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Enhancing the Contribution of Weather, Climate and Climate Change to Growth, Employment and Prosperity

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Cover Photos

(Top to Bottom)
Floods that ravaged Pader district in September 2007
Photo credit**:** Daily Monitor Newspaper, September 2007
Floods that damaged property in Kampala in 2007
Photo credit: NEMA archives

Table of Contents

Tables

Figures

Photos

Acronyms and Abbreviations

CAA	Civil Aviation Authority
CDM	Clean Development Mechanism
DoM	Department of Meteorology
DWD	Directorate of Water Development
EU	European Union
EWS	Early Warning System
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GHG	Greenhouse gases
HIV/AIDS	Human Immuno-deficiency Virus / Acquired Immune Deficiency Syndrome
IPCC	Intergovernmental Panel on Climate Change
KCCL	Kasese Cobalt Company Ltd.
KML	Kilembe Mines Ltd.
MWE	Ministry of Water and Environment
MSS	Maritime Surveillance System
NaCCAS	National Climate and Climate Change Advisory Services
NAPA	National Adaptation Programme of Action
NCC–VCP	Neglected Climate Change-Vicious Cycle of Poverty
NEMA	National Environment Management Authority
PEAP	Poverty Eradication Action Plan
TLM	tree-livestock-mushroom
U Sh	Uganda shillings
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UPE	Universal Primary Education
WFP	World Food Programme

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Foreword

Uganda started the process of developing a five-year National Development Plan (NDP) for the period 2009/10–2014/15 to replace the Poverty Eradication Action Plan (PEAP) as a national development framework. The theme of the NDP is "**Growth, Employment and Prosperity**". This weather, climate and climate change report aims to inform the preparation of the NDP process and demonstrate the contribution of the subsector to the NDP objectives.

Weather and climate data contribute to Uganda's development by providing decision-makers with information to make budgetary and enterprise plans. For example, air transport needs daily weather information, and energy development planning needs long-term weather and climate data.

It is in part through the limited capacity of the weather and climate services of the Department of Meteorology (MWE) that we are aware that climate change is already affecting Uganda and that some areas are more vulnerable than others. Weather and climate services are crucial to detect the impacts of climate change on all aspects of the Ugandan economy, and to forecast the onset of drought or flood periods. Such data are essential for planning strategies to avoid flood and drought occurrences from turning into disasters that threaten food security, livelihoods, health, power supply and infrastructure. They can also give us indications of whether and how our valuable biodiversity will continue to thrive in the changing ecological zones of our country.

This report aims to show policy-makers, national development planners and implementers the importance of weather, climate and climate change in national development, including the attainment of the Millennium Development Goals (MDGs).

Despite the knowledge that the impacts of climate change, aggravated by population pressure and environmental degradation, cost Uganda billions of shillings each year, there has been little attention given to the maintenance and improvement of the weather and climate monitoring infrastructure. There are some barriers for implementation including limited awareness of climate change at all levels and its devastating impacts on socio-economic development as well as the challenges, benefits and adaptation measures to climate change.

Since 2007, however, attention to the issue of climate change has increased. A National Adaptation Programme of Action (NAPA) and its implementation strategy to address immediate and urgent issues of climate change have been developed and approved by the government. Uganda is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and acceded to the Kyoto Protocol. In addition, several greenhouse gas inventory studies have been undertaken. Furthermore, a Climate Change Unit has been established in the Ministry of Water and Environment and the development of National Climate Policy is underway.

The NDP planning process provides an opportunity for developing strategies to address the identified gaps and challenges, and to enhance the contribution of the subsector to national development. In line with the NDP theme and objectives, and the MDGs, the following priority interventions have been identified:

- strengthening weather and climate change infrastructure;
- building and strengthening human capacity in weather and climate change monitoring and information dissemination;
- strengthening climate and climate change information management and early warning systems (EWS) to increase productivity of climate and climate change-sensitive sectors and communities;
- strengthening the establishment and implementation of regulations for climate and climate change, natural resources and climate-sensitive sectors;
- promoting the engagement of young people and rural households in climate change mitigation and adaptation;
- promoting investments (public-private partnerships) and value addition to climate change mitigation and adaptation in order to improve rural and urban livelihoods;
- promoting the development of commodity value chains for strategic natural resources and natural products;
- exploring and developing climate opportunities as a traded commodity and as a global public good.

When these priority interventions are sufficiently budgeted for and implemented under the new NDP, Uganda will be less vulnerable in the long term to the negative impacts of extreme climatic events, and the subsector will make even more substantial contributions to growth, employment and prosperity. I therefore urge Parliament, all central and local government agencies, civil society organizations, the private sector, communities, individuals and development partners to support the implementation of these priority interventions.

Dr. Aryamanya-Mugisha, Henry (PhD)
Executive Director
National Environment Management Authority (NEMA)

Executive Summary

Socio-economic development is the overriding priority of all developing countries. Climate and weather are a primary natural resource for development and the driver for secondary resources such as water, forestry and agriculture. Climate change aspects, such heat waves, heavy rainfall, floods, droughts, hailstorms and landslides, have considerable negative effects on economic activities, peoples' livelihoods and health. Increasing frequencies of severe droughts, floods, landslides, epidemics of malaria, pests and other diseases demonstrate Uganda's vulnerability to climatic events. The poorest nations such as Uganda will suffer the most from the negative impacts of climate change. If ignored, the achievements of Uganda's National Development Plan will be undermined, as well as other development targets including the MDGs. This report aims to show national development planners and policy implementers the importance of weather, climate and climate change in national development.

Uganda is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and has acceded to the Kyoto Protocol (KP). Its equatorial climate provides plentiful sunshine, moderated by the relatively high altitude of most areas of the country. Rainfall is the most sensitive climate variable that affects social and economic activities. This, together with increasing frequency of droughts, has made Uganda more vulnerable to climate change. Climate changes over time may be due to natural variability or human-induced increases in greenhouse gases (GHGs) in the atmosphere. In practice, climate change is reflected in the variation of the mean state of weather variables, including temperature, precipitation and wind. The main socio-economic factors predisposing Uganda to climate and microclimate changes include: (a) excessive land use for agriculture, extensive grazing, industrialization and urbanization at the expense of trees and forest cover; (b) inefficient technologies in the energy, production, construction and transport sectors; (c) deforestation and dependence on biomass especially for energy and housing; (d) population explosion; and (e) wild/bush fires. Therefore, while there are ongoing debates on climate change as the cause of reported effects, there is no doubt that it is a predisposing factor.

Is Uganda's climate changing?

The world is warming and Uganda is no exception. According to Intergovernmental Panel on Climate Change (IPCC) reports (2001), Africa warmed by 0.7°C in the last century. Projected warming for the 21st century for Africa ranges from 0.2 °C (low scenario) to over 0.5°C (high scenario) per decade. For Uganda, the fastest warming has apparently been in the south-west, where the rate was approximately 0.3^{o}C per decade. In the last century, the frequency and intensity of extreme climatic events has been generally on the increase. In the 1991–2000 decade alone (peak observation), Uganda experienced seven drought episodes. Extreme droughts had significant negative effects on water resources, hydropower production, agriculture and the overall economy. El Niño and La Niña episodes have been the principal causes of most severe climate change-related disasters. After the extreme and prolonged drought of 2004/2005, the water level of Lake Victoria dropped dramatically by one meter in 2006 due to high evaporation from the lake surface, low rainfall in the headwaters of the rivers draining into the lake, and the excessive removal of water for power generation from Owen Falls Dam to meet the growing demand for electricity in the country. In addition, the ice caps on the Rwenzori Mountains are disappearing. Also, the melting of the ice caps on tropical mountains has a negative effect on water catchments downstream, eco-tourism and the overall

economy. In the past, malaria was not a disease of the cold highland areas such as in the then Kigezi District (now Kabale, Rukungiri, Kisoro, Ntungamu and Kanungu districts). Now, however, there is a general increase of malaria incidence throughout the country, particularly in the south-west, where it has reached epidemic proportions. The south-west is also Uganda's fastest warming region.

Climate change and Uganda's economic development

It should be noted that impacts of climate change will affect people differently, depending on their livelihood strategies and asset base. The issues of climate change can seem a low priority compared to more immediate problems such as poverty, disease and economic stagnation. Yet, climate change directly affects the efficiency of resource investments and the achievement of many development objectives. Climate change threatens to undo decades of development efforts in a short time, as has been witnessed in some regions of the country. Estimates of the relative cost of climate change damage in Uganda have been calculated from the second United Nations World Water Development Report (2006) and the Uganda Energy Sector Report (2007). Climate change damage is equivalent to over 4.4 percent of the national 2007/2008 fiscal budget. The damage actually exceeds budget allocations for four of the sectors, including water and environment, whose budget share was 3.3 percent. Climate change-related disasters contribute well over 70 percent of the natural disasters and destroy annually an average of 800,000 ha of crops, resulting in economic losses of over U Sh 120 billion. The annual economic losses resulting from the associated transport damage, accidents, fires are estimated at U Sh50 billion. Using 2005/2006 figures, the dramatic shortfall in hydropower incurs a conservative loss of 148 GWh (over U Sh37 billion), excluding other costs and losses involved in emergency energy responses and industrial and institutional losses due to power cuts.

Today, climate change and variability are the greatest threat to socio-economic development throughout the world. Increases in the prices of some foodstuffs as a result of prevailing weather, climate and climate change conditions have been registered. Uganda's population growth rate is about 3.5 percent, while the annual growth rate of food production is about 1.5 percent. These statistics clearly indicate that the current food production levels cannot keep pace with the population growth and that the country is likely to experience acute food shortage in the near future. The trend of World Food Programme (WFP) expenditure on climate change-related interventions in Karamoja Region (a 'hot spot' area) is a crude index of the burden of extreme events of climate change in the country. From 2004 to 2008, the cost of intervention increased more than five times. The 2008 intervention alone cost more than 13 percent of the agricultural sector budget, excluding the cost of government interventions and the actual damage caused in the region. Despite Uganda's fertile soils, 5 percent of rural households continue to experience food insecurity. Better development planning is necessary to integrate climate change. To ensure sustainable supply of human resources for the climate change industry and sub-sector, Makerere University and other competent tertiary institutions should offer training programmes in climate and climate change. Students should be motivated to pursue climate change-related courses. Climate proofing in the construction and transport industry is a necessity. These sectors have faced acute challenges as a result of climatic extremes. Bridges, roads and buildings have been destroyed by heavy floods and heavy downpours. All aviation activities are impacted by weather and climate, and unless weather and climate information is factored in their planning, air transport will be negatively affected, including the export trade. Effective management of forests, fish catching and fishers' safety as

well as biodiversity requires climate information and infrastructure. Poor management of forests can have a negative impact on climate, particularly local climate. This vicious cycle leads to increased emission of GHGs leading to global warming and increasing climate change.

How Uganda is responding to climate change

Weather, climate and climate change were not emphasized among the major constraints to achieving the economic and social development goals identified in the Poverty Eradication Action Plan (PEAP). There are implementation barriers in the climate change sub-sector, including limited awareness at all levels of climate change and its devastating impacts on socio-economic development and of the challenges, benefits and adaptation measures to climate change. However, Uganda has developed a National Adaptation Programme of Action (NAPA) and its implementation strategy to address immediate and urgent issues of climate change. It has published its first national communication in line with her commitment to the UNFCCC and is developing the second national communication. Several GHG inventory studies and ratifications of conventions have been undertaken.

Emerging issues, opportunities and challenges in climate change

Uganda's economy is trapped in a neglected climate change-vicious cycle of poverty (NCC-VCP), which has long been neglected. Understanding this cycle and its implication in development planning is critical in revolutionizing the climate sector and its role in socio-economic development. Given the general competence, it is advisable to develop innovative models of climate change management. Traditionally, the function of climate institutions has been to provide meteorological information, used largely to benefit the aviation system and to a lesser extent, other sectors. Innovative approaches to address climate change challenges and opportunities could focus on:

(a) cheaper insurance cover against climate change by integrating climate change into development planning and implementation: these costs are lower than those of climate change related disasters;
(b) promoting energy efficiency to reduce greenhouse gas (GHG) production and increase savings: increased saving encourages investment;
(c) tree planting: trees are a source of income, poles, timber and firewood fuel; they also draw carbon dioxide from the atmosphere, among other functions;
(d) climate change proof infrastructure (e.g. roads and buildings), which should be constructed with designs to withstand extreme climate events and disasters;
(e) Clean Development Mechanism (CDM) and ecological restoration programmes, which offer various opportunities such as promoting the use of renewable energy. The use of the latest technologies and concepts, e.g. (i) the Clima-Eco-Tourism (CET) Zone Concept and implementing appropriate NCC-VCP studies and plans; (ii) hydrogel technology for large-scale afforestation in degraded lands; and (iii) the tree-mushroom-livestock (TLM) production and energy system in marginal ecosystems;
(f) climate and climate change education and human resources development: integrating climate and climate change advisory services as pillars in wealth creation and poverty eradication in order to improve livelihoods is an innovation that requires a new set of competences and understanding at all sectoral and community levels;
(g) institutional reforms at the climate and climate change sector could include: (i) establishing a legal institutional framework and convert the meteorology service department into an agency; (ii) establishing climate change sector to coordinate and

implement climate change adaptation and mitigating projects; (iii) developing a climate change action plan and engage local government in implementation; (iv) developing tertiary institutions and a meteorological department to carry out policy research, education and technology development; and (v) developing curriculum for institutions, research and studies.

A new agenda for the climate and climate change sub-sector

Setting a new agenda has the following specific objectives:

- increasing incomes of communities;
- ensuring community climate change resilience and security;
- creating employment opportunities through climate change mitigation and adaptation;
- promoting value addition to climate and associated natural resources;
- promoting climate and climate change investment for the domestic and global public good.

The strategies include:

- strengthening climate and climate change information management and early warning system (EWS) to increase productivity of climate and climate change-sensitive sectors and communities;
- strengthening the establishment and implementation of regulations for climate and climate change, natural resources and climate-sensitive sectors;
- promoting the engagement of young people and rural households in climate change mitigation and adaptation;
- promoting investments (public-private partnerships) and value addition to climate change mitigation and adaptation in order to improve rural and urban livelihoods;
- promoting the development of commodity value chains for strategic natural resources and natural products.
- exploring and developing climate opportunities as a traded commodity and as a global public good.

In support of each of the above strategies, public investments by the MWE are needed to boost multisectoral productivity, incomes and climate change resilience.

Key target outputs in the next five years (2009–2013) include:

- a policy, legal and institutional framework;
- a National Climate and Climate Change Action Plan;
- a National Climate and Climate Change Advisory Services (NaCCAS) Programme;
- model pilot climate change-resilient communities (ECO/NAPA villages);
- model natural resources commodity value chain enterprises and investments;
- a Climate and Climate Change Institute;
- competent human resources;
- appropriate curricula mainstreamed at all levels;
- public education and awareness programmes;
- model CET and CDM projects;
- 50 percent reduction in climate change-induced national wealth wastage;

- climate change proofing (mainstreaming) in national development strategies;
- the Uganda Meteorology and Climate Change Management Agency established.

Budget: A total of U Sh74.4 billion is proposed for the five-year weather, climate and climate change sub-sector development plan.

Introduction

1.1 Background

Uganda's economy has been growing at a rate of 5-7 percent over the past decade. Head count poverty declined from 56 percent in 1992 to 35 percent of people living below the poverty line in 2002. However, in 2004, it rose to 38 percent, apparently due to increased frequency of climate variability and conflicts. While Uganda's climate offers great potential for food production, the prolonged and frequent droughts in many parts of the country, particularly the northeast, have led to almost perpetual dependency on food aid. A typical example is in the arid areas of Karamoja, where the World Food Programme (WFP) supplies the people with almost all their food needs. In the other parts of the country, floods and droughts have led to major negative impacts and pushed back development for as many as ten to 20 years (e.g. road infrastructure damaged by floods is not yet fixed ten years after the El Niño floods).

This aid was provided because Uganda's economy depends mostly on the exploitation of its natural resources, which are greatly dependent on the patterns of weather and climate as well as a robust weather and climate services sector. The two major resources for production are land and climate. The climate is the driver for secondary resources such as water, forestry and agriculture. Currently, climate, perhaps Uganda's most valuable natural resource, is the most neglected, as successive governments have continued to take it for granted and have not yet invested in weather and climate services. Indeed, Uganda's climate is also a key determinant of the status of other natural resources, such as water resources, forest, agriculture, ecotourism and wildlife. Uganda has a diverse and rich biodiversity, which provides both food and medicine. Unsustainable exploitation of these resources, often driven by external market forces, has resulted in serious biodiversity loss with some species close to extinction. However, climate change, which has started manifesting itself through increased frequency of extreme weather events such as droughts, floods and landslides as well as high temperatures, is posing a serious threat to the country's natural resources, social and economic development.

Consequently, it is essential to recognize that today, climate variability and change are easily the most important obstacles to meeting development objectives such as poverty alleviation, food and water provision, and even improved health. Other sub-sectors that will be severely affected by climate variability and change include energy production, tourism, agriculture, industry, biodiversity conservation and transportation, among many others. These impacts arise due to increased severity and frequency of severe weather and climate events, such as floods and droughts as well as changes in temperature and rainfall patterns.

In Uganda, recent events – frequent severe droughts, floods landslides, malaria episodes and even the increase in pests and some diseases – demonstrate the country's vulnerability to climate events. The poorest nations like Uganda will suffer the most from these negative impacts of climate change. Countries with the fewest resources are likely to bear the greatest burden of climate change in terms of loss of lives and the related effect on investment and the economy. While there is little that Uganda can do to reverse global warming, much can and should be done to prepare communities to live with climate change by implementing various adaptation measures, principally the strengthening and redirecting of the climate services (Meteorological Services) to guide adaptation measures and continuously monitor the weather and climate.

As Uganda's Poverty Reduction Strategy and PEAP is currently under review, it is important to consider two aspects of weather and climate services to include in the overall PEAP: Climate Change and Climate variability. This is essential because weather and climate have a major role in attaining the National Development Plan under the theme: '*Growth, Employment and Prosperity'*. Second, the potential negative impacts of climate change will undermine the achievements of the proposed National Development Plan as well as other development targets including the MDGs.

Objectives of this Paper

- To highlight the significance of weather and climate in the development process and raise concern regarding the likely impacts of climate change to the development process.
- To propose ways to climate-proof the development process against the increased climate change and climate variability in the light of the global warming phenomena.
- To inform the *ENR Sector Working Paper* and constitute a major input into the revised PEAP. This is important because planning for Uganda would be a futile exercise without factoring weather and climate information in the planning process at this time of increased climate change and variability.
- To provide an overview of composite trends on progress achieved and to highlight innovative approaches and economic challenges faced.
- To contribute to enhancing public awareness and education on climate change and its potential impacts in Uganda.

The structure of this paper follows the guidelines provided by PEAP revision/NDP formulation secretariat of the government of Uganda in October 2007.

1.2 Definition of weather, climate, and climate change

Weather and climate

Weather is the atmospheric condition of a place for a short period of time, while climate is the atmospheric condition of a place for a long period of time. Climate refers to "average weather" and represents the state of the climate system over a given time period. Climate changes over time may be due to natural variability or as a result of human induced increases of GHGs in the atmosphere and is reflected in the variation of the mean state of weather variables including **temperature, precipitation and wind**. Weather and climate conditions are predicted for public consumption, especially the civil aviation industry and the agricultural sector and other relevant sectors. The Civil Aviation Authority has been among the main information users; other sectors have also used this information in planning, but on a very small scale. This paper aims to demonstrate the importance of weather, climate and climate sub-sector in development.

Climate change

Climate change means a change of climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere in addition to natural climate variability, observed over a comparable time period.

1.3 What causes climate change?

Climate changes over time may be due to natural variability or as a result of human-induced increases of GHGs in the atmosphere. The earth has a natural control system, which keeps the temperatures of the earth at reasonable values to support life and economic activities. This control is carried out by atmospheric gases, such as water vapour, carbon dioxide, nitrous oxide, ozone and methane, which occur naturally within the atmosphere. These gases trap the infrared radiation from the earth's surface and reflect it back to the earth, thus warming it. These gases behave like a greenhouse, hence the name *greenhouse gases* (GHGs). Human activities such as burning of fossil fuels for heating, transport and power generation, clearing of bush for agriculture, deforestation and animal rearing (livestock) result in emissions of GHGs into the atmosphere. In the last 50 years these emissions have significantly increased the concentrations of GHGs in the atmosphere, resulting in offsetting the natural equilibrium and hence warming the earth's surface, which has resulted in global climate change.

