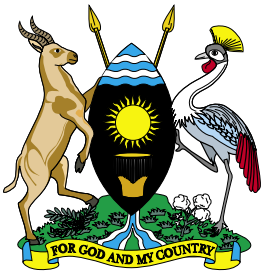
THE REPUBLIC OF UGANDA

STATE OF THE ENVIRONMENT REPORT FOR UGANDA 2010





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STATE OF THE ENVIRONMENT REPORT FOR UGANDA 2010

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Cover page photographs
Top: Cracks in soils in Bunamunzu, Manafwa District, pathways for fast flow of water into the lower layers of soils causing landslides.
Below: An Oil Rig at Butiaba, Floods in Karamoja region, Depleted Iyamuriro wetland.

Foreword

Hon. Maria Mutagamba

It is now known worldwide that natural assets play a critical role in fostering economic growth hence the greater need to manage them well for sustainable development. It is the responsibility of the National Environment Management Authority (NEMA) to update policy makers on environmental trends so as to make well informed decisions about the environment. This role is reflected in its systematic production of State of the Environment reports since the last two decades.

The State of the Environment 2010 with the theme, **"environment sustainability and health"** is an integrated assessment of the state and trends of key environmental resources including land, fresh water and aquatic resources, biodiversity and energy resources among others. The report takes a multi-pronged approach in assessing utilization and vulnerability of all environmental resources in the country. Resultantly, the report strives to highlight gaps and opportunities of the country to meet the Millennium Development Goals.

This publication is the 10th report produced by NEMA since 1994.The first report came at a time when knowledge on environmental issues was still at its infancy. It came barely two years after the United Nations Conference on Environment and Development (UNCED) hence was a direct response to what was agreed by governments on this historic event.

Through an in depth research and use of scenarios, the report clearly highlights the effects of environmental degradation at both local and national level. The country faces severe environmental problems including soil erosion and declining soil fertility, deforestation, pollution of land, water and air resources, loss of biodiversity and over-harvesting of forests, fisheries and water resources. This continued liquidation of the country's natural capital undermines long-term economic progress and will aggravate poverty. To spur the contribution of environmental resources to national economic development therefore, it will be necessary to improve environmental governance with specific focus on information provision, compliance and enforcement as well as the participation of all stakeholders.

This report also reveals the impacts of some of the emerging challenges in the country such as the catastrophic effects of climate change. It also highlights that climate change can also bring with it other opportunities for the economic development, science and technology growth through targeted research and development programmes. It is pleasing to note that the State of Environment report for 2010 is one of the first publications in the whole country with an intention of providing useful information in order to mainstream the environmental issues in every sector of the economy. Therefore, I urge all policy makers at various levels to make good use of this vital information.

Hon. Maria Mutagamba
MINISTER OF WATER AND ENVIRONMENT

Acknowledgements

Dr. Tom O. Okurut

The National Environmental Management of Uganda, NEMA is privileged to present its 9th State of the Environment report this year.

On behalf of the board and management of NEMA, I wish to thank the Government of Uganda for its steadfast support in the production of the State of the Environment reports throughout the years. I thank the Central Government institutions under the umbrella of the Environment information Network who authored this report. The districts across the country are also acknowledged for their valuable contributions. Much of the districts helped us to identify major environmental hotspots showing evidence of environmental degradation taking place around the country.

In addition, I appreciate the great support received from the development partners and here I wish to single out the World Bank and United Nations Development Programme (UNDP) for their continued support.

I wish to thank the NEMA staff who coordinated and guided the process.

Last but not least, I also want to acknowledge those who provided guidance and useful comments to strengthen facts in this report.

I hope that this report will be used as a guiding tool in promoting a better environment for the current and future generations. I look forward to receiving your feedback.

Dr. Tom O. Okurut
EXECUTIVE DIRECTOR
NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

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List of Acronyms

BMU	Beach Management Unit
CDM	Clean Development Mechanism
CERs	Certified Emission Reductions
CFCs	Chlorofluorocarbons
CSR	Corporate Social Responsibility
DFR	Department of Fisheries Resources
DFS	District Forest Service
DFS	District Forestry Service
DJM	Dual Joint Management
DPSEEA	Drivers-Pressures-State-Effect-Exposure-Action
EA	Environment Audits
EAC	East African Community
EIA	Environment Impact Assessments
EIA	Environmental Impact Assessment
EIN	Environment Information Network
FACE	Forests for Absorbing Carbon Emissions
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
HDI	Human Development Index
HSSP	Health Sector Strategic Plan
IAEA	International Atomic Energy Agency
IAS	Invasive Alien Species
IK	Indigenous Knowledge
ITCZ	Inter-Tropical Convergence Zone
IWRM	Integrated Water Resources Management
KCCL	Kasese Cobalt Company Limited
LULUCF	land use, land use change and forestry
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MDG	Millennium Development Goals
MEMD	Energy and Mineral Development
MFPED	Ministry of Finance, Planning and Economic Development
MSWC	Municipal Solid Waste Composting
MUIENR	Makerere University Institute of Environment and Natural Resources
MWE	Ministry of Water and Environment

NAADS	National Agricultural Advisory Services
NAPA	National Adaptation Programmes of Action
NBI	Nile Basin Initiative
NDP	National Development Plan
NEMA	National Environment Management Authority
NEPAD	Partnership for Africa's Development
NFA	National Forestry Authority
NFA	National Forestry Authority
NGO	Non-Governmental Organisation
PA	Protected Area
PEAP	Poverty Eradication Action Plan
PMA	Plan for the Modernisation of Agriculture
POPS	Persistent Organic Compounds
POPs	Persistent Organic Pollutants
PPP	Private-Public Partnership
SEA	Strategic Environmental Assessments
SOE	State of the Environment
SOER	State of the Environment Reporting
UAE	United Arab Emirates
UBOS	Uganda Bureau of Statistics
UETCL	Uganda Electricity Transmission Company Limited
UNCBD	United Nations Convention on Biological Diversity
UNCED	United Nations Conference on Environment and Development
UNCSD	United Nations Conference on Sustainable Development
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UWA	Uganda Wildlife Authority
WCED	World Commission on Environment and Development
WCS	Wildlife Conservation Society
WENRECO	West Nile Rural Electrification Company
WFP	World Food Programme
WHO	World Health Organization
WSSD	World Summit on Sustainable Development

Executive Summary

Introduction

The theme for this **State of the Environment (SOE) Report** is ***environment sustainability and health***. The focus on health and environment underlines the growing recognition of the link between environmental sustainability and health outcomes. The focus is dual faced; first, several health management activities have considerable environmental implications including the environmental impacts of medical waste management; or the use of pesticides, for instance DDT, for disease vector control. The other face is the health implications of poorly managed environments including the risk of environmental diseases, increased vulnerabilities due to climate change and the cost of managing otherwise avoidable environmental diseases.

Previous reports have had various thematic focus. The first **SOE (1994)** was a baseline report establishing the environmental situation in Uganda and was used as a background report to catalyze the passing of the **National Environment Act, Cap 153** and the **National Environment Policy of 1994**. **The 1996 Report** incorporated the drivers-pressure-state-impact-response (DPSIR) framework. **The 1998 Report** looked at the inter-linkages between environment and development and discussed how environmental degradation impacted people's livelihoods, their wellbeing and the economy. **The 2000 SOE Report** highlighted the environmental implications of key Government programmes including Vision 2025, the Poverty Eradication Action Plan (PEAP) and the Plan for the Modernisation of Agriculture (PMA).

The **2002 edition** on the other hand, addressed the principles of sustainable development and the relationship between poverty and the environment. It also adopted an 'outlook' approach by incorporating a section on future scenario analysis. The next series of reports **(2004 and 2006)** provided a scientific and policy basis for environmental governance focusing on the principles of sustainable development. The **SOE 2008** adopted a new analytical framework - the Opportunities approach and highlighted the opportunities presented by Uganda's natural resource base.

The key message from the current report is that environmental degradation costs the national economy colossal amounts of money through otherwise avoidable expenditure on curative health care, water treatment, re-settlement of environmental refugees, emergency food aid and restoration of degraded ecosystems. These costs will increase in view of the exacerbating effects of climate change and increased vulnerability. The report however, notes that immense opportunities to correct or even augment the contribution of Uganda's environmental resources to economic progress and human well-being exist. The report therefore recommends various strategic actions for improving the state, opportunities and outcomes from the environment and natural resource base in Uganda.

The Structure of the Report

The report is divided into four parts.

The first part, ***Environment and Development***, consists of a discussion of environment, economic development, socio-economic issues including poverty, gender and equality issues in the country.
Part two is an analysis of the ***State of the Environment***. The chapters contain an integrated assessment of the major natural resources under the following themes: land resources; atmospheric resources; freshwater and aquatic resources; biodiversity resources; energy resources; and environmental vulnerability. Under each theme, opportunities provided by the natural resources are identified; and where possible economic valuation is included so as to better highlight the need for safeguarding and improving the remaining asset.

The third part - ***Future Outlook and Policy*** – consists of two chapters. Chapter 8 on scenarios; and chapter 9 that discusses policy options for addressing the challenges identified in this report.

Thematic Conclusions and Policy Recommendations

Environment and Development

The link between the environment, economy and social development is well established. This is particularly true for Uganda where the majority of the population directly thrive on agriculture and the natural resource base. The environment and natural resource base therefore drives development, while development activities also impact on the environment.

Uganda's current development pathway has not adequately integrated or balanced the environment, social and economic pillars of sustainable development. The country faces severe environmental problems including soil erosion and declining soil fertility, deforestation, pollution of land, water and air resources, loss of biodiversity and over-harvesting of forests, fisheries and water resources. This continued liquidation of the country's natural capital undermines long-term economic progress. To spur the contribution of environmental resources to national economic development therefore, the national development plan included in its objectives and principles key tenets of environmental management. It also emphasized the need to improve environmental governance with specific focus on information provision, compliance and enforcement, restoration of degraded ecosystems as well as the participation of all stakeholders.

Land Resources

Uganda's land resources are critical to national development and human well-being. Land supports agriculture, human settlements, industrialization and important infrastructure. Rapid population growth and environmental degradation however pose a growing challenge to the continued productivity of the land resource. The key recommendations of the chapter focus on developing and implementing policies that promote soil and water management and ensure the sustainable management of critical ecosystems particularly wetlands.

Atmospheric Resources

Uganda's atmospheric resources refer to the state and interactions among the key elements of the climate system and its component parts, the state of air, sunshine, atmospheric gases including ozone and the now evident frequent and intense climatic extremes.

The key challenge to the state of atmospheric resources is climate change. The impacts of climate change are already being felt in Uganda; especially in sectors that are critical to the economy

and people's livelihoods. These include agriculture, water supply, health, transport, housing and personal safety and security. Various measures to climate proof Uganda's economy are proposed particularly regarding research and forecasting, water storage and disaster risk reduction.

Water and Aquatic Ecosystems

The regular supply of clean and safe water for domestic, agricultural and industrial use remains a key development challenge in Uganda. Uganda is well endowed with water resources. However many of the challenges faced in supply and quality are due to degradation of the water catchment areas. For instance, the degradation of wetlands has exacerbated the water supply problem, first by undermining the water filtering function of wetlands, but also by reducing their water storage capacity. Degradation of the aquatic ecosystem also affects the resources therein such as fish.

The recommended actions in the aquatic resources, freshwater, fish and wetlands sub-sectors include effective management of water catchment areas by harmonizing land use, forestry, agriculture, industry and environment policies in addition to investing in research and development in the water sector.

Biodiversity

Uganda's rich biodiversity provides a unique opportunity to support poverty eradication as part of a sustainable management and conservation strategy. The multiple roles performed by biodiversity encompass food security, agriculture (including the fishing, livestock and crop industry), tourism, wealth creation, serving cultural purposes and the supply of ecosystem services. Ecotourism based on forest biodiversity is fast becoming a niche market product for Uganda. The continued loss and degradation of Uganda's biodiversity therefore presents a serious challenge to livelihoods, economic growth and human well being.

The key recommendations include increased protection of forest habitats to reduce deforestation induced biodiversity loss; further implementation of the National Land Use Policy to address issues of encroachment on forests, wetlands and other fragile but biodiversity rich ecosystems; and better management of invasive alien species.

Energy Resources

Uganda is an energy poor country. Less than 5 percent of Ugandans have access to electricity, making Uganda's per capita energy consumption one of the lowest worldwide. While it is critical to further invest in the modern energy sector, specific investment focus should be given to the new and renewable energy sub-sector. Renewable energy sources have the potential to lift the burden off Uganda's forests. They could also provide the much needed power for irrigation and support coping mechanisms for communities faced with the dire impacts of climate change and extreme weather conditions.

Environmental Vulnerability

Vulnerability is directly linked to the extent to which populations in a region are vulnerable to the impacts of the disaster. The key vulnerabilities in Uganda include environmental, economic, social and physical vulnerabilities. All of these have to do with reduced ability of the respective systems to withstand shock. The key strategies to increase resilience therefore include strict adherence to land use plans, conservation and sustainable use of the natural resource base, development and implementation of the requisite policy and legal framework on disaster risk reduction and management. Capacity development for vulnerability assessment and an early warning system are important ingredients of a good strategy for increased resilience.

Scenarios

Uganda's overarching policy goal as guided by Vision 2040 is to transform the country into an industrialized middle income nation by year 2040. The aim is to ensure that all Ugandans have a high quality life in a clean and healthy environment. In order to achieve this target the government needs to actively choose to follow a sustainable development pathway.

