastures, fodder crops and grains, water availability, and the severity and distribution of diseases and parasites.

Warmer-than-normal surface water temperatures and variability in rainfall patterns could affect fish physiological processes, thereby affecting spawning, survival of juveniles, and recruitment into the exploitable phase of population size, production, and yield.

IMPACTS ON WATER AND AQUATIC ECOSYSTEMS

Climate change, climate variability, and socioeconomic conditions have imposed additional pressures on water availability, water accessibility, and water demand in the LVB. It is projected that this will aggravate the water stress currently faced by some countries, while those that currently do not experience water stress will become at risk.

Surface water resources are extremely vulnerable to climate change. Results from dynamic modeling predict that the LVB will experience more rainfall, but that 20 out of its 23 rivers will experience highly variable discharges. Continuous heavy rainfall may increase risk by increasing flooding in some low-lying areas. The coefficient of variability in these predicted stream flows is high, in some cases above 70 percent. Groundwater recharge could increase, especially during the short rains. Where increases in heavy rainfall events are projected, floods could wash away sanitation facilities, spreading wastewater and potentially contaminating groundwater resources. This may lead to increased risk of diseases, especially in areas where pit latrines are used.

With continuous climate variability, the region is at risk of biodiversity losses. With the changes in climate patterns, variability, and trends; fish reproductive patterns, distribution of macro-invertebrates and amphibians, and migration patterns for migratory water birds have been and will be adversely affected.

IMPACTS ON TERRESTRIAL ECOSYSTEMS, FORESTRY, WILDLIFE, AND TOURISM

Changes in a variety of ecosystems are already being detected at a faster rate than anticipated, particularly in the LVB. Climate change, interacting with human drivers such as deforestation, is a threat to the region's forest ecosystems. Changes in grasslands and marine ecosystems are also noticeable with consequences for pastoralism and fisheries. The impacts on ecosystems already have a negative effect on tourism and according to one study, between 25 and 40 percent of mammal species in national parks in East Africa have become endangered.

The impacts of combined anthropogenic drivers, such as human population growth and land use changes, may have more far-reaching impacts on terrestrial ecosystems than climate change. Wildlife populations in the Serengeti have remained stable for many species, including wildebeest, the numbers of which have remained relatively stable at about 1.3 million. However, in the Maasai Mara National Reserve and the adjoining conservancies, the population of almost all wildlife species has declined to a third or less of their former numbers. Encroaching farmland and livestock grazing appear to be the main reason for this decline, as wildlife habitats and corridors are shrinking. However, future drying and warming trends are likely to exacerbate declining wildlife degradation and depletion.

IMPACTS ON HEALTH, SANITATION, AND HUMAN SETTLEMENTS

Human health has already been compromised by a range of factors and further negatively affected by climate change and climate variability. Vectors, pathogens, and hosts reproduce within certain optimal climate conditions, changes in which can greatly modify the properties of disease transmission, such as for malaria in the East Africa highlands. It appears that climate change has altered the ecology of some disease vectors in the region and consequently the spatial and temporal transmission of these diseases.

The LVB is expected to become warmer and wetter in the short and long rainy seasons, thus providing conducive environments for both vector-borne and diarrheal diseases. The most common killer diseases in the LVB are malaria, diarrheal illnesses (e.g., cholera), and respiratory tract infections. For malaria, an extremely deadly disease in the basin, the projections into 2030, 2050, and 2070 indicate that there will most likely be an increase in reported malaria cases. Due to increasing temperatures, the disease will also be prevalent in areas previously free of malaria, especially in the highlands. Other projected impacts include prolonged periods of elevated malaria transmission interspersed with periods of low transmission as malaria is a highly seasonal and cyclic disease.

The potential costs of preventing and treating malaria in the LVB will increase due to the expected increase of malaria cases in the future. For example, in Rwanda an estimated 2.5 million people could be affected in the absence of adaptation measures and the additional burden of endemic and epidemic malaria is estimated at between $61 million and $77 million annually.

The region has made progress in improving access to safe drinking water and sanitation over the past decade. However, future extreme events, such as floods, could lead to increased contamination of safe water sources and a breakdown of sanitation facilities and sewer systems, while droughts will reduce the availability of safe water to ensure proper hygiene is maintained.

The projections for 2030, 2050, and 2070 indicate that stresses on rural populations are likely to sustain or increase the level of rural-urban migration. Meanwhile, increasing temperatures in cities will put additional pressure on available water supplies and could compromise efforts to expand or even maintain current levels of sanitation control, resulting in increased incidence of disease.

IMPACTS ON ENERGY AND INFRASTRUCTURE

Energy demand is increasing in East Africa and hydropower accounts for 35 to 90 percent of energy produced, depending on the country. In recent years, changes in rainfall and temperature patterns have greatly affected power generation output due to varying water levels, leading to increased power rationing.

Another key source of energy for this region is biomass, which accounts for 80–90 percent of household energy used, with firewood and charcoal being the most consumed products. Prolonged droughts have affected biomass availability and regeneration. Extreme temperatures lead to bush fires that destroy biomass reserves. The rate of regeneration is low in the region due to below-average rainfall.

Extreme events such as floods lead to destruction of infrastructure. Precipitation, temperatures, and wind play a significant role in Lake Victoria maritime transport and safety. An estimated 5,000 people drown annually due to maritime accidents on the lake. Most of these accidents have been attributed to hazardous weather conditions and water currents in the lake.

LAKE VICTORIA BASIN CLIMATE CHANGE ADAPTATION STRATEGY AND ACTION PLAN

The goal of the LVB CCASAP is to address climate uncertainties, variability, and extreme events in order to improve and sustain livelihoods and adaptive capacities of vulnerable communities.

Taking account of the findings from the VIA, along with the current actions to address areas of vulnerability and existing gaps, the CCASAP provides an overall strategy for each thematic sector and identifies key adaptation options that support improved resilience in the LVB to address current and future vulnerability. For each of the five sectoral themes, the CCASAP includes programmatic adaptation options leading up to 2030.

Sector	Adaptation options
Agriculture and food security	Strengthen, integrate, and coordinate national food security early warning information systems to be responsive to priority user needs.
	Promote climate-smart agriculture and risk management programs.
	Support and strengthen agricultural value chains through public-private partnerships.
	Harmonize and coordinate climate change initiatives for optimal use of limited resources.
Water and aquatic ecosystems	Develop and implement community-based climate change resilience programs for water catchment management.
	Develop a decision support system that integrates climate change and integrated water resources management information.
	Enhance technological advancement for water resources harvesting, storage, processing, and use.
	Develop sustainable funding mechanisms and regional policy frameworks that support water security.
Terrestrial ecosystems, forestry, wildlife, and tourism	Apply a climate lens across key transboundary ecosystems.
	Analyze options for mitigation and adaptation for various regional and national governments, private sector, and local communities.
	Prepare a regional approach in the LVB to address community-based climate change impacts on wildlife, forests, and tourism.
	Develop climate change information hubs in the EAC and LVBC secretariats.
Health, sanitation, and human settlements	Build the capacity of the health workforce on climate change preparedness and response.
	Strengthen and institutionalize surveillance, early warning, and communications systems on climate-sensitive diseases.
	Strengthen research and interventions (prevention, preparedness, response) that address climate-sensitive sanitation and diseases.
	Use climate-appropriate technologies for health and sanitation infrastructure.
Energy and infrastructure	Develop an all-encompassing Specific, Measurable, Achievable, Relevant, and Time-Bound (SMART) regional renewable energy policy that reviews and harmonizes existing strategies that support participation of the private sector and nongovernmental organizations.
	Research and invest in alternative energy, including the establishment of regional standards and setting up an internationally accredited energy laboratory.
	Develop incentives and a funding framework for regional energy project incubation and start-ups.
	Develop and promote community-based biomass reduction and efficient best practice models for the region.

This strategy has been developed with a vision to enhance climate resilience in the LVB and to reduce the vulnerability of natural and social systems to climate change. The adaptation options identified in this CCASAP must be implemented through coordination and management structure to enhance synergies and minimize duplication of effort. The implementation modality will focus on the governance and management, resource mobilization mechanisms, capacity building, monitoring and evaluation framework, stakeholder engagement mechanisms, and communication and outreach programs.

1.0 INTRODUCTION

1.1 BACKGROUND

The East African Community (EAC) is an intergovernmental organization, consisting of six Partner States: Burundi, Kenya, Rwanda, South Sudan, Tanzania, and Uganda. Collectively the countries cover an area of 2,467,202 square kilometers, of which Tanzania accounts for 38.4 percent; Kenya, 32.1 percent; South Sudan, 26.1 percent; Uganda, 9.8 percent; Burundi, 1.1 percent; and Rwanda, 1.1 percent. The equator bisects the region into two approximately equal parts. The area is part of the Great Lakes Region, and ranges in height from sea level to 5,895 meters above sea level at the peak of Mount Kilimanjaro, Africa's highest mountain. Of the six Partner States, only the Republic of South Sudan falls outside the Lake Victoria Basin (LVB); the other five Partner States share the basin.

The total estimated population of the EAC in 2015 was 180.2 million1-10.5 million Burundians, 48.4 million Kenyans, 11.9 million Rwandans, 55.6 million Tanzanians, 12.2 million South Sudanese, and 41.5 million Ugandans. The average population density of the region is 73 people per square kilometer. Rwanda has the highest population density (452 people per square kilometer), followed by Burundi (378), Uganda (172), Kenya (83), Tanzania (55.7), and South Sudan (19). With an average growth rate of about 2.3 percent, the East African population is projected to reach 184.3 million by 2025 and 278.4 million by 2050. This puts great pressure on existing resources.

The region has several agro-ecological zones, ranging from tropical alpine zones at the highest elevations to coastal lowland zones that are sub-tropical to arid and semi-arid. Mean annual temperatures range between 20° and 28° Celsius across the region. Rainfall patterns in East Africa are mostly bimodal, with two wet seasons, one in late March to June and the other early October to mid-December. The periods of July to September and mid-December to early March are mostly dry.

The agriculture sector, mainly consisting of rain-fed agriculture, employs about 80 percent of the rural population in East Africa. The sector contributes significantly to foreign exchange earnings and provides raw materials for agro-based industries. The sector accounts for about 34 percent of the gross domestic product (GDP) in Burundi, 29 percent in Kenya, 32 percent in Rwanda, 25 percent in Tanzania, 15 percent in South Sudan, and 23 percent in Uganda. Major food crops include maize, rice, potatoes, bananas, cassava, beans, vegetables, wheat, sorghum, millet, and pulses, some of which contribute to cash crops. Other cash crops include tea, cotton, coffee, pyrethrum, sugarcane, sisal, horticultural crops, oil crops, cloves, tobacco, coconut, and cashew nuts. People also raise and manage cattle, sheep, goats, poultry, camels, and pigs. The main freshwater fish species include Nile perch **(*Lates niloticus*),** Nile tilapia **(*Oreochromis niloticus*),** and dagaa **(*Restrineobola argentea*),** while tuna, snapper, and crustaceans are fished in the region's oceans.

Map 1: Lake Victoria Basin

The LVB covers 180,950 square kilometers, with Tanzania occupying 44 percent, Kenya 22 percent, Uganda 16 percent, Rwanda 11 percent, and Burundi 7 percent of the land area (Map 1). Agriculture and livestock, fisheries, wildlife and tourism, and mining are the major sources of income in the LVB. Comprising significant areas of savannah, forests, mountain highlands, and wetlands, the LVB contains an extremely rich, unique, and wide range of aquatic and terrestrial species. Its biologically significant areas include over 100 globally or regionally recognized, significant ecosystems, including Maasai Mara–Serengeti, Mount Elgon, Nabugabo RAMSAR Site in Uganda, and the Nyungwe–Kibira transboundary landscape.

Lake Victoria, which covers about 68,870 square kilometers, is the world's second largest and

1 World Bank Population Database, 1960–2016 (https://data.worldbank.org/indicator/SP.POP.TOTL)

Africa's largest freshwater lake. A relatively shallow water body, the lake is only 80 meters at its deepest point and has an average depth of about 40 meters. Over 80 percent of its water comes directly from rainfall and the rest comes from tributary runoff. High evapotranspiration affects water loss, and the lake has one major outlet through the Nile River in Uganda.

The socioeconomic importance of Lake Victoria to East Africa is associated with the fact that it is the largest inland water fishing sanctuary; a major inland water transport link for the EAC Partner States; a source of water for domestic, industrial, and commercial purposes; a major reservoir for hydroelectric power generation; a major climate modulator; and a rich biodiversity sanctuary.

1.2 CLIMATE CHANGE-GLOBAL, AFRICA, AND REGIONAL CONTEXT

Climate change is a global phenomenon the effects of which are different on continental, national, and local scales. Those differences, particularly regarding temperature, indicate that the effects of climate change are already evident and are rapidly increasing across most of the globe. Climate models suggest a global warming of about 3°C and a sea level rise of about 68 centimeters by the year 2100 due to the carbon dioxide (CO_2) emissions projected under the business-as-usual scenario.

The Fourth Assessment Report (AR4) of the IPCC confirmed that climate change is real and presents unprecedented danger to human well-being. The Fifth Assessment Report (AR5) demonstrated that the impacts of climate change are not, however, evenly distributed geographically across the world. Africa has been highlighted as the most vulnerable continent to climate change. Given the dependence of the economies of EAC Partner States on the environment and natural resources, economic growth and the livelihoods of both urban and rural populations are highly vulnerable to climate variability and change.

According to the African Ministerial Conference on the Environment (AMCEN), the continent has been and will be particularly vulnerable to climate impacts due to the limited adaptive capacity, dependence on rain-fed agriculture, widespread poverty, and the low levels of economic development. IPCC estimates that by 2050, average temperatures in Africa will increase by between 1.5° to 3° Celsius. Adverse anthropogenic changes in land use, land degradation, deforestation, and water resources depletion, pressured by increasing populations dependent on the direct use of natural resources to sustain their livelihoods and needs contribute to the increasing vulnerability to climate change.

The dependence on rain-fed agriculture in East Africa makes it highly vulnerable to climatic variability and climate change. Most future adverse impacts will arise not only from shifting and variable rainfall patterns but also from increasing temperatures. Future climate change in the region will likely result in declining crop yields and increasing food insecurity, melting snow fields and glaciers, increased frequency and intensity of droughts and floods, and reduced water supply. It will also bring an increase in pests and diseases for livestock, wildlife, and crops and an increase in vector-borne diseases, including malaria and Rift Valley Fever, water-borne diseases such as dysentery, bilharzia, cholera, and typhoid affecting human health. It will also create conditions for an increase in invasive species. Declining levels of freshwater resources, rising sea levels leading to displacement of people and disruption of both terrestrial and marine ecosystems and other important natural habitats will contribute to increased natural resource–based conflict among communities.

Climate extremes manifest themselves as floods and droughts, which have severely affected the livelihood and economic development of the East African countries. Droughts and floods have increased in frequency and severity over the past 30 years. The recurrence patterns of some of the droughts and floods have been associated with El Niño and La Niña, the Indian Ocean Dipole, and anomalies in many other systems that drive the climate of various parts of Africa.

Other documented impacts of climate change in the EAC region include sea level rise, which has already led to infrastructure destruction along the East African coast; the submergence of some small islands in the Indian Ocean, such as Maziwe and Fungu la Nyani; saltwater intrusion and contamination of freshwater wells along the Tanzanian coast; beach erosion in Mombasa; and rampant floods and droughts across the region. Various studies of long-term temperature trends of Lakes Edward, Albert, Kivu, Victoria, Tanganyika, and Nyasa indicate that deep water temperatures have risen by 0.2° to 0.7° Celsius since the early 1900s. Since 1912, the size of Mount Kilimanjaro's ice fields has decreased by 50 to 80 percent. Moreover, the Mount Ruwenzori icecap has decreased from its initial 563 hectares to less than 50 hectares.

1.3 LINKAGES TO REGIONAL AND NATIONAL POLICY FRAMEWORKS

Several policy frameworks address climate change at both regional and national levels. Three EAC documents focus on improving regional cooperation on climate change through a variety of policy instruments, plans, and strategies. These include a regional Climate Change Policy, Climate Change Strategy, Climate Change Master Plan, Summit Declaration on Food Security and Climate, and Food Security Action Plan, which includes discussion of the relationship between climate change and food security. The EAC Treaty, in Article 100 on Meteorological Services also provides for harmonization of the collection, management, and dissemination of meteorological information to facilitate early warning efforts.

The EAC Climate Change Policy, Climate Change Strategy, and Climate Change Master Plan guide the regional climate change approach and programming, including in the LVB. These three documents are distinct but complementary.

1. **EAC Climate Change Policy** is a statement by the EAC Secretariat expressing recognition of a climate change problem and stating its commitment to address it through specified actions with adaptation as a top priority. The focus is on an integrated, harmonized, and multisectoral framework for responding to climate change in the EAC region.
2. **Climate Change Strategy** establishes a range of measures giving the direction and scope of implementation, defining all the necessary actions and resources needed to achieve its goal.
3. **Climate Change Master Plan** is a blueprint and comprehensive 20-year document that takes a long-term view of the challenges, opportunities, and priority actions to combat climate change. It provides the overall picture and vision for the region insofar as climate change response is concerned, giving estimates of all the resources needed for the EAC to be climate-resilient.

The main recurring theme in these policy documents is to institute and implement measures that will improve the adaptive capacity and resilience of the East Africa region to the negative impacts of climate change. The EAC Climate Change Policy prioritizes adaptation measures; regions, sectors, and communities that are more vulnerable to climate change impacts; mainstreaming climate change into national development plans; social and economic development; as well as partnerships, collaboration, and synergies among various stakeholders.

The Lake Victoria Basin Commission (LVBC) Secretariat has completed its Third Strategic Plan covering the period 2016–2021, which is anchored on the Protocol for Sustainable Development of December 2004. The plan adopts a programmatic approach aimed at implementing six program areas with an emphasis on management by results. The six program areas aim to:

- Enhance environmental and natural resources management;
- Promote and facilitate the implementation of IWRM and development;
- Enhance maritime transport safety and security on Lake Victoria;
- Promote social development services in the LVB;
- Improve investments and economic productivity in the LVB; and
- Strengthen the institutional and coordination capacity of the LVBC.

The plan's Environmental and Natural Resources development objective identifies three strategies:

- Facilitate the implementation of sustainable management of transboundary natural resources;
- Facilitate the conservation of transboundary ecosystems including watersheds, wetlands and biodiversity; and
- Promote and facilitate the implementation of climate change mitigation and adaptation programs.