In practice, climate change is reflected in the variation of the mean state of weather variables including **temperature, precipitation and wind**. When examining in greater depth the core climate variables at the local level, it can be observed that the changes in the micro-climate of an area, e.g. a country, region or district also depend on the prevailing local socio-economic factors and activities, in addition to GHGs and natural causes. These factors are actually the true predisposing factors to micro-climate change disasters. For example, an area with many forests and trees will experience cool temperatures and weaker winds than bare land area under the same conditions. The main socio-economic factors and activities predisposing Uganda's micro-climate to changes include:

(a) excessive land use for agriculture, extensive grazing, industrialization and urbanization at the expense of trees and forest cover;
(b) inefficient technologies in the energy, production, construction and transport sectors;
(c) deforestation and dependence on biomass, especially for energy and housing;
(d) population explosion as an insurance against poverty;
(e) wild / bush fires.

1.4 Uganda's global obligation to climate and climate change management

In 1993, Uganda became a signatory to the United Nations Framework Convention on Climate Change (UNFCCC); in 2002, it acceded to the Kyoto Protocol. Uganda is thus obligated under international law to abide by the provisions of the stated legal system and to show its expected participation in the unfolding steps and measures to address the main objective of the Convention, "*stabilization of concentrations of GHGs in the atmosphere at a level that will minimize the costs of future adaptation through reduction of GHG emissions*". These obligations must be carried out in respect of the underlying adopted principle of "common but differentiated responsibility". In other words, there are general commitments and obligations for all parties, as well as commitments and obligations with respect to the capacities and levels of development of member categories – least developed countries, small island states, developing countries, countries with economies in transition and developed countries.

Article 4 of the Convention commits all Parties to:

- Develop a national inventory of sources and sinks of anthropogenic emissions of GHGs in accordance with Article 12 of the Convention.
- Formulate national/regional programmes to mitigate anthropogenic emissions of GHGs.
- Promote and cooperate in the development, application and diffusion of technologies that limit anthropogenic emissions of GHGs.
- Promote sustainable management, conservation and enhancement sinks and reservoirs of GHGs.
- Cooperate in preparing for adaptation to adverse effects of climate change.
- Promote and cooperate in sharing relevant information related to climate change and public awareness.
- Take climate change into account in national development planning.

The Department of Meteorology (DoM), which is the designated National Focal Point for the UNFCCC, is mandated to coordinate activities leading to the fulfillment of the above obligations. To date, Uganda is a very active member within the climate change process by taking a frontline role in UNFCCC meetings. In addition, even though it has not yet fully domesticated these instruments, much has been done, including the following:

i. A national inventory of GHGs by sources and sinks was undertaken under the United States Country Climate Studies Programme and the first communication, from the Intergovernmental Negotiating Committee (INC) to the Conference of the Parties, was prepared, as required of the non-Annex 1 parties. Country-specific emission factors are to be established in preparation for the second National Communication (2NC).
ii. An interim arrangement is in place to ensure Uganda's participation in mitigation activities, as required by the CDM Executive Board of the Kyoto Protocol. The CDM-Designated National Authority (DNA) is in place to approve carbon transactions. Relevant capacity has been built within public and private sectors through various government-led initiatives.
iii. Relevant sectoral policies and institutions have been put in place. The National Environment Management Authority (NEMA) Act, which established NEMA, is an example of such policies.
iv. Uganda has prepared its short-term adaptation strategy (NAPA) focusing on urgent and immediate interventions. NAPA emphasizes, *inter alia*, integration of climate change into development planning.

Unfortunately, the level of awareness at all levels is still low, which undermines the urgent responses required to address the climate change threat.

Some examples of the potential benefits from participating in the climate change process are as follows:

- benefits from the development, transfer, application and diffusion of appropriate technology, practices and processes that control, reduce or prevent anthropogenic emissions of GHGs. The technology transfer will cover all the relevant sectors including energy, industry, agriculture, forestry and waste management.

- promotion of sustainable management of natural resources through conservation and enhancement of sinks of GHGs, including biomass and forests.
- financial and technical assistance from developed countries through the Convention's provisions; e.g. NAPA Project funding by the Global Environment Facility (GEF).
- cooperation in scientific, technological, technical, legal and socio-economic research, systematic observation and development of data archives related to the climate system and the full, open and prompt exchange of information.

Uganda has also actively participated in the process, both in the international negotiations and actions at home towards mitigation and adaptation. In addition to the home environmental policies related to the Convention objectives, it has participated in two capacity-building activities for CDM funded by the United Nations Environment Programme (UNEP) and EU, for a total of US$150,000. A third capacity building activity funded by the Dutch Government is ongoing with a multi-institutional implementation approach (DoM and the Department of Mechanical Engineering, Makerere University. This has been funded to an amount of approximately US$300,000.

1.5 Consequences of the failure to implement UNFCCC and Kyoto Protocol Instruments

Failure to implement UNFCCC and Kyoto Protocol instruments would lead to an increase in atmospheric temperature globally. The projected increase is about 20°C or over. This very large increase is expected to accelerate the melting of glaciers, thus leading to an increase in sea-level waters, flooding, heavy rains and storms, prolonged droughts and frequency of hurricanes, etc.

Due to the increased frequency of extreme weather and climatic events, developing countries, including Uganda, are finding it difficult to cope with extreme weather and climate events whose impacts have the potential to undo decades of development efforts. These events have been witnessed before and will continue to face the same challenges if nothing is done. Yet, these countries have limited resources to cope with the challenges of climate change.

Chapter I: Analysis of Climate and Climate Change Situation in Uganda

2.1 Uganda's Weather and Climate

Uganda's equatorial climate provides plentiful sunshine, moderated by the relatively high altitude of most areas of the country. Mean annual temperatures range from about 16° C in the south-western highlands to 25°C in the northwest; in the northeast; however, temperatures exceed 30°C about 254 days per year. Daytime temperatures average about 8–10 degrees warmer than nighttime temperatures in the Lake Victoria region, and temperatures are generally about 14 degrees lower in the south-west.

Rainfall is well distributed except in the northeast of the country. The southern region has two rainy seasons, usually beginning in early April and again in October. Little rain falls in June and December. In the north, occasional rains occur between April and October, while the period from November to March is often very dry. Mean annual rainfall near Lake Victoria often exceeds 2,100 mm, and the mountainous regions of the south-east and south-west receive more than 1,500 mm of rainfall yearly. The lowest mean annual rainfall in the northeast is about 500 mm.

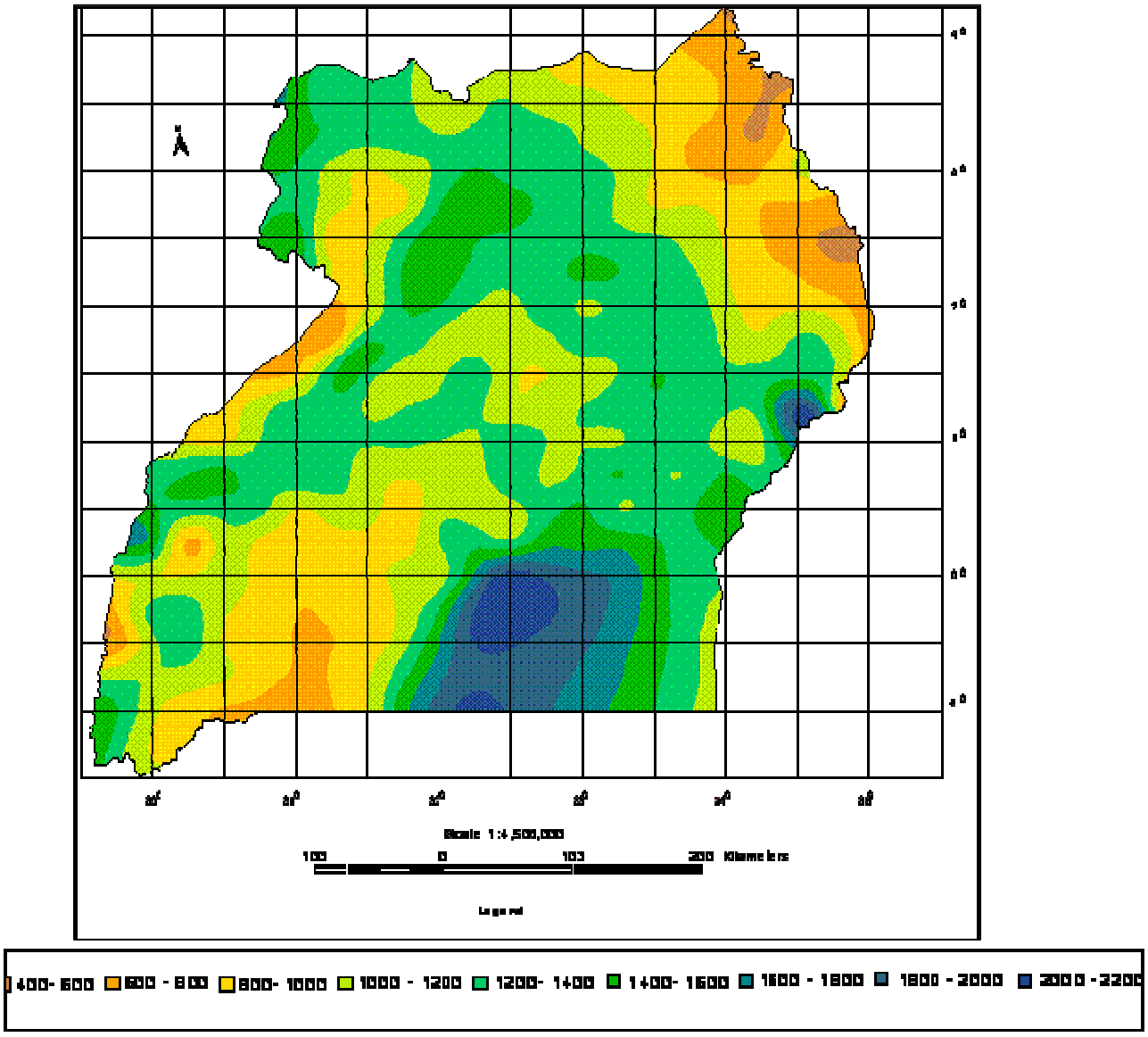
a) Rainfall

In Uganda, rainfall is the most sensitive climate variable that affects social and economic activities. Figure 1 shows the mean annual rainfall distribution in the country. The wettest districts are located within the Lake Victoria Basin, the eastern and the north-western parts of the country. These areas include Kalangala, Kampala, Mpigi, Mukono, Jinja, part of Masaka and Bugiri (Lake Basin), Mbale and Kapchorwa (eastern) and Arua (north-western). It has been observed that rainfall events are heavier and more violent than before. This is consistent with the Intergovernmental Panel on Climate Change (IPCC) prediction that wetter areas will become even wetter. The western, northern and northeastern districts are experiencing long droughts, which are becoming more frequent. The eastern region, including Pallisa, Kumi, Soroti, Tororo, Busia and Bugiri, receives moderate rainfall. The average long-term annual rainfall for Uganda is about 1,318 mm, which is adequate to support agricultural activities. However, recent years have witnessed erratic onset and cessation of rainfall seasons. This together with increasing frequency of droughts has made Uganda more vulnerable to climate change.

b) Temperature

Uganda experiences moderate temperatures throughout the year. The mean daily temperature is 28^{o}C. Extreme temperatures as low as 4^{o}C are experienced in Kabale, which is located in the western highlands. Temperatures below 0^{o}C are experienced on the mountain ranges of Rwenzori and Mount Elgon. Rwenzori has a permanent ice cap, which is vulnerable to global warming. The highest temperatures, those above 30^{o}C, are experienced in Gulu, Kitgum and Moroto in the north and north-eastern part of the country.

Figure 1: Mean Annual Rainfall in Uganda, 2002



Source: Department of Meteorology, 2002

2.2 Is Uganda's Climate Changing?

Climate, probably the most important natural resource in the world, necessary for the well-being of all the other natural resources, has always varied naturally. However, the rising concentrations of GHGs in the earth's atmosphere, resulting from both economic and demographic growth since the industrial revolution, are overriding natural variability and leading to potentially irreversible climate change.

With current knowledge, evidence and experience, the question today is no longer whether climate will change in response to an atmospheric build-up of GHGs. Rather, questions concern the magnitude, rate of change and the regional patterns of climate change and climate-

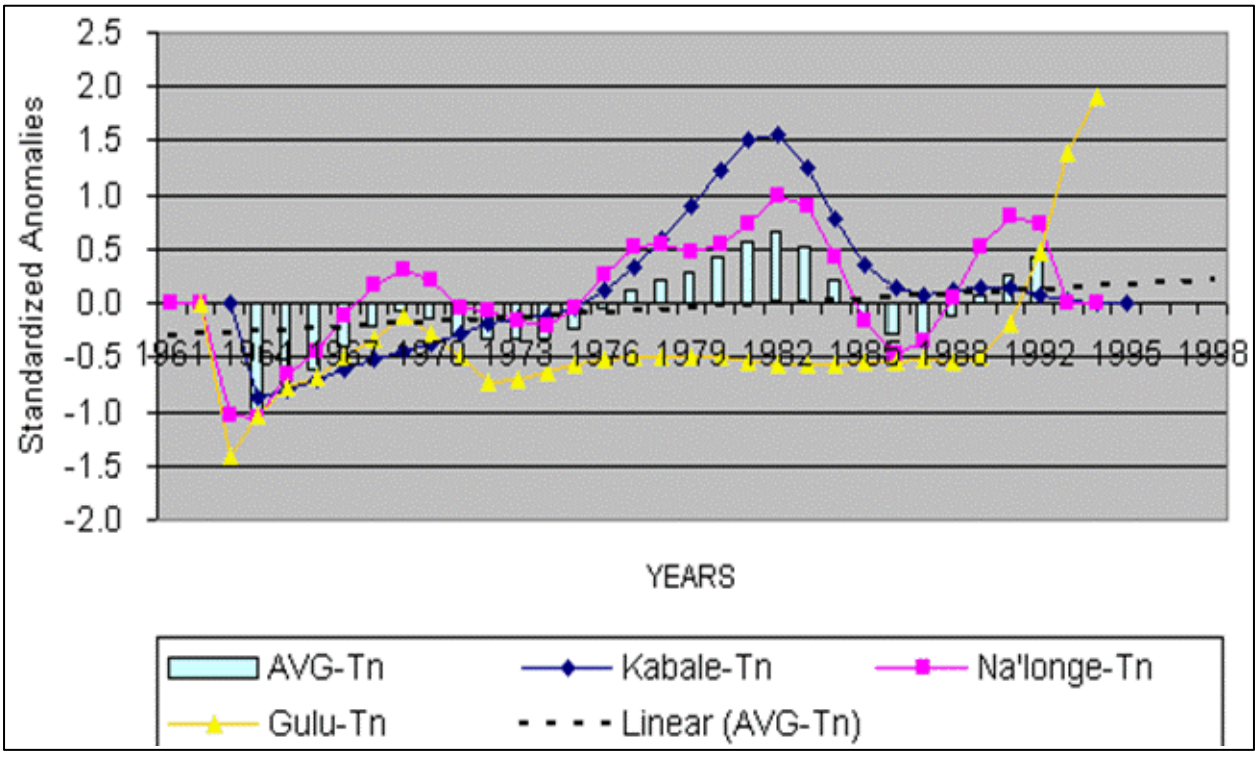
change-related impact and how the most affected countries such as Uganda should cope? How should the international community deal with this catastrophe?

It is clear, however, that climate change will continue to adversely affect socio-economic sectors, including water resources, agriculture, fisheries, human settlements, ecological systems (particularly forests), and human health, particularly diseases such as malaria and cholera. Developing countries such as Uganda, which is one of the least developed countries, depend on these sectors for their economic and social wellbeing. These countries are and will continue to be the most vulnerable.

Scientific evidence

The scientific evidence is now overwhelming. The world is warming and Uganda is no exception. According to IPCC reports (2001), in the 20th century, Africa warmed by 0.7°C. Precipitation in East Africa also increased. In the 21st century, projected warming for Africa ranges from 0.2 °C per decade (low scenario) to more than 0.5°C per decade (high scenario). Increase in precipitation from December–February (wet months) is estimated at 5–20 percent, and decrease in precipitation from June–August (dry months) at 5–10 percent. For Uganda, analysis shows sustained warming, particularly over the southern parts of the country. The fastest-warming regions are in the south-west of the country where the rate is approximately 0.3°C per decade. The minimum temperature is rising faster than the maximum temperature. The year-to-year variation in annual mean, maximum and minimum temperatures over selected stations in Uganda are shown in Figure 2.

Figure 2: Mean Minimum Temperature Anomalies: Selected Regions, 1961–1998



Source: NAPA, 2007

In 2007, in northeastern Uganda, the historical floods and the decline of the Lake Victoria water levels in 2005/2006 should therefore not be surprising. Thus, climate change presents very serious global, regional and national challenges and risks. It is a reality whose impact is being experienced in various forms, such as increased frequency of droughts, floods, and hail storms with associated outbreaks of water-borne diseases and melting of ice caps on tropical mountains. It is everyone's responsibility to rise to this challenge. This report shows the challenges to strategies for eradicating poverty caused by climatic extremes. It proposes appropriate strategies to adapt to climate change.

Climate change-related disasters in Uganda

Past experience in Uganda shows that El Niño and La Niña episodes coincided with the most severe climate change-related disasters in Uganda. During a year of La Niña, the chances of drought conditions – often leading to famine conditions, during the November to April/May period of the following year – are increased, especially over the eastern areas of the country. On the other hand, during an El Niño year, chances of intense flood level rains are increased during the October to December period over most parts of the country. The intense flood-level rains are reflected in increased incidences of intense lightning and thunderstorms, hailstorms and windstorms. The widespread flooding leads to destruction of life and property, and increased outbreaks of water-borne diseases such as cholera and dysentery.

Table 1: Landmark Climate Change-Related Disasters in Uganda

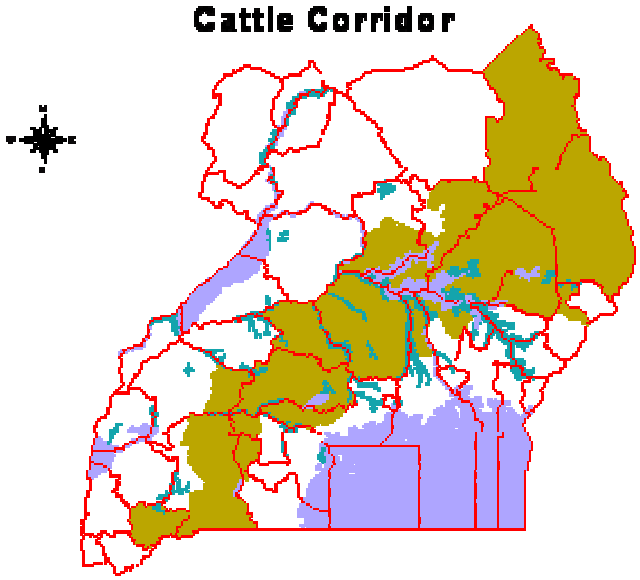
Year	***Nature of Disaster***	***Impacts***
1961/1962	El Niño rains	• Extensive floods experienced in many parts of the country • Roads, bridges, houses, crops and property, worth millions of dollars (actual loss not established) destroyed; • Drastic rise in the water level of Lake Victoria (by 2.5 M, submerging all major infrastructure along the lake shores.
1993/1994	Drought and famine	• Over 1.8 million people affected due to lack of food, water, and inadequate pasture for livestock.
1997/1998	El Niño rains	• 53 people killed in landslides and over 2,000 people displaced; • Roads, bridges, houses, crops, and property, worth more than US$20 million destroyed.
1999	Drought and famine	• Over 3.5 million people in 28 districts affected by lack of food and a large number livestock suffered from inadequate pasture and water.

Source: PEAP, 2004

The 1997/1998 El Niño, the most severe weather phenomenon in Ugandan history, resulted in one of the worst widespread record floods witnessed by the country in over 50 years. The floods mainly affected the eastern and central parts of the country, where several people died, transport infrastructure was damaged, crops and homes were destroyed, and thousands of

people were displaced from their homes. There were severe landslides experienced in the mountainous areas of eastern Uganda, where many people and homes were buried and much property destroyed. The El Niño of 2002, which also resulted in moderate floods, also affected the east of the country. On the other hand, during the 1998/1999 La Niña, severe drought was experienced, especially in the south-east of the country. There were massive crop failures in many parts of the country, which resulted in widespread famine. The Government and relief agencies carried out the necessary interventions to avert the human suffering caused by this drought. The drought mostly affected the 'cattle corridor', which covers 18 districts, where there was a complete lack of pasture and water for livestock.