This *Best Case Scenario* will ensure implementation of appropriate policies, legal and institutional frameworks necessary; and be based on traditional knowledge and sound scientific evidence. An emerging lesson from this discussion is the need to take a long-term view of trends in the environmental arena.

Policy Options for Action

Environment and Development

- Further integrate the MDGs in the national Development Plan and medium term expenditure framework to ensure inclusion of both income and human poverty issues in national development
- Enhance the synergies and harness inter-sectoral linkages between the three components of sustainable development
- Ensure sound economic and public financial management, corporate governance and accountability
- Strengthen the policy and institutional frameworks on science, technology and innovation for sustainable development.

Land, Agriculture and Forests

- Improve the management of water and soil resources and promote the use of improved technologies including high yielding seeds.
- Develop and implement food security strategies in the context of poverty eradication and net exportation of agricultural products
- Increase the national budget allocation to agriculture and forestry with the aim of increasing productivity and promoting value addition
- Further strengthen the position of forestry in the National Development Plan by undertaking regular forest valuation and forest-environment accounting studies.

Climate Change

- Development robust policies and regulatory responses on climate change adaptation and mitigation and the use of biofuels.
- Identify and implement measures that have both mitigation/adaptation and poverty reduction co-benefits.
- Improve disaster risk management and response to extreme weather events including floods, landslides, droughts and thunderstorms and their associated health implications.
- Further strengthen national capacity to systematically collect, analyse, model and forecast the impacts of weather variability and climate change on agriculture, water resources management, health, fisheries, transport and communication and national development.

Aquatic Resources: Fresh Water, Fish and Wetlands

- Promote integrated watershed management programmes aimed at reducing depletion and pollution of water resources in light of the anticipated impacts of climate change.

- Establish river and lake catchment and basin organisations and lake monitoring systems.
- Develop and implement long-term strategies and plans for investment in and the development of urban and rural water and sanitation infrastructure.
- Strongly enforce local bye-laws, ordinances and regulations on sanitation and hygiene.
- Strengthen management, monitoring, control and surveillance capacity of the Fisheries Department with particular focus on the Albertine Graben.

Biodiversity Resources

- Further integrate the National Biodiversity Strategy and Action Plan (NBSAP) into the National Development Plan (NDP).
- Implement national programmes and networks for information sharing and collaboration in order to scale up conservation activities and address cross-border biodiversity issues.
- Ensure the effective participation of civil society, local communities and indigenous peoples' in national programmes/processes on biodiversity conservation so that they are afforded the opportunities to influence decisions that impact on their livelihoods.
- Review and update the NBSAP and promote a synergistic approach to the implementation of the plan with respect to other Rio conventions (National Forests Programmes, NAPAs for climate change, and National Adaptation Plans for Drought and Desertification).

Energy Resources

- Increase access to modern energy resources particularly using off-grid systems with the aim of supporting the development of productive and income generating activities and entrepreneurship.
- Commit commensurate financial resources to the development of biomass energy which supports the energy needs of up to 91 percent of the population – charcoal, biogas and fuel wood.
- Provide an attractive national investment climate for both domestic and foreign investors in the energy sector.
- Promote use of energy efficient and low-carbon energy access technologies.

Vulnerability

- Mainstream vulnerability issues into the development agenda so as to improve budgetary allocations to the sector.
- Develop and implement adaptation strategies to climate change which is seen as a main trigger to the main natural disasters.
- Build capacity for vulnerability risk assessment and hazard mapping at all levels and across sectors to encourage a more integrated approach to vulnerability and disaster management.

Scenarios

- Implement the flagship projects that have been identified in the National Development Plan to help the country achieved the desired *best case* development in a sustainable manner.
- Enhance integration of sustainable indicators into the National Development Plan through green accounting, valuation of natural resources and strategic environmental assessment.

COUNTRY BACKGROUND AND INTRODUCTION

General Overview of Uganda

This section provides a summary of the location and natural resources of Uganda and is adopted from NEMA (1996).

Location

Uganda is a landlocked country in the eastern part of Africa. It is surrounded by Kenya in the east, Sudan in the north, Tanzania and Rwanda to the south and the Democratic Republic of Congo to the west. The map below shows Uganda including districts. Key geographical indicators are highlighted in the Box shown.

Key geographical indicators of Uganda

Latitude		4o12'N and 1 o29'S
Longitude		29o34'E and 35 o0'W
Altitude	(minimum ASL)	620 metres
	(maximum ASL)	5,110 metres
Total surface area		241,550/7 km2
Area under land		199,807 km2
Area under water and swamps		41,743 km2
Temperature		16-31oC
Rainfall		700-3,000 mm/year

Source: UBOS 2010

Relief

Most of Uganda forms part of the interior plateau of the African continent. It is characterized by flat-topped hills in the central, western and eastern parts of the country. The rise of the plateau in the eastern and western parts of the country is represented by spectacular mountainous topography found along the borders. These include the Block Mountains of the Rwenzori and the Mufumbira volcanoes in the West; and Mt. Elgon, Mt. Moroto, Mt. Morungole, Mt. Timu and Mt. Kadam in the East.

Geology and Soils

The geological formations of Uganda reveal rocks formed between 3,000 and 6,000 million years ago (pre-Cambrian era); hence they are very old. The younger rocks are either sediments or of volcanic origin, formed from about 135 million years ago (Cretacous period) to the present. Hence there is a gap in the geological history of Uganda of about 460 million years. The soils of Uganda are defined by a number of parameters including parent rock, age of soil and climate. The most dominant soil type is ferralitic soil which accounts for about two-thirds of the soils found in the country. Uganda's soils are divided into 6 categories based on productivity: i) very high to high productivity; ii) moderate productivity; iii) fair productivity; iv) low productivity; v) negligible productivity; and vi) nil productivity.

Figure i: Administrative Divisions of Uganda
Map production: UBOS 2010

Drainage

Lake Victoria, shared with Kenya and Tanzania is the second largest freshwater body in the world. Most of the rivers in the southern part of the country drain into Lake Victoria. Its waters then drain through the Owen Falls dam through the Victoria Nile and Lake Kyoga into Lake Albert, the Albert Nile and White Nile in Sudan down to the Mediterranean sea through Egypt. This drainage pattern represents past geological adjustments which include the reversal of the direction of flow of some of the rivers in Uganda which originally flowed westwards of Lake Victoria. Areas of impeded flow are due to the influenced of warping and are associated with wetland areas. There are also crater lakes in western Uganda associated with the Western Rift Valley.

Climate and Vegetation

Uganda's climate is shaped by the Inter-Tropical Convergence Zone (ITCZ) and air currents such as the southeast and northeast monsoons. There are two main season: the rainy and dry seasons. Mean temperatures show great variation depending on elevation and landscape. Temperatures in areas adjacent to water bodies are modified by the maritime conditions.

Uganda has 5 climatic zones, using rainfall received as the dependent variable. They are Zone 1 – the Lake Victoria zone; Zone II – the Karamoja region; Zone III – western Uganda; Zone IV – the Acholi-Kyoga region; and Zone V – the Ankole-southern area.

There are 11 main vegetation categories: high montane moorland and heath; medium altitude forests; forest/savannah mosaic; moist thicket; woodland; wooded savannah; grass savannah; steppe; bush land and dry thicket; swamp (wetlands) and cultivation communities. The vegetation classification and descriptions used in Uganda today are still based on 1967 Langdale-Brown and Osmanson classification.

Population

The population is a key driver for environmental change in this country – affecting the availability and renewability of natural resources. As populations grow resource use increases in line with changes in people's aspirations, values and socio-economic status. Uganda hopes to become a middle-income country by 2040. Demographics will thus play an important role in mitigating or exacerbating the country's prospects for development and the well-being of its people. Achieving and sustaining the 10 percent economic growth that will be required to achieve this goal, will be heavily dependent on the health of the environment and natural resource base.

Driven by a very high fertility rate of 6.7 children per woman, Uganda's population has more than tripled in the past 40 years from 9.5 million in 1969 to 32.9 million in 2011 as shown in the figure below (UBOS 2011). The high rate of population growth puts pressure on the natural resources, including arable land, which in turn drives up the poverty rate and threatens future gains in agricultural production and food security. Land fragmentation, shrinking per capita access to arable land is the reality. The large population also requires more key services including sanitation, housing, transport, energy, education and employment among others. Demographic pressures also affect the environment and compound the impacts of climate change, especially in the northern, more arid and less developed regions, which have the highest fertility rates in the country (MFPED 2010).

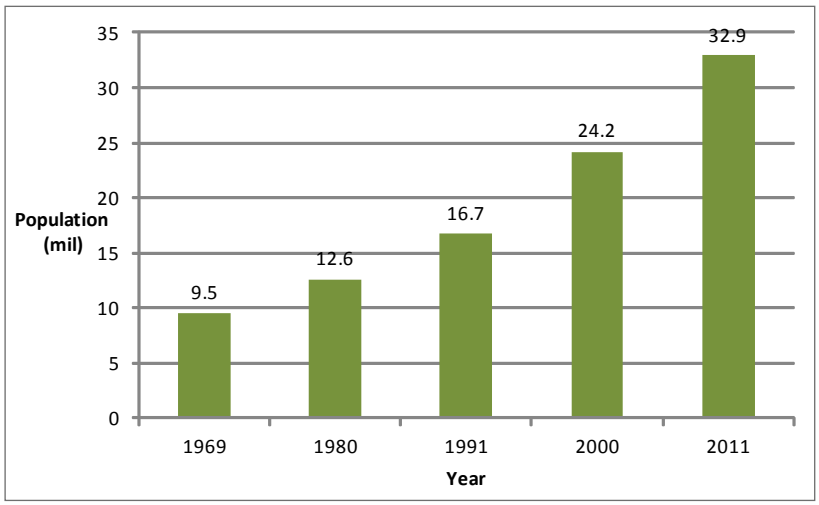


Figure ii:Census population of Uganda 1969, 1980, 1991 and 2002 and mid year 2011 projection
Source: UBOS 2011

Sustainable Development Processes and Environmental Reporting

The United Nations Conference on Environment and Development (UNCED) or Rio Summit of 1992 was a landmark event for the sustainable development agenda. It highlighted the commitment of the international community to providing public and political support for addressing environment and development issues in a holistic and integrated manner.

The main outcome of the Rio 1992 meeting was Agenda 21 (UN 2009). It is a blueprint for environment management at global, national and local level; and considers every area in which human beings are likely to impact on the environment. The requirement for State of the Environment (SOE) reporting was promoted during the Rio Summit in 1992. Indeed Agenda 21 calls on countries to improve the provision of environmental information for decision making and development. SOE reports have since become very popular around the world and are widely published on the Internet. For instance, Uganda's SOE reports are available on www.nemaug.org. SOE reporting in Uganda has grown by leaps and bounds. Since 1994, there have been initiatives at different levels in the country to promote environmental reporting. District State of the Environment Reports are now being produced; and there have been efforts to move towards sectoral environmental reporting. Indeed the Environment Act Cap 153 requires the lead agencies to report annually to NEMA on environmental aspects of their portfolio.

Following on from 1992, a five year review conducted in 1997 (Rio+5), reported that little progress had been made in implementing the global sustainable development agenda. In view of this, the World Summit on Sustainable Development (WSSD) was convened in Johannesburg, South Africa in 2002. The goal of the WSSD was to conduct a further (10 year) review of the implementation of the outcomes of UNCED, particularly Agenda 21, and to re-invigorate global commitment to sustainable development. The key output – the Johannesburg Plan of Implementation - further affirmed the pledge to full implementation of Agenda 21, the Millennium Development Goals and other multilateral environmental agreements.

Uganda actively participated in both world summits. The national report (GOU 2002) to the Johannesburg Summit indicated that little progress in implementing Agenda 21 had been made. The report specifically highlighted land degradation as a major problem. The main underlying drivers being population pressure, land fragmentation, inappropriate farming practices and lack of non-farm income generating opportunities. The report however provided impetus to the discussion on improving access to safe water and proper sanitation and highlighted government's commitment to meet the Millennium Development Goals (MDG) targets on safe water and sanitation.

The UN General Assembly resolved in 2009 to organize the United Nations Conference on Sustainable Development (UNCSD) in June 2012 in Rio de Janeiro, Brazil. The purpose of the conference is to secure renewed political commitment for sustainable development, assess progress to-date and the remaining gaps in the implementation of the outcomes of the major summits on sustainable development, and to address new and emerging challenges. The focus of the upcoming conference is twofold. First the conference will discuss the green economy in the context of sustainable development and poverty eradication. The conference will also discuss institutional frameworks for sustainable development. The national assessment process for Uganda has not started, but should also focus on the green economy, institutional reforms and environmental governance for sustainable development. This ninth edition of the SOE report thus comes at a timely moment when the country is about to kick-start its national reporting process towards Rio 2012.

The SOE Process In Uganda

The Context

Uganda continues to meet its legal obligation under the National Environment Act Cap 153 of 1995, to report on the state of the environment. The SOE reports are published every two years. The aim of SOE reporting is to capture and present information on the environment and natural resources as a basis for evidence based decision-making. The SOE report also forms the basis for the preparation of sector policies, development strategies, environmental action plans and various national reports required under the different multilateral environmental agreements that Uganda is a signatory to.