Activities in three key areas will be implemented to promote and facilitate the climate change program:

- Establishing and operationalizing a climate change unit for the LVB;
- Developing the Lake Victoria Basin Climate Change Adaptation Strategy and Action Plan; and
- Developing a LVB climate change adaptation program to implement the LVB CCSAP.

This is the context in which the CCASAP has been developed and in which it will be implemented by the LVBC Secretariat.

The five LVB states prepared a 2015 Intended National Determined Contribution (INDC) and each has other mechanisms, frameworks, or institutions to address climate change and confirm commitments to reducing greenhouse gas emissions and strengthen resilience in adapting to climate change impacts. Burundi's INDC builds on its Burundi Vision 2025; the National Adaptation Programme of Action (NAPA) (2007); National Climate Change Policy (2012); National Strategy and Action Plan on Climate Change (2012); and key sectoral policies, strategies, and programs. Kenya's institutional framework includes its 2010 National Climate Change Response Strategy; 2013 National Climate Change Action Plan, currently being implemented; and a National Adaptation Plan, currently being developed; and an evolving National Climate Change Framework Policy. Rwanda, like its neighbors, has made significant policy and implementation commitments to address climate change. The government, through its Economic Development and Poverty Reduction Strategy, recognizes the importance of climate change, as is reflected in its INDC, the Green Growth and Climate Resilience Strategy, and its NAPA (2006). Tanzania has several policy instruments and strategies to address the impact of climate change on its economy including its NAPA (2007), National Climate Change Strategy (2012), Zanzibar Climate Change Strategy (2014), and Renewable Energy Policy, among others. Finally, Uganda's intentions are clearly described in its NAPA (2007), National Climate Change Policy (2015), National Policy for Disaster Preparedness and Management (2010), Climate-Smart Agriculture Programme, and a road map for the development of a NAPA.

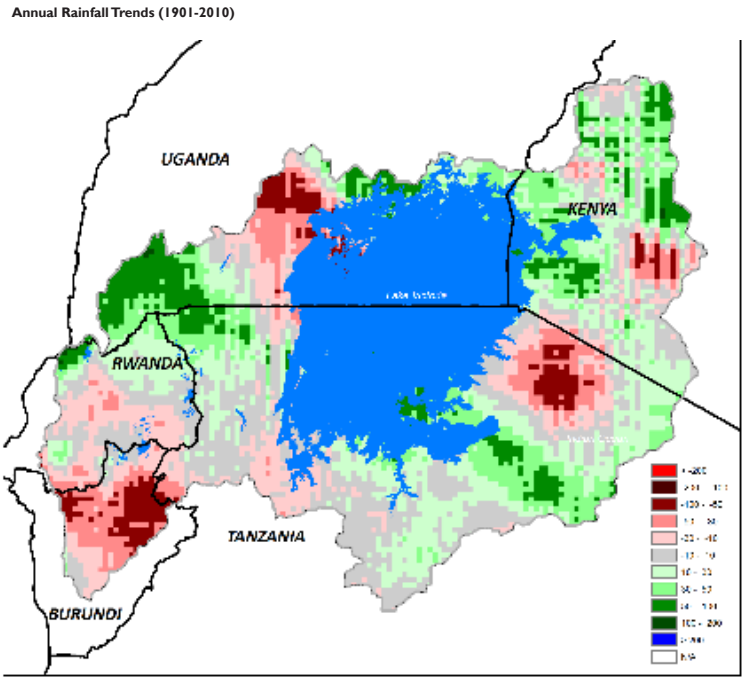
2.0 RATIONALE FOR LVB CLIMATE CHANGE ADAPTATION STRATEGY AND ACTION PLAN

The LVB is an important regional economic growth zone to be developed jointly by the EAC Partner States. The basin's rich resource base, its economic prosperity, and its livelihoods could be significantly threatened by climate change, which has the potential to increase challenges for millions of the basin's inhabitants. The goal of the LVB CCASAP is to address climate uncertainties, variability, and extreme events in order to improve and sustain livelihoods and adaptive capacities of vulnerable communities. The overarching objectives of the strategy are to build resilience in the LVB at the regional, transboundary, and national levels; compliment ongoing national and regional climate change efforts and priorities; encourage new and innovative private sector support and investments; achieve multiple adaptation benefits across sectors; open opportunities for significant medium-term impact at regional, national, and community levels; and build strong institutional capacity to implement adaptation programs.

2.1 CURRENT CLIMATIC CONDITIONS AND TRENDS IN THE LAKE VICTORIA BASIN

The LVB has a typical equatorial climate. The rainfall patterns in basin are mostly bimodal, with two wet seasons in late March–June (MAMJ) and early October–December (OND). Predominantly dry conditions generally occur during June–September and December–March. The inter-annual variability of regional rainfall is dominated by the short rains, which correlate with the El Niño-Southern Oscillation (ENSO), with above-normal rainfall during El Niño and below-normal rainfall during La Niña events.

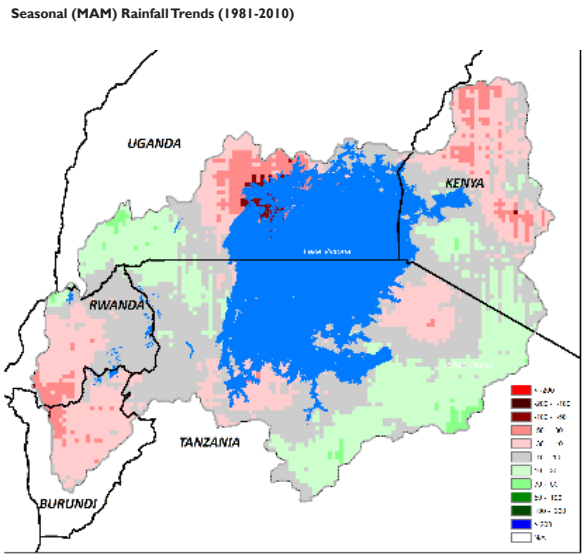
July is the coolest month of the year and February is the warmest. Rainfall varies considerably from one part of the LVB to another. The mean annual rainfall is between 1,200 and 1,600 millimeters, but it exceeds 3,000 millimeters at Nabuyonge Island in the center of the lake. Maximum temperatures range from 28.6°C to 28.7°C and minimums range from 14.7°C to 18.2°C. The temperature in the LVB reaches maximum in February, just before the March equinox and its minimum in July after the June equinox maximum.



Map 2: Lake Victoria Basin Annual Precipitation

The overall climate trend in the region for the recent past (1981–2010) indicates that the climate has become hotter and drier. Variation from the average annual precipitation ranges from 6–50 percent across the region (Map 2). For the long rains of MAMJ, a 40–50 percent variation from average precipitation has been experienced over the majority of Kenya and Tanzania (Map 3).

Annual precipitation trends for this period for the LVB (Map 2) indicate significant areas with declining rainfall (redder areas), including parts of western Tanzania and Uganda, as well as significant areas in Serengeti National Park. Analysis of long-term gridded data from 1930 to 2014 using GeoCLIM indicates wet periods in the 1960s followed by decreasing rainfall periods during the 1970s in the MAMJ season. Distinct 10-year cycles of dry and wet periods have appeared over East Africa, with wet periods occurring in the 1940s, 1970s, and 1990s and dry periods in the 1960s, 1980s, and 2000 to 2010s.



Map 3: Lake Victoria Basin MAMJ Precipitation Trends

Drier periods are getting longer during the long rains (MAMJ) and more pronounced. Map 3 illustrates precipitation trends for the long rains, which indicates decreasing rainfall trends over Burundi and Rwanda and northern portions of the Kenya LVB, as well as in parts of Uganda's basin. Increased rainfall trends were experienced in the southern and eastern portions of the Tanzania LVB.

Drought is a recurrent phenomenon in the region. By comparing Standardized Precipitation Index (SPI) values for 1981–2014, a pattern of recurring drought is illustrated in Figure 1 for the five East Africa countries. Increased frequency of severe droughts (SPI>-1.5), interspersed with short-lived recovery periods or sometimes back-to-back with extreme flooding, such as the 2006, 2009, and 2015 El Niño events, allows insufficient periods for recovery, especially for pastoralists, who require 3–5 years of good rainfall to restock.

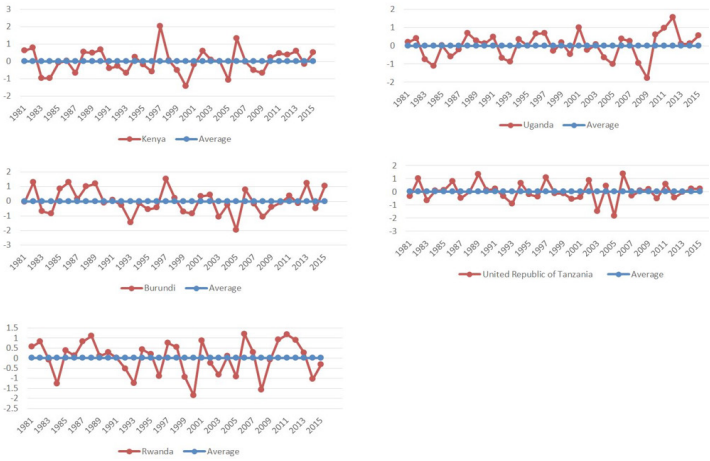


Figure 1: Drought Patterns in the Five EAC Partner States

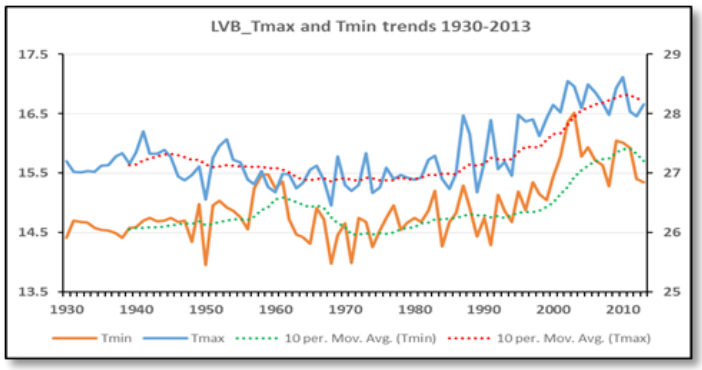


Figure 2: Changes in Maximum and Minimum Temperatures in the LVB (1930–2013)

The total monthly rainfall for October and November increased significantly between 1930 and 2013. The modeled trends suggest that this increasing trend is likely to continue. Concurrent with this increase in rainfall is a significant decrease in April rainfall for Burundi, Rwanda, and Tanzania and marginally in Uganda. In general, for the last century, monthly rainfall has increased during the short rains and decreased during the long rains. After the 1970s, fluctuations in rainfall are dominated by short cycles of about five years duration that normally coincide with the swings in the ENSO.

Based on almost 85 years of GeoCLIM climate data, Kenya had 56 percent of the seasonal rainfall totals below the long-term average; Uganda, 51 percent of its seasons; Burundi, 53 percent of its seasons; Rwanda, 46 percent of its seasons; and Tanzania, 51 percent of its seasons.

Analysis of the 1930–2013 GeoCLIM dataset indicates that temperature increases for most of the 12 months were significant within the five states of the LVB, ranging between 0.7°C and 1.2°C for average monthly maximum temperature and between 1.0°C and 1.1°C for the average monthly minimum (Figure 2).

3.0 APPROACH AND METHODOLOGY FOR THE LVB CCASAP

3.1 APPROACH

The IPCC defines vulnerability as "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and weather extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity." Vulnerability is considered to have three dimensions: exposure, sensitivity, and resilience/adaptive capacity.

Much of the potential adverse impact of climate change can be avoided by improving risk management and implementing integrated adaptive strategies that build resilience across sectors. A critical first step in this process is conducting a Vulnerability, Impacts, and Adaptation Assessment (VIA). A VIA analyzes expected impacts, risks, and the adaptive capacity of a region or sector to the effects of climate change. The purpose of a VIA is to determine which populations and sectors are most vulnerable or at risk to the adverse effects of climate change; identify weaknesses and gaps in existing adaptation strategies and policies; and put in place adaptation measures to respond to these impacts and build resilience. VIAs can also improve the understanding of key inter-sectoral linkages, establish a baseline against which system changes and protective measures can be monitored; and provide the opportunity for building capacity, while strengthening the case for investment in these sectors.

The VIA for the East Africa region and the LVB used an approach that promotes implementation of the VIA by appropriate regional and national institutions that can be regionally endorsed, replicated, and institutionalized. Specifically, the VIA team:

- Built regional capacity for conducting science-based vulnerability assessments;
- Determined current and future vulnerability due to climate change and the potential impacts on different key sectors, activities, ecosystems, communities, and the region;
- Developed a climate hotspots map for East Africa and identified spatial climate risks and impacts; and
- Prepared a climate change adaptation strategy and action plan for the LVBC.

The VIA study resulted in:

- Improved capacity at regional, national, sectoral, and local levels to further identify and understand climate change impacts, vulnerability, and adaptation responses, and to select and implement practical, effective, and high priority adaptation actions;
- Increased development, dissemination, and use of knowledge from practical adaptation activities;
- Enhanced cooperation among EAC Partner States, regional and national organizations, businesses, and civil society, aimed at enhancing their ability to manage climate change risks;
- Improved integration of actions to adapt to climate change with those to achieve sustainable development; and
- A Lake Victoria Basin Climate Change Adaptation Strategy and Action Plan, based upon adaptation options recommended by regional and national stakeholders.

A VIA must meet varying needs, commencing with awareness generation and leading to planning and finally to implementing actions. Therefore, the approach, methods, and tools chosen for the VIA must be consistent with needs of stakeholders. VIAs must contribute to each country's national reporting at the UNFCCC and in meeting the global common objective of addressing climate change. Therefore, a VIA should be:

- Consistent across regions, sectors, and time scales;
- Comparable across alternative policy options and responses;
- Conducted in a transparent manner;
- Enable integration across sectors, time, and space; and
- Capture realities as accurately as possible.

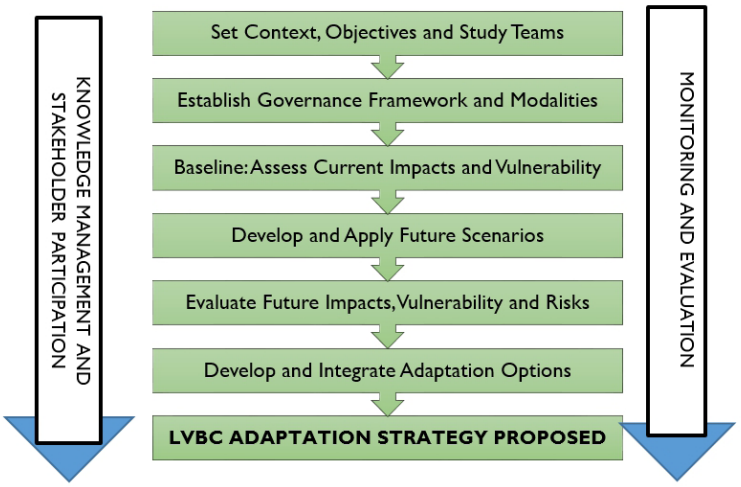


Figure 3: VIA Framework

Based upon the results of a July 2014 Experts Workshop, a VIA framework, based upon IPCC guidelines for conducting VIAs, was agreed by regional and international experts. Figure 3 illustrates the approved framework, which is consistent with the IPCC process for conducting VIAs.

The general approach examines current conditions and identifies key sectors. Then, future climatic and non-climatic scenarios are used to examine the possible effects of climate and sea level changes on the various sectors. These become the basis for identifying possible adaptation response measures recommended for the East African region, and more specifically for the Lake Victoria region, resulting in an LVB CCASAP. Since the VIA framework was accepted and approved by international, regional, and national entities, consistency is ensured with the EAC Partner States' national communications and other previous adaptation work, including each country's NAPA, INDC, and national communications on climate change.

3.2 METHODOLOGY FOR COMPLETING LVB CCASAP

The VIA provided analyses and evidence to inform the preparation of the LVB CCASAP. Regional and national stakeholders were included in each phase of the VIA and development of adaptation options for inclusion in the LVB CCASAP.

Governance Framework for Completing the LVB CCASAP

The EAC and LVBC have formal organs to guide their operations. Environment and natural resources issues and programming across the EAC are overseen by the Sectoral Council for Environment and Natural Resources (SCENR). Environment and natural resources issues specific to the LVB are the mandate of the LVBC and are overseen by its Sectoral Council of Ministers (SECOM).

One of the six working groups reporting to the SCENR is the Climate Change Technical Working Group (CCTWG), which managed the preparation and approval of the 2011 EAC Climate Change Policy, Strategy, and Master Plan documents. The SCENR approved the VIA Terms of Reference in 2013 and delegated responsibility for monitoring, providing guidance, and approving VIA approaches, results, and documents to the CCTWG.

The CCTWG reviewed and validated the VIA Scope of Work and agreed on the five proposed thematic sectors to be analyzed, which are consistent with the EAC's sustainable development goals and the priorities of the LVBC 2016–2021 Strategy. The five thematic sectors addressed in the VIA were:

- Agriculture and food security (fisheries, aquaculture, and livestock);
- Water, aquatic ecosystems, and associated infrastructure;
- Health including sanitation and human settlements;
- Terrestrial ecosystems including forests, wildlife, and associated tourism; and
- Energy and associated infrastructure.

This LVB CCASAP was validated by the EAC Partner States and approved by the SCENR and presented to the SECOM for adoption and implementation.