Figure 3: The cattle corridor in Uganda shaded brown



Source: NAPA, 2007
Note:
Indigo areas = lakes
Blue areas = rivers
White areas = districts not in cattle corridor

According to the NAPA report of 2007, in terms of climate change-related disasters, Uganda is most affected by droughts followed by storms and landslides, as shown in the Table 2.

Table 2: Major Climate Change Disasters in Uganda

Disasters reported in districts	**% Respondents**
1. Droughts (frequent and prolonged)	25
2. Storms (wind, rain, thunder, lightning and hailstones)	21
3. Floods	12
4. High temperatures	12
5. Pests and disease epidemics	13
6. Heavy rains	10
7. Landslides	7

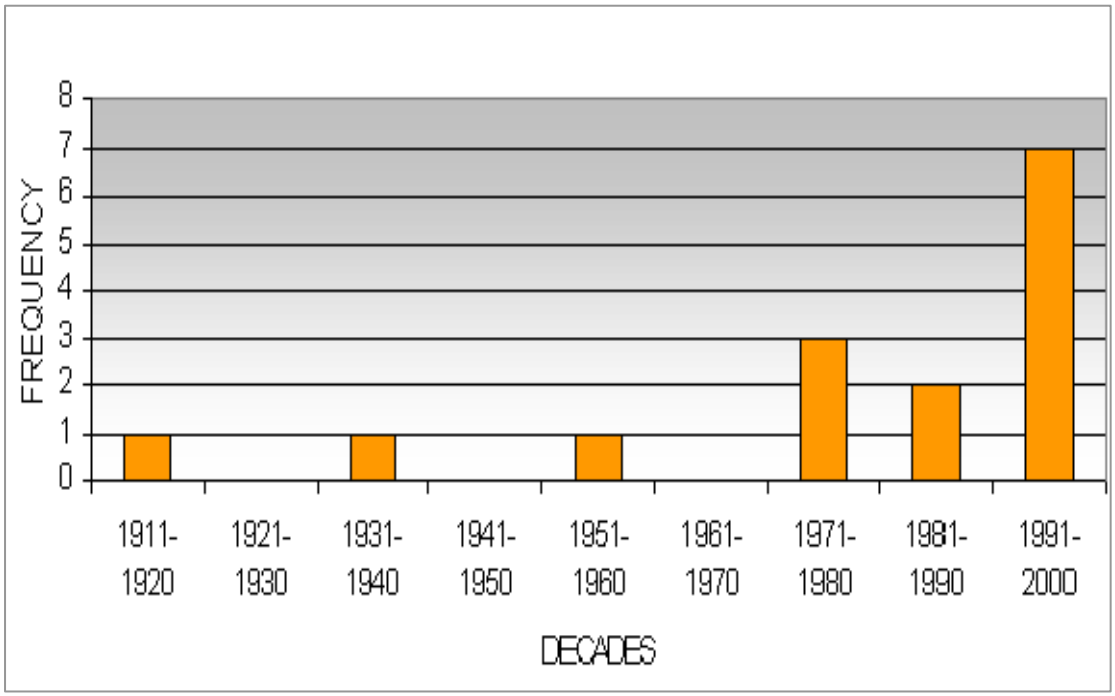
Source: Uganda NAPA Report, 2007

Selected evidence of climate change

a) Increasing frequency and intensity of droughts

Uganda experienced seven drought episodes in one decade (1991–2000) (Figure 4). It is also estimated that, on average, losses due to bad weather can reach 30 percent of the annual agricultural production and can also result in total loss at micro levels. Evidence also shows that the use of weather and climate information will reduce the agricultural losses and vulnerability of the rural poor. At least 10 percent of these losses could have been avoided by proper use of weather and climate information. Climate change has manifested itself in Uganda through several ways, including increased frequency of high temperatures, droughts, leading to food insecurity, and wild fires. These extreme weather and climate events have come to characterize weather and climate patterns in most parts of the world, including Uganda. It is predicted that the frequency and intensity of extreme weather events will continue to increase with increasing climate change.

Figure 4: Frequencies of Droughts in Uganda, 1911–2000



Source: Uganda NAPA report 2007

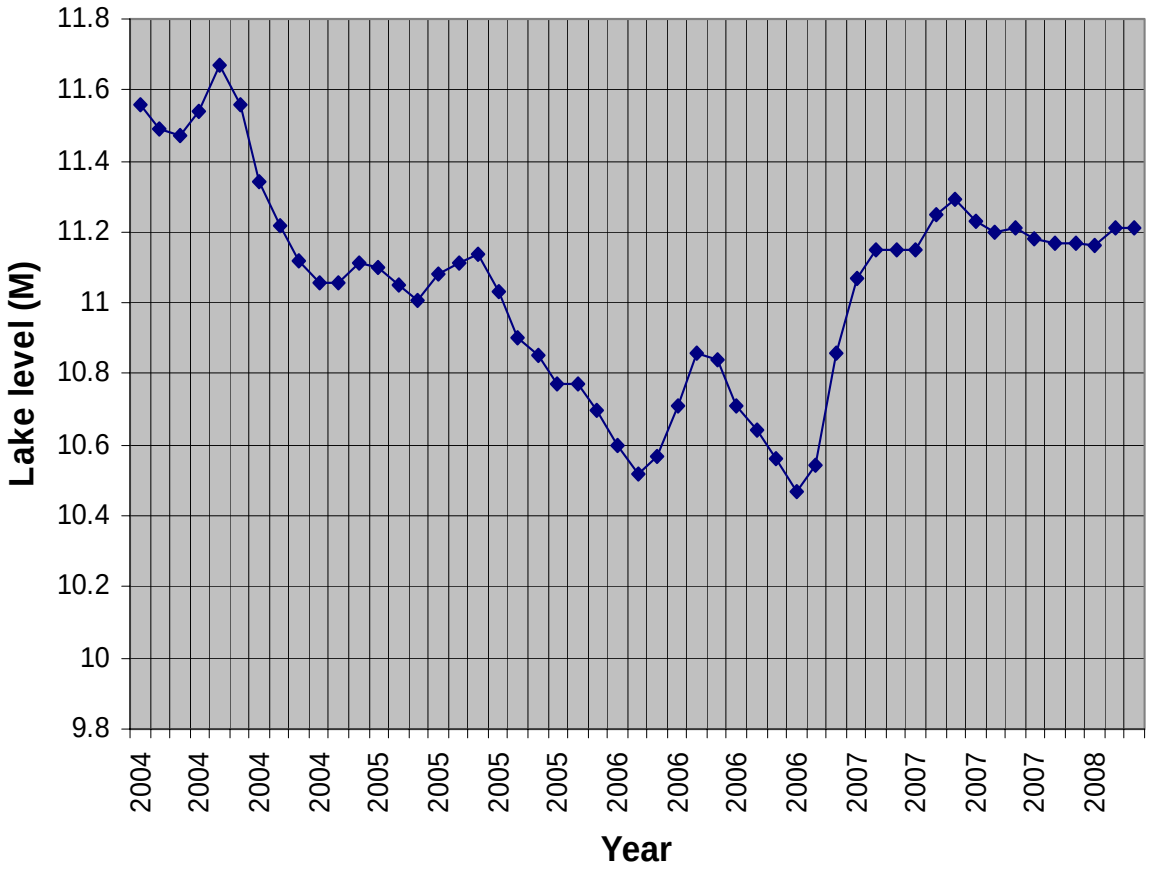
Droughts significantly affect water resources, hydropower production and agriculture, among others. The high frequency of droughts persisted after 2000. Uganda felt the effect of this disaster in 2004/2005, when production of hydroelectricity significantly declined, throwing the country into a power crisis that undermined investment and retarded the country's economic growth.

(b) Declining water levels in Lake Victoria

Figure 5 shows the decrease in Lake Victoria levels from 2004 to 2008. The effect of the decrease in Lake Victoria levels is reflected in the hydropower production and supply of the

two hydropower plants, Nalubale (Owen Falls) and Kiira Dam, as shown in the subsequent figures and literature.

Figure 5: Impact of Climatic Extremes on Lake Victoria Water Levels, 2004–2008



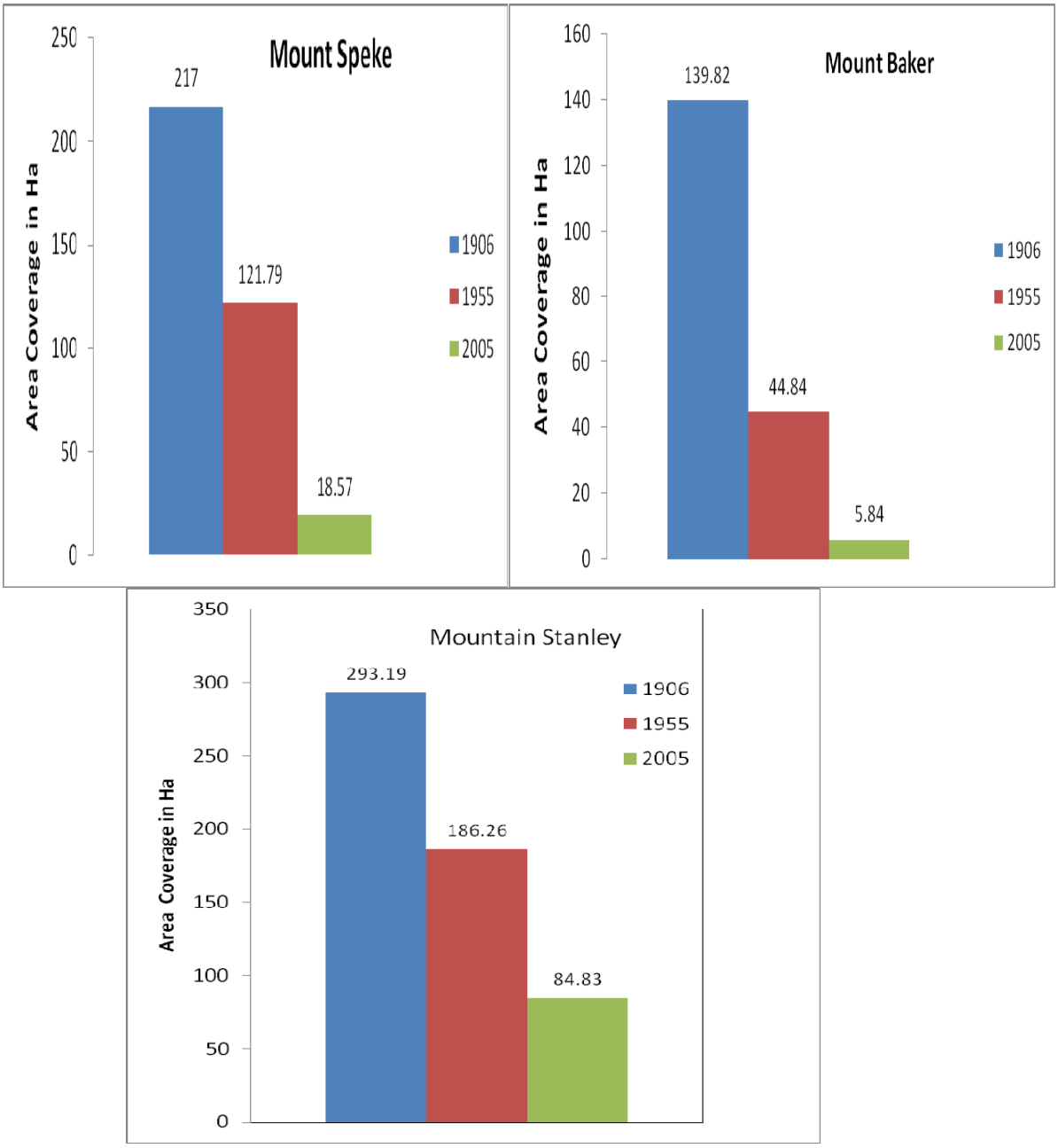
Source: Data from Uganda Electricity Regulatory Authority Annual Reports (2004-2008)

c) Melting of the ice caps of Rwenzori Mountains

The ice cap on the Rwenzori Mountains is also retreating, as indicated in Figure 6, which shows the extent of its disappearance. The rate of ice loss is highest on Mount Baker (96 percent) followed by Mount Speke (91 percent). Mount Stanley has the lowest rate of ice lost (68 percent).

The melting of the ice cap on tropical mountains has a negative effect on both water catchments downstream and eco-tourism, as well as on the overall economy. The cultural loss due to melting of the ice caps cannot be measured. The glaciers of Rwenzori Mountains supply clean water to over 1,000,000 people in the Democratic Republic of the Congo and Uganda.

Figure 6: Rate of Melting of Glaciers on the Rwenzori Mountains – Mts. Speke, Baker and Stanley



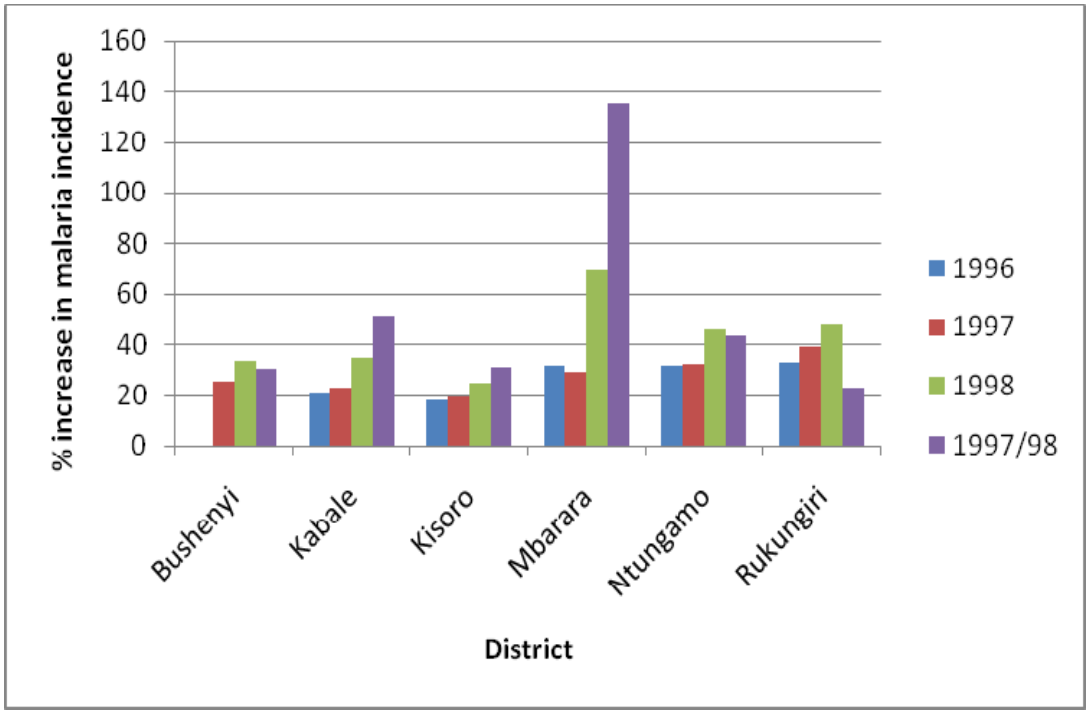
Source: Taylor et al. 2006

d) Alteration and expansion of malaria incidence into the highland areas of south-western Uganda

In the past, malaria was not a disease of the cold highland areas of the then Kigezi District. Now, however, there is a general increase of malaria incidences throughout the country, particularly in the south-west, where it has reached epidemic proportions. Data from health units in the districts of south-western Uganda in 1996, 1997 and 1998 reveal an increase in

malaria cases from 23 percent in Rukungiri to 135.5 percent in Mbarara District (Ministry of Health, 1998).

Figure 7: Malaria Incidence: Comparison of 1996, 1997 and 1998 cases (February)



Source: Ministry of Health, 1999
Note: The 1997/1998 legend represents % increase between the two years.

2.3 Climate Change Impacts and Threats to Uganda's Economic Development

The anticipated impacts of human-induced climate change will affect people differently depending on their livelihood strategies and asset base; hence, some groups are more vulnerable than others. Vulnerability refers to the potential to be adversely affected by an event or change. IPCC considers vulnerability as a function of three aspects of a system: its exposure, sensitivity and adaptive capacity. Exposure refers to the physical hazards or changes that a system experiences due to global warming. The sensitivity of a system and its economic activities to particular climatic changes, such as reduction in rainfall, also shapes vulnerability. Some authors emphasize the state or performance of individuals, groups or systems in terms of their ability to secure livelihoods or basic needs, such as health, education, food and income as the most important aspect of vulnerability. A system that is already performing poorly in these aspects may find that the additional stress of a climatic change triggers severe effects in terms of loss of lives, health, income and welfare. In addition, the ability to cope with or recover from impacts as well as the capacity to adapt to longer-term changes may be poor. Vulnerability may be considered at the individual, household, village and national level. Adaptation to climate change refers to responses to actual or expected climate changes and/or their effects. According to the IPCC, such responses include changes in processes, practices or structure, either voluntarily or planned, to minimize potential damage or to take advantage of opportunities associated with changes in climate. Effective adaptation strategies imply

reducing present and future vulnerability to climate change and applying coping strategies or changes in practices and processes in light of the perceived climatic change. Such actions can be taken by individuals, households, governments and other stakeholders. Adaptation may include policy measures that reduce vulnerability and enhance adaptive capacity, or the ability of people and systems to adjust to climate change.

The issue of climate change may seem remote compared to immediate problems such as poverty, disease and economic stagnation. Yet, climate change can directly affect the efficiency of resource investments and the eventual achievement of many development objectives. How development occurs also has implications for the vulnerability of societies to its impacts. Partner countries and donors have already initiated a number of activities to integrate adaptation within development activities, although more efforts are clearly needed to ensure systematic integration.

Climate change threatens to undo decades of development efforts in a short time, as has been witnessed in some regions of the country. For example, floods in the northeastern region destroyed property worth over US$80 million as well as causing loss of lives. The 2007 hail storm in western Uganda destroyed considerable agricultural produce and structures. Central region droughts that caused a decline of Lake Victoria waters led to a sharp drop in hydropower generation, plunging the country into an energy crisis that immediately slowed down its economic growth, particularly in the industrial sector. In a bid to provide power, the Government had to pay heavily to introduce an alternative energy source (expensive thermal power unit); it has continuously been paying heavily to subsidize thermal power units to make electricity affordable to local consumers.

To date, there have been two major efforts to quantify the degree of exposure of development investments to climate risks by the World Bank, which analyzed its own investments, and by the Organization for Economic Development (OECD), which examined investments by all donors in developing countries. Both studies conclude that a significant share of development investments should be in activities affected by climate risks.

With increased frequency of extreme weather and climate events, poverty has progressively increased and the Government's development's efforts have continuously been frustrated. The Government has often diverted resources earmarked for development programmes to help people cope with impacts of extreme weather and climate events. An example is the 2007 northeastern floods. The MDGs, whose chief objective is to eradicate poverty, have continuously been frustrated by climate change and variability worldwide, including in Uganda, which, has been the hardest hit in the world by extreme weather and climate events.

Climate change impacts on sectors and communities

a) Background macro-economic situation

In the 2005/2006 financial year, the economy grew by an average of 5.3 percent, a reduction from 6.6 percent in the 2004/2005 financial year. The reduction in growth mostly resulted from a prolonged drought, leading to reduced agricultural production and electricity generation. The economy has been hit hard by the reduction in hydro-electricity generation capacity due to falling water levels in Lake Victoria. GDP growth for 2006/2007 is projected at 5.9 percent,

below the target of 7.0 percent, a declining trend that undermines poverty reduction efforts. Industrial output has been the hardest hit by the electricity shortages, declining by 6.3 percent from the last financial year. A significant portion of the country's expenditure continues to be funded from external sources. In the 2006/2007 budget financial year, 41 percent of government spending was financed by development partners.

Average inflation for the year ending June 2006 rose to 7.5 percent compared to 6.1 percent a month earlier. The composite food index for August 2006 increased by 1 percent. Prices of matoke (plantain) went up in all trading centres except Mbale. Similarly, in most trading centres, increases were registered in the prices of certain vegetables, especially cabbage, bitter tomatoes and beans, as a result of prevailing weather, climate and climate change conditions. Prices of meat and milk went up in a number of centres due to reduced supplies from producing areas arising from restrictions on animal movements and dry conditions. On the other hand, fruits and cereals registered lower prices in most centres due to ongoing harvesting.