Evolution of the SOE Reports

The information content of the SOEs has been critical in making the document a prerequisite for sustainable development. The principle of sustainability requires that explicit recognition must be given to existing interrelationships between people, resources, environment and development. So by bringing together basic statistical data, scientific and policy research and using an integrated approach these reports have presented the information in a usable and relevant format (Gowa 2009).

Each report is unique in that they focussed on different thematic areas; or adopted a distinctive analytical and conceptual approach. The first SOE (1994) was a baseline report establishing the environmental situation in Uganda. It was also used as a background report to catalyze the passing of the National Environment Act Cap 153 and the National Environment Policy of 1994 - thus demonstrating strong linkages between the findings of environmental assessments, policy and law making. It also had other impacts within the wider public (see Box below).

Impact of the SOE 1994

With the production of the first SOE in 1994, the document quickly became one of the most anticipated products from NEMA. It gained a reputation as a report with accurate and scientifically-based information. An evaluation of its impact carried out in 1995 highlighted the following:
It had raised awareness of citizens to the state of their environment,

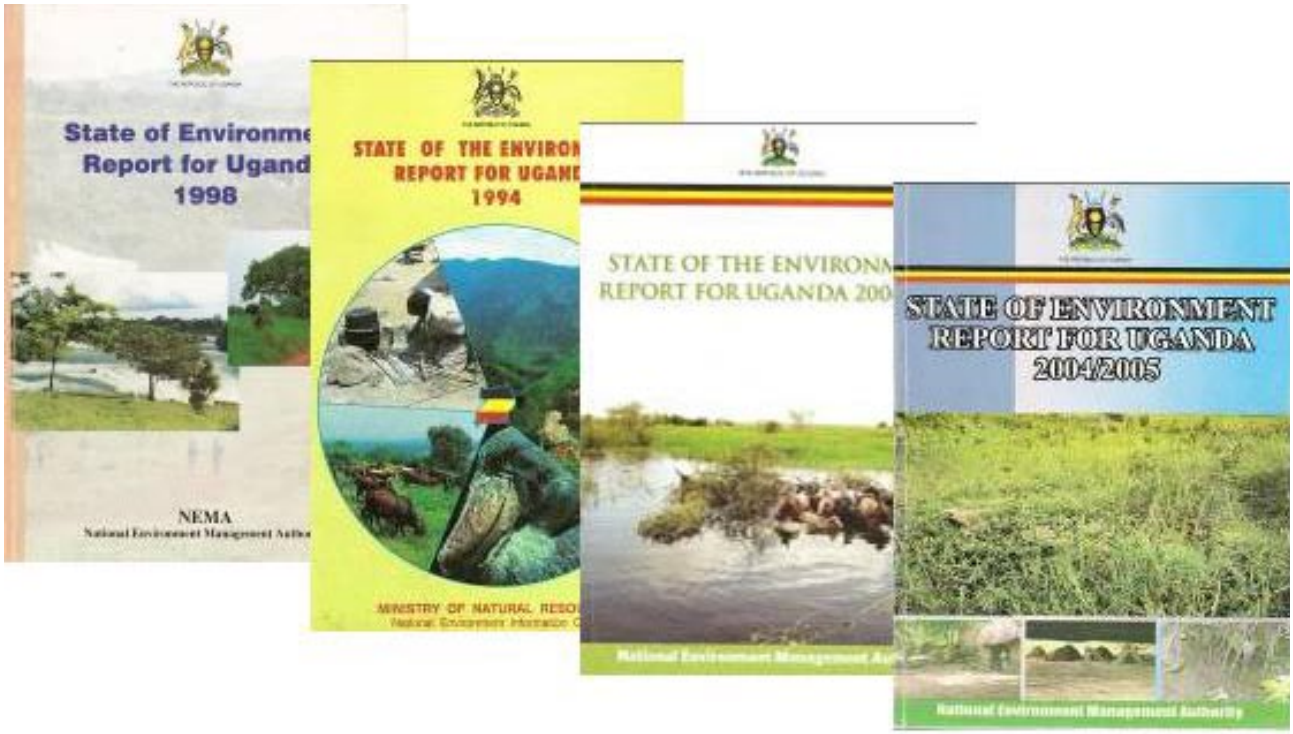
- It quickly became a standard reference document for media and private sector work, public awareness and formal educational purposes,
- It provided the factual basis for various development plans, programmes and policy, as well as the retrospective assessment of existing or past government policy,
- It enhanced the profile of NEIC in Africa with some countries like Lesotho and Gambia seeking technical assistance in preparing their own reports,
- It became a 'must-have' document, as indicated by the willingness to pay an equivalent of US$ 10 for a copy.

Source: NEMA 1995

The **1996** report incorporated the drivers-pressure-state-impact-response (DPSIR) framework. By **1998**, a more integrated form of reporting was emerging. The interlinkages between environment and development were clearly discussed. For instance how degradation of the environment impacted people's livelihoods, their wellbeing and the economy. In **2000**, the SOE report highlighted the environmental implications of key government programmes including Vision 2025, the Poverty Eradication Action Plan and the Plan for the Modernisation

of Agriculture. The **2002** edition addressed the principles of sustainable development and the relationship between poverty and the environment. It also adopted an 'outlook' approach by incorporating a section on future scenario analysis. The next series of reports (**2004** and **2006**) provided scientific and policy basis for environmental governance focusing on the principles of sustainable development. The SOE **2008** adopted a new analytical framework - the Opportunities approach. To that end, the report highlighted the opportunities presented by Uganda's natural resource base to support the 'Prosperity for All' policy. It also assessed the state and threats to key resources including land, freshwater, biodiversity, wetlands, and forests resources. In addition, issues related to economics, poverty and gender; and their inter-linkages with environment were discussed.

This current edition (**2010)** underscores the linkages between a health and environment. The analytical framework buttressing this report is the Drivers-Pressures-State-Effect-Exposure-Action (DPSEEA) framework. The underlying principle with this approach is that a particular environmental state will impact humans with varying amounts of ***Exposure*** resulting in certain health ***Effects***.



State of the Environment Reports from previous years.

The 2010 SOE Reporting Process

Uganda has been using environmental assessment and reporting as a tool to provide information to support development planning, and monitoring of progress towards set targets since 1994. These assessments or state of the environment (SOE) reports provide an overview of the state of the environment and natural resource base. They explain what is happening, analyze why it is happening and indicate the responses at policy and action levels.

This assessment has been quite involving and participatory since the inception of the Ugandan SOE reporting processes. It has been a joint effort of NEMA and the lead agencies. The lead agencies were in charge of identifying the critical issues for discussion under their thematic area. Meetings were held to discuss the format and to write the thematic submissions. Part 2 of this report is a direct outcome of this process.

Involving the lead agencies in the SOER production process should greatly enhance the credibility and ownership of the SOER. Furthermore it should also establish clearer linkages between the sector reports and the national SOER, and thus act as a stimulus for future annual environmental reporting by the sectors.

Apart from the Lead Agencies, major governmental, non-governmental stakeholders, the private sector and national experts in the different thematic areas have been involved at different levels of the process. The report is approved by the Parliamentary Committee on Natural Resources once complete.

Data issues

Data availability and currency remains an issue. Some of the issues mentioned in the SOE 1996 (NEMA 1996) regarding environmental data and information are still current today. These include: i) insufficient institutional input regarding cross-sector collaboration for effective management of natural resources information; ii) insufficient metadata to enhance/ enable information searches by data users; iii) lack of a cohesive approach among institutions for data dissemination; iv) inadequate investment (in terms of skills and financial resources) for environmental information management; and v) inadequate baseline and trend data due to incompatibility of datasets in that a great number of datasets cannot be combined to give meaningful information.

In terms of analysis, there is still a clear need for capacity building for environmental reporting. Most especially if the lead agencies are to support the national SOE report production process effectively. The use of the DPSIR approach that is the cornerstone of integrated environmental assessments is still not widespread within the country. It is an extremely useful framework for analysis given the fact that environment management involves cross-cutting and multi-sectoral approaches. Encouraging an integrated approach to reporting will, eventually, also lead to an integrated approach to the actual management of the natural resources.

Structure of the SOE Report 2010

This report is divided into three sections.

Part 1: Environment and Development includes a discussion of environment, economic development and socio-economic issues. It examines the sectors against the sustainable development framework. Underlying the analysis is the fact that Uganda's economic policy thrust as guided by the National Development Plan is to accelerate socio-economic transformation to a middle income country by 2040.

Part 2: State of the Environment includes an integrated assessment of the key environmental resources of land, atmosphere, freshwater, biodiversity and energy. Under each theme, opportunities for sustainably deriving benefits from the resource base and/or reversing environmental degradation are identified. Furthermore a discussion of the possible health impacts is included to emphasize the need for improving or maintaining the remaining asset. The last chapter in this section explores environmental vulnerability which is increasingly becoming a critical part of strategies for sustainable development.

In Part 3: Future Outlook and Policy scenario analysis is used to imagine what course environment management is likely to take in the future based on key decisions by Ugandan policy makers. The section concludes by tying together key policy suggestions from the foregoing chapters and presenting a set of recommendations for action.

Siltation and flooding can damage food crops and roads and lead to contamination of water sources especially boreholes increasing vulnerability

References

GOU (2002). *Uganda National Report to the World Summit on Sustainable Development*. Government of Uganda (GOU), Kampala. Also available on: http://www.johannesburgsummit.org/html/prep_process/national_reports/uganda_national_report.pdf

Gowa, E. (2009). *Best Practices in Environmental Information Management in Africa: The Uganda Case Study.* UNEP-GRID Arendal/National Environment Management Authority, Norway.

NEMA (1996). *State of the Environment Report for Uganda 1996*. National Environment Management Authority (NEMA), Kampala.

UBOS 2011. *Statistical Abstract 2011*. Uganda Bureau of Statistics (UBOS), Entebbe.

UN (2009). Agenda 21. United Nations (UN), New York. Also available on http://www.un.org/esa/dsd/agenda21/

PART I
Environment and Development

Cracks in soils in Bunamunzu, Manafwa District; pathways for fast flow of water into the lower layers of soils causing landslides.

CHAPTER 1
Environment and Economic Development

Introduction

Uganda's economic policy thrust as guided by the National Development Plan (NDP) 2010/11-2014/15 is to accelerate socio-economic transformation to achieve the national vision of a transformed Ugandan society from a peasant to a modern and prosperous country by the year 2040. The national development policy theme is to achieve growth, employment and socio-economic transformation for prosperity. The NDP replaced the Poverty Eradication Action Plan (PEAP), and outlines the government's intention to improve road and rail networks, create employment opportunities, improve labour productivity and consolidate the private sector as 'engine of growth and development' (GOU 2010).

The NDP recognizes the significant contribution of the environment and natural resource base to economic growth and well-being. The plan in its vision attributes, notes that Ugandans should be able to exploit and use natural resources gainfully and sustainably to promote competitiveness, independence, self sustenance and a dynamic economy whilst protecting the biological and physical systems upon which the economy is based. The plan, in its objectives therefore emphasizes the need to promote the sustainable use of the environment and natural resource base (GOU 2010).

The NDP operates on nine principles which emphasize ownership, political will, good governance, resource availability, balanced development, behaviour change, careful planning and commitment of resources, sustainable and equitable development and monitoring and evaluation. Principle eight on sustainable and equitable development highlights the importance of the balanced integration of the economic, social and environmental pillars of sustainable development.

This chapter addresses a number of issues surrounding the relationship between the economy and the environment. It provides an assessment of economic growth and sector performance, social well-being and MDG performance and resource use efficiency. It also touches on the challenges and constraints to sustainable development and highlights some of the opportunities for sustainable development including a transition to a green economy in the context of poverty eradication and job creation. In so doing, this chapter provides a measure of the level of integration of environmental considerations in the national economic policy framework and establishes why focusing on sustainable development is important.

Economic Development, Health and Environmental Management

Linking Economic Development to Environmental Management

Uganda's economic growth of 6 to 7 percent over the last decade has enabled one of the region's most impressive reductions in poverty levels. The poverty level fell from 56 percent in 1992 to 24.7 percent in 2010 making the country a regional leader in ensuring that high levels of economic growth lead to poverty reduction. The pace of poverty reduction, though rapid, has been unevenly distributed with the North, East and North-East retaining high levels of poverty (Kakande 2010). Figure 1.1 shows the national trends in poverty levels from 1992 to 2010.