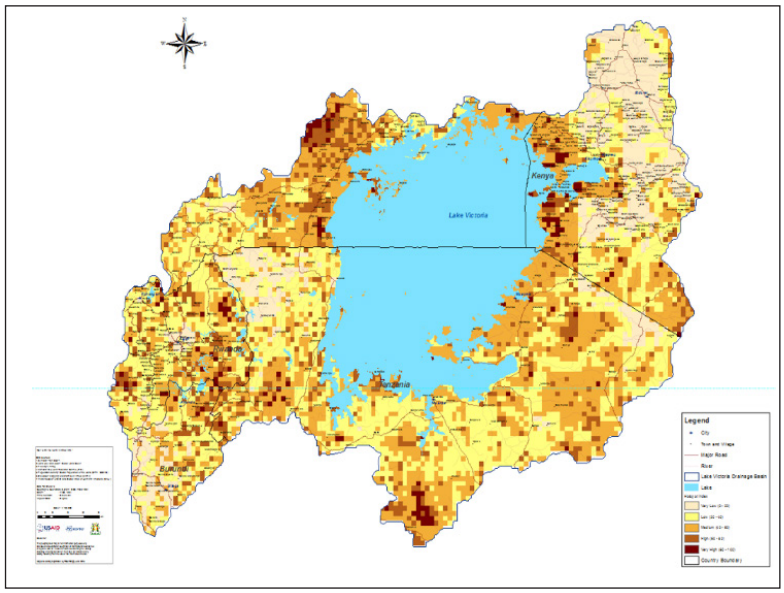
Tools and Models

Several organizations participated in conducting the VIA, including the EAC Secretariat, the LVBC Secretariat, United States Geological Survey (USGS) through its FEWS NET program, the Intergovernmental Authority for Development

Climate Prediction and Applications Centre (ICPAC), Columbia University's Center for International Earth Science Information Network, and the Regional Centre for the Mapping of Resources for Development (RCMRD) and its USAID-funded SERVIR program. The USAID/Kenya and East Africa (USAID/KEA) PREPARED Project coordinated the technical approach and program.

Specific tools and models used to conduct the analyses are in table below.

Tool	Description of statistical methods applied
GeoCLIM	GeoCLIM is a software program that allows the blending of Climate Hazards Infra-Red Precipitation with stations (CHIRPs) data with observational station data to produce a gridded database for temperature and precipitation. The GeoCLIM blended database fills in data gaps and allows historical and future trends.
CORDEX 10 RCM	The Coordinated Regional Climate Downscaling Experiment (CORDEX) suite of 10 dynamical regional climate models was developed by the Task Force on Regional Climate Downscaling established by World Climate Research Program and provides future climate projections under different scenario assumptions.
Vulnerability Index (VI) and hotspots mapping	Using the AR4 definition for vulnerability = exposure + sensitivity + adaptive capacity, VI maps are produced using combined layers of relevant sectoral indicators in these three categories to determine vulnerability hotspots.
Community Climate Change Adaptation Assessment (C3A2)	C3A2 is a participatory methodology to assess community-level perceptions on climate variability, change, and risk and determine household and community responses employed to adapt to changing conditions. The C3A2 toolkit contains approaches to map hazards and risks, determine socioeconomic impacts from climate change, and compile community-based adaptation practices.
Vector Autoregressive Moving Average Model (VARMAX)	VARMAX is a statistical model for time series analysis and forecasting. The model is used to forecast sector indicators for each of three scenarios (RCP 2.6, RCP 4.5, and RCP 8.5) in relation to rainfall and temperature.
Unobserved Components Model (UCM)	UCM is a statistical model for forecasting sector indicators for each of three scenarios (RCP 2.6, RCP 4.5, RCP 8.5) in relation to rainfall and temperature. The model was used for cases in which sector indicators are nonlinearly related to rainfall and or temperatures.
Semiparametric Generalized Linear Mixed Model (SGLMM)	This tool is used to model nonlinear trends in sector indicator series and in rainfall and temperature series.
Spectral analysis	This tool is used to establish periodicity in rainfall and estimate period of rainfall cycles.
Two Component Normal Mixture Models	This is used to establish if rainfall seasonality is unimodal or bimodal and if the seasonality is changing over time.
Constructed spline effects	This tool is used to test for significance of differences in estimates of rainfall or temperature at two specified points on rainfall or temperature trend curves.
Random coefficients regression models	These are used to model intra- and inter-annual variation in phenology, synchrony, and fecundity of births in ungulates in relation to rainfall.
Spatial modeling	These methods are used to develop vulnerability maps by combining multiple historical and projected sector indicators.



Map 4: Communities vulnerable to climate change within the Lake Victoria Basin

FEWS NET/USGS has developed a suite of applications that were used to analyze historical trends, develop seasonal forecasts, model crop needs, and predict future rainfall patterns. The software program GeoCLIM was used for analyses of gridded historical precipitation and temperature data to determine key parameters, such as annual and seasonal trends, coefficients of variability from mean figures, and comparative patterns over specific temporal ranges. ICPAC provided dynamical modeling expertise to model future climate, using the Regional Climate Downscaling Experiment (CORDEX) Regional Climate Model (RCM) to determine projected temperature and precipitation changes in the LVB across three Representative Conservation Pathways (RCPs): RCP 2.6, RCP 4.5, and RCP 8.5 for 2030, 2050, and 2070.[2] RCMRD applied a vulnerability index mapping tool to determine vulnerability hotspots for key sectoral issues and to identify communities for conducting community climate change adaptation assessments (C3A2). All these tools were used to determine current and future vulnerability of the LVB to climate change. An example of a community vulnerability map for the LVB is in Map 4.

A process for developing the adaptation options must be flexible and responsive to the VIA results. In identifying options, the LVBC Secretariat recognized that the development of options with a reasonable chance for implementation, require the support and backing of key stakeholders, need to be championed and expanded, are cost-effective and can be flexibly adapted to changing conditions. A consultative and participatory approach was used for stakeholder buy-in and ownership.

The LVBC Secretariat hosted an Options Development Workshop with more than 80 stakeholders from the five EAC Partner States in the LVB (Burundi, Kenya, Rwanda, Tanzania, and Uganda), the donor community, the private sector, and civil society in July 2016 in Entebbe, Uganda. The participants reviewed critical results and findings from the VIA and proposed adaptation options to address projected future climate change impacts and scenarios. The workshop concluded with country-level and regional action plans that identified critical next steps for each Partner State and regional institutions to move forward with the development and implementation of an LVB CCASAP.

Communication and Outreach Process for the VIA

A key element of the VIA was to determine which populations were most at risk from climate change, and a strategy for addressing gender, including women and youth, was included as part of a stakeholder engagement strategy. A communication and outreach strategy has been developed and will guide the dissemination of key findings, recommendations, and LVB CCASAP programs to regional, national, and international partners. Outreach will be accomplished primarily with key decision makers, but also target potential funders, international organizations, civil society, and the media, which will be the conduit to reaching the public.

2 RCPs are four greenhouse gas concentration (not emissions) projections adopted by the IPCC for its Fifth Assessment Report (AR5) in 2014. Each represents a future scenario for greenhouse gas concentrations. RCP 2.6 assumes that global annual emissions peak between 2010 and 2020, with emissions declining substantially thereafter. Emissions in RCP 4.5 peak around 2040, then decline. In the RCP 6 scenario, emissions peak around 2080, then decline. RCP 8.5, the worst-case scenario assumes emissions continue to rise throughout the 21st century. The RCPs are used in future climate prediction modeling.

4.0 VULNERABILITY OF THE LVB TO CLIMATE CHANGE

The climate trends described in Section 3.1 have had various implications for agriculture and food security; water and aquatic ecosystems; terrestrial ecosystems, forests, wildlife, and tourism; health and human settlements; and energy and infrastructure. The VIA team also modeled potential future climate scenarios to determine the impacts on these five thematic sectors.Future projections for precipitation and temperature were determined for 2030, 2050, and 2070.

Precipitation. Based on dynamic modeling conducted by ICPAC, the projected changes in annual rainfall under each of the three scenarios and timeframes indicate the following:

- Annual rainfall generally shows a tendency to increase over the LVB.
- The short rains (October-December [OND] season) are projected to increase over most of the region under all three future scenarios (5-25 percent by 2020 and 2030, and 25-50 percent by 2050 and 2070).
- The long rains (March-May [MAM]) are projected to decrease over the northern part but increase over the southeastern part of the LVB.
- The June-September (JJAS) dry season, which is when the western and coastal parts of the region receive substantial amounts of rainfall, is projected to receive less rain over most of the region (25-50 percent by 2020 and 2030, and 50-75 percent by 2050 and 2070).
- Extreme rainfall events are expected to increase across the region.

Temperature. For maximum and minimum temperatures, the following changes are projected.

***Maximum Temperature*:**

- By 2030, maximum temperatures during the long rains (MAM), the dry season (JJAS), and throughout the year (annual component) will likely increase by 1.0°C to 2.0°C over most of the region.
- The greatest potential warming will likely occur in the dry season (JJAS) and during the long rains (MAM) and least during the short rains (OND).
- In the far future (2070), projected annual maximum temperatures will likely be 0.5°C to 1.5°C higher under the RCP 2.6 scenario, which is notably smaller than the changes anticipated by 2050.
- In contrast, under the RCP 8.5 scenario, the expected annual warming will likely result in 3.5°C to 4.5°C higher temperatures, with far greater warming expected during the dry season (JJAS).

***Minimum Temperature*:**

- There will likely be a greater increase in the minimum than the maximum temperatures in the future across the basin.
- By 2030, almost all the EAC region will likely be 1.0°C to 2.5°C warmer, with the greatest warming expected during the dry season (JJAS) under the RCP 8.5 scenario.
- By 2070, the projected increase in the annual minimum temperatures will likely be 4°C to 5°C higher under the RCP 8.5 scenario.

4.1 AGRICULTURE AND FOOD SECURITY

The agriculture and food security sector, including arable and irrigated crop production, fisheries, aquaculture, and livestock, is an important economic driver for sustainable development in the LVB. The sector contributes to food security and foreign exchange earnings, provides raw materials for agro-based industries, and employs 80 percent of the rural population. It accounts for about 34 percent of the GDP in Burundi, 29 percent in Kenya, 32 percent in Rwanda, 25 percent in Tanzania, and 23 percent in Uganda.

Agriculture and food security in the LVB are highly vulnerable to climate-related shocks and stresses due to low agricultural productivity and limited adaptive capacity, manifested by high levels of food insecurity, population growth, and poverty. Crop productivity in the region is low and below global average levels.

This is because production is dominated by smallholder farmers who are constrained by limited access to quality inputs and markets, limited access to credit, low use of appropriate production technologies, as well as high food and energy costs.

The projected temperature rise, reduced rainfall in some parts of the region, and increased frequency and intensity of extreme weather events (drought, floods, hailstorms, and strong winds) will further decrease agricultural productivity. High inter-seasonal rainfall variability, reduction of arable land, shifts in agro-ecological zones, and increasing natural resource conflicts will therefore be expected in the future. Climate change–related loss of pasture and unfavorable temperature increases will adversely affect livestock and fish breeding.

Overall vulnerability in agriculture will increase and under the most extreme global emission scenario, when maximum and minimum temperatures are projected to increase by 3.5°C to 4°C, more than half of the LVB area will become extremely vulnerable. With projected population increases in the basin more people will face increasing food insecurity. Cropping land suitability projections suggest that opportunities may arise for the expansion of some crops, while others will suffer. Sorghum, cassava, yam, and pearl millet show, on average, either little area loss or even gains in area in most regions. However, suitable areas for cultivating bean, maize, banana, and finger millet are projected to decrease significantly. Most of these reductions result from temperatures that exceed the optimal and marginal maximum temperatures at which the crops can grow, and in a few cases (e.g., pearl millet, sorghum, and yam), decreases in precipitation.

A 1°C temperature rise above optimal levels (10–30°C) for livestock may reduce their feed intake by 3–5 percent. The result of increased ambient temperature and concurrent changes in heat exchanges causes heat stress which influences growth, reproduction performance, milk production, wool production, and animal health and welfare. The changes will influence the quantity and quality of pastures, fodder crops, and grains. Various RCPs will result in a substantial reduction in annual net primary productivity of rangelands. The implication for this trend is reduced productivity for livestock with serious implications as this will reduce income and food security, which will be worsened by high population growth rate and result in more conflicts over grazing areas. For fish, elevated water temperatures affect physiological processes, thereby affecting spawning, survival of juveniles, and recruitment into the exploitable phase of population, population size, production, and yield.

4.2 WATER AND AQUATIC ECOSYSTEMS

Aquatic ecosystems in the basin include wetlands, rivers systems, and open lakes. LVB aquatic ecosystems are internationally recognized for their high levels of species richness and endemism. The freshwater fisheries, for example, have one of the greatest endemism of cichlid species resulting from adaptive radiation. To date, many of these species remain undescribed. This rich biodiversity supports large commercial and artisanal fisheries, providing income and food security to a large portion of the poorer communities. Additionally, freshwater ecosystems provide immense benefits to local, national, and regional economies and provide the basis for indigenous medical practices, food, energy, shelter, crafts, and various raw materials.

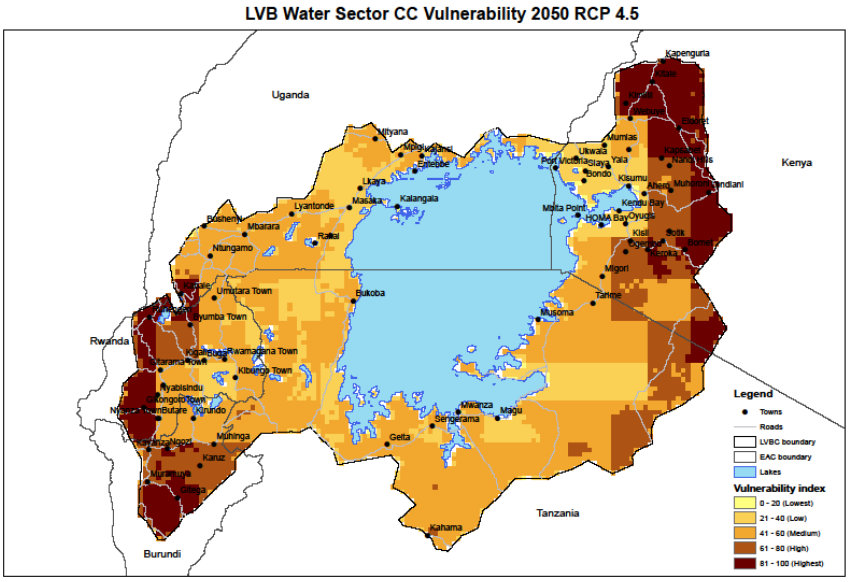
Mara River in Tanzania

The water resources of the LVB are finite, yet uses have continued to increase exponentially. The five countries of the LVB (Burundi, Kenya, Rwanda, Tanzania, and Uganda) combined have a renewable water volume of 187 cubic kilometers per year. Population in the EAC had increased to about 150 million people in 2014, meaning available water per capita has been reducing dramatically. Rapid population growth and migration into urban areas has resulted in the increasing demand for water for domestic, industrial, and agricultural use.

However, in all the Partner States, less than 75 percent of rural residents have access to safe drinking water. To address this gap, the Partner States identified priority interventions for water sector development and sustainability, which include infrastructure development, catchment conservation, rainwater harvesting, and setting up hydro-meteorological stations. These are factored in the respective National Vision Statements and NAPAs for climate change and INDCs for each country.

The LVB contains about 45 million rural inhabitants the majority of whom remain very poor. Projections indicate that this population will increase to more than 68 million by 2020 and by 2050 it could be around 165 million people, creating great competition for water resources. Moreover, the open water of Lake Victoria provides drinking water for urban centers in the basin, including Kampala, Kisumu, Mwanza, Bukoba, and Jinja. Other urban centers such as Masaka, Entebbe, Jinja in Uganda; Muleba and Musoma in Tanzania; and Homa Bay in Kenya are also within the basin and access water from wetlands and rivers.

The LVB is rich in aquatic biodiversity, including aquatic plants, insects, mollusks, crustaceans, fishes, reptiles, water birds, and mammals. Lake Victoria provides protein for approximately 8 million people and supports over 100,000 fishermen. However, change in precipitation due to climate change is of concern as it could affect fish reproductive patterns, distribution of macro-invertebrates and amphibians, and migration patterns for water birds. The LVB faces significant threats from the expansion of poorly planned settlements, unsustainable farming practices, tree cutting, charcoal burning, and pollution of water resources. These threats contribute to siltation of the rivers and increased turbidity caused by excess runoff from upstream sources; encroachment and degradation of riverbanks and eutrophication by invasive water hyacinth; degradation of riverine forests and the unique biodiversity and ecosystem of the groundwater forest in floodplains; and encroachment of wetlands thus degrading their functions.



Map 5: Water Stress vulnerability map for the Lake Victoria Basin, 2050 under RCP 4.5

As indicated in Map 5, future climate change projections will cause some areas increasing water stress vulnerability. Severe areas most likely will be in Rwanda and Burundi portions of the LVB and the Kenya segment of the basin.

Water stress, based on three climate scenarios for the LVB for 2030, 2050, and 2070 shows higher vulnerability in Kenya for 2030 and Tanzania for 2050. In 2050 the threats will concentrate on the western sections of the LVB. In 2070 the impacts will be severe across the whole basin. In 2070 the vulnerability will be high in Kenya (the Mau), Uganda, and parts of northern Rwanda and Tanzania. The increased annual runoff may produce benefits for a variety of both in-stream and out-of-stream water users by increasing renewable water resources, but it may simultaneously generate harm by increasing flood risk in some low-lying areas. Map 5 illustrates the projected water stress for 2030 over the LVB based upon the RCP 4.5 scenario.

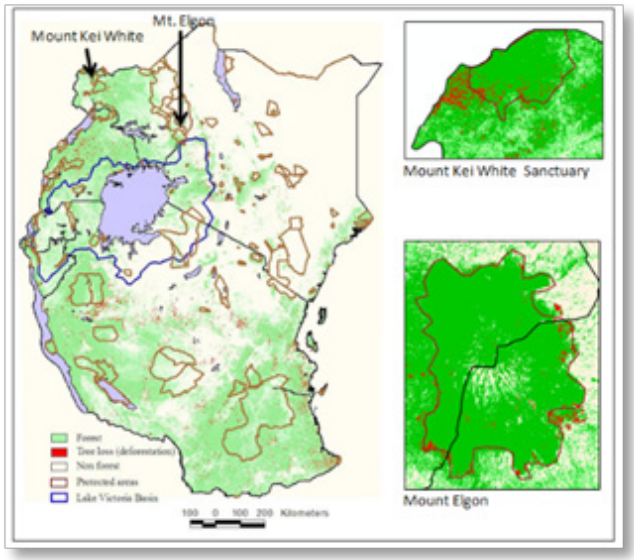
Surface water resources are extremely vulnerable to climate change. Future scenarios predict that the LVB will have increasing river flows, but with 20 out of 23 rivers being projected to have highly variable discharge. The coefficients of variability in the predicted stream flows in these key rivers are high, in some cases above 70 percent. The most variable period for majority of the rivers is the 2031–2050 period. For lake systems, more intense rainfall and flooding is likely to result in increased suspended solids, sediment yields, and associated contaminant metal fluxes as well as nutrient loads from degraded catchments leading to higher water treatment costs.