Today, climate change and climate variability are the single greatest threat to socio-economic development the world over. The poorest in any community are the most vulnerable to these negative impacts. Uganda is among those countries that are expected to be most affected by the impacts of climate change. There is scientific evidence – and Uganda has begun to experience this – that the frequency and intensity of extreme weather events will increase with increasing climate change and climate variability.

b) Magnitude of climate change damage and wealth wastage nationally

It is difficult to establish the exact social and economic impacts of most climate change disasters in Uganda due to lack of a systematic approach and mechanism for collecting the relevant data and information. In most cases, the Government /or government agencies and other relief agencies are only interested in offering relief aid to the affected persons during such disasters, but no effort is made to comprehensively assess and document causes, extent and the social and economic impacts of the disasters. Worse still, as soon as the disaster is contained, it is totally forgotten, and no effort is made to document lessons learned for future reference. However, retrieved data from credible reports have been used to model estimates in monetary terms as indicators of climate change damage and impacts.

The relative cost of climate change damage/impacts in Uganda has been calculated from estimates of damage provided by *The Second United Nations World Water Development Report* (2006) and the *Uganda Energy Sector Report* (2007). It is documented that in Uganda, climate change, water-related disasters, such as droughts, floods, landslides, windstorms and hailstorms, contribute well over 70 percent of the natural disasters and destroy annually an average of 800,000 ha of crops, resulting in economic losses of over U Sh120 billion. Second, economic losses resulting from transport accidents and fires and other climate change-related disasters are estimated at U Sh50 billion annually. Third, the persistent climate change-related droughts and alterations in precipitation have resulted into a lowering in Lake Victoria water levels. The consequences peaked in 2005/2006 with a severe shortfall in hydropower of 148 GWh, equivalent to about U Sh 37 billion. This energy and revenue loss is added to other costs and losses involved in emergency energy responses, industrial and institutional losses due to power cuts. Further, there are additional sector losses, e.g. in the health sector, which are due to emergency responses resulting from water-related epidemics such as cholera and malaria.

Figure 8 summarizes the estimated share of climate change damage relative to the share of selected sectors in Uganda's public funding.

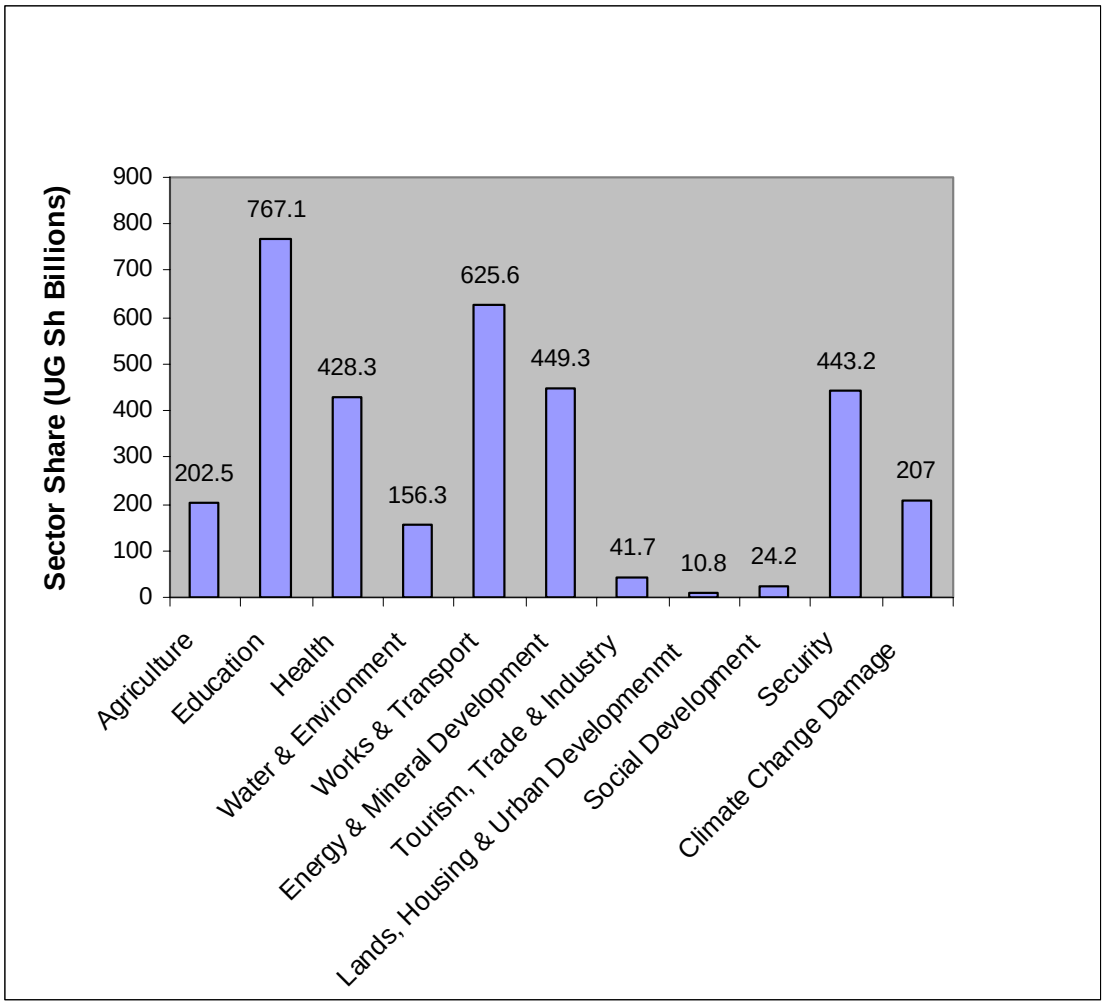
The budgetary allocations used here concern the 2007/2008 fiscal year. Climate change damage is equivalent to over 4.4 percent of the national budget. The cost of the damage actually exceeds each of the budget allocations for four of the sectors including water and environment, whose budget share is 3.3 percent.

Table 3: Share in Public Funding of Selected Sectors Relative to the Cost of Climate Change Damage/Wastage in Uganda, 2007

Sector	**Sector share (%) of national budget**
Agriculture	4.3
Education	16.1
Health	9.0
Water and Environment	3.3
Works and Transport	13.2
Energy and Mineral Development	9.4
Tourism, Trade and Industry	0.9
Lands, Housing and Urban Development	0.2
Social Development	0.5
Security	9.3
Climate change damage	**4.4**

Source: Budget Report 2007

Figure 8: Comparison of Sector Budgets and Climate Change Damage/wastage in Uganda



Source: Budget Report, 2007/2008

The year 2007 witnessed a widespread occurrence of extreme weather and climate events, with floods being the most widespread all over the world. In Uganda, the 2007 floods most heavily affected the eastern and northern parts of the country, and clearly demonstrated the country's vulnerability to impacts of adverse effects of climate change. A statement of the Ugandan Minister of Transport and Works highlighted this: "*We are prepared for* Commonwealth Heads of Government Meeting, *but not for the floods***.**" These floods heavily destroyed infrastructure, notably roads, bridges and buildings, killed human beings, destroyed crops and threatened security in the area. The small and newly created district of Amuria was hardest hit by the rain, the heaviest in 35 years, which also destroyed 18 bridges (*Daily Monitor News Archive*, September 2007).

Photo 1: Floods in Pader District, September 2007
Source: Daily Monitor News, September 2007

"*Hundreds of students from northern Uganda could not go back to school yesterday due to the floods that had washed away the bridges along Aswa River, cutting off some Acholi districts from the rest of the country, this of course a threat to national security*" (*New Vision News* archive, September 2007). Piska Laker, 30 years old, an employee of Médecins Sans Frontières in Gulu, was also stranded on the road as she was trying to take her children back to school in Kitgum. "*I am really stranded here with my children. Let our MPs come and see the bridge for themselves and tell the Government how serious the problem is*," she complained (*New Vision News* archive, September 2007).

c) Climate change and agricultural productivity trends

The productivity, profitability and continued expansion of the agriculture sector are critical to the well-being of millions of Ugandan households. In 2007, agriculture was the source of employment for 70 percent of the labour force.

Productivity growth in Ugandan agriculture has resulted primarily from area expansion and not from intensification of production resulting in higher yields. According to the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF, 2002), estimated average yields in recent years have been from 1.5 to 1.8 mt/ ha for maize, from 5.5 and 6.0 mt/ha for cooking banana, and less than 1.0 mt/ha for most pulses. The yield gap between average farm yields and research yields indicates that there is immense potential for sustainable improvements in crop productivity. The livestock sub-sector has exhibited more encouraging trends as producers respond to increasing demand for milk and meat in local markets. Livestock production has grown at more than 4 percent annually during the past ten years.

Both the productivity and the profitability of agriculture enterprises are constrained by a range of broader development challenges for Uganda. These include extreme weather events, e.g. droughts and floods, and limited market information accessed by these producers, which hampers their bargaining power. Transport costs are high, increasing transaction costs along commodity value chains serving local, regional, and international markets, while also making the use of commercially supplied inputs such as improved seed, inorganic fertilizer and veterinary supplies prohibitively costly for many smallholders. Local institutional issues, including unpredictable local government taxation and inadequate oversight in the operations

of farmer and other cooperative groups, also pose important challenges to farmers seeking to develop prosperous agricultural enterprises. Climate change-related disasters such as droughts, floods, landslides, windstorms and hailstorms contribute well over 70 percent of the natural disasters and annually destroy an average of 800,000 ha of crops, resulting in economic losses of over U Sh120 billion. The increasing intensity and frequency of climate change or climate change-related disasters has escalated farmers' risks and losses, and is now a major reason for the disparity between the crop and livestock productivity and sub-sector growth. In Mbarara, for example, hail storms in 2007 (photo 2) greatly affected the production of matoke in the region, subjecting the residents to food shortages, and the subsequent days after the hailstorm registered significant increase in matoke prices all over the country, which consequently increased the inflation rate. Hail storms affect livelihoods as well, as shown in photo 2.

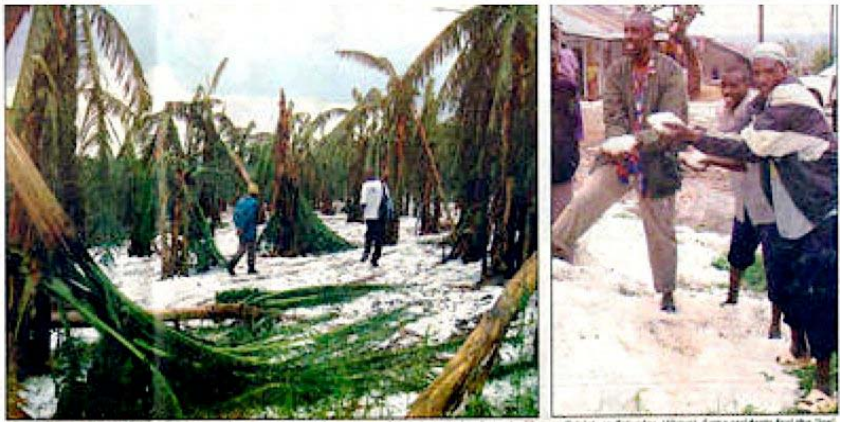


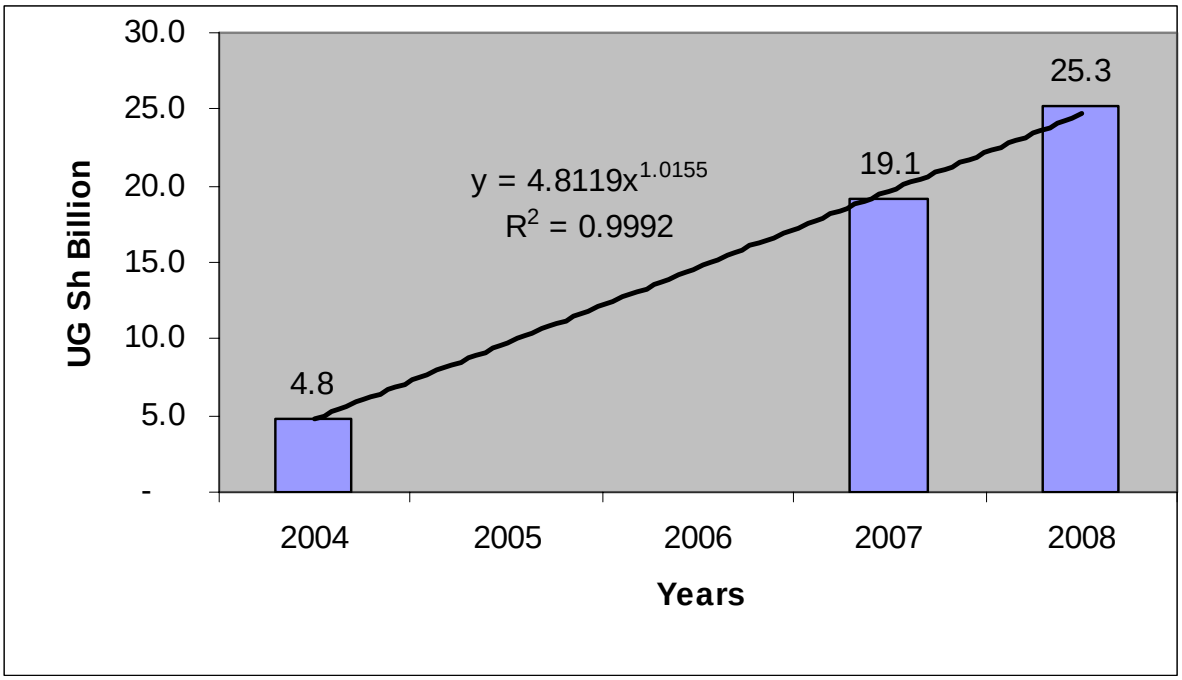
Photo 2: Hail storm damage and hail in Kashaka, Kashari, Mbarara District, Uganda

d) Climate change and food security/nutritional adequacy

The economic strategies pursued by Uganda during the past two decades have been somewhat pro-poor. The proportion of the population living in poverty decreased from 56 to 31 percent between the late 1980s and 2006, although the decline was not always consistent and the actual number of poor people increased. Advances have been achieved in ensuring food security and addressing under-nutrition. However, the successes in poverty reduction in Uganda are not fully reflected in the food security and nutritional well-being of the population. Levels of child stunting in the country have declined during the past ten years: 35.5 percent of children fewer than five years of age stunted for their age in 1995, compared to 28 percent in 2006. Similarly, the proportion of people suffering from inadequate calorie consumption has fallen during the past two decades. However, the rate is not fast enough to bring about substantial reductions in food insecurity. The number of people who live with inadequate calorie consumption – 14 million Ugandans in 2002 – has increased in 2008 to 68% of the total population (27 million), Masika, FAO representative (*New Vision*, September 2008) due to population growth during this period and to increased incidence of climate change disasters that continue to disrupt food production and incomes. Analysis of records from WFP (Figure 12) reveals that climate change-related nutritional insufficiency and burden among Ugandans is on the increase, especially in the hot spot areas such as Karamoja region. WFP intervention costs increased more than five times, from 4.8 billion in 2004 to 25.3 billion in 2008. This burden excludes

costs incurred by other government interventions and the actual damage caused in the region in terms of infrastructure, crop and animal production, health interventions and market losses. Figure 9 shows that the cost of intervention increased more than five times from 2004 to 2008.

Figure 9: Trend of WFP Expenditure on Victims of Climate Change-Related Extreme Events



Source: WFP statistics 2008

e) Climate change and the fishing industry

The fishing industry, heretofore the second largest export earner, has been severely and negatively impacted, resulting in a tremendous decline in the fish population in Lake Victoria. The decline of water level in lakes, rivers and open water aquifers, together with unsustainable fishing pressure, greatly affect the fish population. Fish normally lay eggs at the banks of lakes/rivers. When levels of water decrease the exposed eggs die, resulting in less young stock in these water bodies. Lake Victoria was producing about 3 tonnes of fish per day in the early 1990s, but it has now decreased to 1 tonne. Those whose livelihoods solely depend on fishing are stressed both economically and socially to cope with such impacts of climate change. It is therefore high time to ensure and implement sustainable water resources management policies.

f) Climate change and energy adequacy

Hydropower is the major source of electrical power, the most abundant and cheapest electrical power source in the country. Uganda has a comparative advantage in hydropower resources in the region. Most of its hydropower potential is concentrated along the White Nile, with a total estimated potential of 2,000 MW. In addition, there are also several small rivers in different parts of the country (Table 5), with a potential for mini- and micro-hydropower development.

Almost all of Uganda's current hydropower is generated at Kiira and Nalubaale (Owens Falls) stations located at the outlet of Lake Victoria, which is part of the Nile system. There are also a few small-scale hydropower schemes contributing a total of 20 MW. Currently, domestic power demand exceeds the available supply by as much as 80 MW during peak periods, and is growing at the rate of 8 percent per year. Load shedding is common, and the shortfall in generation capacity is limiting growth in many sectors of the Ugandan economy.

The Government formulated a Hydropower Development Master Plan (Kennedy and Donkin, 1997) to guide the hydropower planning and development process in the country. This Plan includes a comprehensive study of all the potential large- and small-scale hydropower schemes on the White Nile and on all non-Nile rivers in the country. It also outlines a well-documented energy development strategy based on power demand forecasts, historical Lake Victoria hydrology, project generation potential, environmental effects and cost criteria.

However, being climate-, weather- and climate change-dependant, hydropower development and production have already suffered a setback due to the recent declines in Lake Victoria water flows.

Table 4: Major Current and Projected Hydropower Schemes in Uganda

Site	*Current Installed Capacity (MW)*	*Max. Potential (MW)*	*Proposed Installed Capacity (MW)*	*Status*	*Comm Date*
Owen Falls	180	-	-	In Operation	1954
Owen Falls Extension	-	-	200	Partly Commissioned. (120MW from 3 units). The other 2 units are to be commissioned by June 2005.	2000
Bujagali	-	320	250	Negotiations in progress	2005
Kalagala	-	450	350	Feasibility study completed	N/A
Karuma	-	180	150	Feasibility studies completed, negotiations in progress	N/A
Ayago South	-	234	N/A	Preliminary studies available	N/A
Ayago North	-	304	N/A	Preliminary studies available	N/A
Murchison	-	642	N/A	Preliminary studies available (has adverse environmental effects)	N/A

The dramatic fall was attributed to high evaporation from the lake surface, low rainfall in the headwaters of the rivers draining into the lake, and the excessive removal of water for power generation from Owen Falls Dam to meet the growing demand for electricity in the country; this, however, had a toll on overall hydropower generated.

Photo 3: Nalubaale Power Station (Owen Falls Dam)

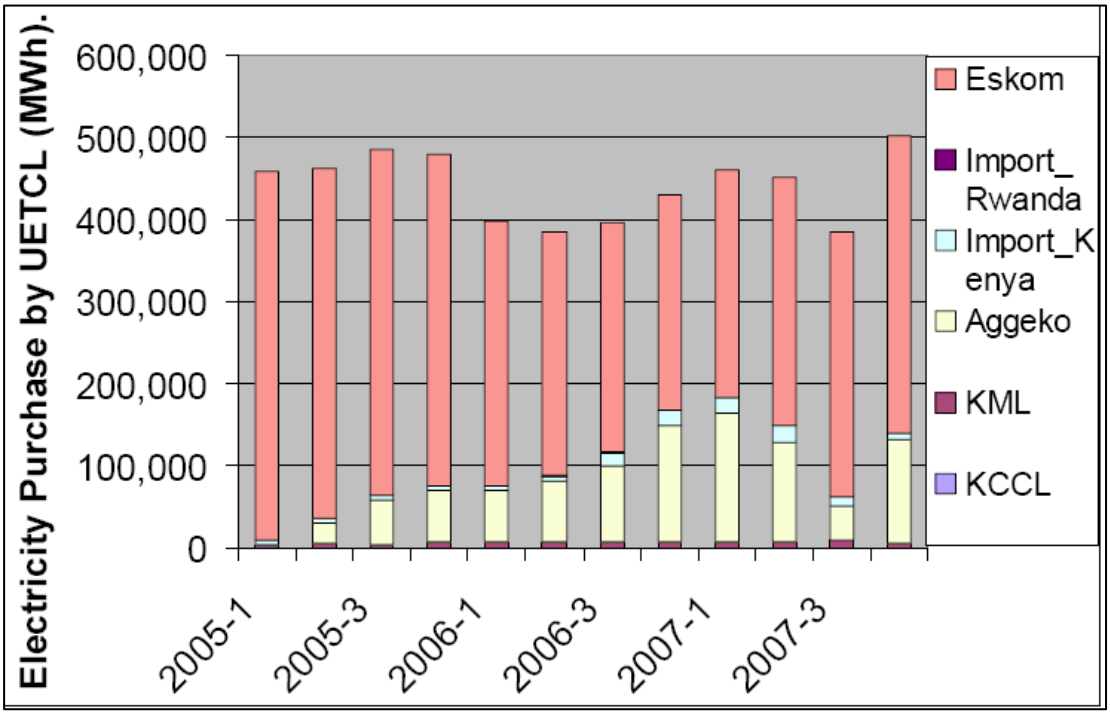
Recent lowering of the water level of Lake Victoria has reduced water supply to the power station resulting in power shortage. Low water levels can be observed by the decreased fountain at the turbines exit.