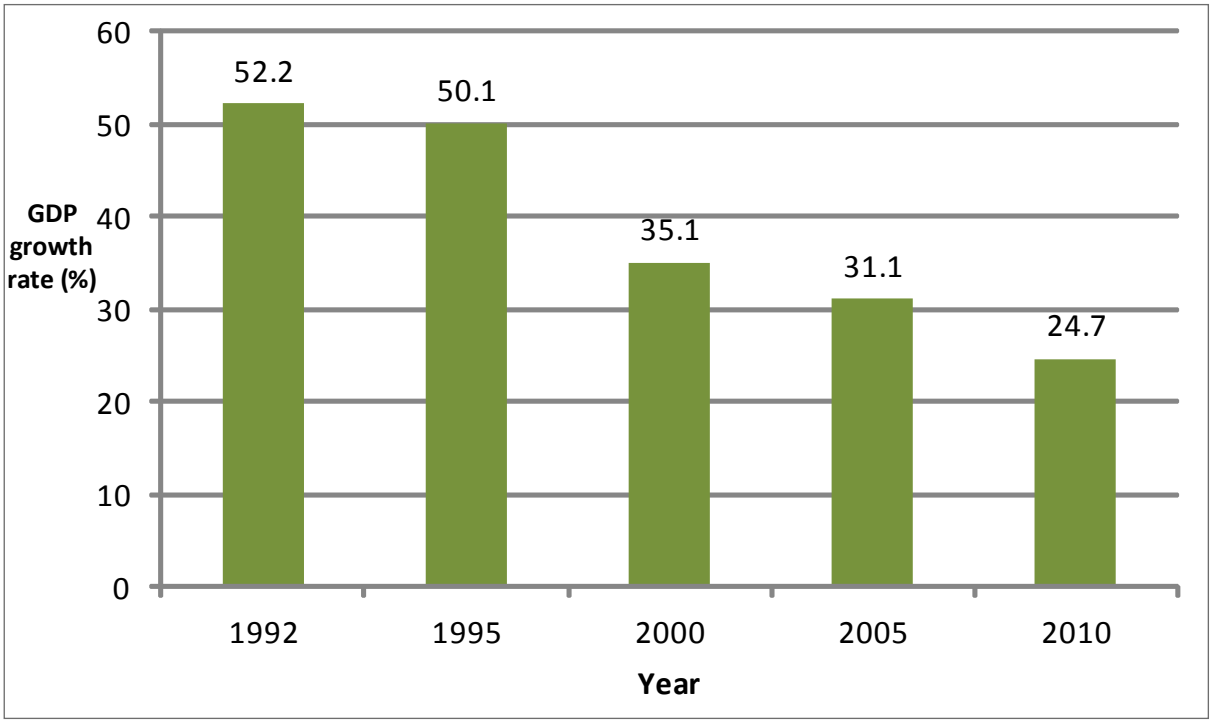
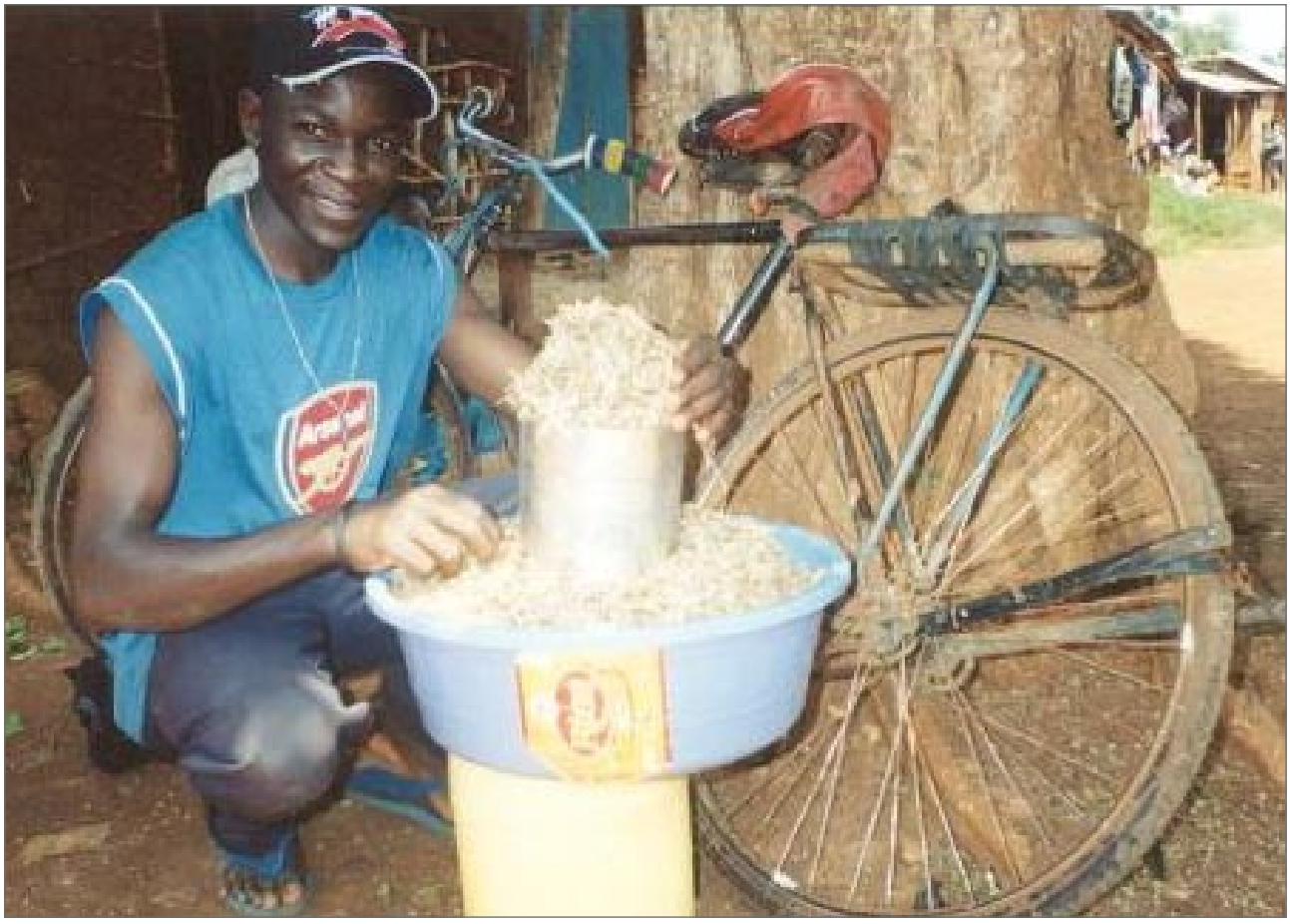


Figure 1.1: National trends in poverty levels
Source: Statistical Abstract 2010

Rapid economic growth also had implications for the environment and natural resource base. Consciously or otherwise, there has been a political and public willingness to 'sacrifice' environmental assets to achieve economic growth. Widespread deforestation and wetland degradation paved the way for agricultural expansion while unsustainable fishing levels supported fish exports over the last 15 years. Many flower farms for instance were located in wetlands on the shores of Lake Victoria and involved widespread reclamation of wetlands (Ogwal and Guloba 2011).

Yet poor people disproportionately depend on environmental assets. Clean water, fertile soils and rich biodiversity are critical for poor peoples' livelihoods, especially for the more than 80 percent of the population who live in the rural areas and depend on agriculture (UBOS 2011). Clean air, water and sanitation support the health of all Ugandans, and indeed poor people often express their poverty in terms of ill-health. They offer safety nets in times of trouble, for example, access to medicinal herbs when unwell, or to wetlands for water and pasture when weather conditions are extreme. Environmental assets are also a key source of income both for poor people (from farming, forestry, fisheries, tourism and other activities that depend directly upon the quality of the environment) and for the nation itself in terms of revenue from natural resource extraction.

The link between the environment and the economy moved to the centre stage of policy following the report by the World Commission on Sustainable Development (WCED) also known as the Brundtland Commission in 1987. The report emphasized that no region in the world faces separate environmental challenges, development challenges or energy challenges. They are all one (WCED 1987). The report also noted that these challenges cannot be solved by fragmented institutions or policies. Holistic institutions, embracing trans-disciplinary competencies and approaches have to be developed to advance a sustainable development approach to economic growth and well-being.



Small scale fish vending is a major source of income.
Photo credit: Fisheries Department.

Linking Health, Economic Development and Environment

Human health is defined by the World Health Organization (WHO) as *a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*. This definition is reflected in the national health sector strategic plan 2010/11-2014/15 and provides an opportunity for environmental and conservation strategies to play a much greater role in ensuring health than has been the case in the past. African countries, including Uganda, have recognized the link between health and environment through the Libreville Declaration on Health and Environment signed in 2008, and the subsequent Luanda Commitment in 2010.

Much of Uganda's disease burden is environment-related. More than 75 percent of the overall burden of diseases, either communicable diseases or non-communicable diseases is preventable, including malnutrition (MOH 2010). Access to safe water, sanitation, hygiene, nutrition and living conditions are still poor, especially in rural areas and urban slums, resulting in poor health, especially in women and under-five children. Urbanization and unhealthy lifestyles (changing diets and a more sedentary existence) have led to an increase in non-communicable diseases.

But sometimes the increases in health problems are due to the environmental risks that arise largely from unsustainable development policies related to the use of water and land resources, transportation and energy. Economic, institutional, political and social factors present barriers to more sustainable environment and health policies with macroeconomic considerations tending to be the major drivers of policy. This is clearly seen in Box 1.1 that discusses the Structural Adjustment Policies and their impacts on health and environment.

Box 1.1: Structural Adjustment Policies and their impact on health and environment in Uganda

Structural adjustment policies (SAP) were implemented in Uganda the late 1980s and 90s. These were meant to help rebuild the devastated economy. One of the goals of the SAP was to reduce government expenditures as a major instrument for the control of inflation. During this period, social spending focused on priority areas which included primary education, primary health care, water and sanitation, agricultural research and extension and roads. Other strategies included spending cuts and controls by keeping expenditures within available revenue and raising revenue through a combination of institutional changes.

The major changes included the scrapping of subsidies with the objective of widening the tax base through the introduction of cost sharing and user fees in the major social services of health and education. Another strategy was to reduce the size of the public sector and privatize state enterprises. The social costs of adjustment of retrenched civil servants were severe. And even among those that were still employed, many could ill afford the services and were thus unable to access social services. Many people left urban areas and went to villages where they could earn a living from cultivation. This had a direct impact on the education of the children and families' access to health services. It also caused an invasion of the hitherto unused lands and some gazetted areas were encroached on. The result of this new and re-invented livelihood system became soil exhaustion, fragmentation and degradation. In some cases, as a coping mechanism, encroachment into protected areas was adopted. Households turned to their tracts of land, selling them, to meet the costs of health and education. This sometimes precipitated landlessness.

Source: Tukahirwa 2002, Makokha 2001.

Economic Growth and Sector Performance

Overview

The Ugandan economy enjoyed strong economic growth based on continued investment in infrastructure, improved incentives for production and exports, lower inflation and better domestic security which enabled the growth of business and entrepreneurship as shown in Figure 1.2. The economy grew by over 7 percent per annum in the last decade. This sustained growth improved Uganda's Human Development Index (HDI), with particular progress in education, health and the standards of living (Kakande 2010).

Lately however, there have been reversals of these gains. The economy recorded weaker growth of 5.1 percent in 2010. This was because of receding aggregate demand, mainly in private consumption, and weak external demand for traditional exports, in particular coffee and the global financial down-turn. Export earnings fell from US $2.9 billion in the financial year 2008/09 to US $2.8 billion in 2009/10. Although lower than 2008/09 levels (US $883 million), remittance receipts in 2009/10 (US $820 million) surpassed traditional foreign exchange earnings from coffee and tourism. Earnings from coffee and tourism in 2009/10 were US $262 million and US $400 million respectively. Regional demand for Uganda's exports however remained high in-spite of the overall declines (UNECA 2011, MFPED 2010).

Sustained public investment in infrastructure and the global recovery are expected to spur growth in the short to medium term. The near-term prospects for the oil and gas sector remain uncertain because of disputes between the government and oil exploration firms. The real GDP growth rate is projected to increase to 5.6 percent in 2011 and 6.9 percent in 2012 because of increasing regional demand and the improved global outlook (MFPED 2010).

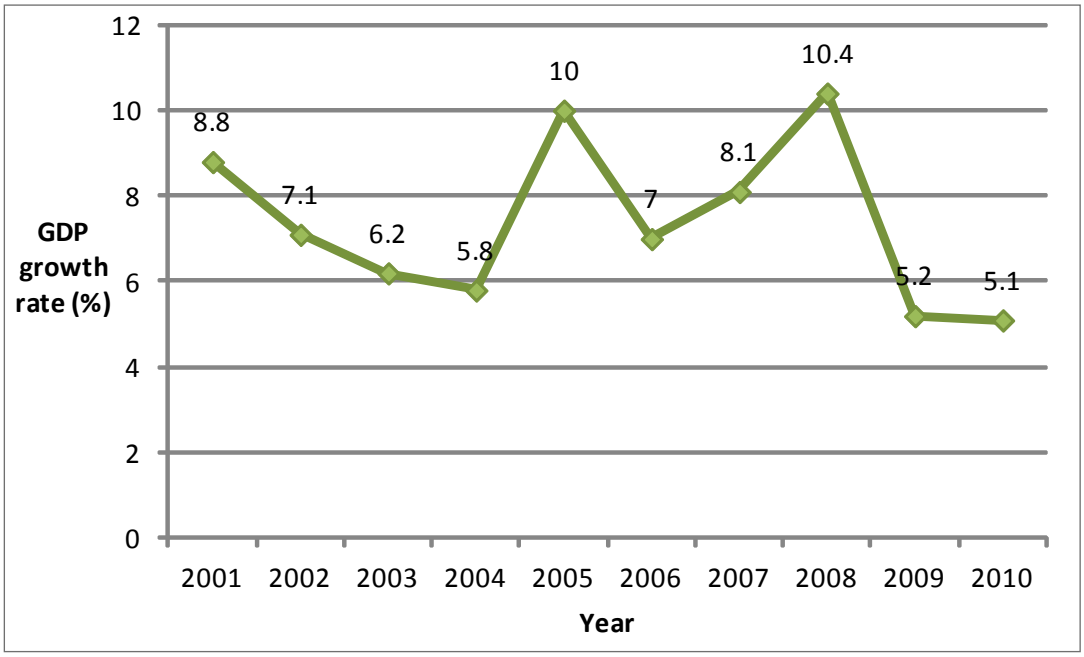


Figure 1.2: GDP growth rate in percent at constant 2002 prices.
Source: UBOS 2010

Uganda's major Emerging Partners since 2008 have been China, Hong Kong, India, Singapore and the United Arab Emirates (UAE). These partners accounted for 29 percent of total foreign direct investment (FDI) in 2009, with 54 percent of these investments in equity capital. FDI flows are concentrated in the three sectors of finance, insurance and business services. The key business services benefiting from this FDI are manufacturing, wholesale, retail, catering, accommodation and tourism. Emerging partners in Asia and the Middle East accounted for 13 percent of Uganda's export earnings and 57 percent of imports.