Groundwater recharge could increase, especially during the short rains. Where increases in heavy rainfall events are projected, floods could wash away sanitation facilities, spreading wastewater and potentially contaminating groundwater resources. This may lead to increased risk of diseases especially in areas where pit latrines are use.

Many individuals within the LVB depend on aquatic ecosystems for food (meat and fish), building materials (typha and papyrus reeds), and energy (timber and biomass). Changes in rainfall patterns leading to heavy rainfall events, flooding, or droughts could affect water supply, water quality, and availability as well as freshwater ecosystems and their functions. Among the potential effects are the following:

- Species extinction will result in biodiversity loses.
- The resilience of aquatic plants will be reduced in relation to low precipitation rates (in some regions during the long rains) resulting in the disappearance of aquatic habitats, especially during dry months.
- The breeding rates in aquatic populations will be altered, resulting in changed genetic structures in those populations.
- The migratory routes (and timings) of species that use both seasonal wetlands (e.g., migratory birds) and track seasonal changes in vegetation (e.g., herbivores such as hippopotamus) will change, leading to increased human-wildlife conflicts.
- Fish species inhabiting the streams will be severely affected by climate change. Similarly, riverine fish species subjected to climate change and variability tend to react by restricting their range or by colonizing new climatically suitable habitats.
- If a 1°C to 2°C increase occurs, some tropical fish species will be reduced in number or even face extinction.
- Algae will be strongly affected by increased light and temperature after the removal of riparian vegetation, with increased algal biomass and altered community composition.
- Eutrophication due to increased flooding and consequently nutrient inflows from the catchment could lead to further extinctions and increased water hyacinth.
- Deep water oxygen loss (anoxia) in Lake Victoria due to eutrophication has been shown to have facilitated the decimation of demersal haplochromine fish stocks by the Nile perch by elimination of deep water refuge that would have accorded protection for these fishes.
- Wetland vegetation losses result in reduction of "spongy-like" effect of wetlands, an effect that leads to floods, such as those witnessed in Nyando (Kenya).
- Swarming of lake flies and elate termites could increase and become more frequent.

4.3 TERRESTRIAL ECOSYSTEMS, FORESTS, AND WILDLIFE



Map 6: Forest Cover in East Africa

East Africa is losing its forest cover due to the expansion of agricultural land and settlements, forest fires, overgrazing, and illegal timber harvesting. According to analyses of tree loss in the EAC region between 2000 and 2014, it appears that significant deforestation is occurring in all five countries in the LVB (Map 6).

For example, Tanzania is losing 124,949 hectares of forest annually and Uganda and Kenya lose 22,274 hectares and 17,314 hectares respectively. Within the boundaries of the LVB, Burundi and Rwanda have much higher deforestation rates than the other three EAC Partner States. Lower rates of deforestation have been observed in most of the protected areas, but these areas are surrounded by highly degraded areas, including wildlife corridors.

The LVB is renowned for its biodiversity. The Greater Serengeti-Mara Ecosystem (GSME) supports one of the largest animal migrations on earth, including over 1.7 million wildebeest, 260,000 zebras, and 470,000 Thomson's and Grant's gazelles moving south in December and moving north in June–September annually.

Climate change has the potential to affect seasonal changes in vegetation and alter migratory routes (and timings) of species that use seasonal wetlands, such as migratory birds. This may, for instance, increase conflicts between people and large mammals such as elephants, particularly in areas where rainfall is lower. The projected rainfall patterns for the GSME for the long rains under an optimistic future greenhouse gas emission scenario indicate an extension of drier conditions, while the more severe future scenarios predict wetter conditions. The projected rainfall patterns for the GSME for MAM for the RCP 2.6 emission concentration scenario indicate drier conditions, while the RCP 4.5 and RCP 8.5 scenarios indicate wetter conditions.

The impacts of combined drivers, such as human population growth and land use changes, may have more far-reaching impacts on the terrestrial ecosystem than climate change. Wildlife populations in the Serengeti have remained stable for many species, including an increase in the wildebeest population of about 1.3 million animals. However, in the Maasai Mara National Reserve and the adjoining conservancies, the population of almost all wildlife species have declined to a third or less of their former abundance.

The projected impact of climate change on bird species in the LVB indicate high loses in Uganda, except the southeastern section of the country. The Kenyan side of the LVB, Burundi, and Rwanda can expect minimal impacts, while the Tanzania side may experience significant impacts. Montane species, for example, will be forced toward higher elevations, but may not always be able to shift their range upwards.

CRITICAL BIODIVERSITY IN THE LVB

- The Annual Wildebeest Migration from the Serengeti in Tanzania to Maasai Mara in Kenya is one of the greatest natural spectacles in the world.
- Savannahs of the National Park Ruvubu in Burundi represent the last place in in the LVB where there are buffalo, the Cobe waterbuck, the antelope roan, the Cobe redunca, and the red colobus
- Nyungwe Forest National Park includes the largest segment of remaining montane forest in East or Central Africa.
- The Serengeti-Mara ecosystem hosts about 1.3 million migratory wildebeests, more than 200,000 plain zebras, more than 300,000 Thomson gazelles, more than 3,000 elephants, about 3,000 lions, about 9,000 spotted hyenas, and many other antelope and carnivore species.
- Uganda is the host to Nabugabo RAMSAR Site, a wetland of international significance and the Sango Bay wetlands.

4.4 HEALTH, SANITATION, AND HUMAN SETTLEMENTS

The LVB is expected to become warmer and wetter in the short and long rainy seasons, thus providing conducive environments for both vector-borne and diarrheal diseases.

General historical trends for malaria were used to project future vulnerability in the LVB.

- **Burundi:** Trends in malaria cases in Burundi for 1996–2011 show a decline in cases for the over-five population, but an increase for the under-five population.
- **Kenya:** Wide variability will occur in both the incidence and prevalence of malaria cases under the three future emission scenarios. In the worst-case scenario (RCP 8.5), cases will increase. The projections provide evidence of seasonality, cyclical patterns, and strong but temporally varying trends in malaria cases whose nature and details vary for different sites among the three scenarios. Occasional spikes suggest epidemic outbreaks could become the norm.
- **Rwanda:** Rwanda demonstrates how fragile gains in malaria control are, with significant upsurges in malaria incidences recorded for 2012 and 2013 relative to the declining trend characteristic of 2005–2011. This steep upsurge occurred after the widespread distribution of long-lasting insecticidal nets in 2006 and 2009, implicating the role of other factors in malaria transmission.
- **Tanzania:** The scenarios show evidence that prolonged periods of elevated malaria transmission interspersed with periods of low transmission will likely be an enduring feature of the 2030s, 2050s, and 2070s. Malaria trends for 1997–2100 indicate that the average number of malaria cases will remain steady in all age groups, and in the under-five group under all three scenarios. Under the three scenarios, the under-fives are the vulnerable group in Tanzania. Increasing cases of malaria are projected in the over-five population, hence the need for an all-inclusive malaria control strategy.
- **Uganda:** There was a significant regression relationship between reported malaria cases in Uganda and the five-month moving average of the monthly minimum temperature. The scenarios show evidence that protracted periods of elevated malaria transmission, interrupted by periods of low transmission will likely be persistent features of the 2030s, 2050s, and 2070s. The worst-case scenario showed a very steep increase in malaria cases through to the 2030, 2050, and 2070 for those aged five years and above in Uganda, associated with rising minimum temperatures. In the under-five age group, malaria cases will also increase in the future, following anticipated increase in rainfall (Figure 4 and Figure 5).

The projection for RCP 2.6 for 2030 indicates the eastern section of the LVB will be highly vulnerable to malaria. The vulnerability increases into southern Uganda and into Rwanda and Burundi; and in 2070 these areas become highly vulnerable. Similar patterns are exhibited by RCP 4.5, except in 2070 about half of the LVB will be highly vulnerable of malaria. Malaria has been projected to increase in the LVB region in 2070, especially in the highland areas. Under RCP 8.5 for 2030, 2050, and 2070 more than half of the area will be extremely vulnerable.

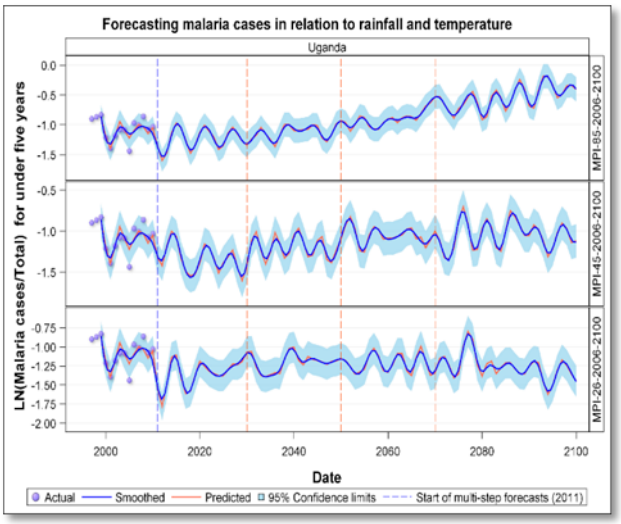


Figure 4: Malaria Projections for Under-Fives (Uganda)

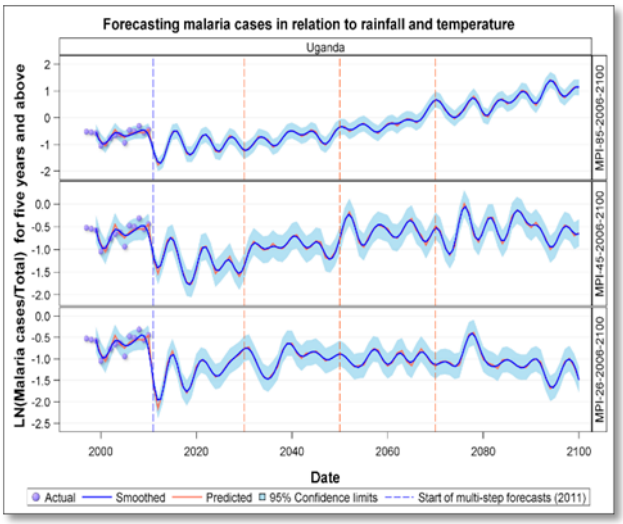
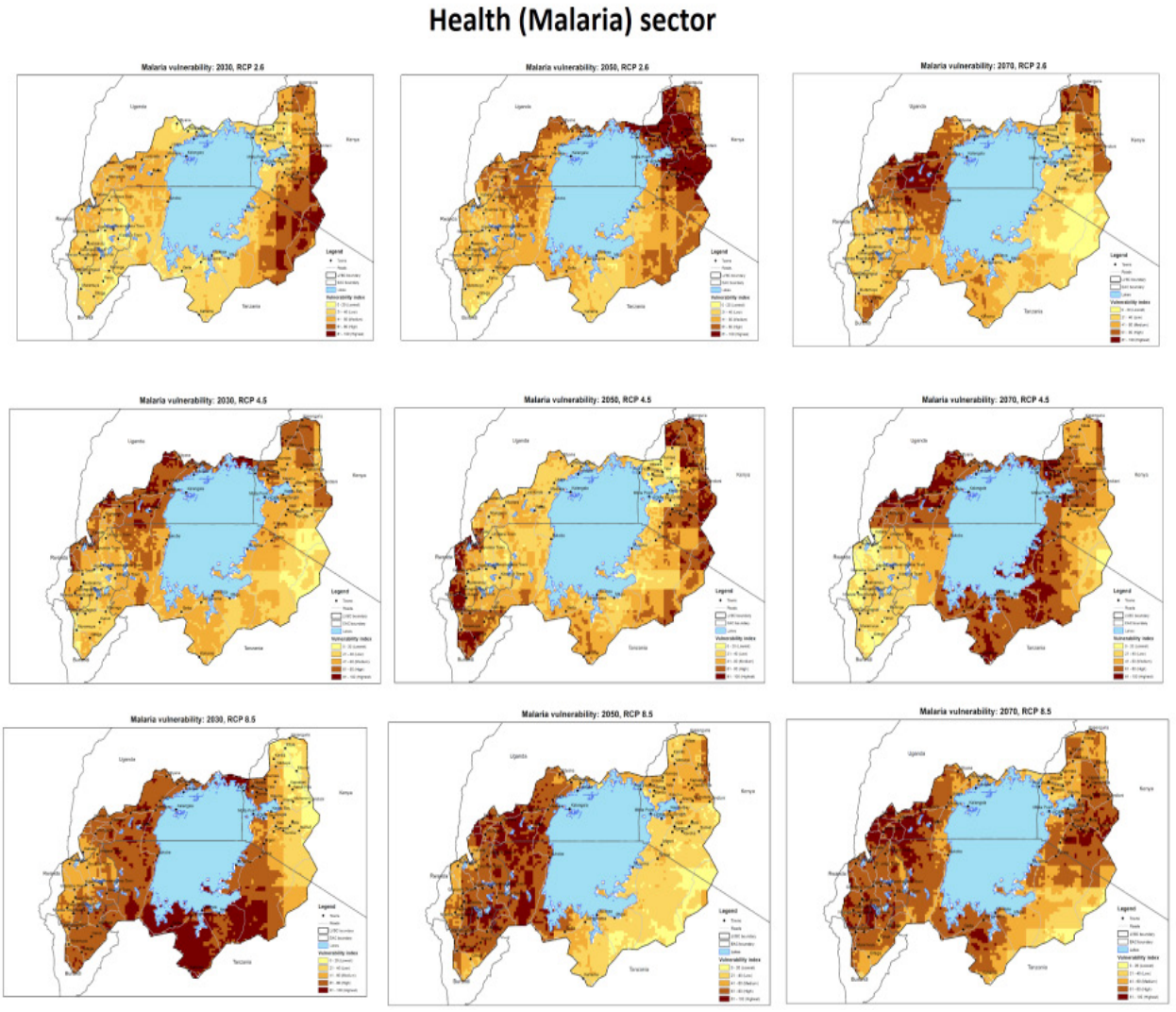


Figure 5: Malaria Projections for Five and Above (Uganda)

With a projected population increase in the highlands, more people will be affected by the disease. Targeted malaria control strategies will be needed to control the impacts of the disease and epidemic outbreaks, especially in areas where the disease is new.

The potential costs of preventing and treating malaria in the LVB will increase due to the expected increase in malaria cases in the future. The following figures demonstrate the challenges facing the five LVB Partner States in the 2050s to address future malaria cases:

- In Kenya, an additional 5.8 million people annually can be expected to be affected. Mortality would increase to about 15,700 people per year (11,400 below the age of 15). Additional hospitalizations (about 36,400 per year for infants) will stretch existing facilities, requiring a 20 percent increase in capacity. The cost of treatment could exceed $86 million annually.
- In Rwanda, an extra 2.5 million people will be affected in the absence of adaptation measures. The additional burden of endemic and epidemic malaria is estimated at between $61 million and $77 million annually.
- Initial estimates for a limited number of health facilities in Tanzania indicate that climate change could lead to additional treatment costs of $20 to $100 million by 2030, and $36 to $150 million a year by 2050.
- In Kabale, Uganda, the cost for treating malaria is estimated to increase from $0.7 million–$15.8 million in 2010 to $1.55 million–$41.7 million in 2050.



Map 7: Malaria hotspots in the Lake Victoria Basin under different future scenarios

4.5 ENERGY AND INFRASTRUCTURE

The LVB has the smallest per capita power generation and electricity access rates on the continent and has lagged in developing a regionally integrated power pool. Apart from developing the energy sector to better meet the power needs, the EAC Partner States should also invest in technologies that will mitigate the effects of climate change. To achieve the EAC vision to provide 90 percent access to electricity by 2050, the Partner States urgently need to build their energy infrastructure and consider the potential effects of climate change and extreme weather events.

Most of the EAC countries rely on hydropower plants (35–90 percent) for electricity generation. Biomass, mostly firewood, is used (80–90 percent) for heating and cooking needs in rural areas and in agro-based industries and charcoal is often used in the urban areas, especially in the LVB. Changes in rainfall and temperature patterns, through their effects on reservoir levels and water flows, will adversely affect electricity generation. Extreme weather events will increase soil erosion and siltation within reservoirs resulting possible equipment damage. In addition, prolonged droughts will affect biomass availability with a decrease in productivity and quality of firewood. Also, indoor pollution will be increased due to use of inferior fuelwood.

VIA analyses were completed for several dams outside of the LVB, but the results can be extrapolated to cases within the basin. Case studies from Tanzania demonstrate the estimated impact of climate change on hydropower. For example, climate change will adversely affect generation by the Kidatu hydropower facility, with a general decline in power generation after 2030 for all three emissions scenarios. Figure 6 shows significant annual variation in future power generation due to changes in precipitation under RCPs 2.6, 4.5, and 8.5. Figure 7 shows that increasing temperatures would significantly decrease power generated at Kidatu, especially under RCPs 4.5 and 8.5.

Analyses of other hydropower facilities in Rwanda and Kenya show similar trends. Projected future increases in temperatures will have significant adverse effects on hydropower production.

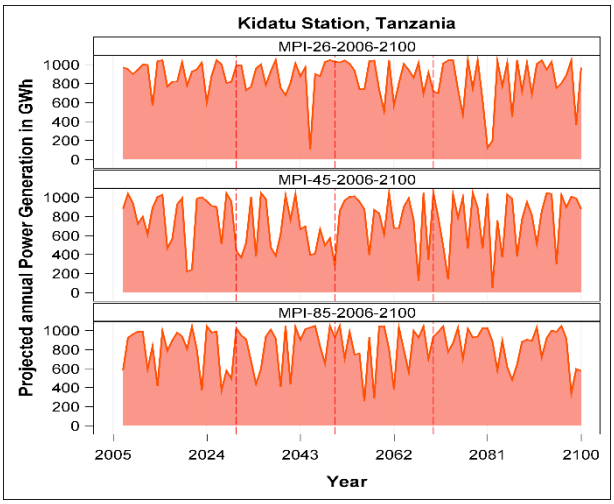


Figure 6: Projected Impact of Future Precipitation on Power Generation-Kidatu Hydropower Plant in Tanzania

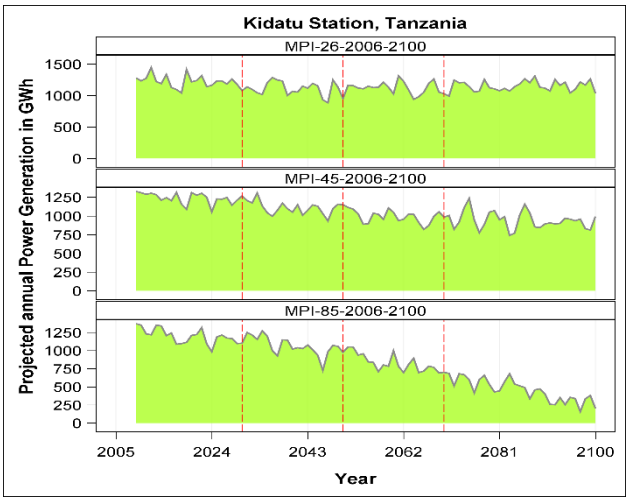


Figure 7: Projected Impact of Future Temperature Changes on Power Generation-Kidatu Hydropower Plant in Tanzania

As demand for charcoal has increased, over-harvesting of existing natural forests has contributed to deforestation and biomass scarcity. The EAC Partner States lose 73,000 to 133,600 hectares per year to deforestation, yet charcoal demand continues to grow. The price of charcoal has almost doubled in the last five years for all the EAC Partner States. Suitable tree species for charcoal are becoming scarce or unavailable, so rural charcoal producers have been forced to use other trees, including mango, cashew, and other fruit trees. In Kenya, for example, reduced rainfall and the slow growth of trees has resulted in the use of fruit and fodder trees for fuel.