2006. With reduced water availability for power generation in Lake Victoria, the only source of water for the Owen Falls Dam, the country experienced unprecedented power reduction, which caused a rationing of the industrial and domestic sectors. The shortage of power caused the interruption of economic activities and had an overall negative impact on the country's economy and the livelihoods of its people.

To meet the demand for electricity, the Government resorted to expensive thermal power, which escalated electricity tariffs from U Sh216 to U Sh426 (US$0.13 to US$0.25) per unit of domestic consumption. Figure 14 illustrates the quarterly electricity supply for three years, 2005–2007. The total grid supply was highest in 2005, at 1,857GWh.

In 2006, the grid electricity supply decreased, however, to 1,609 GWh due to climate change persistent droughts that resulted into very low levels in Lake Victoria. This shortfall (148 GWh) was equivalent to a loss of about U Sh37 billion, considering that an energy unit (KWh) cost a conservative average of U Sh250 at the time.

Figure 10: Quarterly Electricity Supply, 2005–2007



Note:
KML *Kilembe Mines Ltd.*
KCCL *Kasese Cobalt Company Ltd.*
Source: Ministry of Energy and Mineral Development, 2007

One result of higher electricity prices has been increased pressure on forest resources. Almost all households (95 percent) in the country use wood fuel (fuel wood or charcoal) to meet their energy needs. With the exorbitant power tariffs, dependence on tree and forest products for fuel has been heightened even further. Urban populations that generally used electricity for cooking reverted to use of wood fuel. The demand for wood fuel then surpassed the supply, causing the prices of charcoal and fuelwood to skyrocket. An offshoot of this dynamic has been increased deforestation in unsustainably managed forests, especially private natural forests, as wood fuel suppliers seek to meet the increased demand and take advantage of the price boom. Many rural households have resorted to cutting their trees, including fruit trees, for fuelwood which results in forests becoming increasingly depleted. The heavy cutting of the forest, together with unsustainable slash-and-burn practices have contributed to land and soil degradation, which in turn is responsible for poor food crop yields, further threatening food security. Due to abnormally high rains experienced in Uganda in 2007, with almost no recognizable dry season during the July to September period, the Lake Victoria levels slowly rose. However, electricity generation levels have not recovered and hydropower is still being supplemented by thermal generators. Power tariffs have thus remained excessively high for poor and middle-class Ugandans, who make up the largest part of the population. Tree cutting and deforestation thus continue unabated in response to the increasing scarcity of wood fuel. Heavy rains wash away the bare soils into the lake and rivers, increasing the problem of siltation. It is feared that if and when extreme dry conditions set in, the vicious cycle will be further exacerbated, posing a threat to human life in present and future generations. Ecstatic

Photo 4: Fishers bagging charcoal for smoking fish along the shore of Lake Victoria
Fuelwood and charcoal are widely used in the country. Unsustainable wood fuel production,especially from private natural forests, is a cause of deforestation.

g) Climate change and water adequacy

Type of Irrigation	*Area (ha)*	*Relative Water Use (M^3/ha/year)*	*Total Water Use (10^6 M^3/year)*
Small-scale irrigation technologies	300	10,000	3.00
Government Irrigation Schemes	2,036	12,000	24.43
Commercial	5,282	12,000	63.38
Commercial, supplemental irrigation (Kakira Sugar Plantation)	6,800	5,000	34.00
Total	14,418		124.01

Source: DWD, 2003

Uganda's population growth rate is about 3.5 percent, while the annual growth rate of food production is about 1.5 percent. These statistics clearly indicate that the current food production levels cannot keep pace with the population growth and that the country is likely to experience acute food shortages in the near future. The Government has therefore recognized an urgent need to develop and implement programmes aimed at increasing agricultural productivity to ensure food security for the country. One of its strategies over the next 30 years is to increase cereal production by 70 percent through intensified irrigated farming. Irrigation water requirements are summarized in Table 5. However, according to projections, Uganda may become a water-stressed country by 2030.

Table 5: Irrigation Development in Uganda

Type of Irrigation	*Area (ha)*	*Relative Water Use (M^3/ha/year)*	*Total Water Use (10^6 M^3/year)*
Small-scale irrigation technologies	300	10,000	3.00
Government Irrigation Schemes	2,036	12,000	24.43
Commercial	5,282	12,000	63.38
Commercial, supplemental irrigation (Kakira Sugar Plantation)	6,800	5,000	34.00
Total	14,418		124.01

Source: DWD, 2003

h) Climate change and the education/human resources development sector

Developing, maintaining and disseminating knowledge on climate and climate change remain a major challenge and an economic opportunity to all stakeholders in the climate change sub-sector. The Government of Uganda must recognize the seriousness of this challenge and implement appropriate intervention measures to address the issues:

(i) Although most of the ENR sector personnel are highly trained and have the requisite qualifications for their respective job assignments, many of them still require specialized refresher training and advanced skills to keep up-to date with the emerging fields of climate change.

(ii) The increasing frequency of extreme climatic events such as lightening, hailstorms, droughts and floods make educational and institutional infrastructures vulnerable, such as school buildings. This vulnerability requires adjustments in the way schools are planned, designed and constructed. Thus, climate proofing in all schools and institutions is a necessity.

(iii) Free basic education, popularly known as Universal Primary Education (UPE), is one of the Government's strategies to address the low literacy rates in Uganda. The strategy provides for free primary education for all school age children. The strategy emphasizes the role of education (literacy and numeracy) in human resource development and in enhancing the quality of life for the poor. However, UPE offers few if any subjects on climate change in the curricula. There is need to integrate climate change education in the primary and secondary school curriculum as part of the basic science education at these levels. The aim of this initiative is to develop and inculcate knowledge and characteristics that will enhance a sustainable environment and healthy living, not only in the schools, but also at the community level. The education minimum standards and a basic requirements document should also spell out issues of climate change in school curricula and stress the use of climate change clubs and societies in schools to enhance the knowledge and practice of climate change management among learners.

(iv) To ensure sustainable supply of human resources to the climate change sub-sector, Makerere and other universities/ tertiary institutions with essential capacities for climate change training should offer degrees and specialization courses in climate change science and climate change disaster management. The Faculty of Arts, the

Department of Geography and the Faculty of Veterinary Medicine of Makerere University, as well as the Makerere Institute of Environment and Natural Resources offer courses related to climate change. The biggest challenge facing the universities is inadequate qualified staff. Due to the low salaries offered, it is difficult to attract and retain highly qualified staff. Motivation of students pursuing climate change-related courses needs support of the focal unit in climate change.

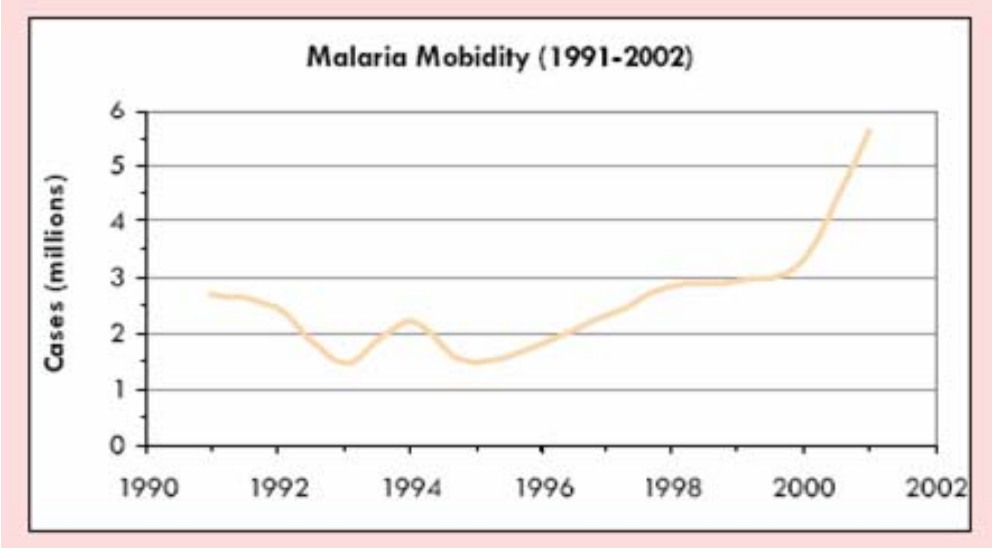
(v) The major problem still remains the low priority rating given to training and capacity-building activities by policy makers, which is evident in the small budgetary allocations channeled to higher education.

(vi) There are no government strategies to address the public's low levels of understanding of climate change issues.

i) Climate change and the health sector

The country's health sector is concerned with alleviating some of the major ongoing health issues such as malaria, water-borne diseases and malnutrition. This sector is also a user of climate information, especially on the outbreak and spread of diseases. Because of climatic changes, some disease vectors such as *Anopheles* mosquitoes move to higher altitudes, thus spreading malaria in areas such as Kabale, where malaria was rare.

Figure 11: Trend of Malaria Morbidity in Uganda, 1990–2002



Source: Ministry of Health, 2004

The Ministry of Health has and will continue to allocate huge portions of their budgets to natural disaster-hit regions if nothing is done to strategically and appropriately plan well in advance for these extreme weather and climate events.

In the recent floods in the north-east, immediate health problems were observed: in eastern Uganda, malaria and asthma were the major illnesses, particularly in children and the elderly; there was also a risk of a looming outbreak of cholera, dysentery and other water-borne diseases.

The high population growth rate of Uganda is not matched with growth in health services and wealth. Also, the high population puts additional stress on the natural resources and weak health infrastructure. The health implications of flooding are likely to be worsened by increased climate change. Developing countries are particularly at risk, because flooding brings increased risks of diseases through the spread of water-borne diseases and increased incidences of malaria, particularly in children. The indirect impacts of flooding are more severe than the direct impacts. Floods may also increase respiratory infections, skin infections and diarrhoeal diseases. Risk of infection is worsened by contaminated water sources. Climate change may lead to reduction in food production with serious consequences of malnutrition, particularly for children, leading to impaired child development and decreased adult activity. This will in turn lead to severe reduction in economic productivity and hence, a negative impact on the country's social and economic development.

In sum, climate change exerts influence on the health sector in a number of ways, including specific water-associated disease transmission. There are several ways in which water is involved in transmission of disease:

(i) *Water-borne diseases* result from the contamination of water by human or animal faeces, or by urine infected by pathogenic viruses or bacteria, both of which are more likely to occur in floods. Diseases are transmitted directly when the water is drunk or used in the preparation of food.

(ii) *Water-washed diseases* result from inadequate personal hygiene as a result of scarcity or inaccessibility of water, including water-borne diseases and typhus.

(iii) *Water-based diseases* are caused by parasites that use an intermediate host living in or near water (e.g. guinea worm).

(iv) *Water-related diseases* are borne by insect vectors that have habitats in or near water (e.g. malaria).

(v) *Water-dispersed diseases* spread infections whose agents proliferate in fresh water and enter the human body through the respiratory tract (e.g. legionella). [1]

j) Climate change and the construction industry

Although statistics are deficient, the media has many reports of schools being blown away by strong winds, and loss of lives of school children and staff through lightening. Adjustments must be made in how buildings, roads and bridges are planned, designed and constructed. Climate proofing in the construction industry is now a necessity. The construction sector has faced acute challenges as a result of climate change. Bridges roads and buildings have been destroyed by extreme climate conditions such as heavy floods and heavy downpours. Architects and engineers now design climate-proof structures and the Government has begun to opt for these structures and advocates for a policy to implement them.

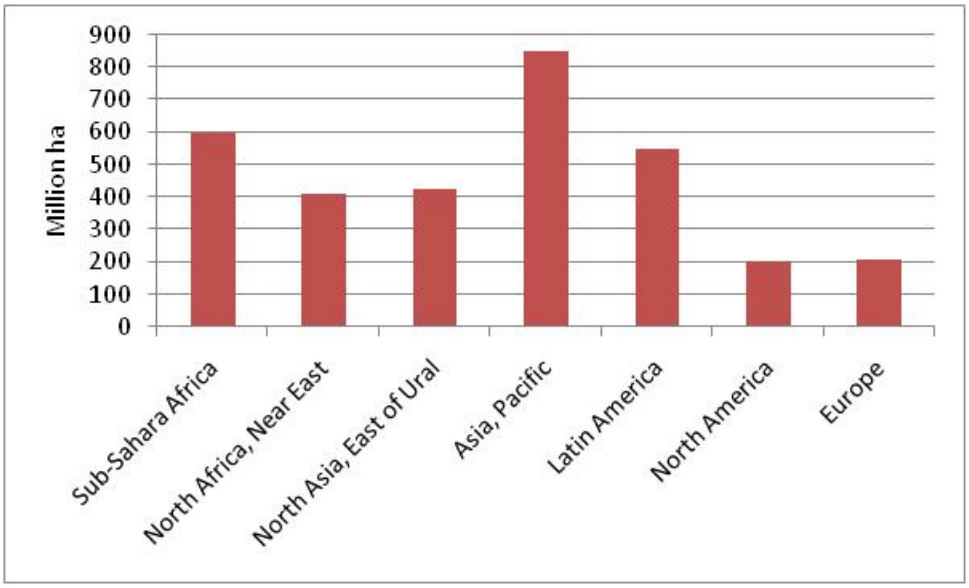
It has been continuously and increasingly challenging for the insurance industry to cope with losses incurred by clientele as a result of extreme climate conditions. Extreme climate conditions such as floods, heavy rainfall, and hail storms have the potential to undo decades of development efforts in a single hour.

[1] See http://www.microbiologyprocedure.com/microbes-and-hydrosphere/waterborne-diseases.html.

k) Climate change and potential for social unrest and national insecurity

Land degradation is becoming a major threat to peace in the world. It has been observed that, in the future, environmental pressures and conflicts may become a leading cause of war and civil strife and that land degradation and food shortage may lead to pressures for out-migration, which are likely to lead to conflict ((FAO, 2000).

Figure 12: Lands Degraded by Human Activities (total 3.5 billion ha)



Source: FAO, 2000

It seems likely that increased stress, caused by pressure of population on land resources, will lead to a breakdown of traditional property rights to land, and ultimately of law and order. Among the many consequences of such changes is serious land degradation.

The most recent *World Soil Resources Report* (FAO, 2000) very clearly states that about 3.5 billion hectares of land has been degraded by human activities, i.e. rendered unsuitable for agriculture (Figure 14). In addition, during the last three centuries, the area under grazing increased from 530 Mha to 3,300 Mha, which currently amounts to 25 percent of the global surface. Grazing systems persevere under marginal bioclimatic and edaphic conditions of different biomes,

Climate change disasters, especially water stress resulting from chronic and extreme droughts and floods, have the potential to cause social unrest and national insecurity. A mismatch of water supply and population explosion in sub-Saharan Africa is a time bomb in the region.

l) Climate change and economic vulnerability of Uganda

More than 40 percent of the 25 million plus population derive economic benefits from Lake Victoria through fishing, water supply, transport, hydro-energy and tourism. The population is largely rural (88.7 percent) and depends primarily on land resources, the majority of whom are women. Poverty levels are high: by 2000, 35 percent of the population was living below the

poverty line. It was more concentrated in the north and east of the country, partly due to the persistent civil strife in those areas.

The vulnerability of many Ugandan communities to water-related disasters is growing daily due to many undesirable human activities, such as deforestation, ecosystem degradation, environmental pollution, social unrest, transport accidents, urban and wild fires, and poor land use in many parts of the country. Better decision making, improved planning, effective risk management, innovation in development and environmental protection activities – these are the human activities that can reduce the vulnerability of communities. To achieve this, risk assessment and disaster reduction should be integral parts of all sustainable development projects and policies. Such projects and policies can significantly reduce the number and impact of disasters by building sustainable communities with long-term capacity to cope with and/or withstand the hazards.

m) Poverty intensification due to climate change

The major challenge in Uganda is the improvement of conditions in the rural areas and thus reversing the drift to the cities that has been caused by droughts, floods and hard economic times. Climate changes have made it very difficult to improve these conditions; it is necessary to integrate climate change into development planning.

From 1992 to 2004, Uganda recorded increased literacy and life expectancy rates and a reduction in the number of people living in absolute poverty from 56 to 38 percent. However, in 2005, it ranked 144th out of 177 countries in the *UNDP Human Development Index*. Despite its fertile soil and favourable climate, 5 percent of rural households continue to experience food insecurity. The economy is challenged by prolonged civil strife, high population growth and a growing disparity in income distribution.

In 2006, in northern Uganda after 20 years of civil conflict, 1.45 million displaced persons, 165 000 refugees and other vulnerable persons received food assistance. Traditional coping mechanisms of displaced people are overwhelmed and cyclic droughts affect household food security, especially in the northeast. Malnutrition and pockets of hunger and food shortages continue to affect food security in Uganda. Insecurity in the north and east, droughts, and refugees in the West Nile and western Uganda exert significant pressure on agricultural populations.

For Uganda to escape the poverty trap and ensure security and stability, it is vital that conflicts be quickly resolved and their root causes be addressed. Although peace is a necessary pre-condition for the reduction of poverty and improvement of food security, it is not the only one. The consolidation of the peace process might be the starting point for the achievement of sustainable food security throughout the country, but progress towards recovery and development is unlikely to be linear. Emergency, recovery and development situations are likely to coexist in Uganda for several years to come. In order to pre-empt conflict, priority strategic objectives should include increasing access to food, credit, jobs, markets and basic services. They should also include achieving a more equitable geographical and sectoral allocation of public resources and reducing chronic and transitory food insecurity.

Uganda's actions in climate and climate change: activities, strategies, measures and programmes to combat climate change-related problems

Current status of national implementation of UNFCCC and the Kyoto Protocol

The Government of Uganda's overall development strategy places priority on macro-economic stability, the eradication of poverty (through meeting the people's basic needs and raising rural incomes), environmental protection, agricultural modernization, infrastructure development, especially roads, universal primary education, decentralization of the government institutions and good governance.

Ongoing actions and programmes

Uganda is in a process of domesticating the UNFCCC and Kyoto Protocol and should create appropriate budgetary support to the related activities. The activities include participation in the Carbon Finance Programme and capacity building in accordance with the Clean Development Mechanism (CDM) of the Kyoto Protocol. This will involve mitigation measures for GHG emission, which is UNFCCC's main objective, through the participation of investors, the Uganda Investment Authority (UIA) and developed country members in the Carbon Finance Programme. The Designated National Authority (DNA) for CDM in the interim is the Honourable Minister of Water and Environment, supported by the National Climate Change Steering Committee (NCCSC).

Uganda has developed its National Adaptation Programmes of Action (NAPA) for climate change, which must be urgently implemented in order to climate change proof its national economic programmes and investments against the increasingly disastrous effects of climate change. An implementation strategy for NAPA has been finalized.

Climate change linkage to economic reforms: the Poverty Eradication Action Plan and Millennium Development Goals

Uganda still faces many challenges, including accelerating economic growth, eradicating poverty and reducing inequality. In the next few years, defining and implementing a new wave of reforms that build on previous efforts will be critical to attain sustained growth. Unfortunately, past efforts have not listed weather, climate and climate change among the major constraints to achieving the economic and social development goals identified in the PEAP and the MDGs.

As an example, the *World Bank Country Office Brochure* of May 2006 highlights the key constraints to the implementation of the PEAP reform programmes to include a high dependence on primary commodities, power shortages and risk perceptions (security issues, political transition, governance), which all constrain future development. Although most of these are weather- and climate-dependent, the World Bank did not mention weather, climate and climate change. Yet, the World Bank is strongly committed to assisting Uganda in attaining these goals. World Bank priorities are linked to overarching goals such as the MDGs, and influenced by directions set out in new development assistance models such as the Strategic Framework for Assistance to Africa, the Africa Action Plan, and the Paris Declaration on Aid Effectiveness. Adherence to these models should provide exciting opportunities for development growth in the future, and Uganda is well positioned to take advantage of them. The World Bank would not be able to fulfill these objectives without factoring weather and climate information in the planning and operational process.

In addition to responding to the MDGs, at the country level, specific World Bank activities and funding in Uganda are integrated with PEAP, and coordinated through the UNFCCC frameworks.