Oil exploration on the shores of Lake Albert.
Photo credit: PEPD

Growth in 2010 was however, primarily driven by the telecommunications, financial services and construction sectors, while the services and agriculture, forestry, fishing and hunting sectors, which account for 54.4 percent and 24.8 percent of GDP respectively, showed weaker growth. Growth in telecommunications (figure 1.3) was bolstered by expansion in mobile telephony while financial sector growth was boosted by the licensing of an additional commercial bank and expansion in the size and outreach of the existing financial institutions. The rebound in fishing and food production was offset by falling growth for the cash crops of coffee and cotton, leading to stagnation in the agriculture sector. In the recent past the declining GDP share of the agriculture sector has been the result of low productivity, limited value addition and lack of commercialisation. On the demand side, growth was driven by private consumption and investment growth, albeit at rates lower than in 2009. Private consumption and private investment projections indicate weaker growth projections in 2011 but recovery in 2012 (ECA 2011).

Inflation declined markedly from 13.0 percent in 2009 to 4.0 percent in 2010 as a consequence of falling food prices resulting from favourable weather conditions and subsequent improved food production (UBOS 2011). Although the projections indicated further reductions in 2011 and 2012, this has not been the case. The Bank of Uganda indicates that inflation in the year ended October 2011 is 30.8 percent. The monetary policy stance over the medium term remains focused on seeking to restrict inflation at the target of 5 percent. The fiscal policy stance will remain expansionary in view of the government's sustained public investment in infrastructure, including roads and energy. Tax receipts were expected to recover in tandem with the improving economic prospects and tax administration efficiency gains, although these gains will not be sufficient to cover the shortfall in grants. Thus the overall fiscal deficit (including grants) as a percentage of GDP is expected to increase in 2011.

The external position weakened as a result of a decline in export earnings from the traditional export crops, in particular coffee. International reserves, currently covering slightly less than five months of imports, are expected to remain healthy, in part because of the weekly purchase of foreign exchange by the central bank. Weak infrastructure, inadequate financial services to the private sector, and weaknesses in public sector management and administration however remain major constraints to growth. The National Development Plan (NDP) is expected to prioritise reforms aimed at addressing these constraints.

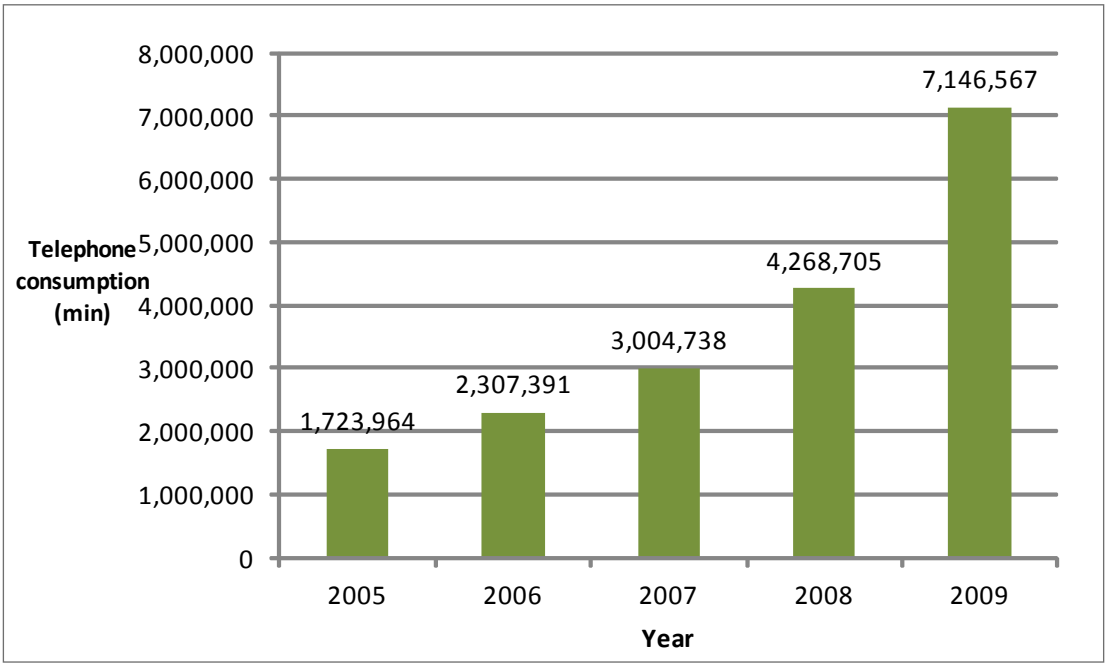


Figure 1.3: Growth in Telephone service consumption (000) minutes
Source: UBOS 2010

Social Well-being and MDG Performance

The social sector experienced remarkable improvements over the last decade, with a reduction in the poverty rate from 31 percent in 2005 to 24.7 percent in 2010. Income inequality however, worsened. Progress was also recorded in education due to the universal primary and secondary education programmes. Uganda is among the few countries in Sub-Saharan Africa that will meet the Millennium Development Goal (MDG) 1 target of halving poverty by 2015. The proportion of the population living below the absolute poverty line declined from 56 percent in 1992 to 31 percent in 2005 and to 24.5 percent in 2010 (UBOS 2011). The pace of poverty reduction has slowed, however, as a result of the increasingly unequal distribution of income in the country: the Gini coefficient, a measure of income inequality, increased from 0.3 in 1992 to 0.41 in 2005 and to 0.42 in 2010. Stagnation and reversals were also reported for the health-related indicators (UN 2009).

With 50 percent of the population below 15 years of age, Uganda has one of the highest overall dependency ratios in the world - estimated at 115 (MFPED 2010). At the current annual population growth rate of 3.2 percent, the population is projected to reach 91.3 million by 2050. This presents several significant challenges in terms of provision of social services. For example, the latest Uganda Demographic and Health Survey (2006) shows that although the proportion of underweight children under five years of age fell from 23 percent to 16 percent between 1991 and 2006, 68.5 percent of the population were still unable to obtain enough food to meet the recommended calorie intake in 2006 (UBOS and MII 2006).
Figure 1.4 shows the population pyramids for 1975, 2005 and a projection to 2025.

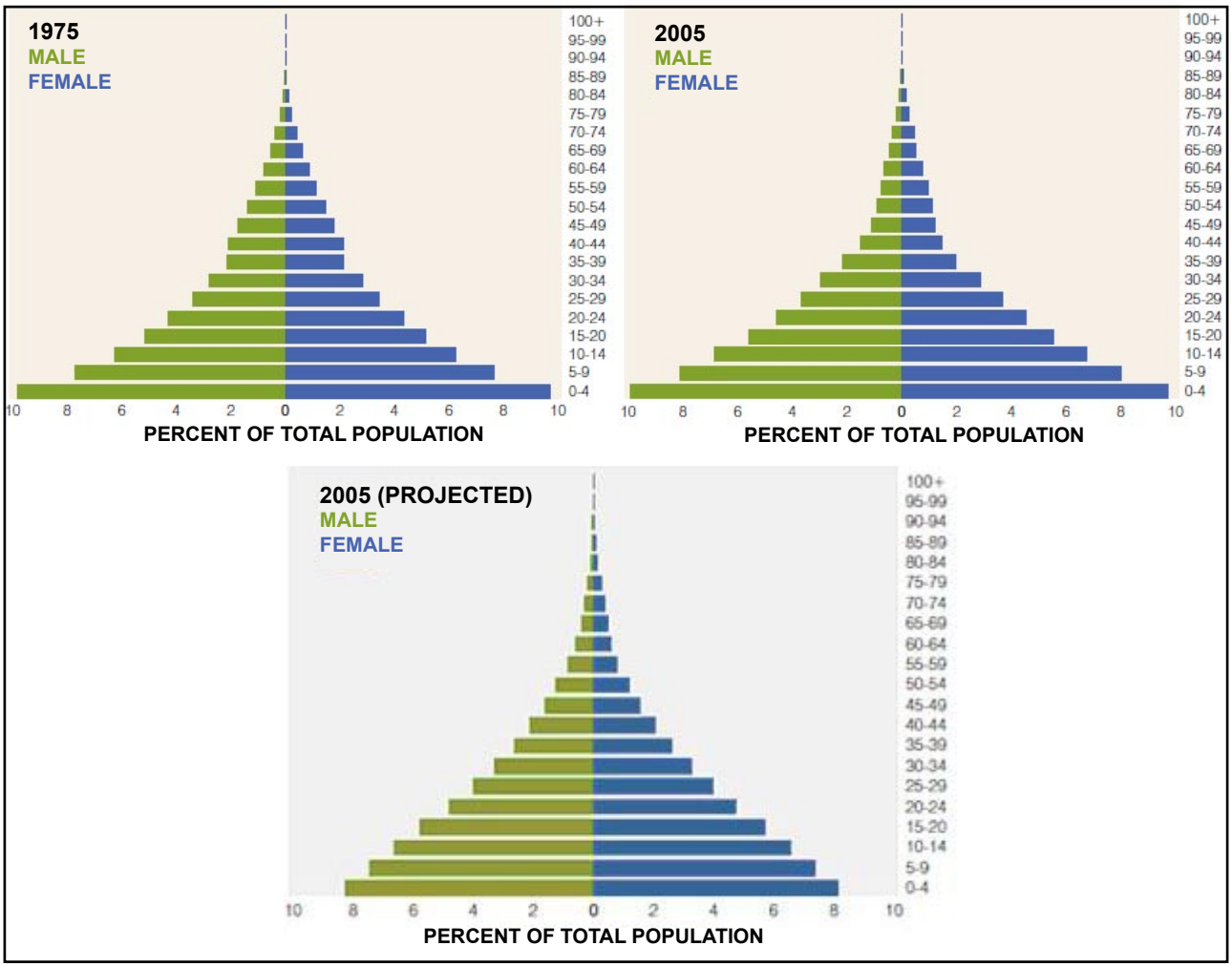


Figure 1.4: Population pyramids for Uganda – 1975, 2005 and 2025
Source: Daumerie and Madsen (2010)

The introduction of universal primary education in 1997 led to a 204 percent increase in gross enrolment, from 2.7 million children in 1996 to 8.2 million in 2009. The Net Enrolment Ratio that measures the proportion of children of school-going age who are actually in school, increased from 86 percent in 2000 to 93 percent in 2009, close to the 100 percent required to meet the MDG target. In addition, the gender gap in primary education has disappeared, with the proportion of girls in total enrolment rising from 93 percent in 2000 to 100 percent in 2009. However, the primary completion rate at 53 percent in 2009 remains low. The pupil-teacher ratio remains very high, at 57 to 1 in 2007, although this is a slight improvement from 59.4 to 1 in 2000. The number of pupils per classroom is also high at 72, but considerably better than the 84 in 2004 (MFPED 2010).

Uganda has managed somewhat to reduce its once very high death rates. The crude death rate in 2010 was 14.4 per 1,000 down from 19.3 in 2003 (MFPED 2010). The death rate is a rough indicator of the mortality situation but it accurately points toward the current mortality impact on population growth. A further look at the indicators also indicates some positive impacts. Infant mortality has declined from 81 deaths per 1 000 live births in 1995 to 76 in 2006, but still far above the MDG target of 31 deaths per 1 000 live births. Similarly, the under-five mortality rate has declined, but not by enough to put Uganda on track to meet the target by 2015. The maternal mortality rate is also high, although it fell from 505 per 100 000 live births in 2000 to 435 in 2006 as shown in figure 1.5. To meet the MDG target, Uganda will need to reduce the maternal mortality rate to 131 deaths per 100 000 live births by 2015. HIV/AIDS prevalence fell from 18 percent in 1992 to 6.4 percent in 2008 but continued vigilance is needed to combat the pandemic. Communicable diseases contribute over 50 percent of disability adjusted life years (DALYs) lost. This dismal performance of the health sector reflects limited access to existing facilities most of which are dilapidated (MFPED 2010).