Due to climate change and unsustainable management of wood supply resources in the EAC Partner States, forest cover and wood growing stock per unit area has declined both in total standing volume and mean annual increment (MAI) per unit area. For example, in Tanzania the MAI has dropped by an average of 2 cubic meters per hectare per year and the average density per hectare in Tanzania is around 50 cubic meters per hectare. Non-climatic factors that already have led to increased habitat loss and degradation will be compounded by the effects of climate change.

Rwanda, Tanzania, and Uganda have developed Biomass Energy Strategies (BEST) that aim to integrate biomass supply and demand management into long-term development planning. Rwanda is currently updating a BEST first developed in 2009. Uganda developed its BEST in 2013 and its various aspects are currently under implementation. Tanzania developed its BEST in 2014.

The transport sector for the East Africa region can be divided into three broad categories: water transport, surface transport, and air transport. Most of the population relies on surface transport, including road, rail, and pedestrian travel. The EAC has a transport strategy that is the core planning document for guiding regional policies and investments. The East African Railway Master Plan is a proposal for rejuvenating existing railways serving Kenya, Tanzania, and Uganda and extending them initially to Burundi and Rwanda and eventually to South Sudan, Ethiopia, and beyond.

The EAC Climate Change Master Plan acknowledges that adequate and well-maintained infrastructure significantly contributes to economic growth and builds a society's resilience to climate extremes. Transport of hydrocarbons (oil and natural gas) is expected to increase in the region following recent discoveries of deposits. The three major lakes in the region have transboundary transport potential and the region is experiencing growth in air transport. The transport sector and its infrastructure are generally affected by three climatic factors: precipitation, temperature, and wind.

Increased rainfall and storm intensity have impacts through greater water runoff, which may lead to flooding where drainage systems are inadequate. Coastal infrastructure, such as roads and harbor facilities, including docks and bridges, will be exposed to more frequent and permanent flooding resulting from sea level rise and storm surges.

Temperature rise may have negative impacts on the transport sector. The effects of climate change will vary across time and space in the region requiring specificity in addressing these impacts rather than generic solutions. The potential impacts of climate change on the transport sector will also have negative impacts on other sectors of the economy.

Increased precipitation in the future could destroy water transport infrastructure if sewer systems and water treatment plants are overstretched by increased volumes of water. More extreme events, resulting in heavy downpours, could increase the amount of runoff into rivers and lakes, washing sediment, nutrients, pollutants, trash, animal waste, and other materials into water supplies, making them unusable, unsafe, or in need of treatment.

5.0 REGIONAL AND NATIONAL ADAPTATION RESPONSE TO CLIMATE CHANGE

5.1 CURRENT STRATEGIC ACTIONS TO ADDRESS VULNERABILITY

This section addresses the actions that can be taken now to address vulnerability in the five thematic sectors. A wide range of existing actions are already being implemented by key institutions and individuals in the LVB that support adaptive capacity. These existing actions are described below by thematic sector (agriculture and food security, water and aquatic ecosystems, terrestrial ecosystems, energy and infrastructure, and health). Although these actions are helping to mitigate climate risk, significant gaps remain that hold back efforts to adapt to climate change impacts.

Agriculture and Food Security

Agriculture is the main economic activity in the LVB and is mainly rain-fed and therefore susceptible to climate change impacts. The LVB is vulnerable to low agricultural yields that could lead to severe food shortages. The LVBC and EAC Partner States implement a wide range of research and development (R&D), early warning systems (EWS), and diversification of livelihoods and production systems. However, data and information gaps, insufficient funding and investment, inconsistent implementation of policies, and limited institutional capacity hinder efforts in agriculture and food security to effectively adapt to climate change impacts. The table below identifies current actions to address vulnerability, including gaps for crops, livestock, and fisheries.

Agriculture and food security	Current actions to address vulnerability	Gaps
Crops	1. National ministries responsible for agriculture and partners support capacity building, R&D, and extension services. 2. National initiatives exist on disaster risk reduction. 3. National EWS for climate and food security exist in most EAC Partner States. 4. Some livelihoods diversification efforts are taking place in the LVB, including, at the household level, off-farm activities that are reducing the risks of climate change impacts.	1. National budgetary allocations for the agricultural sector are low (below Maputo agreements), particularly for improved services to spur climate-smart agricultural productivity. 2. Comprehensive, timely, and reliable agro-climatic data are lacking to support EWS in LVB regions that are highly vulnerable to climate change. 3. Policies and subsequent implementation are needed to support integrated land and water resources management, particularly in the context of improving agricultural productivity. 4. Institutional capacity gaps within farmer organizations and associations need to be filled and linkages with public-private partnerships to support value-addition and marketing need to be strengthened.

Livestock	1. Households are increasingly diversifying their livestock holdings (shoats, poultry, and piggery). 2. Efforts are under way to improve disease surveillance, monitoring, and control. 3. R&D efforts are supporting more resilient livestock, herd dynamics, and disease control, led by the International Livestock Research Institute (ILRI) and other research institutes.	1. National budgetary allocations for the agricultural sector are low (below CAADP agreements), particularly for improved services to spur climate-smart agricultural productivity. 2. Comprehensive, timely, and reliable agro-climatic data are lacking to support EWS in LVB regions that are highly vulnerable to climate change. 3. Policies and subsequent implementation are needed to support integrated land and water resources management, particularly in the context of improving agricultural productivity. 4. Institutional capacity gaps within farmer organizations and associations need to be filled and linkages with public-private partnerships to support value-addition and marketing need to be strengthened.
Fisheries	1. Diversification in production systems is growing for both aquaculture and caged culture. 2. Enforcement to protect and conserve fisheries in the LVB has been strengthened. 3. R&D efforts are targeting improved fisheries management. 4. Awareness raising campaigns are supporting improved fisheries management.	1. Low investment in the sector by national government and through PPP, for improved fisheries management and marketing (inadequate catch documentation, harvesting, processing, storage, and marketing). 2. Lack of coordinated national/regional policies for better management and use of LVB resources (marine and fisheries around the LVB).

Water and Aquatic Ecosystems

The water and aquatic ecosystems thematic sector has existing actions to address vulnerability that highlight the policy and legal framework to support management and sustainable use of resources in the and governance institutions in the LVB that support transboundary management. However, weak enforcement and implementation of policies, legislation, and management plans; limited availability and access to hydro-meteorological data and information; and insufficient technology and infrastructure to support water resources monitoring, allocation, and storage are hindering efforts to effectively adapt to climate change impacts. The current actions to address vulnerability, along with gaps for the lake ecosystem, river basins, and water availability are described below.

Water & aquatic ecosystems	Current actions to address vulnerability	Gaps
Lake ecosystem	1. A policy and legal framework exist for the conservation and sustainable use of resources in the LVB. 2. Transboundary institutions exist, such as the LVBC, Nile Basin Initiative, and Lake Victoria Fisheries Organization as well as national institutions.	1. Enforcement and implementation of policies and legislation are weak. 2. Monitoring, reporting, and dissemination of key management actions in the LVB are inadequate. 3. Management plans at the catchment level and for resource management are not adequate.
River basins and water availability	1. Policies and legal framework exists to support river basin management. 2. Water harvesting technology and water access infrastructure. 3. EWS.	1. Hydro-meteorological data are inadequate. 2. Accessing hydro-meteorological data is challenging. 3. Technology for measuring and allocating groundwater is limited 4. Water storage facilities are inadequate.

Terrestrial Ecosystems

For the terrestrial ecosystems, existing actions to address vulnerability include an enabling policy and legal and institutional framework for forestry and wildlife management, established protected areas, and site-based practices that support forest management and wildlife conservation and reduce the impacts of climate change on terrestrial ecosystems in the LVB. However, many gaps exist, including inconsistent implementation of policies, limited large-scale and landscape-level adoption of conservation practices, insufficient resources, data gaps across LVB Partner States, among other critical areas. The following table identifies current actions to address vulnerability, along with gaps for forestry and wildlife.

Terrestrial ecosystems	Current actions to address vulnerability	Gaps
Forestry	1. Small-scale agroforestry practices that support sustainable forest management and mitigate climate risks are being adopted. 2. An enabling policy, legal, and institutional framework exists to support forest management. 3. Energy-saving technologies are being introduced and adopted. 4. Participatory forest management has been introduced.	1. Agroforestry practices have not been scaled up to the landscape level. 2. Policies that support forest management have been inadequately implemented. 3. Limited research has been carried out on impacts of climate change on forests. 4. Resources to support forest management are limited. 5. Economic valuation of resources and PES schemes are not widely applied in the LVB. 6. Data, information, and monitoring on forest cover and management are lacking.

Wildlife	1. An enabling policy and legislative framework to support wildlife management exists. 2. Protected areas (national/local/community/private) exist in the LVB to support wildlife conservation. 3. Ex-situ conservation programs are being implemented. 4. A regional wildlife strategy has been developed to support wildlife conservation in the EAC Region and LVB.	1. Private sector interest is limited. 2. Stakeholder engagement/inclusiveness in protected area governance is inadequate. 3. Economic valuation of resources and ecosystem services is needed. 4. Enhanced research on climate change impacts on wildlife is needed. 5. Transboundary collaboration is inadequate.

Energy and Infrastructure

For the energy and infrastructure sector, the Partner States are addressing vulnerability by identifying abundant, potential alternative energy sources and implementing energy efficiency and conservation programs. Key gaps that are hindering capacity to effectively reduce climate change vulnerability on energy and infrastructure include lack of policies that support renewable energy development, limited private sector engagement and financing, and inadequate technology and capacity, among other areas. The current actions to address vulnerability, along with gaps for energy and infrastructure subsectors, including hydropower and biomass, are described below.

Energy and infrastructure	Current actions to address vulnerability	Gaps
Hydropower	1. Power interconnectivity. 2. Existence of national policy, laws, and regulations around hydropower development.	1. A regional renewable energy policy is needed. 2. Funding to support hydroelectric projects is inadequate. 3. Technology use and capacity are insufficient. 4. Private sector involvement is limited, including banking, manufacturing, green bonds (incentive), hedge funds. 5. R&D on hydropower issues are inadequate.
Biomass	1. Energy efficiency and conservation programs exist (e.g., energy efficient stoves, etc.). 2. Alternative energy sources (biogas, briquettes, LPG, etc.) are being explored.	1. A biomass energy policy is needed. 2. Resource assessments are inadequate, which contributes to inadequate planning. 3. Tariffs for renewable energy are uncompetitive.

Health, Sanitation, and Human Settlements

The current actions to address vulnerability in the health sector include policies, legislation, and strategies intended to reduce health risks by improving disaster preparedness and response plans; behavior change campaigns; and support for research institutions. Gaps that need to be addressed to reduce vulnerability of health systems to climate change in the LVB include limited enforcement and compliance of public health policies, inadequate preparedness and response of health systems to climate-induced disease outbreaks, particularly at the national and district level, and insufficient research on the linkages between climate change and health impacts. The table below identifies current actions to address vulnerability, as well as gaps for health subsectors, including sanitation and malaria.

Health sub-sector	Current actions to address vulnerability	Gaps
Sanitation	1. Availability of sewerage lines and sewerage treatment plants in urban areas. 2. Existence of sanitation policies, acts, legislation, and regulations. 3. Existence of disaster preparedness, strategies, and response plans. 4. Awareness and education about best sanitation practices (hand washing, latrines, etc.).	1. Sanitation technology that addresses climate-related impacts, such as flood-resistant latrines and treatment plants, is limited. 2. Enforcement of and compliance with public health polices is inadequate. 3. Preparedness and response to climate-induced disease outbreaks by health systems (national/district) are inadequate.
Malaria	1. Existence of malaria policies, legislation, strategies, programs, etc. 2. Existence of malaria control programs (governmental and nongovernmental). 3. Existence of health infrastructure and workforce. 4. Availability of malaria research institutions (governmental and nongovernmental). 5. Diverse stakeholders involved in malaria research, planning, and interventions. 6. Awareness raising programs.	1. Access to health facilities and malaria medication is inadequate. 2. Support for implementation of good practices of malaria prevention is insufficient. 3. Research is needed on the link between climate change and malaria (how climatic factors affect mosquito populations, mutations, malaria zones, human drug resistance, etc.). 4. Regulations and enforcement of malaria drug prescription and use need to be strengthened.

6.0 LAKE VICTORIA CLIMATE CHANGE ADAPTATION STRATEGY AND ACTION PLAN

The goal of the LVB Climate Change Adaptation Strategy and Action Plan is to address climate uncertainties, variability, and extreme events to improve and sustain the livelihoods and adaptive capacities of vulnerable communities.

The CCASAP takes account of the findings from the VIA-along with the actions already taken to address areas of vulnerability and remaining gaps-to provide a strategy for each thematic area and to identify adaptation options that support improved resilience in the LVB to address current and future vulnerability. For each of the five sectoral themes, the CCASAP includes programmatic adaptation options leading to 2030. In addition, the roles of the EAC, LVBC, and Partner States are identified to support implementation.

6.1 AGRICULTURE AND FOOD SECURITY

ASO1 Strengthen regional and national early warning systems to be more responsive to users' needs

a) **Improve agro-climatic data observation in vulnerable areas within the LVB**. The National Meteorological and Hydrological Service (NMHS) in each of the Partner States and relevant regional institutions (e.g., FEWS NET) can develop and promote products and services to assist national agriculture departments provide bulletins and periodic forecasts, extreme weather alerts, and relevant agricultural production information to agribusinesses, farmers' associations, and farmers. The Kenya Meteorological Department (KMD), for example, has developed a strong working relationship with the State Department of Agriculture with the purpose of producing downscaled forecasts for farmers. In Burundi, there is need to improve on infrastructure, capacity building on agro-climatic data and information, and data sharing within the LVB.

b) **Train national meteorological services and users in the skills necessary to provide required climate products and services.** The EAC, LVBC, and PREPARED Project facilitated a Quality Service Improvement Program (QSIP) with the KMD that has resulted in each unit in the department developing and implementing recommendations to improve their services to address climate information users' needs for relevant products. The LVBC Secretariat will take lead in replicating the QSIP and other tools with other National Meteorological institutions in the Partner States.

c) **Support climate information network platforms and protocols for sharing and exchanging data, products, and information**. The EAC Secretariat is developing an Information and Knowledge Management System (IKMS) and a web-based portal for coordinating and communicating climate change information. This portal will become the "hub" for a regional Climate Change Information Network (CCIN) that will connect service providers (e.g., ICPAC, RCMRD, and NMHSs) with users. The LVBC and EAC secretariats will collaborate to ensure that the CCIN is fully operational and contains relevant information from the region and globally to enhance its operations, including availability of data and climate information for all stakeholders. A robust communication and outreach program to promote the CCIN will also be developed and implemented.

d) **Enhance and strengthen private sector participation in public-private partnerships intended to improve early warning systems and be responsive to users' needs in the region.**

ASO2 Promote climate-smart agriculture and risk management programs

Climate-smart agriculture (CSA) is an approach to developing the technical, policy, and investment conditions to achieve sustainable agricultural development for food security under changing climate conditions. Some of the experiences to be built upon include those of the COMESA-EAC Climate Change Adaptation and Mitigation in Eastern and Southern Africa as well as the PREPARED Project Community Climate Change Adaptation Assessment (C3A2) program in the Partner States. Several community-based adaptation projects introduced CSA technologies and can provide additional lessons and best practices. Among the activities that can be undertaken are the following:

1. **Scale-up weather insurance index for crops and livestock**. The Republic of Kenya and the Republic of Rwanda have piloted crop and livestock insurance programs. Given the recent series of droughts in the region, the historical decreasing rainfall trends across most Partner States, and the conflicts arising over pasture and grazing land, these pilots need to be monitored and evaluated, and best practices identified and promoted across the region. The LVBC Climate Change Unit will develop a library of best practices within the region and globally and develop project concepts for resource mobilization.

2. **Promote small-scale irrigation, water harvesting, and post-harvest management technologies across the entire value chain through PPPs**. As part of a broader CSA approach, the LVBC Secretariat will include the best practices acquired from the Lake Victoria Environmental Management Programme (LVEMP) II and others to prepare a regional approach for small-scale irrigation and water harvesting technologies, as well as post-harvest techniques that can be piloted under their CSA program. One of the first tasks for the LVBC Climate Change Liaison and Coordination Unit (CCLCU) will be to identify and index potential and relevant private sector partners within the region for outreach and communication on shared value in technology development and expansion within the LVB.

Figure 8: Mkombozi cassava variety demonstration farm at Kyankoma Village in Butiama

3. **Promote drought-tolerant and early maturing crops, forage, and livestock breeds through PPPs and seed companies.** International and regional research is focusing on the development and extension of drought-tolerant crops, especially tubers and grains that can supplement maize. LVBC will explore opportunities for piloting popular and appropriate drought-tolerant crops within the CSA program, similar to the successful PREPARED Project pilot in Butiama, Tanzania, that expanded a drought-resistant variety of cassava (***mkombozi***) for six local communities.

4. **Build the evidence base to promote CSA,** including conducting a cost-benefit analysis and participatory evaluation of CSA best practices in the region.

ASO3 Support and strengthen agricultural value chains through PPPs

1. Strengthen farmers, associations, organizations, and cooperatives for collective action in mitigating climate change vulnerabilities.
2. Develop and support management information systems.
3. Develop and support agro-climate advisories and decision support tools for the entire value chain.