Implementation barriers under the climate change sub-sector are:

- √ limited awareness at all levels of climate change and/or climate variability as well as their devastating impacts on socio-economic development plans and activities;
- √ failure to adapt a holistic approach to solving climate change challenges with sub-sectors preferring a lopsided sectoral approach over cross-cutting solutions.
- √ lack of centralized awareness of the challenges and benefits of climate change and climate variability as well as adaptation measures;
- √ the slow pace of domesticating the Climate Change Convention and its Protocol, which has led to the lack of a legal framework for the implementation of UNFCCC and the Kyoto Protocol;
- √ lack of guidelines for mainstreaming climate change into all development planning.

Challenges, weakness and strengths in the climate change sub-sector are as follows:

- √ People are highly educated, but lack adequate experience with this sector.
- √ The climate and climate change sub-sector is underfunded.
- √ Although climate change significantly hinders economic development, conceptualization of weather and climate information by strategic planners is insufficient.
- √ Linkages with other sectors are weak, yet the sector is cross-cutting.
- √ Technology capacity needs to be boosted.
- √ The dissemination of climate and climate change information to end users is inadequate.

Table 6: Ongoing and Planned Programmes/ Projects

List of programmes / projects	**Implementing agency**	**Total cost (US$)**	**The NDP's objective met by the programme**						**Location**	**Donor(s)**	**Status**
			1	2	3	4	5	6			
1. NAPA	Department of Meteorology	200,000	✓	✓	✓		✓	✓	National	Global Environment Fund (GEF)	Completed
2. CDM capacity building		150,000	✓	✓	✓	✓	✓	✓	Kampala	United Nations Environment Programme (UNEP), EU, Dutch Government	Ongoing
3. Carbon market and financing			✓	✓	✓	✓	✓	✓			
4. National emission factor											

Critical analysis of the weather and climate sub-sector linkages to development

This section analyses the contribution, roles and linkages of the weather-climate sub-sector in socio-economic development, including in the attainment of the MDGs and poverty eradication.

Natural resources constitute the primary source of livelihood for most Ugandans. Indeed, the economy of Uganda currently depends on the use of its natural resources. This situation will continue into the foreseeable future. Effective management of these natural resources is therefore important and critical to the nation's long-term development.

This analysis will therefore demonstrate the potential of the climate and climate change sub-sector, and suggest possible strategies for harnessing it. The subsequent section discusses the contribution of the weather-climate sub-sector to the various public sectors.

a) Contribution of the weather-climate sub-sector to agriculture

Seventy-one percent of Uganda's working population is engaged in subsistence agriculture as their main occupation and 68 percent of households depend on it for their livelihoods. Agriculture constitutes about 42 percent of GDP and over 90 percent of export earnings. The contribution of agriculture to total GDP decreased from 45.7 percent in 1995/1996 to 41.5 percent in 1999/2000. The decline in agricultural contribution to GDP is not a result of a diversified economy, but of the factors that control agricultural production. The major factors that influence agricultural production include soils, climate, agricultural implements, management practices and access to markets, both domestic and international. The decline in agricultural production in 1999/2000 is partly explained by the 1999/2000 drought. Agricultural performance fluctuates with climate variability and climate change, and is also adversely affected by the rudimentary means of production, poor markets and storage facilities.

Agricultural performance, therefore, fluctuates with climate variability and climate change. With the current Government's rural development strategy, whose focus is on increasing both farm productivity and household outputs, it is paramount that the rural poor, who use rain fed agriculture, receive timely weather/climate information. It is the combination of modern farming techniques and the use of climate information that will ensure increased agricultural production. In addition to other information, farmers are provided with seasonal forecasts to announce the start of the planting season.

The negative impacts of climate change, e.g. droughts, delay in the onset of rains and erratic rainfall distributions can be greatly minimized through the prudent use of weather and climate information. If the weather and climate information generated by the DoM is made available to end users well in advance, measures could be taken to mitigate the negative effects of the adverse weather and climate conditions. It is estimated that losses due to bad weather can sometimes reach 30 percent of the annual agricultural production. The consequence of poor seasons, droughts and floods, therefore, is rampant poverty. However, the Government has introduced the *Bonna Bagagawale* (Prosperity for All) Programme, whose primary objective is to lift the incomes of the poor communities by increasing their production capacity. Some of its pillars include promoting commercial agriculture, increasing non-traditional exports, and strengthening the service sector; all of these have the capacity to create jobs, leading to an overall improvement in the economy. Although the Meteorological Services cannot prevent a

severe weather event, the use of weather and climate information can mitigate the impacts and can help the country to adapt accordingly, and thereby increase the chances for the programme's success.

b) Contribution of the weather-climate sub-sector to the water resources sector

Uganda has abundant water resources although its distribution is not even, particularly in the semi-arid areas of the country. Up to 15 percent of Uganda's total area is covered with water, 80 percent of which is accounted for by Lake Victoria. However, the semi-arid areas of the country experience water stress, and prolonged and severe droughts lead to low water levels in rivers, lakes, reservoirs and underground aquifers, affecting the hydrology, biodiversity, hydroelectric power production and water supply. Negative effects on hydro-power production due to reduced water levels lead to power rationing, both in the domestic and commercial sectors, and thus result in the interruption of economic activities and a decline in manufacturing outputs. Prolonged and severe droughts can also lead to losses of animals, low production of milk, food insecurity and increased food prices, thus negatively affecting the economy.

The rural poor depend on streams, springs and swamps. These sources dry up during severe droughts, resulting in the diversion of resources to emergency operations. Currently, water resources development and management are not only a priority focus in directly alleviating poverty through the provision of domestic water supplies, but are ultimately linked with other development priorities of food security, agriculture modernization, health, energy production and conflict resolution in some areas.

Today, the water supply sector is undergoing rapid expansion with respect to rural and urban water supply and water for production. Small-scale irrigation is being promoted and will be of increased importance in the Plan for Modernization of Agriculture (PMA), and water supply for livestock in pastoral areas is one of the Government's priority plans. Sewerage and sanitation requirements increase together with improvements in water supply and have significant public health implications. Fishing in lakes and rivers is a major component of the country's economy, and fish ponds built along watercourses are increasing in numbers and importance. In the energy sector, Uganda is almost totally dependent on hydropower for electricity generation. There is, therefore, an urgent need for a holistic approach to water resources management to satisfy these, at times conflicting, demands, while ensuring sustainable water resources development. This approach is impossible without factoring weather and climate information in water resources management and in the overall development process of the country.

Effective utilization of weather and climate information in the management of water resources can yield substantial socio-economic benefits, particularly during periods of droughts and floods.

c) Contribution of the weather-climate sub-sector to the forestry sector

Forests play an important role in the socio-economic development of Uganda because of their products and services. However, this role is not fully reflected in the National Statistics (Initial National Communication of Uganda). Forestry products such as timber, building poles, charcoal, fuelwood, crafts and medicines are of significant socio-economic importance and

value. Biomass provides more than 90 percent of the country's household and small-scale energy needs, including small-scale industries such as lime, brick and tile making and agro-based industries such as tea, tobacco and fishing. These activities are important for their contribution to poverty reduction. In addition to forest products, forests provide ecosystem services, such as stabilization of soils and enhancement of soil fertility, regulation of microclimate, biodiversity and diverse habitats for other biodiversity species. Effective management of forests, including tree planting, requires climate information. Poor management of forests can have a negative impact on climate, particularly local climate.

Dry conditions and prolonged droughts create conditions conducive to spreading wild fires, thus destroying forests leading to serious consequences. Land left open as a result of the fires becomes vulnerable to soil erosion during the rainy season. This vicious cycle leads to increased emission of GHGs, leading to global warming and increasing climate change. Also, since forests in Uganda either border or are in the proximity of important water bodies, their destruction will mean increased non-point pollution into the water bodies, notably silting. Increased pollution load into these water bodies will also result in increased costs for treating drinking water and a higher level of water-borne diseases' prevalence, among many other negative effects.

d) Contribution of weather-climate sub-sector to the health sector

For development to be sustainable, health and economic growth must be mutually reinforcing. Health is an essential prerequisite as well as an outcome of sound development policies. Without good health, individuals, families, communities and nations cannot hope to achieve their social and economic goals. Weather, climate and climate change have major roles in health services delivery, which is increasingly important in these times of climate change.

Heavy rainfall that leads to floods has resulted in the outbreak of water-borne and water-related diseases such as diarrhea, dysentery, cholera and malaria. Most of these diseases are commonly reported after El Niño episodes. On the other hand, prolonged drought spells have resulted in outbreaks of respiratory diseases. Weather conditions also affect road networks by destroying bridges and thus seriously affecting the distribution of drugs and other supplies to the affected areas. Floods can lead to washing away of health facilities, latrines and some water sources, and heavy rains in highland areas can cause landslides. Extreme weather and climate events can therefore weaken the health infrastructure in addition to destroying lives and property. Strengthening the health sector is, therefore, necessary if sustained economic growth and the goals of PEAP are to be achieved. Early warning and timely climate/weather information provided to the health sector would enable the sector to prepare for eventual outbreaks. The use of weather and climate information in reducing costs in treating of malaria has been underscored. During the unprecedented floods of 2007 covering most of eastern Uganda, Dr. Okware, a top official in the Ministry of Health (*Ministry of Health Reports,* 2007) confirmed that the Ministry had used weather and climate information for early warning purposes to stock drugs and other emergency facilities, which were useful in reducing the negative impacts of these floods. The main constraint for the MoH then was the inadequate resources to stock enough emergency supplies commensurate with the level of anticipated floods.

e) Contribution of the weather-climate sub-sector to the wildlife and tourism sector

Droughts, heavy rainfall and high temperatures are the most significant physical threats to the wildlife and tourism sector. Droughts often lead to a migration of people and animals, and outbreaks of bush fires and soil erosion. During drought periods, pastoralists drive their animals to different places in search of pasture and water. Wild animals also migrate to favourable areas that might end up in cross-boarder migration. The drought-induced movement very often contributes to the increased tendency of wild animals to hide, thus making the affected protected areas less attractive to tourists. This undermines the campaign for increased tourism as a source of foreign exchange for the country. During the drought of 1999, for example, there was a major conflict between the Park Authorities and the cattle keepers around Lake Mburo and Queen Elizabeth National Parks. It is anticipated that with the increase of severe weather events due to the phenomenon of climate change, such weather-related conflicts are likely to increase and negatively affect Uganda's tourism. Furthermore, increasing temperatures associated with global warming, are a suspected cause of the retreating ice caps on the Rwenzori Mountains. In addition, climate change will alter disease transmission patterns at the human-livestock-wildlife interface with potential consequences on tourism health.

f) Contribution of weather-climate sub-sector to the fisheries sector

Uganda has abundant water resources, including swamps, for a total area of 43,942 km^2, representing 18 percent of its total surface area. This large area provides an excellent habitat for fish. Fisheries is a key sector in the Ugandan economy; it contributes to food security, increased household income and economic growth. The fish trade grew from a modest US$1.4 million in 1990 to US$87 million in 2002 (Department of Fisheries Resources). It is now estimated that the sector contributes 2.4 percent (Background to the Budget 2003) to total GDP. It is also argued that this figure may indeed be as high as 5.8 percent (Yaron and Moyini, 2003, using Bank of Uganda and Uganda Bureau of Statistics data).

The fish population is sensitive to climate variability. Also, fish catching and fishers' safety require accurate weather and climate information. Due to climate change, severe weather events, particularly those over the lake, are predicted to increase. The *Vulnerability Study (NAPA, 2007)* showed that severe rainfall events over the lake basin are likely to increase up to 15–20 percent. This will negatively impact the fishing community, the safety of workers and water transportation, and all other marine activities, including fishing. The fisheries sector should be able to use weather and climate information to enable communities living by the Uganda lakes to adapt to the changing climate.

g) Contribution of the weather-climate sub-sector to the transport sector

Uganda is a landlocked country and primarily depends on rail and road transport for its imports and exports. The rail network is poor and has deteriorated over time. This has put substantial pressure on the trunk roads, which also serve neighboring countries, leading to faster deterioration. The air transport sub-sector is important for the movement of goods and passenger transportation. Air transport plays an important role in Uganda's socio-economic development. Flights to Entebbe have increased significantly in the last 15 years. Statistics from the Civil Aviation Authority (CAA) *Annual Statistical Report 2000* indicate that both passenger and cargo traffic have grown fast, although the annual growth rates have been erratic to some extent. The highest passenger traffic growth of 32.7 percent was recorded in 1995.

Indeed, from 1991 to 2000, international passenger traffic increased nearly three fold. During the same period, the overall average growth rate per annum was 13.3 percent for aircraft movements, 13.1 percent for passengers and 22.8 percent for cargo. The growth of this sector has direct relevance to increasing the incomes of the poor due to access to market, which stimulates further production. With respect to agricultural production, all high-value agricultural products, for example, horticulture and floriculture products are exported by air through international airports such as Entebbe. All aviation activities are impacted by weather and climate, and unless such information is factored in their planning, air transport will be negatively affected, including the export trade. Weather and climate information is essential in the design, construction and operation of transport facilities. For instance, the aviation industry is a major customer of the Meteorological Services. Weather and climate information is used for designing airports/fields, planning routes and operating flights. No flights take off or land without weather forecasts. Therefore, weather and climate information is a major factor in both civil and air force operations, and the sub-sector significantly contributes to the country's economic development.

Similarly, all transport is affected by changes in weather and climate. During the 1997/1998 El Niño, for example, considerable transport infrastructure, especially bridges, were destroyed and lives lost. Estimates of damage of road infrastructure varied from US$300 million to US$500 million. The El Niño that followed (2001/2002) was of comparable magnitude, yet not as many bridges were washed away. The difference was that the Ministry of Works and Transport (MoWT) used weather and climate information to clear drainage and prepare adequately before the onset of the El Niño. This demonstrated further that the use of weather and climate information was pivotal in protecting Uganda's road infrastructure.

h) Contribution of the weather-climate sub-sector to the education sector

Uganda, like all countries, views human resources and its development as a key to its development. The government policy of universal primary education (UPE) is expected to reduce the illiteracy rate and stimulate the education sector's development. In the last ten years or so, the private sector has injected substantial resources into the education sector, at various levels including the university.

Increased severe weather and climate events, particularly in Uganda, are expected to lead to the washing away of bridges (in case of severe rains) or severe water stress (in case of droughts). Both of these phenomena will affect school children, preventing them from crossing raging rivers and streams (in case of severe rains) or making them travel long distances to search for water and pasture (in case of droughts). Weather and climate information can provide early warning systems to enable communities to make alternative arrangements for their school children and the disadvantaged.

i) Contribution of the weather-climate sub-sector to the construction sector

Historical information and seasonal forecasts are of great importance to the construction sector. Such information includes rainfall forecasts, sunshine hours, temperatures, wind direction and wind strength. Moving heavy equipment is impeded when it rains, for example, tarmacking and lime spraying cannot be done. The design of culverts and water channels is based on the highest amount of rain calculated to fall in a specific area. Selection of materials for use in a

building is based on the amount and duration of rain, sunshine, wind speed and strength in a given area.

j) Contribution of the weather-climate sub-sector to national security

At the national and regional levels, there is a high likelihood that climate change will lead to increased conflicts over diminishing resources. The most vulnerable areas in Uganda include the cattle corridor and other fragile ecosystems. This is also likely to stress the national defence system and threaten the overall security.

Weather and climate information has already been used to guide policing and/or air defence and military operations and strategies. The need for weather and climate information increases with climate change.

k) Use of weather and climate information

Much relevant weather and climate information is generated by the DoM, but its use is still inadequate largely due to gaps in knowledge and skills to manage and plan for extreme weather and climate disasters.

The national development planners, policy makers and politicians are uncertain of how much should be secured to mitigate and facilitate adaptation to extreme weather and climate events.

Performance of weather and climate sub-sector

a) Status of the Department of Meteorology

The Department of Meteorology within the Ministry of Water and Environment has the mandate to establish and maintain a weather and climate observing network and to collect, analyse and produce weather and climate information, including warnings, in order to support social and economic development. The realization of the DoM's mandate contributes to the attainment of the vision of the Ministry of Water and Environment: *"sound management and sustainable utilization of water and environment resources including weather and climate for the betterment of the population of Uganda"*.

The key sectors served by the DoM include transport (mainly aviation), defence, agriculture, disaster preparedness, environmental and water resources management, tourism and construction industry. The DoM cooperates with the World Meteorological Organization (WMO) and its member states as well as world and regional centres. The Head of DoM and Permanent Representative of Uganda with WMO acts as the main link and official channel of communication between WMO and the Government of Uganda.

The DoM carries out its tasks in partnership with local and international organizations. It delivers its products to the end users as follows:

√ The products (meteorology services) are produced and distributed by DoM for the climate-sensitive sectors of the economy (agriculture, fisheries, civil aviation, water, construction, transport, wildlife/tourism, health, etc.).

√ Physical infrastructure is used to generate, analyse and disseminate the climate and weather information (i.e. the observing station network and the information management systems) to end users through different media, including television, newspapers and radio broadcasts. .

Users of information in the climate-sensitive sectors, whose activities and products could be improved by its proper use of information, do not use it effectively. Furthermore, it has been noted that some do not know how to use this data, especially the highly variable weather data. Technical personnel with highly specialized training in the science of the atmosphere and atmospheric phenomena (meteorology) are available, but there is insufficient capacity to satisfactorily provide a full service in all upcountry regional centres.

b) Achievements of the sub-sector and the Department of Meteorology

Through its programmes, WMO has assisted member states in accessing products developed by world centres. These centres have played a major role in improving understanding and advancing the science of meteorology, particularly climate prediction. Predicting climate has developed considerably in the last 20 years; today, climate can be predicted accurately and well in advance. DoM is able to predict extreme weather and climate well in advance and its information has been valuable. For example, the Ministry of Transport used its weather information to rehabilitate a drainage system that prevented bridge destruction during the 2001/2002 floods.

c) Matrix showing assessment of previous sector performance

Sector objective	Set target/ outcome indicator	Current level of achievement	Constraints	Source of funding
1. Predict accurate weather and climate conditions.	Rehabilitate high-tech forecasting equipment acquired. Train operators. Weather stations.	80 rainfall stations rehabilitated	Inadequate funding.	The Government and the donor community.
2. Develop a reliable national weather and climate monitoring network.	Increase the number of operating weather and climate monitoring stations	Weather and climate forecasting equipment installed.	Difficulty in mobilizing funds.	The Government and development partners.
3. Install early warning systems (EWSs) in all regions.	Timely EWSs produced well before natural disaster hits.	No high-tech early warning equipment set up.	No funds; Low technical capacity.	The Government and development partners.
4. Promote the use of weather and climate information in planning at the national and community levels.	No. of people prepared for extreme climate events, e.g. amount of food stored during this period. No. of awareness-raising materials disseminated.	Daily televised weather updates; however, they mostly benefit the well-off, and are therefore less watched by local people who do not know English.	Insufficient money available to translate this information in local languages.	The Government, donors/ development partners.

Possible measures to minimize impacts of climate change on key sectors

a) Early warning systems

All sectors need early warning and accurate information on weather, climate and climate change in order to prepare for these extreme weather and climate conditions. It is imperative for them to have a well-equipped meteorology department to consistently and accurately monitor and predict weather and climate conditions that will encourage preparedness and effective adaptation mechanisms. For example, if information on heavy floods is well known in advance, human deaths can be minimized or completely prevented by temporary evacuation, heavy losses of livestock can also be prevented, and property can be saved. The Government should therefore increase support to the DoM, equip it with the latest technology and train personnel in obtaining accurate and reliable information to facilitate quick, effective and better preventive response. Also, the Government should encourage the use of climate and weather information locally, across the country, in various activities such as crop management as well providing information on timing for spraying fertilizers, weeding or harvesting.

b) Transport

The vulnerability of the transport sector is mainly due to poor or a lack of architectural designs that do not inculcate climate change proofing in developing road and bridge designs. The flood of 2007 destroyed infrastructure (roads, bridges and buildings), which are not yet fully reconstructed. The Government, particularly the Road and Bridge Authority, should therefore be able to encourage rebuilding new roads and bridges with the capacity to resist extreme weather and climate conditions such as floods, hail storms and heavy showers. In their terms of references for road and bridge constructions, the Road and Bridge Authorities could include aspects of climate change-proofing.

c) Energy

Uganda is vastly endowed with many undeveloped potential sources of hydropower. Hydropower energy is emission-free and therefore regarded as clean energy. At the moment, over half of Uganda's energy comes from thermal plants fuelled by heavy diesel combustion. Much carbon dioxide is generated, thus contributing to global warming. When considering government activities, such as piloting the construction of two dams at Bujagali and Karuma falls, it is hoped that Uganda will be able to fully source all its energy from hydropower. However, with Uganda's growing economy, more and more energy will be needed. The Government should therefore continuously encourage hydropower development because the country's potential is so huge that once fully developed, it will be able to sell energy to neighbouring countries such as Rwanda, Kenya and the Democratic Republic of the Congo. The Government should note, however, that while exploiting these hydropower resources (i.e. water bodies), water resources must be properly managed to ensure sustainable generation; otherwise, poor management of water resources may lead to a dwindling of water resources, thus causing underproduction or complete plant closure. It is important that all water resources, in particular hydropower, be effectively managed and regulated.