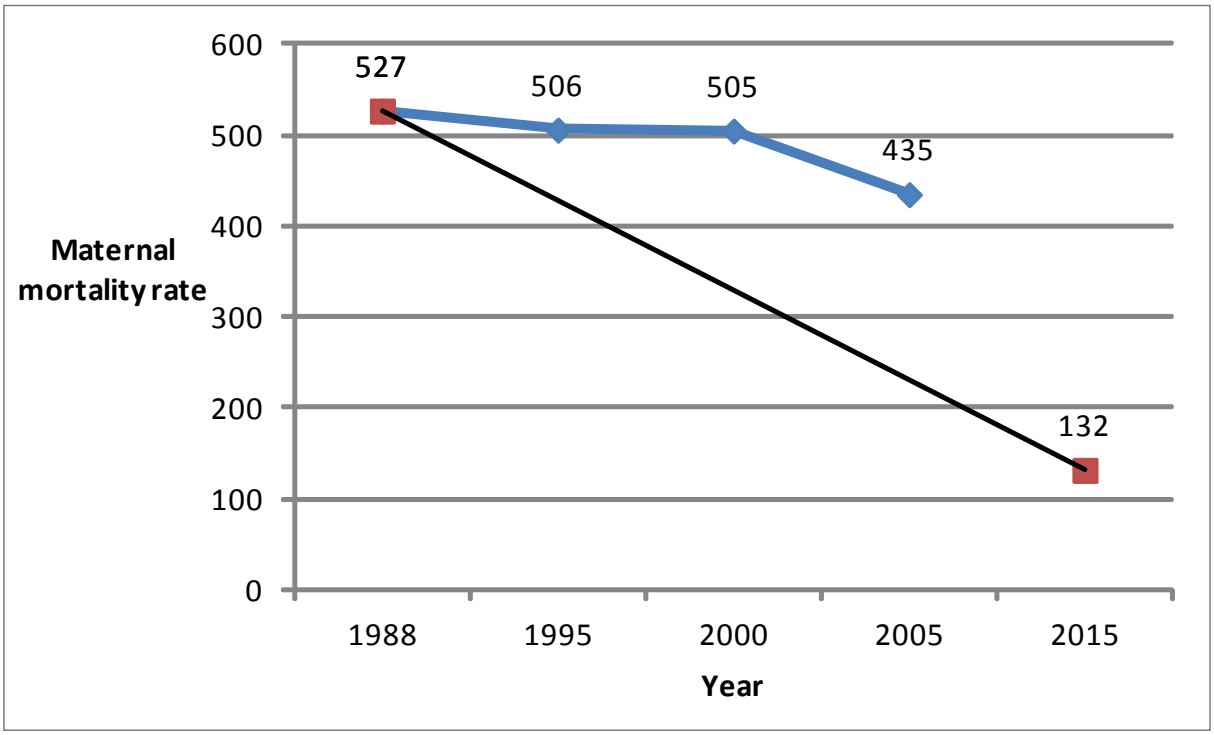


Figure 1.5: Maternal mortality rates in Uganda 1988-2015
Source: MOH 2010

Significant progress has been made with regard to increasing access to safe water and sanitation but access to potable water remains low, especially in rural areas. It is estimated that only 65 percent of the rural population and 66 percent of the urban population have access to safe water, while access to sanitation is estimated at 68 percent and 73 percent for the rural and urban areas, respectively (MFPED 2010). In sum, Uganda is on track to achieve at least three of the eight MDGs, namely halving poverty, HIV/AIDS, and achieving universal primary school enrolment. Strong progress has also been made in addressing gender inequality in education. However, strategic interventions are urgently required to sustain progress and to meet the other MDGs especially those relating to reducing child mortality and improving maternal mortality.

Uganda has ratified several international conventions and commitments, including the Convention on the Elimination of All Forms of Discrimination against Women and the Beijing Platform of Action; and there are several provisions in the country's constitution which guarantee equality between women and men. Despite this, progress in eliminating gender disparity is mixed. For instance, the share of women in wage employment in the non-agricultural sector dropped from 39 percent in 2003 to 28 percent in 2006 and then rose to 43.7 percent in 2009 (UBOS 2011). The number of seats held by women in the national parliament increased from 18 percent in 1995 to 29 percent in 2009 (GOU 2010). However, ownership rights of women remain extremely limited. Access to land is governed by customary laws. Although in theory, women have access to land, traditional practices persist limiting women's ability to make decisions about their land holdings or even to purchase land. For instance access to bank loans is difficult for women in Uganda as most commercial banks will not approve loans unless women hold the title deed as a guarantee.

There are linkages between ownership of assets by women: for themselves, their families and also for the economy. Asset ownership by women has been linked to increased spending on food, housing, durable goods and children's schooling (Kes et al 2011). At the macro level, gender equality in asset ownership is shown to improve agricultural productivity, bolster resistance to economic shocks, and foster economic growth (Deere and Doss 2006 in Kes et al 2011). Nearly 85 percent of economically active women in Uganda work in the agricultural sector producing 70 to 75 percent of the country's agricultural output (Rugadya 2010 in Kes et al 2011).

Climate variability and change has serious implications for the Ugandan economy and the welfare of the population since these are intricately linked to the natural environment. In particular, as current average temperatures in Uganda are expected to increase by up to 1.5oC by the 2020s and as rainfall patterns change, some urgent measures are needed to mitigate the effects of the expected socio-economic impacts of climate change on food security, health, and the economic development of the country (GOU 2007). The 2007 National Adaptation Program of Action indicate that drought is the most dominant consequence of climate change in Uganda, the others being floods and landslides. Extreme weather increases the susceptibility of populations to harsh living conditions and outbreaks of waterborne diseases such as diarrhoea and cholera. Prolonged dry spells, on the other hand, have resulted in respiratory disease, and rising temperatures are changing the geographical distribution of malaria and other disease vectors.

Resource Use Efficiency

Uganda's economic growth is dominantly driven by agriculture, industry and services including tourism as shown in figure 1.6. The positive growth impetus of the economy is therefore heavily dependent on the health of the environment and natural resource base. Agriculture and industry actively extract resources and raw materials to drive growth. Tourism on the other hand depends on the non-extractive aesthetic contribution of the environment and natural resource base. All the three sectors however, generate wastes which the environment assimilates in order

to maintain the positive growth potential of the overall economy. This important function is called the sink function of the environment.
The scale of economic activity thus has to remain in a range that can be accommodated by the

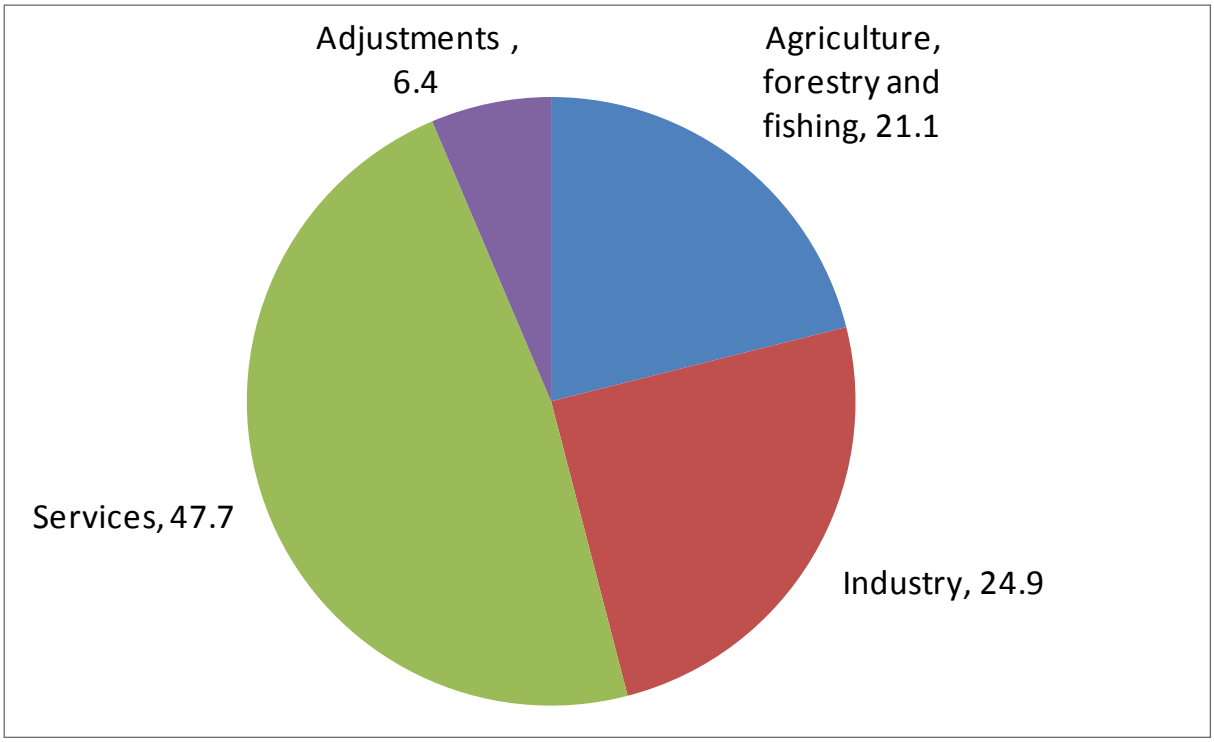


Figure 1.6: GDP by Economic sector at current prices in 2010 (percentage)
Source: UBOS 2011

environment in terms of its capacity to supply raw materials, but also its capacity to absorb wastes. There are already signs that waste generation in Uganda today is higher than the environment can cope with. The transport and energy sectors for instance, consume a high amount of petroleum products. The average annual growth of petroleum consumption is about 5 percent. In reality, sales of petroleum products rose significantly in 2009 by 27 percent for petrol and 17 percent for diesel respectively, compared to 2008 (UBOS 2011). Thermal power generation using heavy fuel oil also contributed to this increase in oil consumption. The increased consumption of petroleum products is already having implications on the ambient air quality of the main cities and towns in Uganda.

There are attempts to remedy the situation. In the transport sector, draft air quality regulations have been developed. There have been issues with operationalising them; and they are currently in the process of being updated. The use of alternative sources of energy like solar energy, bio-fuels and biogas, in addition to energy saving technologies is also being encouraged.

At a wider scale, government has put in place an institutional, legal and policy framework to manage the efficient use and governance of the natural resources base. Regular discussions on sustainable development have been encouraged and a Sustainable Development Think Tank has been proposed. Requirements under the various laws and regulations have created a demand for environmental services such as Environmental Impact Assessment (EIA) and Environment Audits (EA). These processes provide opportunity for mainstreaming environment and improving resource use efficiency in these developments. The other tool is environmental valuation. Environmental valuation helps to determine the cost of environmental degradation and resource draw-down on the economy through environmental cost-benefit calculations.

If this is appropriately included in the EIA process, the overall development outcome could be much more sustainable and efficient.

Solar street lights installed along Entebbe Road in the capital city Kampala.
Photo credit: Elizabeth Kironde.

Challenges Affecting Sustainable Development in Uganda

Poverty and Environment Linkages

Poverty is widespread and remains a critical development challenge in Uganda. National poverty levels are currently estimated at 24.4 per cent. The number of people living in poverty constitutes nearly a third of Uganda's population which currently stands at 32.9 million (UBOS 2011). Poverty is largely concentrated in the rural areas where an estimated 80 per cent of the population lives (UBOS 2011). Many poor people derive their livelihood from subsistence agriculture and therefore thrive directly on land and other natural resources. Uganda's fast growing population therefore exerts considerable pressure on fragile ecosystems.

The task of fighting poverty with long-lasting results is unavoidably linked to improved management of natural resources. The national economy and the livelihoods of the people rely on the environment. Natural resources provide food and a wide range of other goods (medicines, fuel, fodder, building materials and inputs to industry, among others). In addition, natural resources provide services on which human activity depends (including carbon sequestration, soil fertility and watersheds). Consequently, the protection of the environment and of natural resources is an essential part of development. In fact, growth that is accompanied by degradation of the natural capital that supports the livelihoods of many poor people only

serves to aggravate poverty. Without adequate environment and natural resource capital, development is undermined and this in turn may reduce the resources available for investing in combating environment and natural resource damage. Thus poverty alleviation is not only a moral imperative but also a pre-requisite for environmental sustainability and sustainable development.

Population pressure

With a population of 32.9 million (UBOS 2011), Uganda is one of Africa's largest and fastest-growing countries. From an economic and human perspective, the large population has the potential to be a tremendous asset, as these individuals will shape the country's future, providing both abundant labour and a large market to absorb production. However, with fertility rates at their current high levels, the economy will have to sustain continuous expansion in order to keep pace with and provide sufficient jobs for the rapidly growing population. A case in point is the Universal Primary Education policy that the government started implementing in 1997. The very young age structure of Uganda poses tremendous challenges for the financing of education – that of simply of keeping pace with a rapidly growing school-age population.

Although, there have been some improvements, the urban environment and health infrastructure have not kept pace with the rapid population growth and are thus increasing the health hazards related to inadequate housing, sanitation and transportation. Some of these health risks include diarrhoea, malaria, TB and respiratory diseases. They are all related to environmental factors such as poor sanitation and waste management, access to water, air quality and malnutrition. Other urban infrastructure indicators are not encouraging. Latrine coverage and access to safe water remain poor: 12 percent do not have toilet facilities and 67 percent have access to improved water sources. The situation is worse in rural areas. Housing conditions are also poor with three quarters of the households having floors made of earth, sand or dung (MOH 2009).

The low number of health professionals adversely affects the delivery of health services for the population. The existing infrastructure is insufficient to ensure that the core functions of the health sector are implemented. The ratio of national referral hospitals is 1:30,000,000 whereas the standard should be 1:10,000,000. For Health Centre III, the ratio is 1:84,507 whereas the optimum is 1:20,000 (MFPED 2010). Overall about 72 percent of the population lives in a 5 km radius of a health facility (MOH 2009). In recent years, health expenditure as a proportion of government's discretionary expenditure has been relatively stable around 9.6 percent, but still below the Abuja Declaration target of 15 percent (MOH 2009).