ASO4 Harmonize and coordinate climate change initiatives for optimal use of limited resources

The EAC Secretariat has responsibility for coordination, facilitation, and networking for all climate change initiatives and policies across the East Africa region. Its Climate Change Technical Working Group prepared and facilitated the approval of the EAC Climate Change Policy, Climate Change Strategy, and Climate Change Master Plan. The CCTWG is responsible for overseeing and monitoring the implementation of these policies, strategies, and plans. Assisting the CCTWG is the EAC Secretariat's Climate Change Coordination Unit (CCCU), operating within the Directorate for Productive and Social Sectors. The LVBC Secretariat will coordinate closely with the EAC's CCCU and CCTWG to ensure that its appropriate role and responsibilities are clearly outlined and understood relevant to the following key activities under the CCASAP for the LVB:

1. Develop appropriate and relevant platforms for harmonizing and coordinating all climate change initiatives within the basin.

2. Coordinate and harmonize existing climate change policies across the LVB and create awareness within the LVB and the Partner States.
3. Establish an appropriate monitoring and evaluation system to track all climate change initiatives, studies, and R&D within the LVB.

6.2 WATER AND AQUATIC ECOSYSTEMS

Water is one the resources most sensitive to any changes in the climate. Climate change is expected to alter rainfall and temperature patterns and thereby affect the hydrological cycle. 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 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 LVB Partner States unless conservation and management measures are put in place at different levels. The adaptive strategy for the water and aquatic ecosystems sector in the LVB is to **develop and implement programs that take into account collective measures to address climate change impacts and causes in aquatic ecosystems and water resources**.

The key elements of the four recommended adaptation options for the water and aquatic ecosystems sector are as follows:

WSO1 Develop and implement community-based climate change resilience programs on water catchment management

Consistent with the LVBC Strategy (2016–2021), and supportive of improving and expanding climate-centered IWRM programming, the LVBC Secretariat will focus its efforts on two adaptation options.

a) **Develop and implement climate change–resilient catchment management plans and promote Transboundary Water Resource User Associations (TWRUAs).** The LVBC Secretariat has actively supported the development and coordination of Water User Associations (WUAs) in Tanzania and Water Resource Users Associations (WRUAs) in Kenya under previous USAID programs in the transboundary Mara River Basin. In addition, a Transboundary Water Resource Users Forum in Mulot, Kenya, is organized to provide coordination and support to WRUAs and WUAs in water catchment management at the sub-basin level. The LVBC Secretariat assisted the Republic of Kenya and the United Republic of Tanzania to sign a memorandum of understanding (MoU) to jointly manage the Mara River Basin.

Currently, the PREPARED Project, WWF, the Dutch-funded MaMaSe Project, and GIZ–NELSAP are partnering to complete a transboundary Water Allocation Plan (WAP) for the entire Mara River Basin. In addition, further USAID support through its SERVIR program, managed by the RCMRD, will be assisting the Mara River Basin Joint Steering Committee (JSC) and the Joint Technical Committee to apply a climate lens to determine potential future impacts on water availability within the basin.

b) **Promote cross-border experience sharing.** The LVBC Secretariat, as interim secretariat to the Mara River Basin JSC, will coordinate all the activities above and capture the best practices for further replication at the sub-basin level and for expansion into other transboundary basins within the LVB. These include Rweru-Bugesera Ecosystem, Kagera, Minziro–Sango Bay, Lake Chala–Jipe Ecosystem, and Umba River Transboundary Ecosystem. Additionally, the Secretariat will identify and use regional and global forums to promote, communicate, and expand these best practices for the benefit of EAC Partner States.

WSO2 Develop a decision support system that integrates climate change and IWRM information

a) **Improve the availability and dissemination of climate change and IWRM information in the LVB.** As indicated in the Agriculture and Food Security Adaptation Program above, the EAC Secretariat will coordinate and facilitate the EAC CCIN at the Secretariat in Arusha. The CCIN will provide access to climate information on a wide array of sector technical areas, including information relevant to climate change and IWRM. Practitioners, decision makers, researchers, and policy advisors will all have access to climate change and IWRM information through the CCIN portal.

b) **Develop a comprehensive hydro-meteorological network for monitoring in the LVB.** The LVBC plans to develop a decision support system (DSS) consistent with the Mike Basin DSS of Nile Basin Initiative. Under this strategy, hydro-meteorological data will be integrated into the LVBC DSS.

c) **Develop best practices on water allocation plans that takes account of climate change and can be scaled up to other sub-basins within the LVB.**

WSO3 Enhance development and uptake of technological innovations for water resources harvesting, storage, processing, and use

Consistent with the LVBC Strategy (2016–2021), the CCASAP will mainstream climate change into water resources management. This will be done through the following actions:

a) **Promote, develop, and implement water harvesting and storage facilities (e.g., dams and water pans).**

b) **Promote groundwater assessment and management technologies to improve aquifer recharge.**

c) **Promote cleaner production technologies that improve water quality and efficiency. Design of these water harvesting approaches and facilities will integrate future climate change projections to ensure adequate location and capacity of facilities.**

WSO4 Develop a sustainable funding mechanisms and regional policy frameworks that support water security

a) **Finalize an LVBC Resource Mobilization Plan.**

b) **Harmonize regional policy frameworks on water security that mainstream climate change.**

6.3 TERRESTRIAL ECOSYSTEMS

Key elements of the four recommended adaptation options for terrestrial ecosystems are as follows:

TSO1 Apply climate lens across key transboundary ecosystems, especially biologically significant areas such as Mara–Serengeti, Mount Elgon, Sango Bay–Minziro, Nyungwe–Kibira, and Greater Virunga

a) **Develop and implement transboundary collaboration mechanisms and frameworks in the Mara–Serengeti, Mount Elgon, Sango Bay–Minziro, Nyungwe–Kibira, and Greater Virunga.** The LVBC Secretariat has been facilitating several transboundary agreements, including already signed MoUs in Chala–Jipe, the Mara River Basin, and Nyungwe–Kibera Landscape (NKL). The LVBC Secretariat plans to use the format and content of the Mara River Basin and Chala–Jipe MoUs to make other MoUs within the region. The LVBC Secretariat will continue to identify opportunities, such as the Sango Bay–Minziro transboundary ecosystem, to continue facilitating transboundary agreements for joint ecosystem management. Additionally, as is being done in the Mara River Basin, LVBC will identify opportunities to partner with key regional organizations, such as RCMRD, to develop and apply a climate change lens to these transboundary landscapes. LVBC will develop standardized guidelines to promote transboundary ecosystem management. LVBC will also develop and pilot technical methodologies for integrating climate change into transboundary ecosystem management.

b) **Establish EAC and LVB regional climate change monitoring programs.** The LVBC Secretariat, in establishing the Climate Change Liaison and Coordination Unit, will coordinate with the EAC CCCU in the development of methodologies for monitoring climate change activities across key biologically significant areas (BSAs) within the region and the LVB. Establishing monitoring systems will be done in close collaboration and partnership with regional and national climate information service providers, such as ICPAC, RCMRD, and the respective NMHS in each of the Partner States.

c) **Identify and pilot best practices in climate change adaptation in terrestrial ecosystems in the LVB**. The Climate Change Liaison and Coordination Unit will be responsible for developing best

practices in collaboration with the EAC CCCU IKMS. Based upon best practices, the LVBC Secretariat will develop and pilot adaptation approaches across key transboundary terrestrial ecosystems during the life of the CCASAP.

TSO2 Provide analysis of options for mitigation and adaptation for various governments in the LVB (national and regional), private sector, and local communities

a) **Undertake specific VIA assessments and detailed sector analyses based on future scenarios.** Under the guidance of the EAC, CCTWG, and LVBC, the PREPARED Project conducted a comprehensive VIA for the LVB. The VIA results were used to develop the adaptation components and activities listed in this CCASAP. The CCASAP, when implemented, will be monitored by the LVBC Secretariat and subsequent VIA's will be planned in accordance with IPCC guidelines and Partner States' needs. The LVBC Secretariat will mobilize funds for any future VIAs at regional and/or national levels.

b) **Undertake economic studies and valuation of various options for adaptation and mitigation for selection of interventions and programs.** The implementation of the CCASAP requires the development of a National Adaptation Strategy and Action Plan (NASAP) based upon the activities within the CCASAP. Each NASAP will require an economic analysis of proposed actions, with budgets and financial rationale for implementing actions. The LVBC Secretariat will develop an approach for evaluating the cost-effectiveness and viability of each proposed action as a "no regret" or "limited regret" activity before funding is sourced or committed. LVBC Secretariat will engage a consultant to develop and institutionalize an economic valuation process for evaluating the financial viability of proposed actions under this CCASAP and each NASAP.

c) **EAC and LVBC to lead mobilization of resources to support adaptation and mitigation.** Proposed resource mobilization by the LVBC Secretariat is discussed in more detail in Section 7.2.

d) **Promote public-private partnerships in support of climate change adaptation and mitigation interventions.** PPPs are an important aspect of the CCASAP implementation.

TSO3 Prepare a regional approach in the LVB to address community-based climate change impacts on wildlife, forests, and tourism

a) **Promote incentives through payment for ecosystem services (PES, 'polluter pays') for protection, conservation, or management of terrestrial ecosystems (forests, wetlands, wildlife) in the LVB.** With support from the PREPARED Project, a Total Economic Valuation (TEV) and Conservation Investment Plan (CIP) were developed for each of the following BSAs within the LVB: Nabugabo (Uganda), Mara Wetlands (Tanzania), Minziro National Forest (Tanzania), Sango Bay (Uganda), and Nyungwe National Park (Rwanda). Also, a TEV has been completed for Nyungwe and a CIP for Nyungwe–Kibira is being developed for completion in 2018. In addition, the LVBC Secretariat developed draft guidelines for PES and a consultant for the PREPARED Project has applied PES guidelines to the Mara River Basin to determine opportunities for applying PES within a WAP that will be developed. For three of these BSAs-Nabugabo, Nyungwe, and Mara Wetlands—a climate lens has been applied and integrated within the existing management plans. These best practices will be consolidated under the LVBC's programs and disseminated to appropriate institutions within the Partner States through training and technical support. In addition, to supporting the CIP, the EAC/LVBC will mobilize resources through a series of investment forums.

b) **Build community resilience through diversification into tourism and provision of other ecosystem services and integrate community programs with other key sectors, such as water, health, agriculture, and energy.** The LVBC will apply the C3A2 and community-based adaptation planning approaches to develop programs addressing water, wildlife, and habitat conflicts within key BSAs.

TSO4 Develop a climate change information hub in the LVB and EAC region

a) **EAC to support ICPAC and Partner States to develop tools on climate projection information, such as GeoCLIM.** Both the EAC CCCU and the LVBC CCLCU have roles in developing and promoting simple and effective tools for identifying climate risks, hazards, and extreme events. Suites of tools (e.g., GeoCLIM, GeoMOD, CORDEX 10 RCM, and Vulnerability Index Mapping)

have been developed by ICPAC, FEWS NET/USGS, and RCMRD. NMHSs from the Partner States have also been piloting other tools for gridding datasets and downscaling seasonal forecasts. LVBC's role is to promote and extend the best practices within the Partner States with key decision makers from all sectors, but most especially with respect to determining the impact of climate change on key natural resources within important transboundary landscapes. The CCLCU, in collaboration with the EAC CCCU, will lead this effort under the CCASAP.

b) **EAC to support Partner States to develop policies that enable easy access to data.** The EAC CCCU will continue to finalize the proposed regional climate data sharing protocol and ensure it is adopted by the EAC ENR SECOM.

c) **EAC and LVBC to support Partner States in capacity building and institutional development.** Through the regional CCIN being developed by the EAC with support from the PREPARED Project, the EAC CCCU and the LVBC CCLCU will identify the climate change adaptation needs of the Partner States. This will be correlated with those needs identified by the Partner States in each INDC, NAPA, or Adaptation Action Plan and used to prepare a capacity development plan.

6.4 ENERGY AND INFRASTRUCTURE

The adaptive strategy for the energy and infrastructure sector in the LVB is to **establish an enabling environment and strategy that supports the development of alternative energy programs that strengthen capacities, research, investment, and standards to make the LVB energy-secure in the context of a changing climate.**

Key elements of the four recommended adaptation options for energy and infrastructure are described below:

ESO1 Develop, promote, and use renewable energy in the LVB (*develop an all-encompassing Specific, Measurable, Achievable, Relevant, and Time-Bound (SMART) regional renewable energy policy that reviews and harmonizes existing strategies that support participation of the private sector and NGOs*)

a) Reform policies and institutions-review national policies and strategies and regional renewable energy policy instruments and create incentives for an environment conducive to strengthening private sector and NGO participation.

b) Enhance capacity building activities and technology transfer to support renewable energy development.

ESO2 Research and invest in alternative energy, including the establishment of regional standards and setting up an internationally accredited energy laboratory

a) Support existing energy labs and establish linkages with identified international and regional research institutions and universities.

b) Review and harmonize national energy standards to support development of regional standards.

ESO3 Develop incentives and a funding framework for regional energy project incubation and start-ups

a) Build the capacity of decision makers (treasury and energy ministries) on incentive mechanisms, such as green bonds and tax holidays.

b) Support the existing incubation and innovation centers for renewable energy start-ups, e.g., the one at Makerere University.

ESO4 Develop community-based biomass reduction and efficient best practice models for the region

a) Conduct a national biomass resource assessment in the LVB.

b) Review co-management forest policies and practices to document best practice models in the region.

c) Promote best practices in the region.

d) Conduct capacity building programs in the region with a focus on gender and youth dimensions and mobilize funds for implementation.

6.5 HEALTH

The adaptive strategy for the health sector in the LVB is to **develop and implement programs that strengthen the resilience of health systems and communities to adapt to climate change vulnerabilities; enhance access to quality health services; improve research to support evidence-based decision making; and promote inter-sectoral collaboration.**

Key elements of the five recommended adaptation options for the health sector are as follows:

HSO1 Build the capacity of the health workforce on climate change preparedness and response

The LVBC Secretariat established and strengthened national population, health, and environment (PHE) networks and developed and rallied stakeholders around a PHE minimum package of services, built the capacity of communities to champion PHE through training, setting up model households and established PHE learning/ resource centers; establishing local institutional frameworks and capacity development to address issues of reproductive health, family planning, safe motherhood, and child survival. All these institutional frameworks and networks will be used to support the following three activity clusters:

a) **Conduct climate change and health capacity needs assessments of healthcare workforce in the LVB.** The LVBC will coordinate this activity through the respective Partner States health ministries and in coordination with the PHE program. Consultant services will be employed to conduct the needs assessments, including training recommendations for integrating climate change adaptation and health.

b) **Develop a capacity building framework and training guidelines on climate change and health-related issues.** Based upon the needs assessment recommendations, the LVBC Secretariat will prepare a capacity building framework, training curricula, and training materials for implementation by Partner States.

c) **Conduct training programs for health workforce on climate change and health awareness and preparedness and response.** The LVBC Secretariat will be responsible for mobilizing resources to assist Partner States to implement training programs for integrating climate change into health early warning and response programs.

HSO2 Strengthen and institutionalize surveillance, early warning, and communication systems on climate-sensitive diseases

a) **Establish a regional platform for data, information, and knowledge sharing on climate change and health in the LVB.** The EAC CCCU is hosting a IKMS portal that provides links and information about climate change adaptation related to the five thematic sectors. Therefore, the IKMS will be periodically updated with recent and relevant information on climate change and health. The Climate Change Liaison and Coordination Unit will ensure that health sector information, acquired from PHE and other sources, will be updated and the most recent within the EAC IKMS portal. The CCLCU will also assist the CCCU in publicizing and disseminating updates and links to key decision makers within the Partner States.

b) **Improve Integrated Disease Surveillance (IDSR) systems by integrating climate information.** Within the LVBC, the CCLCU will lead efforts to build regional and national capacity to link climate information to the IDSR. An effective, functional IDSR includes case detection, confirmation and registration, reporting, data analysis and interpretation, outbreak investigation, dissemination, and feedback and response. The results of correlating climate information, such as historical rainfall and temperature trends, with key infectious diseases, such as malaria, cholera, or meningitis, can provide predictive characteristics, based upon seasonal climate forecasts, for potential outbreaks of specific diseases that require rapid response. The LVBC's CCLCU will coordinate this effort, using its resources under PHE programming.

c) **Develop and disseminate information, education, and communication materials on climate change and health at all levels in the LVB.** The LVBC Secretariat will identify existing or potential resources to develop and disseminate critical information, such as potential seasonal disease outbreaks and epidemics, through appropriate channels, such as national health ministries. Initially, the Secretariat will use malaria and cholera vulnerability maps produced during the VIA to identify target areas.

d) **Implement programs that use identified climate-appropriate technologies and approaches to support improved climate resilience for health at the community level in the LVB**. Based upon availability of PHE and other sources of funding, the LVBC Secretariat will facilitate an LVB-based program on climate and health. Lessons from the PREPARED C3A2 approach will be applied to a pilot roll-out of community-based climate and health programs under PHE.

HSO3 Strengthen research and interventions (prevention, preparedness, response) that address climate-sensitive sanitation and diseases

The three proposed actions under this adaptation strategy build toward the development of a robust research program within the LVB to identify, prioritize, and assess the interaction and correlation of climate change on health and key disease vectors.

a) **Identify and prioritize key research areas in climate and health in the LVB at the regional, national, and sub-national levels.** The LVBC Secretariat will conduct a needs assessment to identify and prioritize research topics and areas of concentration within the LVB. The Secretariat will prepare a concise research strategy that focuses on the priority research necessary to be conducted within the LVB, based upon national and regional needs.

b) **Mobilize resources for research on interventions that address climate-sensitive sanitation and diseases (public, private, donor, and global funds).** LVBC will market the research strategy with relevant donors and the private sector toward funding a small-grants research program. LVBC will consider all sources of funding, including applying for program funding through the Green Climate Fund or the Adaptation Fund.

c) **Conduct research in prioritized research areas in climate and health in the LVB and use findings to inform decision making and programming.** Based upon funds available, the LVBC intends to initially fund 2–3 research proposals annually.