Agriculture
With efficient weather and climate monitoring services, local communities, particularly the farmers, should be encouraged to make use of climate and weather information at an early stage. This would ensure preparedness and hence prevention of heavy agricultural produce losses.

Water resources
As a result of persistent droughts, water resources steadily dwindle; it is therefore imperative to regulate water usage, possibly by rationing in order to prevent excessive water outflow with less inflows which might lead to complete depletion. The Water Resources Management Unit is in place, but needs more funding and capacity building for competent personnel to appropriately regulate use of these water resources while ensuring sustainability.

Specific Measures to Adapt to Extreme Climate Change Events

Floods

(a) Information needs: There is a broad spatial coverage of river flow data, but the spatial coverage of gauging stations is far from uniform. Long time series of records of river flow and other hydrological data are urgently needed.

(b) Future preparation**:** Flood protection measures and use of flood waters can be structural or non-structural.

Structural measures include:

- √ dam construction
- √ flood control reservoirs, i.e. constructing reservoirs where the excess flood waters can be stored and then released as a controlled flow to help alleviate the flood problem by attenuating flood peaks.

Non-structural measures include:

- √ zoning, i.e. regulation of development in flood hazard areas by allowing only low-value infrastructure on the floodplains;
- √ forecasting systems for warning, evacuation, relief and post-flood recovery;
- √ flood insurance, i.e. the division of risks and losses among a higher number of people over a long period:
- √ capacity building by improving awareness of the impacts of flooding, understanding of the processes involved and the implications in flood preparedness.

Forecasting systems hold considerable promise for the future and may be divided into:

- √ short-term forecasts, e.g. for flash floods, requiring high technology such as radar or remote sensing as the basis for quantitative precipitation forecasting and hence floods; quick action plans;
- √ medium-term forecasts, which include seasonal climate forecasts for reservoir operations, advice on agricultural production and, where applicable, information on snow cover;
- √ long-term forecasts, which need to be developed for designing flood protection systems.

Finally, it is important to rectify common misconceptions about floods, e.g. that they occur at semi-regular intervals or that future floods will be similar to those of the past.

Decreasing lakes/rivers water levels

Persistent droughts have caused a steady and continuous decline in the level of open water bodies as well as shifting of the water table to further depths deep down in the ground. There has been a high degree of evaporation due to high temperatures. The decrease in water levels has led to adverse effects on other sectors such as energy. Uganda has been heavily dependent on hydropower for its energy needs until recently, when power dams have not been able to secure enough water for full operation due to low Lake Victoria levels. Hydropower is still a large component of Uganda's energy needs, and more dams are being constructed to increase hydropower output, which calls for proper water resources management to avoid previous mistakes.

Future predictions on droughts

There are many possible reasons for an increase in the frequency and severity of droughts in a particular region:

- √ As temperatures increase and evaporative demands from crops and natural vegetation increase, these demands can be met only up to a point, as the consequent loss of water in the soil may not be compensated for by increases in precipitation.
- √ It is likely that in many different regions of the earth, there will be an increased risk of droughts arising from more frequent and/or more intense El Niño events.
- √ In many regions, changes in the seasonal distribution of precipitation may have even more marked impact on water resources than changes in total annual precipitation.

Needs for drought information

Meteorological, and in particular hydrological, data are not available at the required level of resolution and coverage for adequate drought studies. Many monitoring networks are currently in a state of decline. Access rights to available data are often very limited. The capacity to distinguish between natural climate variability and climate trends is limited by the data coverage, their quality and issues of data access.[2]

Future preparedness

There are both traditional (indigenous) and modern technological approaches to coping with the risk of drought. Any technological management of drought requires medium- (seasonal) to long-term (annual to decadal) climate forecasts and, therefore, the appropriate modelling tools. This information should be translated into early warning and reaction chains.

Supply-side drought protection measures

- √ Supplies of water should be augmented by exploiting surface water and groundwater in the area. However, intensive groundwater withdrawals for drought management are not a sustainable remedy.
- √ Transfers can be made from surface water sources (lakes and rivers) and groundwater, if socio-economically and environmentally acceptable.
- √ Storage of water can be increased. When available, groundwater reservoirs (aquifers), which store water, can be more advantageous than surface water storage despite the pumping costs, because of the reduction in evaporation losses. However, this classical

[2] See http://www.drought.unl.edu/index.htm.

drought management policy is becoming increasingly difficult to implement due to its consequences on the environment. For example, when a large upland reservoir storage was created in Thailand, allowing regulation of dry season flow in the upper and middle basin to satisfy domestic and irrigation water demand, upstream activity resulted in a serious decline in water quality, particularly in the lower part of the basin area. In recent years, the emphasis in action plans to combat drought has increasingly shifted from supply-side management by provision of water resources in required quantities, to effective demand-side management for the finite and scarce freshwater resource, i.e. seeking 'megalitres of conserved water' rather than 'megalitres of supplied water'.

Possible demand-side measures include:

- √ improved land use practices;
- √ watershed management;
- √ rainwater/run-off harvesting;
- √ re-cycling water (e.g. use of treated municipal waste water for irrigation);
- √ development of water allocation strategies among competing demands;
- √ reduction of wastage;
- √ improvements in water conservation via reduction of unaccounted water;
- √ water pricing and subsidies.

Drought contingency planning also requires thorough consideration, including:

- √ restrictions of water use;
- √ rationing schemes;
- √ special water tariffs;
- √ reduction of low-value uses such as agriculture. "National Drought Mitigation Centre, University of Nebraska,")

Emerging Issues, Opportunities and Challenges in Climate and Climate Change

Climate change provides mitigation and adaptation opportunities. In Uganda, adaptation to climate change is vital and has been highlighted as an urgent priority. Although uncertainty remains over the extent of climate change impacts, there is presently sufficient information and knowledge available on strategies and plans to implement adaptation activities. However, Uganda has limitations in human capacity and financial resources, *inter alia*, which make adaptation difficult.

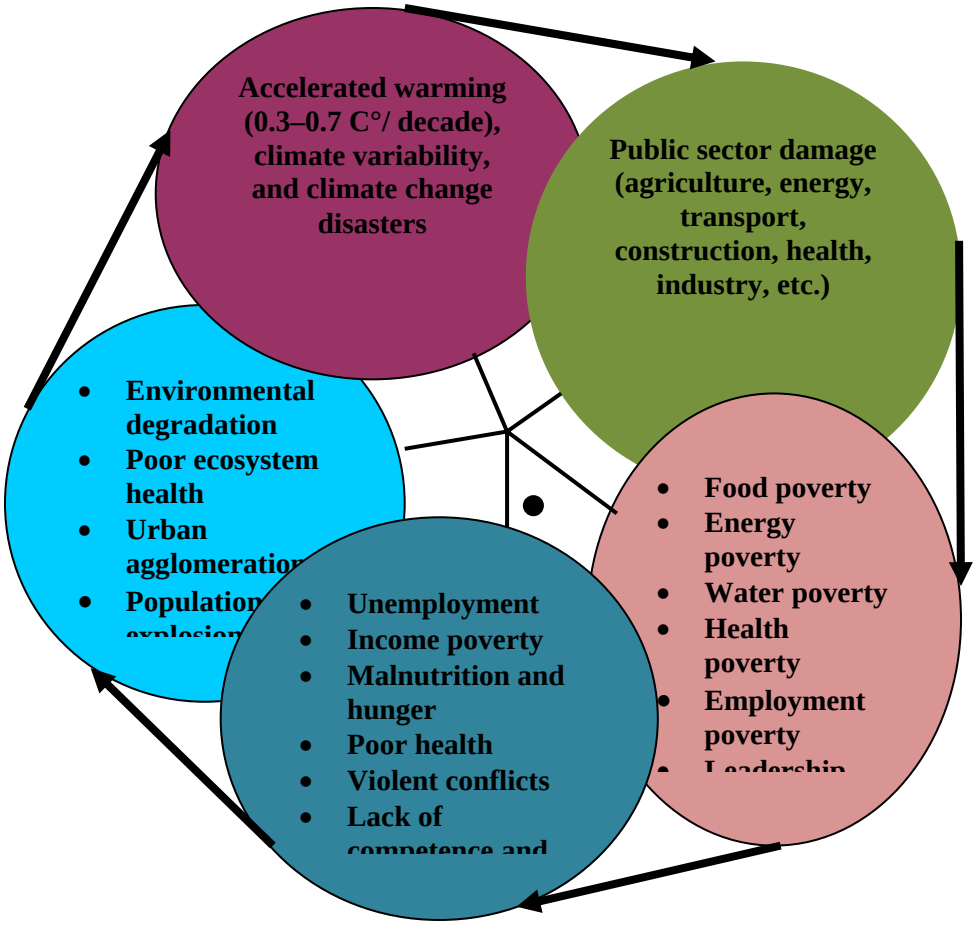
Outputs from UNFCCC workshops and meetings highlighted that the most effective adaptation approaches for developing countries address a range of environmental stresses and factors. Strategies and programmes that are more likely to succeed through coordinated efforts aimed at alleviating poverty, enhancing food security and water availability, combating land degradation, reducing loss of biological diversity and ecosystem services and improving adaptive capacity. Sustainable development and MDGs are a necessary backdrop to integrating adaptation into development policy; risk and vulnerability reduction policies are also important elements of adaptation.

1. **Wealth wastage through climate change:** Uganda has made efforts in controlling wealth-wasting phenomena, notably corruption. This standard should be maintained and extended for all other serious wealth-wasting phenomena, including climate change. In fact, climate change is feared as the most dangerous tsunami of our time. Climate change damage and wastes

Uganda's wealth, valued at **least 4.4 percent of the national budget**. Yet, it has not yet been given its due attention in the poverty eradication campaigns; a radical and immediate turn-around is needed. Climate change impacts Uganda heavily, hitting sectors that are most critical for poverty eradication and prosperity for all programmes. Uganda is already experiencing climate warming, particularly in the south-west.

2. **Concept of neglected or underused natural resources: climate and micro-climate:** Natural resources constitute the primary source of livelihood for most Ugandans. Management and effective use of these natural resources is therefore critical to Uganda's long-term development. Climate is the universal natural resource and can be a very important economic asset if innovatively used. Although Uganda has one of the best climates on earth, it has not gainfully used this natural resource, in contrast to the small island states of the Caribbean whose economy is solely dependent on beach and sun-based tourism. Antigua, Grenada and Barbados, for example, run their economies independent of external donors. Their main revenue is tourism, which takes advantage of its climate and beaches. Uganda needs to innovatively add value to and market its beautiful climate and microclimate for economic gain. It needs to study and exploit many of its neglected and underused natural resources that have promising potential.

3. **Concept of Neglected Climate Change-Vicious Cycle of Poverty (NCC-VCP):** Uganda's economy is trapped in a NCC-VCP that has long been neglected. Understanding this cycle and model, and its implication in development planning will be critical in revolutionizing the climate sector's role in socio-economic development. The NCC-VCP brings in new target groups, actions and programmes that the ENR sector must be taken into account.



4. **Climate and climate change development planning, knowledge and awareness:** Climate change and its damage have long been ignored by development planners. Decision- and policymakers have not been aware of the gravity and urgency of climate change and its impacts. There is urgent need to conduct climate change impact profiles in every district and region with a clear mechanism of operation and information management. This would aim to holistically assess, plan and manage climate change natural disasters. Key planners, policymakers and implementers require sufficient awareness-raising and training to prioritize and integrate climate change into development planning and implementation.

5. **Climate and climate change education and human resources development:** Integrating climate and climate change as pillars in wealth creation, poverty eradication and livelihoods is an innovation that requires a new set of competences and understanding at all sectoral and community levels. There are insufficient human resources and educational arrangements to deal with the emerging issues of climate and climate change science and technologies, private sector investments and entrepreneurship, climate change risk and disaster management, forecasting, quantifying, planning and managing climate change and its interface with the various sectors and development concerns.

6. **The climate and climate change information system**: This system is inefficient and insufficient to sustain impact-oriented development planning and management in all sectors. The technical capacity needs to be upgraded and re-oriented to deal with the emerging meteorological, hydrological, environmental, investment and entrepreneurship challenges, models and forecasts.

7. **Uganda as a regional centre of excellence in climate and climate change innovations**: Given the limited attention heretofore to innovations and solutions in the East African region, it is advisable to consider developing innovative ways and models of weather and climate, and climate change management in Uganda that may transform the country into a regional centre of excellence with best practices in climate change. Uganda has demonstrated such innovation before in other global challenges such as HIV/AIDS.

8. **Poverty philosophy and concept**: Judging from the above NCC-VCP model, it is clear that the concept and philosophy of poverty need to be revisited, rethought and redefined and must break away from traditional thinking, at least in the context of Uganda. Poverty definitions that emphasize income poverty (secondary poverty) over resource poverty (primary poverty, e.g. food poverty, energy poverty, health poverty and leadership poverty, among others) should be the main focus.

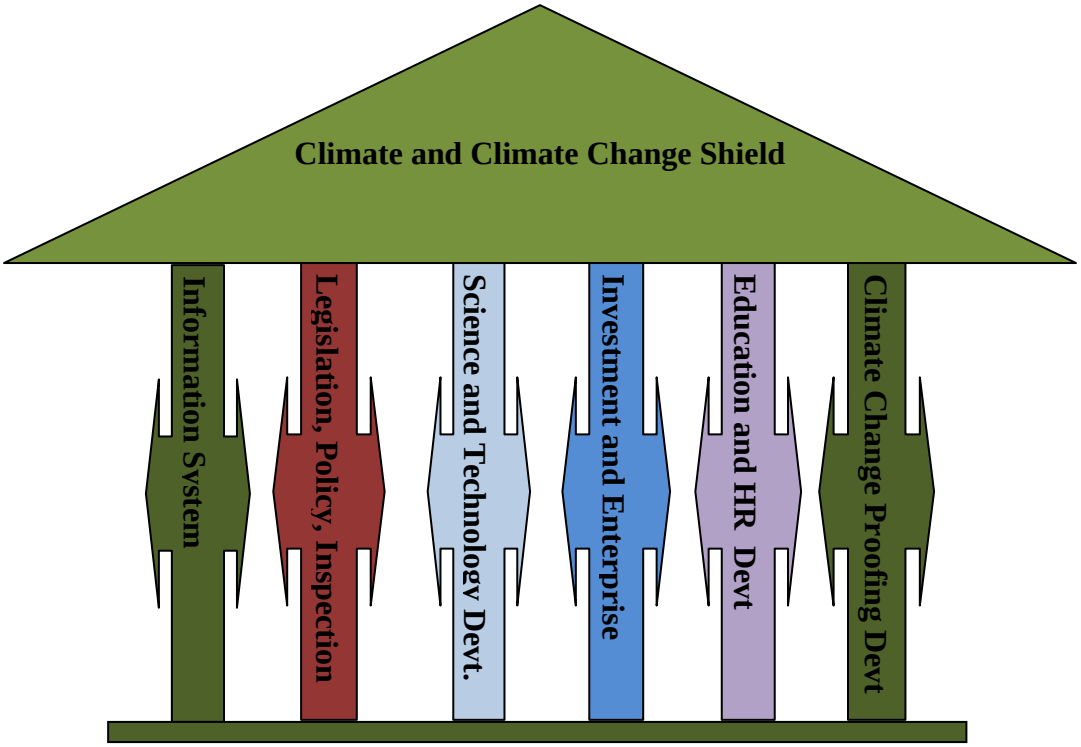
9. **Sectoral, community and private sector commitment**: Climate is the universal natural resource on which all other natural resources and their exploitation depend. Joint planning and implementation with all actors at all levels is essential to attain successful national climate change action plans that are multisectoral and community-owned.

10. **Evidence-based awareness campaigns:** Evidence-based awareness campaigns and stakeholder engagement have underpinned successful fights against global challenges such as HIV/AIDS. There is need to study the impacts of climate change in Uganda in order to support planning, resource allocation and programme implementation. Well-illustrated

statistics are helpful on the cost of climate change damage to the country, which should be related to economic production and prosperity.

11. **Climate and climate change sector functions and structure**: Climate change damage and waste is already far above many sectoral budgets including that of the water and environment sector. Efforts to address climate change challenges and opportunities have only just started.

Figure 14: Proposed functions, pillars and structure of a reformed climate and climate change sector and system in Uganda



Note: The concept of a climate and climate change shield represented diagrammatically with its proposed pillars and structure of a reformed climate and climate change sector system

Given the heavy cost and waste of Uganda's wealth through climate change disasters and impacts (over 4.4 percent of the national budget), the trans-sectoral nature of climate change and the fact that climate is a natural resource whose value can be innovatively added and marketed, the traditional weather and climate sub-sector in Uganda is encouraged to reform and upgrade from being a monofunctional sector for managing meteorological information only, to being a multifunction sector.

This multifunctional sector would also include: (a) climate and climate change legislation, policy and inspection; (b) climate and climate change science and technology development; (c) climate and climate change investment and enterprise development; (d) climate and climate

change education and human resources development; and (e) climate and climate change proofing, among other functions, as shown in Figure 14.

This paradigm shift is worth public investment for establishing a proper system that will reduce the damage and waste caused by climate change and will build the country's adaptive capacities to cope with it. Uganda could benefit from creating and marketing its value-added climate in innovative ways, such as **integrated climate-ecotourism**.

However, the current institutional structures are insufficient to address the emerging complex climate change issues, opportunities and challenges. Multisectoral and transdisciplinary climate management and Departments in the Government are essential at the central and local government level. Thus, the functions of the climate and climate change system, its pillars, structure and organization need to be reworked through a thorough and systematic planning.

12. Emerging climate and climate change opportunities

Promoting energy efficiency reduces GHG production and increases savings. Less energy consumed directly means less money spent on the electricity bill; less energy used means less electricity production and hence less fuel burned and little GHG gas (carbon dioxide) emission. Increased saving encourages investment, which leads to the attainment of the National Development Plan. Energy efficiency can be achieved through the use of energy-saving bulbs and improved cooking stoves and by instilling end users with a sense of responsibility to, e.g. switching off electricity gadgets and devices when not in use and encouraging the use of energy-efficient electronic accessories such as televisions, fridges, computers, printers and microwaves. This can be achieved by levying an extra tax on less energy-efficient, second-hand devices.

The Government is already working in this direction, but due to Uganda's competing needs, this has not been adequately facilitated. As a result, citizens still need awareness-raising and a sense of ownership of the programme. The Government is therefore encouraged to prioritize and allocate enough resources to this end and for other related activities.

Tree planting: Tree planting promotes the National Development Plan by generating revenue through sold products. Tree planting can also generate revenue through the selling of carbon credits, an opportunity that has emerged from international climate change conferences.

Tapping and storing water during floods: This is very important, especially in semi-arid areas in the northern regions. Building dams that tap water would reduce flooding in these and other regions, which can help solve the problem of lack of water during the dry season.

Climate change proof infrastructure: Infrastructure such as roads and building should be constructed with a built-in design element to resist and withstand extreme climate events. This would encourage and improve Ugandan architecture.

The Clean Development Mechanism: There are various opportunities under the CDM such as promoting the use of renewable energy. For example, a project developing hydropower plants and using hydroelectric power not only provides cheap power, but also attracts revenue in the form of carbon credits. Since hydropower is emission-free, it mitigates climate change as a result of reducing GHGs that would otherwise be produced from other carbon emission sources of energy, such as thermal energy power. It is encouraging that the Government is already facilitating the building of hydropower stations. By promoting CDM projects, the country is implementing UNFCCC and Kyoto Protocol, and attaining the National Development Plan through the use of cheap and reliable energy. Integrating climate change into development planning and implementation should be regarded as a cheap insurance cover against climate change, because it costs less than climate change disasters. While increasing dangers posed by climate change are becoming clear, they have not been fully internalized and perceived, and therefore it is difficult to convince various sectors to integrate climate change into the public sector plans.