Uganda has several policies that address its major population and development issues, yet none effectively address the country's fertility, which is among the highest in the world. Despite economic growth in the past decade, many Ugandans live in poverty and confront social and economic inequities.

To understand Uganda's population challenges, one must examine the roles and status of women. Ugandan women are greatly affected by HIV/AIDS, as is the case in many sub-Saharan African countries. In addition, maternal and child health indicators for Uganda show that women and children have very limited access to health services. For example as a result of the growing population, the absolute number of women that die giving birth has increased by 16 percent since 1995, although the maternal mortality rate has come down (MFPED 2010). Even though the country continues to improve the health of its people, Uganda will need to address its high fertility, increase the number of youth who attend secondary school and higher, and foster job creation so that its families, communities, and the nation as a whole grow economically.

The factor driving Uganda's current population growth of 3.2 percent per year is a total fertility rate (TFR) averaging between six and seven lifetime births per woman as shown in figure 1.7. This level is only a slight reduction from the high level in the 1970s of 7.1 children per woman (UBOS 2011). If the current fertility level persists, Uganda's population will double to 70

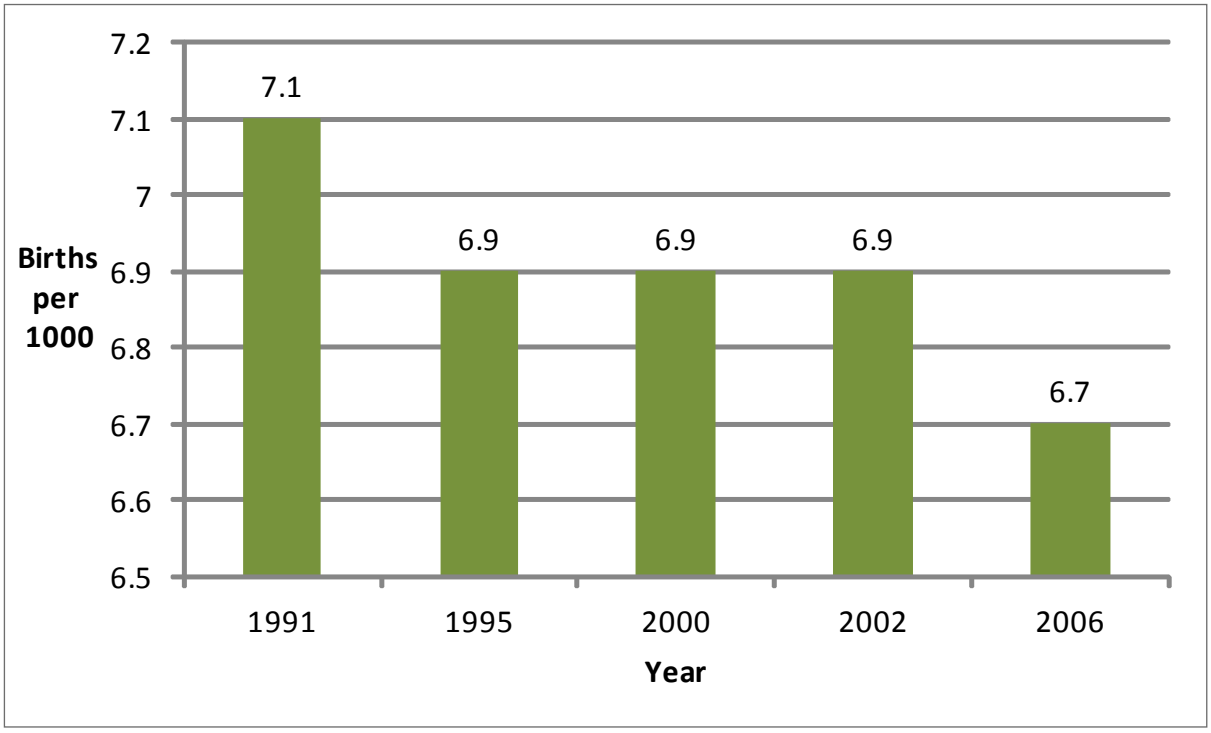


Figure 1.7: Fertility trends 1991-2006
Source: UBOS 2011

million by 2031, and could reach 100 million after 2040.
One reason for this high TFR is that only about 18 percent of Uganda's married women between ages 15 and 49 use effective contraception, with injectable contraceptives, pills, and sterilization the most popular methods. An additional 41 percent of married women want to postpone or avoid pregnancy but are not using an effective family planning method. The rate of unmet need for family planning among married women is 41 percent (Daumerie and Madsen 2010). This is the second highest in the world.

Uganda's 2008 population policy prioritizes birth spacing and youth-friendly sexual and reproductive health services, and allocates funding for these programmes. Two focal areas of Uganda's National Population Policy Action Plan 2011-2015 are sexual and reproductive health and rights; and gender and family welfare. In spite of these and other policies, Uganda's government shows relatively little support for family planning. For example, government funding for contraceptives is not sufficient even to address the needs of women living in urban areas, who represent only 15 percent of the total population (UBOS 2011). The lack of public support for family planning by national leaders is visibly noticed by the global community.

Economic inequalities

Uganda's GDP is growing annually at a rate of between 5 to 10 percent (GOU 2010). Historically an agriculturally based economy, the discovery of oil in 2006 offers Uganda an opportunity for economic growth and diversification. Yet Uganda is still a resource-poor country and 65 percent of its population lives on less than US $2 per day. This inequality is stark: the wealthiest 20 percent (quintile) of the population holds 49 percent of total income, while the poorest quintile

holds only 6 percent (PRB 2010).
According to the 2006 Uganda Demographic and Health Survey (DHS), wealth distribution is closely related to fertility. Women in the poorest quintile have eight children on average during their lives, while women in the wealthiest quintile have just over four children. Similarly, 41 percent of young women ages 15 to 19 in the poorest quintile have begun childbearing, while only 16 percent in the wealthiest quintile have (UBOS and MII 2006). These differences are further reinforced by the practice of child marriage: more than half of women in all but the wealthiest quintile are married before age 18 (PRB 2011).

Gender inequalities

Gender inequalities are some of the barriers impeding progress towards sustainable development in Uganda. Gender roles play out in virtually every aspect of life - from educational attainment among youths to decisions made within families. In households where the 2006 DHS was conducted, men age 20 or older always had higher levels of education than women of the same age. However, females under age 20 had roughly the same education as males, suggesting greater attention to educating girls. This finding supports recent MDG assessment reports which indicate that gender parity in the education system has been achieved and Uganda is on course to attain this global goal. Women's empowerment on health related matters however, remains elusive - men indicate that family size is primarily their decision (47 percent), though many see it as a joint decision (45 percent); few (5 percent) see it as the woman's decision. Women reinforce their own lack of power as well: more than 70 percent of women thought that a husband could be justified for hitting or beating his wife, suggesting a cultural acceptance of violence against women.

Gender inequalities also play out in the HIV/AIDS epidemic. According to the 2010 Uganda Report to the United Nations, 6.4 percent of Ugandans between ages 15 and 49 are infected with HIV. However, young women experience much higher rates of infection than young men. For example, among 20-to-24-year-olds, 2.4 percent of men are HIV positive, compared to 6.3 percent of women. Prevalence is highest among women ages 30 to 34, at 12.1 percent, compared to 8.1 percent among men in that age group. Although AIDS continues to contribute approximately 64,000 deaths per year in Uganda, these deaths do not offset the population growth resulting from the approximately 1 million births each year in Uganda.

According to the high projection of the United Nations, this continued rapid population growth, will expand Uganda's population in 2050 to 105.6 million; half the population would be age 20 or younger - significantly older than the current median age of 15. However, if fertility remains at a level of 6.7 children per woman (from the 2006 DHS), Uganda's population could be as high as 145 million by 2050 and have the same youthful structure as it currently has. To address this challenge, Uganda will need to focus not only on family planning to slow its population growth, but on wise investments that will help develop an educated labour force and create jobs to sustain and increase its recent economic growth.

Opportunities for Sustainable Development: Towards Rio+20

The Rio Summit of 1992 was a landmark event for the sustainable development agenda. It highlighted international commitment to providing public and political support for addressing environment and development issues in a holistic and integrated manner.

A five year review conducted in 1997 however, reported that little progress had been made in implementing the global sustainable development agenda. In view of this, the World Summit on Sustainable Development (WSSD) was convened in Johannesburg, South Africa in 2002.

The goal of the WSSD was to conduct a further (10 year) review of the implementation of the outcomes of UNCED, particularly Agenda 21, and to re-invigorate global commitment to sustainable development. The key output – the Johannesburg Plan of Implementation - further affirmed the pledge to full implementation of Agenda 21, the Millennium Development Goals and other multilateral environmental agreements.

Uganda actively participated in both world summits. The national report in Johannesburg, however, indicated that little progress in implementing Agenda 21 had been made. The report specifically noted the problem of land degradation as occasioned by population pressure, land fragmentation, inappropriate farming practices and lack of non-farm income generating opportunities. The report however provided impetus to the discussion on improving access to safe water and proper sanitation and highlighted government's commitment to meet the MDG targets on safe water and sanitation.

The UN General Assembly resolved in 2009 to organize the UN Conference on Sustainable Development (UNCSD) in June 2012 in Rio de Janeiro, Brazil, also called Rio+20. The purpose of the conference is to secure renewed political commitment for sustainable development, assess progress to-date and the remaining gaps in the implementation of the outcomes of the major summits on sustainable development, and to address new and emerging challenges. The focus of the conference is twofold. First the conference will discuss the green economy in the context of sustainable development and poverty eradication. The conference will also discuss institutional frameworks for sustainable development. The national assessment process for Uganda has not started, but should also focus on the green economy, institutional reforms and environmental governance for sustainable development.

The sustainable development agenda of the Rio+20 meeting provides several opportunities that will allow Uganda to meet its own sustainable development goals. As indicated in the opening paragraphs of this chapter, the NDP is guiding Uganda's transformation to a modern and prosperous country by 2040. The NDP recognizes the contribution of the environment and natural resources base to economic growth and social well-being and is as such is guiding the transition to the green economy. It also allows for engagement with all stakeholders in the country such as the private sector who are a key part of this transition. Further afield Rio+20 will strengthen Uganda's participation in regional and global environmental initiatives.

The Rio+20 national reporting process will thus allow for critical analysis of the extent to which the three pillars of sustainable development (social, economic and environmental) have been integrated. It will further allow for scaling up of successful interventions and lastly enable greater mainstreaming of environment into national and local development plans.

Traditional indigenous knowledge and management of the environment

Indigenous knowledge refers to a now large body of knowledge and skills that have developed outside the formal education system and that enables societies to survive. Indigenous knowledge, also referred to as 'traditional' or local knowledge, is embedded in the community and is unique to a given culture, location or society (UNCST 2006).

Indigenous knowledge in the environment management sphere therefore, refers to that body of knowledge that is primarily based on local experiences of a specific local community or society and has evolved over time. Indigenous knowledge is characteristically passed from generation to generation by word of mouth or by practice and involves little or no formal documentation, teaching or research. The main examples of traditional environmental management systems and practices include fallow cropping, minimum tillage and indigenous soil and water conservation

practices, conservation and management of sacred grooves, traditional herbal medicines and health care and application of fire particularly in agriculture and pasture management (UNCST 2006).

Indigenous knowledge is characteristically location and culture specific, is not systematically documented and is generated within communities. It is often the basis for decision making and survival strategies and concerns critical issues of human and animal life including primary production and natural resource management. Although oral and rural in nature, indigenous knowledge is dynamic and based on innovation, adaptation and experimentation (UNCST 2006).

There are specific examples of the application of indigenous knowledge in Uganda. One of them is the use by local communities of the forest as a source of medicine, food and fodder. A survey around Budongo Forest Reserve indicated that local communities use over 63 species of plants for food, fodder or medicine (Eilu and Bukenya-Ziraba 2004). Community use of forest plants offers exceptional opportunities for landscape-scale conservation. The argument is that the benefits from the forests serve as motivational foundations to improve the management of the plants and their habitats.

Fallow cropping and slash and burn practices are old methods of agriculture in Uganda. The use of fire is deeply embedded in these farming practices. Farmers burn to clear bush, release nutrients, kill pests, manage shade or to fell snags. Whereas fallow cropping significantly reduces the value of production, at least in the short run, many indigenous communities know that in the longer run, it contributes to productivity improvements by restoring soil fertility and reducing pests and diseases. Many farmers therefore use fire in their farming systems, but also to hunt, gather honey and create fire buffers. Villagers' burn around their grass thatched houses and un-harvested crops; and priests around sacred grooves to create fire belts to curtail the spread of hot late season fires. Broadcast burning as well as burning in heaps, are some of the techniques of burning developed by local people over the years.

Some of the practices are however, fraught with weaknesses. Inappropriate use of fire for instance has been blamed for causing deforestation, land degradation and greenhouse gas emissions. Some medicinal plants face extinction because of over extraction. These weaknesses need to be addressed through cultural re-orientation and infusion of local practices with appropriate scientific knowledge and education.

Livestock grazing in a rangeland.
Photo credit: NEMA

Transition to a Green economy in the context of poverty eradication and job creation

In the last few years, mounting evidence of global environmental degradation convinced most of the world's political leaders that the planet faces a serious crisis. The nature and extent of the crisis has been the subject of several conferences, speeches and declarations. But economic policy and global development models have remained largely unchanged.