HSO4 Use climate-appropriate technologies for health and sanitation infrastructure

a) **Identify and invest in climate-appropriate technologies and approaches for health and sanitation infrastructure in the LVB.** The LVBC-coordinated LVEMP II and LVWATSAN programs will be completed by December 2017. LVBC is in discussion with the program donors for follow-on programs, building upon the successes under the current phases. Proposals to the African Development Bank and World Bank will include proposed components that identify best practices for climate-smart infrastructure design and construction. Assuming funding availability, the follow-on activities will be included for implementation in LVEMP Phase III or LVWATSAN Phase II.

b) **Assess key health and sanitation infrastructure in the LVB to determine its ability to withstand climate-related shocks and stresses and take appropriate action**. The LVBC will hire consultants to complete this assessment.

HSO5 Improve maritime security and safety

a) **Establish and improve regional early warning monitoring and surveillance systems**. The LVBC, through Multinational Lake Victoria Maritime Communications and Transport Project (MNLVMCT), will establish three Maritime Rescue Coordination centers in the LVB with the capability to monitor early warning, surveillance systems and weather alerts for Lake Victoria. This project's component will include weather forecasts and value-added services with installation of a weather data collection system and information dissemination channels. The project's weather forecast activities will build on the existing national meteorological facilities, including the airport safeguard systems at Entebbe, Mwanza, Bukoba, and Kisumu.

b) **Improve search and rescue capability.** The LVBC will establish, equip, and strengthen the emergency search and rescue capability in Lake Victoria. The MNLVMCT project will establish 22 emergency search and rescue stations distributed around the lake, equipped with fast rescue boats and trained crews. Three additional boats to be stationed at the main station will have larger capacity and first aid facilities to provide emergency medical services to victims rescued during search and rescue operations.

c) **Establish and implement maritime response communications network and centers.** The LVBC will establish Regional Maritime Rescue Communication Centre (MRCC) in Mwanza, Tanzania, and two other regional sub-centers in Kisumu (Kenya) and Entebbe (Uganda) capable of receiving and responding to distress calls, locating victims, mobilizing, controlling, and coordinating rescue missions by rescue boats in the Lake Victoria. The implementation of MRCC and network development for the Maritime Communication Network will extend the range of the current Global System for Mobile communications around Lake Victoria to its technical maximum, using the extended range features.

7.0 IMPLEMENTATION PLAN FOR THE LAKE VICTORIA BASIN CLIMATE CHANGE ACTION PLAN

This strategy has been developed to enhance climate resilience in the LVB and reduce the vulnerability of natural and social systems to climate change. The adaptation options identified in the strategy will need to be implemented through coordination and using a management structure that will enhance synergies and minimize duplication of effort. The implementation modality will focus on governance and management, resource mobilization mechanisms, capacity building, monitoring and evaluation frameworks, stakeholder engagement mechanisms, and communication and outreach programs.

7.1 INSTITUTIONAL COORDINATION

The EAC Climate Change Policy highlights the prevailing uncoordinated approach by stakeholders in implementing climate change–related initiatives at the Partner State and regional levels, and the need for a defined coordination and management structure to enhance synergies and minimize duplication of effort. The policy directs that the institutional framework for implementing the policy shall include the EAC Secretariat working jointly with relevant government agencies in Partner States; EAC organs and institutions, including the LVBC; Lake Victoria Fisheries Organization (LVFO); Inter-University Council of East Africa; and any other institutions that may be established by relevant Sectoral and Coordination Committees. This will facilitate the creation of institutional arrangements at the EAC level with clear linkages to institutions at the Partner States, EAC organs, and institutions. A similar working relationship with regional and international entities will also be established. The policy further directs that the coordinating institution shall be vested with the following mandates:

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

The Climate Change Coordination Unit (CCCU) was established at the EAC Secretariat, as a specialized technical unit dealing with climate change under the Department of Environment and Natural Resources. The establishment of the CCCU was based off the EAC Heads of State Summit Declaration signed on April 19, 2011, calling for the creation of an institution to coordinate climate change actions. The CCCU is charged with coordinating the implementation of the EAC Protocol on Environment and Natural Resources Management, including climate change, in accordance with Article 24 of the Protocol. The unit may evolve with time and report directly to the Directorate of Productive and Social Sectors under the Office of the Deputy Secretary General for Productive and Social Sectors (DSG-PSS). This will ensure effective mainstreaming of climate change within the EAC to facilitate coordination across different EAC directorates, organs, and specialized institutions.

Once the CCCU exists in LVBC institutional arrangements, it will need to be strengthened by establishing proper mandates, including all aspect of climate change. Moreover, the CCCLU needs to be established in all the Partner States.

7.2 RESOURCE MOBILIZATION

The current LVB CCASAP has been aligned to the LVBC Strategic Plan (2016–2021) that was approved by the LVBC Sectoral Council of Ministers in June 2017. Upon approval, the SECOM directed the LVBC Secretariat to mobilize resources for implementation of the strategy, starting with the development of a Resource Mobilization Strategy, which is in progress.

The Resource Mobilization Strategy proposes actions that aim, among others, to diversity funding sources, build internal capacity for resource mobilization, and ensure funding sustainability.

Some of the foreseen resource mobilization initiatives include[3]:

a) Develop capacity in the LVBC and Partner States to be accredited to access global funds. Specifically, the LVBC will pursue opportunities to become a regional implementing entity of the Adaptation Fund, which finances adaptation projects and programs in EAC Partner States who are parties to the Kyoto Protocol. In addition, the LVBC Secretariat will apply to become a Global Environment Facility (GEF) implementation agency. GEF is the financial mechanism of the United Nations Framework Convention on Climate Change (UNFCCC), the Special Climate Change Fund, and the Least Developed Countries Fund, and manages the GEF Trust Fund.

b) Explore other partnerships, including the European Commission's Global Climate Change Alliance and World Bank–administered climate investment funds. The LVBC also recognizes the trend in the private sector to finance investment in response to climate change and will explore strategic partnerships with the private sector, including corporations.

c) Establish the Climate Change Adaptation and Mitigation Fund under the Environmental Trust Fund. Several resource mobilization events will be organized, such as the strategic dialogue forum and donor roundtable, to invite resource partners to support LVBC initiatives, including as long-term partners in a thematic group of interest within the Environmental Trust Fund.

Overall, the LVBC Secretariat acknowledges that resource mobilization is a collective effort and it will explore all avenues for coordinating with the EAC Secretariat and Partner States in resource mobilization initiatives. This will be done through information sharing, capacity building initiatives, contributing to projects concepts and proposals, participation in EAC-initiated Regional Resource Mobilization Committee, and so on.

7.3 CAPACITY BUILDING

Implementing CCASAP interventions requires knowledge, skills, expertise, and cooperation among different sectors to effectively counter the challenges posed by climate change and to explore opportunities associated with it. Hence the need for climate change capacity building and training that targets LVBC staff and government staff, with a focus on integrating climate change risks and opportunities into projects and programs for climate-resilient development. Other stakeholders, such as researchers, who are the primary custodians of current scientific climate change knowledge, and the private sector also need to be engaged. The need to equip the young generation with climate change knowledge and skills necessary for adaptation and mitigation is also crucial. The CCASAP focuses on capacity of the institutions in the LVB, primarily academic, research, governmental, and nongovernmental, to competently handle various aspects of climate change. Specific interventions address:

a) LVBC capacity to address climate change-related challenges: Providing advisory services on how to mainstream climate change considerations into development decision making, including for the achievement of the Paris Agreement targets and United Nations Sustainable Development Goals in the LVB; strengthening vulnerability analysis and food security monitoring capacity; helping to plan capacity development initiatives to reduce risk and prepare and recover from disasters such as diseases, floods, drought, and famine.

b) Capacity in finance/mitigation: Assisting the LVB region to improve its level of participation in the Clean Development Mechanism; building the foundation for pro-poor ecosystem service markets to achieve impacts of scale in the lake.

c) Capacity in technology transfer: Supporting education, training, information exchange, best practices, and regional strategy initiatives related to the development and application of renewable energy adapted to local needs, as well as facilitating access to state-of-the-art technologies; creation of regional networks of climate change focal points to promote exchange of experience and knowledge on technology transformation; training programs and capacity building in the use of information systems and practical mechanisms for technology transfer; regional capacity building seminars/workshops to assist Partner States in implementing new standards aiming at the reduction of greenhouse gas emissions on the LVB.

3 For details on planned resource mobilization initiatives, refer to the LVBC Resource Mobilization Strategy (2018–2021).

d) **Capacity in Reducing Emissions from Deforestation and forest Degradation (REDD):** Conduct education and awareness campaigns on reducing deforestation in the LVB through improved governance, local socioeconomic development, and sustainable management of forest resources and wooded areas.

7.4 MONITORING, EVALUATION, AND REPORTING

The LVBC shall be responsible for tracking, coordinating, and overseeing the implementation of this strategic plan in collaboration with the Partner States. The LVBC Secretariat will develop a robust monitoring and evaluation framework with clear milestones and indicators for the efficient implementation of the regional climate change programs and projects as prioritized by the Climate Change Policy and Strategy. Monitoring and evaluation of national climate change projects will be the responsibility of the Partner States. The monitoring plan will ensure collection of information for use by coordinating institutions and key stakeholders to measure progress of implementation of the activities and facilitate timely decision making.

7.5 ENGAGING STAKEHOLDERS

A participatory and consultative approach will be used to engage all stakeholders in the EAC Partner States. Workshops and forums to engage stakeholders will be held within each thematic area to identify the most important issues related to climate change impact, as well as adaptation and mitigation measures. The stakeholders' engagement will also facilitate on the additional VIAs to be conducted during implementation of the CCASAP. Throughout the implementation of the CCASAP, various stakeholders, including governmental departments and allied institutions, the private sector, donor agencies, and observers, are to be involved for sustainability of the planned and ongoing interventions. The LVBC will need to inventory all relevant stakeholders in the LVB region and develop a stakeholder engagement plan to be implemented by all stakeholders in the EAC Partner States.

7.6 COMMUNICATION AND OUTREACH

Access to climate change information and technology is a key element in an effective response to climate change. Learning and research institutions are important in developing climate change knowledge and in the preparation and presentation of climate change information in a way that benefits local communities, Partner States, and the region.

The EAC has already established the Inter-University Council for East Africa, an autonomous institution of the EAC. The mission of the Council 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.

In addition, individual Partner States of the EAC have well-established research bodies and industrial development institutes. Some of these institutions offer courses on climate change integrated in 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.

The realization of the goal and objectives of this strategy will depend on effective communication among coordinating partners and implementing agencies/institutions as well as the ultimate beneficiaries of the desired change(s). Sustainable adaptation of better attitudes, practices/behaviors, action plans, and policies can be triggered by well thought-out communication approaches and strategies at all levels-bottom up, (community), national, and regional. The coordinating unit of the communication and outreach strategy will be at regional level and the implementation at national and community levels. Since each level has a unique operating context, context-informed communication and outreach strategies shall be developed. An elaborated audience analysis and communication SWOT (strengths, weaknesses, opportunities, and threats) analysis will be required. This process shall lead to developing SMART communication objectives and strategies responsive to existing needs at earlier stated levels.

7.7 QUICK START OPPORTUNITIES AND NEXT STEPS

Present the LVB CCASAP to the 5th Sectoral Council of Environment and Natural Resources

The LVB CCASAP document will be validated by Partner States and submitted to the 5th Sectoral Council on Environment and Natural Resources Management for consideration.

Donor/investment forum for resource mobilization

The EAC Secretariat and LVBC, in collaboration with partners under PREPARED Program, are organizing a Donors Roundtable and Learning Event in February 2018. The goal of the event is to share achievements, lesson, and success stories emanating from the implementation of the PREPARED Program. The goal of the donor roundtable is to mobilize resource to implement EAC priority climate change, biodiversity, and water, sanitation, and hygiene programs.

7.8 IMPLEMENTATION PLAN AND BUDGET

The LVB implementation plan and budget was developed based on the five thematic sectors identified by a regional stakeholders meeting. The sectors are:

- Agriculture, food security, livestock, and fisheries
- Water and aquatic ecosystems
- Terrestrial ecosystems, forestry, wildlife, and tourism
- Energy and infrastructure
- Health and human settlements.

The stakeholders further identified key strategic areas for each sector that are detailed in the matrix at the end of this section.

Financial estimates for the implementation of the LVB Strategic Plan are based on experience in the region on finances for ongoing projects and programs of the EAC Secretariat, LVBC, and Partner States.

The proposed financing covers the first five years of implementation and provides an indicative action plan. The action plan for the implementation of the policy is presented jointly with the financial plan for the five-year period.

The estimated total financial requirement to implement the LVB Climate Change Strategy is US$100,000,000. Figure 9 shows the detailed allocation for each sector.

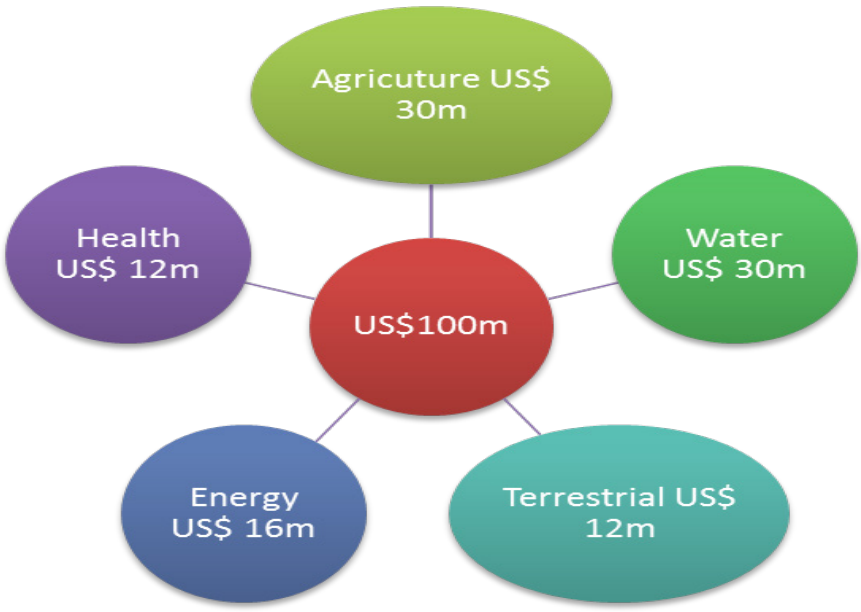


Figure 9: Budget Allocation by Sector

The development of the implementation plan was based on the assumptions detailed in the table below.

Year	Percentage distribution allocated funds per year	Assumptions
1	10%	System, modalities, operational teams being established, project development period
2	40%	Major investment in procuring equipment, etc.
3	30%	Projects running
4	10%	Normal operational cost
5	10%	Normal operational cost + sustainability period

Implementation Plan and Budget

Sector	Strategic objectives & supporting activities		Cost Yr 1 (USD)	Cost Yr 2 (USD)	Cost Yr 3 (USD)	Cost Yr 4 (USD)	Cost Yr 5 (USD)	Total estimated cost (USD)
Agriculture and food security	**ASO1**	**Strengthen regional and national early warning systems to be more responsive to users' needs**						
	1.1	Improve agro-climatic data observation in vulnerable areas within the LVB	100,000	400,000	300,000	100,000	100,000	1,000,000
	1.2	Strengthen the capacity and collaborative mechanisms of regional climate-related service providers and national meteorological services and users in the skills necessary to provide required climate products and services	100,000	400,000	300,000	100,000	100,000	1,000,000
	1.3	Support climate information network platforms and protocols for sharing and exchanging data, products and information	100,000	400,000	300,000	100,000	100,000	1,000,000
	1.4	Develop and expand R&D and scientific studies (e.g. agriculture, water resources)	100,000	400,000	300,000	100,000	100,000	1,000,000
	1.5	Enhance and strengthen private sector participation in PPPs to improve EWS in the region and be responsive to users' need.	100,000	400,000	300,000	100,000	100,000	1,000,000
	Total ASO1 cost		500,000	2,000,000	1,500,000	500,000	500,000	5,000,000
	ASO2	**Promote climate-smart agriculture approach and risk management programs**						
	2.1	Promote, extend, and sustain integrated weather-based insurance for crops and livestock (e.g. policy development, pilot activities, etc.)	71,428	285,714	214,286	71,428	71,428	714,284
	2.2	Promote small-scale irrigation, water harvesting technologies, and	71,428	285,714	214,286	71,428	71,429	714,285

Sector	Strategic objectives & supporting activities		Cost Yr 1 (USD)	Cost Yr 2 (USD)	Cost Yr 3 (USD)	Cost Yr 4 (USD)	Cost Yr 5 (USD)	Total estimated cost (USD)
		post-harvest management technologies across the entire value chain through PPPs						
	2.3	Develop and promote conservation and sustainable agriculture systems	71,429	285,714	214,286	71,429	71,428	714,286
	2.4	Promote drought-tolerant and early maturing crops, forage, and livestock breeds through PPPs and seed companies	71,429	285,714	214,286	71,429	71,429	714,287
	2.5	Promote affordable and water-efficient smallholder irrigation schemes	71,429	285,715	214,284	71,429	71,429	714,286
	2.6	Establish sustainable climate-smart agricultural extension services closer to the farmers	71,429	285,715	214,286	71,428	71,429	714,287
	2.7	Build the evidence base to promote CSA, including conducting a cost-benefit analysis and participatory evaluation of CSA best practices in the region.	71,428	285,714	214,286	71,429	71,428	714,285
	Total ASO2 cost		500,000	2,000,000	1,500,000	500,000	500,000	5,000,000
	ASO3	**Support and strengthen agricultural value chains through PPPs**						
	3.1	Strengthen farmer associations, organizations, and cooperatives for collective action in mitigating climate change vulnerabilities and optimizing outputs throughout the value chains	83,334	333,334	250,000	83,333	83,332	833,333
	3.2	Develop and support management information systems	83,333	333,333	250,000	83,333	83,334	833,333