Emerging concepts and strategies for implementing identified priorities

1. Neglected Climate Change–Vicious Cycle of Poverty (NCC-VCP)

Degraded and marginal lands are modern-day deserts. They are the hottest and most vulnerable poverty and climate change disaster 'hot spots'. Restoration of such semi-arid lands to prevent expansion of the deserts and escalation of climate change in the sub-Saharan region is critical. The following could be explored to develop and pilot an **ecological restoration and clean development** programme for degraded lands using the latest technologies and concepts.

- The **Clima-Eco-Tourism Zone Concept:** models, strategies and implementation of appropriate NCC-VCP studies and plans, such as decoding the model, mapping out zones and establishing pilot infrastructure for **CET Zones.**
- The use of **hydrogel technology** (artificial manure) to undertake large-scale tree planting in degraded lands. This technology has already used in China and Israel to restore hundreds of hectares. Makerere University in Uganda and the University of Göttingen in Germany have undertaken initial research on the suitability of this technology in select areas in Uganda.
- The **tree-livestock-mushroom production and energy system** in marginal ecosystems such as the cattle corridor: this entails establishing infrastructure and piloting the system in select areas.

2. Climate change knowledge and awareness

From the situation analysis and information gathered, it was observed that the public is not well informed about climate and climate change, and the steps needed to mitigate and adapt to natural disasters. The following are proposed to fill the knowledge and awareness gaps:

- Develop partnerships and collaboration with the media for providing climate and agricultural programmes in local languages.
- Build capacities of the communities to plan and respond to climate change and climate change disasters.
- Mainstream climate change planning in local communities and local government.
- Involve communities and local government in activities such as large-scale tree planting and management.
- Integrate climate change into UPE curriculum and related programmes.

- Establish ECO/NAPA villages using competitive solutions to act as demonstrations of sustainable green technology and clean development
- Provide education on climate change to the community and local government.
- Conduct evidence-based awareness campaigns and programmes.

3. Climate and climate change education and human resources development

The current human resources are neither sufficient nor multi-skilled to effectively deliver the required services nation-wide.

This sector and stakeholders should be involved in the following activities:

- Develop capacity in medium- to long-range weather forecasting.
- Conduct pre-season seminars and awareness-raising campaigns.
- Ensure a joint commitment by the Government and the tertiary institutions and universities in training competent human resources in planning and implementing programmes to adapt to and mitigate climate change.
- Develop human resources capable of planning and managing the climate change interface with environmental degradation, demographic dynamics and urbanization.
- Develop human capacity to forecast disasters related to climate, hydrology and the environment.
- Develop sector-specific competences and human resources to support climate change sectoral development planning and poverty eradication.

4. Climate change information generation and management system

The available equipment is inadequate and not equally distributed throughout the country. It is also archaic and needs to be upgraded for fast, timely and accurate information. Also, the information gathered is not adequately filtered for end-user use, especially farmers.

The following should be carried out in the next five years 2009-2013)

- Renovate and equip weather observation and monitoring stations throughout the country.
- Install modern data processing and distribute tools at the DoM.
- Expand meteorological services to all districts and county levels. This will improve on the feedback mechanism between the meteorologists and the end user communities of weather and climate information. This will also enhance the use of weather and climate information by the rural poor to improve their production and livelihoods.
- Ensure close collaboration between extension services and meteorological services for effective weather information delivery to the farmers.
- Improve networking and EWSs.
- Develop technologies.
- Develop human resources.
- Develop community management systems.

Forecasting and the early warning system

- Conduct a user needs assessment and information delivery system analyses for all key climate-sensitive sectors and review every five years.
- Review or design EWSs for extreme weather conditions (drought, El Niño, etc.).

- Develop and install a monitoring and evaluation mechanism with clear performance indicators.
- Procure and install the necessary equipment: radio telephones, VSAT facilities, station computer networks, Maritime Surveillance System (MSS) visual software, high-speed data processing computers and RANET systems.

5. The climate sector and the climate change system structure

The current climate and climate change institution is almost invisible and lacks adequate human resources, which cripples climate and climate change programmes. The following strategies should be implemented by the Government:

- Establish legal institutional framework and convert the DoM into an executive agency.
- Ensure that the climate change sector to coordinates and implements climate change adaptation and mitigating projects.
- Build technological capacities of the DoM and provide financial and human resources.
- Develop and engage local government in implementing the climate change action plan.
- Educate and filter knowledge to end users through DoM staff.
- Develop tertiary institutions.
- Engage the DoM in research and upgrading institutions.
- Develop curriculum for institutions, research and studies.

6. Uganda as a regional centre of excellence in climate and climate change innovations

The following innovations are recommended to tap the opportunities under climate change and alleviate poverty in Uganda:

- Establish and promote CET zones and NAPA villages.
- Establish innovative production systems integrating TLM enterprises.
- Encourage large-scale tree planting and produce electricity from wood; this is not only a CDM project to sell carbon credits, but also an income source from electricity. This project has potential investors from Germany; e.g. 10,000 ha of trees would attract investments in a wood-fueled power plant.

7. Sectoral, community and private sector engagement

Poverty is Uganda's biggest problem. Strategic and influential sectors long neglected but with potential to eradicate poverty must be supported. Indeed, this is one factor that explains why poverty continues to prevail. The private sector needs to invest in climate change research and development. Poverty eradication approaches must therefore be redesigned and revised. The following proposals are recommended:

- Develop a new poverty philosophy and concept based on the NCC-VCP model with key actors and stakeholders. Collaboration should be supported between the Meteorological Services and research/agricultural institutions, especially studies on the crop-weather relationship.
- Encourage large-scale tree planting and produce electricity from wood.
- Invest in integrated mushroom production, tree planting and livestock.
- Develop and tap CDM project opportunities.
- Develop and tap carbon market opportunities.

- Develop and pilot climate change-sensitive production system that involves integrated production of trees, mushrooms and livestock.
- Promote energy-saving technologies with the private sector.

Table 7: Linkages between Climate Change and Development

	Parameters		Factors promoting the attainment of the parameters	Factors hindering the attainment of parameters	Emerging opportunities to further improve parameters	The challenges which have to be addressed in the next five years
1	Growth (GDP %)		• Reliable and/or good climate • Reliable water sources • Quick response to climate disasters	• Unreliable and changing climate • Climate disasters - Decline in hydro-power output • Destroyed roads and bridges	• Establish climate change institutions. • Promote research and education. •	• Establish a climate change centre. •
2	Employment number]		• CDM projects • Carbon markets • Hydropower production encourages industrial growth	- Poor institutional arrangement • Low level of awareness of available CDM and carbon credit opportunities	• The international community is willing to support climate change capacity building in developing countries.	• Establish competent climate change institution. • Involve the private sector in CDM projects.
3	Food security		• Early warning and preparedness • Adaptation mechanisms	• Little/ no awareness of forthcoming extreme climate events, hence no preparations	• Plan production using climate/weather information. • Plant-resistant crops. • Encouraging crop and livestock diversification.	• Promote the use of weather/climate information planning at all levels. • Conduct research on drought- resistant crops/animals.
4	Contribution to competitive industrialization		• Enough power production (hydro dams operating at full capacity) • Raw materials	• Low levels of water due to droughts • Destroyed crops, lost animal production due to climate disasters	• Adopting climate change proof designs, e.g. climate proof hydropower dams and climate proof roads, bridges, crops ,etc	• Promote climate change resistant architectural designs. • Promote drought-resistant crops.
5	Economic empowerment of vulnerable groups		• CDM projects • Carbon credits	• Funds to start these projects • Inadequate awareness	• Tap international development funding. • Tap donor funding.	• Identify and work closely with key development partners.
6	Support to growth of small and medium-sized enterprises (SMEs)					
7	Potential to contribute to technology innovation		• CDM projects • Hydrogel technology	• Low level of awareness and funding	• Tap international funding and sell carbon credits.	• Make use of university expertise. • Secure funding for CDM projects.
8	Potential to contribute to recovery in northern Uganda		• Planting crops using hydrogel technology • Adopting drought-resistant crops and livestock	• Lack of expertise, funding, awareness. • Inadequate research	• Tap international funding for climate change. • Development partners funding. • Provide training in hydrogel technology.	• Identify key development partners and secure funding. • Involve the private sector.
9	Contribution to health		• Quick response to climate disasters • Better climate change adaptation measures	• Lack of EWSs and of the ability to portray the magnitude of the disaster for better and early preparation.	• Explore joint research opportunities. • Train meteorology forecasters and equip the Department.	• Buy and install high-tech EWSs

Cross-cutting issues in climate change implementation

Table 8: Cross-Cutting Issues that Affect the Implementation of Climate Change Activities

Thematic area	Cross-cutting issues that affect implementation of climate change activities
Poverty	• Damage and loss of poor people's livelihood assets (health, access to water, homes, infrastructure) • Increased pressures on disaster management schemes (floods, droughts) • Large funds that may be tied up in climate-related policy responses, risk of long-term setback to economic growth affecting the poor most severely • The reduced crop yields and their effects on regional and local food security • The decreased hydropower potential.
Environment, energy and natural resources management	• Ecosystem changes, which may reduce biodiversity and compound existing environmental degradation, in turn reducing adaptive capacity • Natural resources depletion, which reduces adaptive capacity • Negative effects such as climate changes • The reduced water availability • The increased risk of forest fires • The increased soil erosion, mud- and landslides • The increased damage to coastal ecosystems, coral reefs and mangroves.
Health, HIV/Aids	• increased health-related mortality and illness, and increased prevalence of vector-borne diseases such as malaria and dengue fever • Children and pregnant women, who are particularly vulnerable • Ill health effects due to declining availability of clean water • Increased risk of malnutrition due to decreased food availability and quality • Increased risks of deaths due to extreme climate events • HIV/AIDS, which increases vulnerability by affecting the most productive part of the population and reduces the transfer of knowledge on grassroots indicators and coping with climate.
Research and education	• Damage to infrastructure • Loss of livelihood assets, which may reduce opportunities for education • Natural disasters, which reduce available time for education • Displacement and migration, which reduce access to education opportunities • Education that would improve the capacity to understand scientific climate information and to use it in a local context • Capacity building in researching climate impacts and adaptations in developing countries (scenarios, socio-economic analyses).
Private sector development	• Access to markets, institutions and credit for the poor • Diversification of the income base, savings and credit, which may act as a buffer to deal with climate impacts; • Global and local market liberalization, which creates winners and losers; • Opportunities that increased market access for the poor, and which may reduce vulnerability to both climate change and market impacts) • Climate change impacts, which may reduce foreign direct investments due to increased risk • Risk/disaster management systems, which may help attract foreign investments.
Governance, corruption, civil society, human rights	• Increasing pressure of climate change on EWS (which tie up more resources) and on emergency management structures • Perceptions of stakeholders shared by institutions, which act as filters and affect the ability to take action (affect vulnerability and the design of responses) • The need of accountability, openness, sharing information and institutional learning processes.
Gender	• Women and children, who are most vulnerable to climate impacts: the great burden on women in household food security that may reinforce traditional gender roles, providing less options for education and alternative activities • Impact on women, which has a direct impact on household food security • Reduction of time available, due to climate change impacts, for participating in decision-making and income-generating activities; • Climate-related disasters that have larger negative effects on female-headed households.

Source: Adapted from Eriksen and Næss, 2003

Chapter II: Setting a New Agenda for Climate and Climate Change Sector

3.1 Vision, Mission, Objectives and Strategies

The **vision** for Uganda's climate and climate change sector is *a production-oriented sector in a climate change resilient Uganda.*
The **mission** is to *transform Uganda into a climate change resilient country guided by sustainable natural resources commodity value chains.*
The main **objective** of Uganda's climate and climate change sector is to *improve the well-being of communities and to contribute to economic growth.*

Specific objectives are to:

- Increase incomes of communities.
- Ensure community climate change resilience and security.
- Create employment opportunities through climate change mitigation and adaptation.
- Promote value addition to climate and associated natural resources.
- Promote climate and climate change investment for the domestic and global public good.

The **strategies** to achieve the sector objectives will include:

- strengthening climate and climate change information management and the EWSs to increase productivity of climate and climate change-sensitive sectors and communities;
- promoting investments (public-private partnerships) and value addition to climate change mitigation and adaptation in order to improve rural and urban livelihoods;
- promoting the development of commodity value chains for strategic natural resources and natural products;
- strengthening the establishment and implementation of regulations for climate and climate change, natural resources and climate sensitive sectors;
- promoting the engagement of young people and rural households in climate change mitigation and adaptation;
- exploring and developing climate opportunities as a traded commodity and a global public good.

3.2 Public Investments Priorities in Climate and Climate Change (five--year plan)

In support of each of the strategies, there will be **public investments by the Ministry of Water and Environment (MWE),** which is needed to boost multisectoral productivity, incomes and climate change resilience. These investment priorities include:

- providing NaCCAS to make knowledge and skills available to sectors, institutions and rural and urban communities, and to promote the adoption of appropriate technologies and innovations;
- strengthening investment and entrepreneurship services in climate and climate change mitigation and adaptation;
- developing and implementation of standards and regulations to improve the quality, safety and resilience of climate and climate change-sensitive sectors;

- developing climate and climate change research and technology to generate demand-driven technologies and innovations based on needs of climate-sensitive production zones and sectors;
- strengthening public education and human resources development in higher education institutions and schools to meet emerging climate change opportunities and challenges;
- controlling damage and wastage in communities and sectors induced by climate change disasters such as strong winds and storms, lightening, floods, high temperatures, landslides and dust storms.

For each of the MWE-led investments, detailed implementation measures will be developed. For most of them, there are implementation frameworks and plans, which will be built on or modified to meet the NDP and MWE development objectives.

3.3 Matrix showing Investment area, output and input targets / monitoring indicators

Table 9:

Area of public investment	Output targets	Input targets
Developing and implementing **standards and regulations** to improve the quality, safety and resilience of climate and climate change-sensitive sectors.	√ A multisectoral **policy, legal and institutional framework** on **climate and climate change policy,** developed and implemented. √ National climate and climate change action plan developed and implemented	√ Multisectoral and stakeholder planning engagements √ Action plan development and implementation activities √ Policy and legal framework development and implementation activities.
Developing National Climate and Climate Change Advisory Services (NaCCAS) to make knowledge, skills and competence available to sectors, institutions and rural and urban communities, and to promote the adoption of appropriate technologies and innovations.	√ An established and formal NaCCAS Programme; √ Climate change-**resilient communities** √ Sustainable **natural resources commodity value chain enterprises and investments** in urban and rural communities.	√ Retooling, training and re-allocation of extension staff and structure. √ Improvement of national climate observation network √ Modernization of the national forecasting and EWS √ Modernization of data and information management / dissemination system.
Developing **climate and climate change research and technology** to generate demand-driven technologies and innovations based on needs of climate-sensitive production zones and sectors.	√ A **Climate and Climate Change Institute** that is a Regional Centre of Excellence. √ **Technologies and innovations** for climate-sensitive production zones and sectors that are available for the domestic and regional market.	√ Upgrading of the School of Meteorology into an advanced institute. √ Establishment of climate and climate change research and a technology development programme. √ Establishment of climate and climate change training programmes for national and regional needs.
Strengthening **public education and human resources development** in higher education institutions and schools to meet emerging climate change opportunities and challenges.	√ Competent **human resources** available in all key sectors. √ Appropriate **curricula** on climate and climate change developed and mainstreamed at all levels of the education sector √ **Public education** and **awareness programmes.**	√ Training and equipping of extension staff, development planners, training of trainers, e.g. teachers at all levels, √ Establishing and piloting of curricula in schools, vocational and higher education institutions √ Establishment, piloting and implementation of awareness activities.
Developing **investment and entrepreneurship** in climate and climate change mitigation and adaptation.	√ Policy and legal framework for investment and entrepreneurship in climate and climate change mitigation and adaptation reviewed / established √ Value-added projects in Clima-Eco-Tourism (CET) √ Projects in **ECO-/NAPA villages**; √ Clean Development Mechanism **(CDM**) and carbon markets projects; √ Sector-targeted climate and climate change **investment and entrepreneurship curricula**	√ Multisectoral and stakeholder planning engagements. √ Action plan development and implementation activities √ Policy and legal framework development and implementation activities √ CET zones / village mapping and infrastructure development √ ECO/NAPA village mapping and infrastructure development √ Training and retooling in climate and climate change investment and entrepreneurship competences √ Curriculum development activities.
Controlling damage and wastage in communities and sectors induced by	√ **50 percent reduction** in climate change-induced national wealth wastage in the various sectors	√ Establishment of an appropriate legal framework on climate change damage control

climate change disasters, such as strong winds and storms, lightening, floods, high temperatures, landslides and dust storms.	√ **Climate change proofing** (mainstreaming) in national development.	√ Comprehensive studies and mapping of climate change damage and hot-spot zones √ Establishment of climate change damage control mechanisms in hot-spot zones √ Mainstreaming and implementation of climate change proofing activities in all sectors and communities √ Implementation of regular climate change and climate change damage audit in all sectors, institutions and development processes
Institutional reform to upgrade the Department of Meteorology (DoM) and integrate emerging demands of climate and climate change.	√ The Uganda Meteorology and Climate Change Management Agency set up.	√ A functional analysis carried out of all activities of the DoM. √ Setting up of a restructuring plan.

3.4 Matrix showing five-year Investment costs according to investment area and targets

Table 10:

Area of public investment	Inputs	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014
1. Developing and implementing **standards and regulations** to improve the quality, safety and resilience of climate and climate change-sensitive sectors.	√ Multisectoral and stakeholder planning commitments √ Action plan development and implementation activities √ Policy and legal framework development and implementation activities	200,000,000	400,000,000	150,000,000	300,000,000	300,000,000
2. Developing National Climate and Climate Change Advisory Services (NaCCAS) to build knowledge, skills and competences of sectors, institutions, rural and urban communities, and to promote adoption of appropriate technologies and innovations.	√ Retooling, training and re-allocation of extension staff and structure √ Improvement of the National Climate Observation Network √ Modernizing the National Forecasting and Early Warning System √ Modernizing the data and information management / the dissemination system	2,000,000,000	3,000,000,000	3,000,000,000	2,000,000,000	2,000,000,000
3. Developing climate and climate change **research and technology** in order to generate demand-driven technologies and innovations based on needs of climate-sensitive production zones and sectors.	√ Upgrading of the School of Meteorology into an Institute of Climate and Climate Change √ Establishing climate and climate change research and technology development programmes √ Establishment of climate and climate change training programmes for national and regional needs	2,000,000,000	3,000,000,000	3,000,000,000	1,000,000,000	1,000,000,000
4. Strengthening **public education and human resources** in higher education institutions and schools to meet emerging climate change opportunities and challenges.	√ Training and retooling of extension staff, development planners, training of trainers, e.g. teachers at all levels √ Establishment and piloting of school, vocational, and higher education curricula √ Establishment, piloting and implementation of awareness activities	500,000,000	500,000,000	500,000,000	500,000,000	500,000,000
5. Developing **investment and entrepreneurship** in climate and climate change mitigation and adaptation.	√ Multisectoral and stakeholder planning commitments √ Action plan development and implementation activities √ Policy and legal framework development and implementation activities √ CET zones /village mapping and infrastructure development √ ECO- / NAPA village mapping and infrastructure development √ Training and retooling in climate and climate change investment and entrepreneurship competences	2,000,000,000	3,000,000,000	3,000,000,000	2,000,000,000	2,000,000,000

	√ Curriculum development activities					

6. Controlling damage and wastage in communities and sectors induced by climate change disasters, such as strong winds and storms, lightening, floods, high temperatures, landslides and dust storms.	√ Establishing an appropriate legal framework on climate change damage control. √ Conducting of comprehensive studies and mapping of climate change damage and 'hot spot' zones. √ Establishing a climate change damage control mechanisms in 'hot spot' zones. √ Mainstreaming and implementation of climate change-proofing activities in all sectors and communities √ Implementation of regular climate change and climate change damage audit in all sectors, institutions and within the development process.	4,000,000,000	5,000,000,000	5,000,000,000	5,000,000,000	5,000,000,000
7. Carrying out institutional reform to upgrade the Department of Meteorology (DoM) and integrate emerging demands of climate and climate change.	√ Performing a functional analysis. √ Drafting of a restructuring plan.	500,000,000	4,000,000,000	4,000,000,000	2,000,000,000	2,000,000,000
TOTAL		**11,200,000,000**	**18,900,000,000**	**18,650,000,000**	**12,800,000,000**	**12,800,000,000**

A total of U Sh**74.4 billion** is proposed for the five-year climate and climate change sub-sector plan.

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UNDP-UNEP Poverty-Environment Initiative
P.O. Box 30552 (00100)
Nairobi/Kenya

Fax: + 254-20-7624525
Email: facility.unpei@unpei.org
www.unpei.org