Sector	Strategic objectives & supporting activities		Cost Yr 1 (USD)	Cost Yr 2 (USD)	Cost Yr 3 (USD)	Cost Yr 4 (USD)	Cost Yr 5 (USD)	Total estimated cost (USD)
	3.3	Develop and support agro-climate advisories and decision support tools for the entire value chain	83,333	333,333	250,000	83,333	83,334	833,333
	3.4	Identify and develop PPPs	83,333	333,333	250,000	83,334	83,333	833,333
	3.5	Promote and sustain cottage industries for agro-processing	83,333	333,333	250,000	83,334	83,333	833,333
	3.6	Develop and promote value-added research institutions for improved crop varieties and livestock breeds	83,334	333,334	250,000	83,333	83,334	833,335
	Total ASO3 cost		500,000	2,000,000	1,500,000	500,000	500,000	5,000,000
	ASO4	Harmonize and coordinate climate change initiatives for optimal use of limited resources						
	4.1	Develop platform for harmonizing and coordinating all climate change initiatives	166,666	666,667	500,000	166,667	166,667	1,666,667
	4.2	Coordinate and harmonize existing climate change policies across the LVB and create awareness	166,667	666,666	500,000	166,667	166,667	1,666,667
	4.3	Establish an appropriate monitoring and evaluation system to track all climate change initiatives, studies, and R&D within the LVB	166,667	666,667	500,000	166,666	166,666	1,666,666
	Total ASO4 cost		500,000	2,000,000	1,500,000	500,000	500,000	5,000,000
	ASO5	**Natural disaster and risk management**						
	5.1	Operationalize the Disaster Risk Reduction and Management Fund/establishment of reserve fund for climate change disaster management	125,000	500,000	375,000	125,000	500,000	1,250,000
	5.2	Strengthen response mechanisms for natural disasters caused by climate change	125,000	500,000	375,000	125,000	500,000	1,250,000

Sector	Strategic objectives & supporting activities		Cost Yr 1 (USD)	Cost Yr 2 (USD)	Cost Yr 3 (USD)	Cost Yr 4 (USD)	Cost Yr 5 (USD)	Total estimated cost (USD)
	5.3	Strengthen the capacity of local, national, and regional organizations to respond to natural disasters	125,000	500,000	375,000	125,000	500,000	1,250,000
	5.4	Establish community-based disaster management approaches and mechanisms	125,000	500,000	375,000	125,000	500,000	1,250,000
	Total ASO5 cost		500,000	2,000,000	1,500,000	500,000	500,000	5,000,000
							TOTAL AGRICULTURE AND FOOD SECURITY	**30,000,000**
Water and Aquatic Ecosystems	**WSO 1**	**Develop and implement community-based climate change resilience programs on water catchment management**						
	1.1	Develop and implement climate-resilient catchment management plans	200,000	800,000	600,000	200,000	200,000	2,000,000
	1.2	Promote Transboundary Water Users' Associations	200,000	800,000	600,000	200,000	200,000	2,000,000
	1.3	Promote cross-border experience sharing	200,000	800,000	600,000	200,000	200,000	2,000,000
	Total WSO1 Cost		600,000	2,400,000	1,800,000	600,000	600,000	6,000,000
	WSO 2	**Develop decision support system that integrates climate change and IWRM information**						
	2.1	Improve the availability and dissemination of information in the LVB	85,734	342,857	257,143	85,714	85,714	857,142
	2.2	Develop a comprehensive hydro-meteorological network for monitoring in the LVB	85,714	342,857	257,143	85,715	85,715	857,144
	2.3	Pilots–apply climate lens to hydrology for transboundary river basin organizations within the LVB (e.g., Mara River Basin in Tanzania)	85,714	342,857	257,142	85,715	85,714	857,142
	2.4	Improve knowledge management frameworks for collection and maintenance of regional knowledge in transboundary	85,715	342,857	257,143	85,714	85,714	857,143

Sector	Strategic objectives & supporting activities		Cost Yr 1 (USD)	Cost Yr 2 (USD)	Cost Yr 3 (USD)	Cost Yr 4 (USD)	Cost Yr 5 (USD)	Total estimated cost (USD)
		water catchment management and climate change adaptation practice						
	2.5	Develop MoUs for equitable use and reduce water stresses for transboundary management	85,714	342,858	257,143	85,714	85,714	857,143
	2.6	Develop a comprehensive hydro-meteorological network for monitoring in the LVB	85,715	342,857	257,143	85,714	85,714	857,143
	2.7	Develop best practices on water allocation plans that takes into account climate change that can be scaled up to other sub-basins within LVB	85,714	342,857	257,143	85,714	85,715	857,143
		Total WSO2	**600,000**	**2,400,000**	**1,800,000**	**600,000**	**600,000**	**6,000,000**
	WSO 3	**Enhance development and uptake of technological innovations for water resources harvesting, storage, processing and utilization**						
	3.1	Promote, develop and implement water harvesting and storage facilities (e.g. rainwater harvesting, dams, water pans, etc.) at community and household levels	150,000	600,000	450,000	150,000	150,000	1,500,000
	3.2	Promote groundwater assessment and management technologies and aquifer recharge	150,000	600,000	450,000	150,000	150,000	1,500,000
	3.3	Promote cleaner production technologies that improve water quality and efficiency	150,000	600,000	450,000	150,000	150,000	1,500,000
	3.4	Promote measures and technologies that will lead to reduction in population affected by water stress by 2050 (water	150,000	600,000	450,000	150,000	150,000	1,500,000

Sector	Strategic objectives & supporting activities		Cost Yr 1 (USD)	Cost Yr 2 (USD)	Cost Yr 3 (USD)	Cost Yr 4 (USD)	Cost Yr 5 (USD)	Total estimated cost (USD)
		productivity–crop per drop, irrigation efficiency)						
		Total WSO3	600,000	2,400,000	1,800,000	600,000	600,000	6,000,000
	WSO 4	**Develop sustainable funding mechanisms and regional policy frameworks that support water security**						
	4.1	Finalize LVBC Resource Mobilization Plan	200,000	800,000	600,000	200,000	200,000	2,000,000
	4.2	Operationalize the EAC Climate Change Fund and LVB Environmental Trust Fund	200,000	800,000	600,000	200,000	200,000	2,000,000
	4.3	Harmonize regional policy frameworks on water security that mainstream climate change	200,000	800,000	600,000	200,000	200,000	2,000,000
	4.4	Sensitize and mobilize communities on significance of mitigating and reduction of climate change impacts	600,000	2,400,000	1,800,000	600,000	600,000	6,000,000
		Total WSO4	1,200,000	4,800,000	3,600,000	1,200,000	1,200,000	12,000,000
		TOTAL WATER AND AQUATIC ECOSYSTEMS						**30,000,000**
Terrestrial Ecosystems	**TSO1**	**Apply climate lens across key transboundary ecosystems, especially biologically significant areas such as Mara–Serengeti, Mount Elgon, Sango Bay–Minziro, Nyungwe–Kibira, and Greater Virunga**						
	1.1	Develop and implement transboundary collaboration mechanisms and frameworks in the Mara–Serengeti, Mount Elgon, Sango Bay–Minziro, Nyungwe–Kibira, and Greater Virunga	75,000	300,000	225,000	75,000	75,000	750,000
	1.2	Establish EAC and LVB regional climate change monitoring programs	75,000	300,000	225,000	75,000	75,000	750,000
	1.3	Identify and pilot best practices in climate change adaptation in terrestrial ecosystems in the LVB	75,000	300,000	225,000	75,000	75,000	750,000

Sector	Strategic objectives & supporting activities		Cost Yr 1 (USD)	Cost Yr 2 (USD)	Cost Yr 3 (USD)	Cost Yr 4 (USD)	Cost Yr 5 (USD)	Total estimated cost (USD)
	1.4	Ensure integration of climate change into EAC/LVBC policy and legal instruments (e.g., transboundary ecosystems management bill)	75,000	300,000	225,000	75,000	75,000	750,000
		Total Cost TSO1	300,000	1,200,000	900,000	300,000	300,000	300,000
	TSO2	**Provide analysis of options for mitigation and adaptation for various governments in the LVB (national and regional), private sector and local communities**						
	2.1	Undertake specific VIA assessments and detailed sector analyses based on future scenarios	75,000	300,000	225,000	75,000	75,000	750,000
	2.2	Undertake economic studies and valuation of various options for adaptation and mitigation for selection of interventions and programs	75,000	300,000	225,000	75,000	75,000	750,000
	2.3	EAC and LVBC to lead mobilization of resources to support adaptation and mitigation	75,000	300,000	225,000	75,000	75,000	750,000
	2.4	Promote PPPs in support of climate change adaptation and mitigation interventions	75,000	300,000	225,000	75,000	75,000	750,000
		Total Cost TSO2	300,000	1,200,000	900,000	300,000	300,000	300,000
	TSO3	**Prepare a regional approach in the LVB to address climate change impacts on wildlife, forests, and tourism**						
	3.1	Promote adoption of user and polluter pays principle	42,857	171,429	128,571	42,857	42,857	428,571
	3.2	Build community resilience through diversification into tourism and provision of other ecosystem services	42,857	171,429	128,571	42,857	42,857	428,571
	3.3	Integrate community programs with other key sectors such as water, health, agriculture, and energy	42,857	171,429	128,571	42,857	42,857	428,571

Sector	Strategic objectives & supporting activities		Cost Yr 1 (USD)	Cost Yr 2 (USD)	Cost Yr 3 (USD)	Cost Yr 4 (USD)	Cost Yr 5 (USD)	Total estimated cost (USD)
	3.4	Establish buffer zones and corridors for conservation areas	42,857	171,429	128,571	42,857	42,857	428,571
	3.5	Determine and mitigate impacts of climate change on human-wildlife conflicts	42,857	171,429	128,571	42,857	42,857	428,571
	3.6	Promote community-based alternative livelihoods projects that integrate climate change	42,857	171,429	128,571	42,857	42,857	428,571
	3.7	Establish an ecosystem monitoring program that includes climate information	42,857	171,429	128,571	42,857	42,857	428,571
	Total Cost TSO3		300,000	1,200,000	900,000	300,000	300,000	3,000,000
	TSO4	**Develop climate change information hub in the LVB and EAC region**						
	4.1	Liaise and coordinate with ICPAC and Partner States to develop tools on climate analysis, (e.g., GeoCLIM, CORDEX 10 RCM, GeoMOD)	50,000	200,000	150,000	50,000	50,000	500,000
	4.2	Support Partner States to develop policies that enable easy access to data	50,000	200,000	150,000	50,000	50,000	500,000
	4.3	Support Partner States in capacity building and institutional development	50,000	200,000	150,000	50,000	50,000	500,000
	4.4	Establish and operationalize LVB Climate Change Unit	50,000	200,000	150,000	50,000	50,000	500,000
	4.5	Support/build the Center of Excellence on IWRM in the LVBC Secretariat	50,000	200,000	150,000	50,000	50,000	500,000

Strategic objectives & supporting activities		Cost Yr 1 (USD)	Cost Yr 2 (USD)	Cost Yr 3 (USD)	Cost Yr 4 (USD)	Cost Yr 5 (USD)	Total estimated cost (USD)
4.6	Establish cooperative and data sharing (e.g., EAC and LVBC metadata bases cooperation) mechanism with regional institutions	50,000	200,000	150,000	50,000	50,000	500,000
	Total Cost TSO4	**300,000**	**1,200,000**	**900,000**	**300,000**	**300,000**	**3,000,000**
					TOTAL COST TERRESTRIAL		**12,000,000**
HSO1	**Build the capacity of the health sector workforce on climate change preparedness and response**						
1.1	Conduct climate change and health capacity needs assessments of healthcare workforce in the LVB	50,000	200,000	150,000	50,000	50,000	500,000
1.2	Develop a capacity building framework and training guidelines on climate change and health-related issues	50,000	200,000	150,000	50,000	50,000	500,000
1.3	Conduct training for the health workforce on climate change and health awareness and preparedness and response	50,000	200,000	150,000	50,000	50,000	500,000
1.4	Conduct research	50,000	200,000	150,000	50,000	50,000	500,000
	Total Cost HSO1	**200,000**	**800,000**	**600,000**	**200,000**	**200,000**	**2,000,000**
HSO2	**Strengthen and institutionalize surveillance, early warning, and communication systems on existing, new, and re-emerging climate-sensitive diseases**						
2.1	Establish a regional platform for data, information, and knowledge sharing on climate change and health in the LVB	40,000	160,000	120,000	40,000	40,000	400,000
2.2	Improve Integrated Disease Surveillance (IDSR) systems by integrating climate information	40,000	160,000	120,000	40,000	40,000	400,000
2.3	Develop and disseminate information, education, and communication materials on climate change and	40,000	160,000	120,000	40,000	40,000	400,000

Sector	Strategic objectives & supporting activities		Cost Yr 1 (USD)	Cost Yr 2 (USD)	Cost Yr 3 (USD)	Cost Yr 4 (USD)	Cost Yr 5 (USD)	Total estimated cost (USD)
		health at all levels in the LVB						
	2.4	Develop and strengthen integrated regional emergency disease response capability	40,000	160,000	120,000	40,000	40,000	400,000
	2.5	Develop and implement pilot surveillance and response system with key service providers	40,000	160,000	120,000	40,000	40,000	400,000
		Total Cost HSO2	**200,000**	**800,000**	**600,000**	**200,000**	**200,000**	**2,000,000**
	HSO3	**Strengthen research and interventions (prevention, preparedness, response) that address climate-sensitive sanitation and diseases**						
	3.1	Identify and prioritize key research areas in climate and health in the LVB at the regional, national, and sub-national levels	40,000	160,000	120,000	40,000	40,000	400,000
	3.2	Mobilize resources for research on interventions that address climate-sensitive sanitation and diseases (public, private, donor, and global funds)	40,000	160,000	120,000	40,000	40,000	400,000
	3.3	Conduct research in prioritized research areas in climate and health in the LVB, and use findings to inform decision making and programming	40,000	160,000	120,000	40,000	40,000	400,000
	3.4	Establish and strengthen water supply and sanitation utilities for sewerage system management and monitoring	40,000	160,000	120,000	40,000	40,000	400,000
	3.5	Create awareness in communities on health hazards of poor hygiene and sanitation practices	40,000	160,000	120,000	40,000	40,000	400,000
		Total Cost HSO3	**200,000**	**800,000**	**600,000**	**200,000**	**200,000**	**2,000,000**

Sector	Strategic objectives & supporting activities		Cost Yr 1 (USD)	Cost Yr 2 (USD)	Cost Yr 3 (USD)	Cost Yr 4 (USD)	Cost Yr 5 (USD)	Total estimated cost (USD)
	HSO4	**Promote use of climate-appropriate technologies for health and sanitation infrastructure**						
	4.1	Identify and invest in climate-appropriate technologies and approaches for health infrastructure and sanitation infrastructure in the LVB	50,000	200,000	150,000	50,000	50,000	500,000
	4.2	Assess key health and sanitation infrastructure in the LVB to determine its ability to withstand climate-related shocks and stresses and take appropriate action	50,000	200,000	150,000	50,000	50,000	500,000
	4.3	Implement programs that use identified climate-appropriate technologies and approaches to support improved climate resilience for health at the community level in the LVB	50,000	200,000	150,000	50,000	50,000	500,000
	4.4	Integrate sanitation into all water supply and sanitation projects to ensure proper wastewater management	50,000	200,000	150,000	50,000	50,000	500,000
		Total Cost HSO4	**200,000**	**800,000**	**600,000**	**200,000**	**200,000**	**2,000,000**
	HSO5	**Improve maritime safety and security**						
	6.1	Establish and improve regional early warning monitoring and surveillance systems	66,667	266,667	200,000	66,666	66,667	666,667
	6.2	Improve search and rescue response capability	66,667	266,666	200,000	66,667	66,667	666,667
	6.3	Establish and implement maritime response communications network and centers	66,666	266,667	200,000	66,667	66,666	666,666
		Total Cost HSO6	**200,000**	**800,000**	**600,000**	**200,000**	**200,000**	**2,000,000**

Sector	Strategic objectives & supporting activities		Cost Yr 1 (USD)	Cost Yr 2 (USD)	Cost Yr 3 (USD)	Cost Yr 4 (USD)	Cost Yr 5 (USD)	Total estimated cost (USD)
	TOTAL COST HEALTH, SANITATION, AND HUMAN SETTLEMENTS							**12,000,000**
Energy and Infrastructure	**ESO1**	**Develop, promote, and use renewable energy in the LVB**						
	1.1	Reform policies and institutions, including review of national policies and strategies, regional renewable energy policy instruments, and creating incentives for a conducive environment to strengthen private sector and NGO participation	200,000	800,000	600,000	200,000	200,000	2,000,000
	1.2	Enhance capacity building activities and technology transfer to support renewable energy development	200,000	800,000	600,000	200,000	200,000	2,000,000
	Total Cost ESO1		**400,000**	**1,600,000**	**1,200,000**	**400,000**	**400,000**	**4,000,000**
	ESO2	**Research and invest in alternative energy, including the establishment of regional standards and setting up an internationally accredited energy laboratory**						
	2.1	Create regional energy lab and establish linkages with identified international and regional research institutions and universities	200,000	800,000	600,000	200,000	200,000	2,000,000
	2.2	Review and harmonize national energy standards to support development of regional standards	200,000	800,000	600,000	200,000	200,000	2,000,000
	Total Cost ESO2		**400,000**	**1,600,000**	**1,200,000**	**400,000**	**400,000**	**4,000,000**
	ESO3	**Develop incentives and funding framework for regional energy project incubation and start-ups**						
	3.1	Build capacity of decision makers (treasury and energy ministries) on incentive mechanisms, such as green bonds, tax holidays	200,000	800,000	600,000	200,000	200,000	2,000,000
	3.2	Establish a regional incubation and innovation center for renewable energy start-ups	200,000	800,000	600,000	200,000	200,000	2,000,000
	Total Cost ESO3		**400,000**	**1,600,000**	**1,200,000**	**400,000**	**400,000**	**4,000,000**

Sector	Strategic objectives & supporting activities		Cost Yr 1 (USD)	Cost Yr 2 (USD)	Cost Yr 3 (USD)	Cost Yr 4 (USD)	Cost Yr 5 (USD)	Total estimated cost (USD)
	ESO4	**Develop and introduce best practices for efficient and sustainable community-based biomass use for the region**						
	4.1	Conduct national biomass resource assessment in the LVB	66,667	266,667	200,000	66,666	66,667	666,667
	4.2	Review co-management forest policies and practices to document best practice models in the region	66,667	266,666	200,000	66,667	66,667	666,667
	4.3	Conduct capacity building programs in the region and mobilize funds for implementation	66,666	266,667	200,000	66,667	66,666	666,666
	4.4	Establish and enforce policies and laws	66,667	266,667	200,000	66,666	66,667	666,667
	4.5	Pilot best practices in Partner States	66,667	266,666	200,000	66,667	66,667	666,667
	4.6	Implement community-based programs for alternative livelihoods	66,666	266,667	200,000	66,667	66,666	666,666
		Total Cost ESO4	400,000	1,600,000	1,200,000	400,000	400,000	4,000,000
		TOTAL COST ENERGY AND INFRASTRUCTURE						**16,000,000**
		TOTAL COST LVB CCASAP						**86,000,000**

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