The economic status quo is rather surprising, since it is evident that the causes of environmental damage lie in economic activities - in agricultural and industrial production, in the consumption of energy and the discharge of wastes. There is abundant evidence that the scale and pattern of these activities is responsible for the pollution and exhaustion of natural resources now causing so much alarm. As recognized by Jacobs (1991) over 20 years ago, tackling the current environmental crisis clearly requires a total change of economic policy, and along with it, the patterns of production, distribution and consumption.

A number of models to define a new approach to economic policy have been proposed in the past. The most appealing one so far is the 'Green Economy'. UNEP defines a green economy as one that achieves improvement of human well-being and social equity while significantly reducing environmental risks and ecological scarcities (UNEP 2010). The green economy is driven by green growth that relies on technologies/processes that 'save inputs including energy and natural resources. Green growth therefore efficiently reduces climate change and damage to the environment. It also secures new growth engines through research and development of green technology, creates new jobs and achieves harmony between the economy and the environment. The key elements of green growth include setting clear green house gas reduction targets and goals for green energy supply and efficiency' triggering green technologies and businesses, and through these improving the quality of life of people and the global community.

The increased rationale for the green economy is twofold. The first reason is climate change. Natural disasters, destruction of ecosystems, environmental degradation and pollution pose many threats to humanity. The fight against climate change is also formidable. To be able to tackle the numerous environmental challenges while simultaneously maintaining economic growth, will require changes and transformations of the economic outlooks of the economies in the region to a low carbon growth paradigm.

The other reason is the energy crisis and the depletion of natural resources. In view of growing resource scarcities and the energy crisis, countries have to acquire alternative sources of energy, improve energy efficiency and promote the adoption of energy saving lifestyles. They have to curb the use of fossil fuels and make massive investments in clean and renewable energy sectors.

In connection with poverty eradication, the green economy model kindles diffuse opportunities for trade and investments by providing means by which industry, civil society and government work together to influence job creation, training and skills enhancement of human resources, access to finance, the evolution of innovative technologies and to motivate the supply chain towards greener methods of production. The green economy model improves and enlarges businesses and provides new opportunities. It also meets the growing demand of energy efficient, eco-friendly products and therefore supports green markets.

Some aspects of the green economy model have been implemented in Uganda. The organic agriculture movement in the country provides an example. To implement a comprehensive national vision of green growth effectively, the government must develop medium to long-term strategies for green growth. The strategies envisage five main objectives. First, to promote

integrated environmental and economic accounting which is a planning tool that reconciles social and economic development with environmental sustainability. Undertaking of Strategic Environmental Assessments (SEA) would also improve the profile of performance towards sustainable development. The second objective is to effectively deal with climate change and attain energy independence. This objective calls for actions such as setting mid to long-term mitigation goals, increasing the use of new and renewable energy sources, as well as efficient demand side management for energy and other input sectors.

The third objective is to create new engines of growth on various fronts including the development of green technologies, greening of industry, transition to a more advanced and cleaner industrial structure, and laying the ground for a green economy. The integration of Corporate Social Responsibility (CSR) practices and principles into business operations will help companies contribute to the realization of a green economy. This aspect of sustainable development planning should form the fourth objective of the strategy for green growth in the country.

The fifth objective is to raise the overall quality of life for the people and to enhance the advocacy for green growth. National level advocacy has however to be cascaded to the local community level, with development of programs that will inculcate the key tenets of the green revolution in people's minds and lives. Hence school curricula at all levels of education in Uganda need to be transformed to reflect green thinking. Other actions include development and monitoring of a green lifestyle index, carbon footprint labels and certifications, promotion of low carbon smart village movements and promotion of ecological tourism.

A local palm farmer in Bwendero Kalangala district.
Photo credit: Isabirye Moses

Greening Uganda's National Accounts

The recognition of the environment and natural resource base as a key sector in national accounts relates to the fact that many Ugandans still directly depend on the environment for their survival and well-being. The key components of the environment critical to well-being in Uganda include forests, freshwater, wetlands, coastal and marine systems, mountains, arid and semi-arid lands, grasslands and agricultural land. These components provide a range of goods and services including provisioning, regulating, cultural and supportive ecosystem services (NEMA 2011).

The proposed Forestry Resource Accounts

Forests and forest products have a high monetary and non-monetary value in Uganda. Over 90 percent of total energy resources used in the country are derived from fuel wood. Forests offer regulatory services including soil protection, hydrological services and sequestration of greenhouse gases. Provisioning services include wood products, non-wood forest products such as honey, medicinal plants, among others (EPRC 2010).

A study to determine the economic value of forest resources in Uganda and their contribution to the national economic was implemented by NEMA between October 2010 and May 2011 with support from several national and international stakeholders. The stakeholders included the World Bank, the National Forestry Authority (NFA), Uganda Wildlife Authority (UWA), Uganda Bureau of Statistics (UBOS), the National Planning Authority (NPA) and the Wildlife

The Murchison Falls in Uganda.
Photo credit: UWA.

Conservation Society (WCS). The overall purpose of the study was to establish the contribution of the country's forestry resources to the national economy while the specific objectives were: (i) to determine the physical stocks and flows of forestry resources in Uganda; (ii) determine the monetary value of the physical stocks and flows of forestry resources in Uganda; and (iii) to estimate the aggregate contribution of forestry resources to the national economy. The economic value of forestry resources in Uganda was established using the natural resource accounting methodology where the value of the contribution of the forestry sector to the national economy was estimated for one financial year.

The physical stocks and flows of forestry resources in the country indicate a general reduction in stocks and flows of forest resources and introduced previously unaccounted for forest resource stocks and flows. The area of forested land continued to decline from 3.6 million ha and closed at 3.3 million ha in 2010, at an annual rate of 1.86 percent. On the other hand, biomass was declining at only 0.6 percent per annum and closed 2010 at 277 million m3 from 280 million m3 in 2005. In 2005, the set sustainable timber harvest was 280,000m3, 19,300,000m3 and 100,000m3 from Tropical High Forests (THFs), woodlands, and plantations respectively, a total sustainable of 19.7 million m3 (NEMA 2010) However, no similar estimates existed in 2010. This was because only limited surveys had been undertaken covering only five major central forest reserves.

Implications of Greening the National Accounts

The integration of environmental costs and benefits into key economic indicators is a very challenging exercise. The process requires a lot of data collection and interpretation, yet most macro-economic measurements only consider and measure some direct use values of the environment and natural resource base. They ignore non-tangible indirect use values of the environment, yet these equally contribute to economic progress. The habitat value of a forest system contributes to the forest production potential and economic performance of the sector. Macro-economic measures however, only account for the tradeable forest products potential of such a system. This means that planning decisions easily ignore the quality and health concerns of the forest ecosystem, even when they aim at improving forest productivity.

Integrating environmental values in the national accounts would ensure that the contribution of habitats and other environmental resources is accounted for and that any negative effects thereof are taken care of in good time. Greening the NDP will also enable economic planners to identify the uses and users of the various natural resources. Green national accounts for instance show the users, suppliers, polluters and distributors of forest products among others. Such data facilitates better targeting of interventions and priorities.

Conclusion and Recommendations

The link between environment, economy and development is well documented. A large volume of literature clearly documents key cause-and-effect relationships including deforestation, loss of soil fertility, reduced agricultural productivity and worsening poverty. The environment and natural resource base is the foundation that drives development. Development activities impact on the environment bringing about a shift in the quantity and quality of the environmental resources. However, this cannot last forever. The concept of sustainable development thus makes remedial measures imperative. The responses become critical services that must be provided by environment management agencies.

The National Development Plan is optimistic about the future development of the economy. It has anticipated corresponding environmental consequences and mainstreamed key intervention measures. The implementation of the flagship projects will ameliorate the impacts and maintain environmental integrity, but also help the country achieve the desired development in a sustainable manner.

This chapter therefore highlights the important link between the economy and the environment. It acknowledges the critical contribution a clean and healthy environment can make to economic progress and structural transformation. The recommendation therefore is for a transformation of Uganda's national economic growth model to a green economy model through organic farming and green industry, green accounting, valuation of natural resources and strategic environmental assessment.

References

BOU (2011). *Uganda's Annual Headline Inflation Hits 30.5 Percent*. Bank of Uganda (BOU), Kampala. Also available on: http://www.bou.or.ug/bou/media/statements/Inflation_hits_30_5_percent.html

Byekwaso N (2010). Poverty in Uganda. In: *Review of African Political Economy* Vol 37, No 126 December, 2010, 517-525.

Daumerie, B. and E.L. Madsen (2010). The *Effects Of A Very Young Age Structure In Uganda Country Case Study*. The Shape of Things To Come Series. Population Action International, Washington D.C.

ECA (2011). *Tracking Progress in Macro-Economic and Social Development in Eastern Africa*. UN Economic Commission for Africa Sub-regional Office for Eastern Africa, Kigali Rwanda.

Eilu G., and Bukenya-Ziraba (2004). *Local Use of Climbing Plants of Budongo Forest Reserve, Western Uganda*. In: Journal of Ethnobiology 24(2): 307-327.

EPRC (2010). *Economic Valuation of Protected Areas in Uganda: A Case Study of Murchison Falls Conservation Area and Budongo Central Forest Reserve*. Economic Policy Research Centre, Kampala Uganda.

GOU (2002). Uganda National Report to the World Summit on Sustainable Development. Government of Uganda (GOU), Kampala. Also available on:
http://www.johannesburgsummit.org/html/prep_process/national_reports/uganda_national_report.pdf

GOU (2007). *Uganda: National Adaptation Plan for Action (NAPA)*. Global Environment Facility, New York, USA.

GOU (2010). *National Development Plan (2010/11 – 2014/15*. Government of Uganda (GOU), Kampala.
Jacobs M. (1991). The Green Economy. Earthscan Publishers, London, United Kingdom.

Kakande M. (2010). *Poverty Monitoring*. In: Kuteesa F., Tumusiime-Mutebile E., Whitworth A., Williamson T (eds). *Uganda's Economic Reforms. Insider Accounts*. Oxford: Oxford University Press 226 – 245.

Kes, A., Jacobs K., and S. Namy (2011). *Gender Differences in Asset Rights in Central Uganda*. International Centre for Research on Women (ICRW), Washington D.C.

Makokha, K.A. (2001). *Structural Adjustment Participatory Review Initiative (Sapri) Uganda Country Report: A synthesis of the Four SAPRI Studies*. SAPRI Civil Society and Uganda National NGO Forum, Kampala. Also available on http://www.saprin.org/uganda/research/uga_country_rpt.pdf

MFPED (2008). *National Population Policy 2008 for social transformation and sustainable development*. National Population Secretariat, Ministry of Finance, Planning and Economic Development (MFPED), Kampala.

MFPED (2010). *Millennium Development Goals Report for Uganda 2010*. Ministry of Finance, Planning and Economic Development, Kampala, Uganda

MOH (2009). *Draft National Health Policy (2010-2019) Reducing poverty through promoting people's health*. May 2009 version. Ministry of Health (MOH), Entebbe. Also available on: http://www.health.go.ug/National_Health.pdf

NEMA (2010). *Contribution of the Forestry Sub-Sector to the National Economy: The Economic Value of Forest Resources of Uganda*. National Environment Management Authority (NEMA), Kampala, Uganda.

OECD (undated). *Gender Equality And Social Institutions In Uganda*. Social Institutions and Gender Index, OECD Development Centre. Also available on: http://genderindex.org/country/uganda

Ogwal F. and Guloba M. (2011). *Trade Opportunities from the EU-ACP Economic Partnership Agreement: Prospects for the Flower Sub-Sector in Uganda*. EPRC Policy Brief No 3. Economic Policy Research Centre, Kampala, Uganda.

PRB (2010). *The World at 7 billion*. Population Reference Bureau (PRB), Washington D.C.

Tukahirwa, J. (2002). *Policies, people and land use change in Uganda. A case study in Ntungamo, Lake Mburo and Sango Bay sites*. Lucid Working Paper 17. LUCID project, International Livestock Research Institute (ILRI), Nairobi.

UBOS (2010). *Statistical Abstract 2010*. Uganda Bureau of Statistics (UBOS), Kampala, Uganda.

UBOS (2011). *Statistical Abstract 2011*. Uganda Bureau of Statistics (UBOS), Kampala.

UBOS and MII (2006). *Uganda Demographic and Health Survey 2006*. Uganda Bureau of Statistics (UBOS) and Macro International Inc. (MII), Alverton, Maryland, USA.

UN (1993). *Report of the United Nations conference on Environment and Development.* Rio de Janeiro 3-14 June 1992, Volumes 1-2. United Nations (UN), New York.

UN (2009). *Agenda 21*. United Nations (UN), New York. Also available on http://www.un.org/esa/dsd/agenda21/

UN(2009). *UN Millennium Development Goal Report 2009*. United Nations, New York, USA.

UNECA (2011). *Economic Report for Africa 2011*. United Nations Economic Commission for Africa. Addis Ababa, Ethiopia.

WCED (1987). *Our Common Future*. Report of the World Commission on Environment and Development (WCED). Oxford Publishers, UK.

WHO/UNEP (2008). *Libreville Declaration on Health and Environment in Africa*. Signed 29 August 2008, Libreville, Gabon.

PART II
State of the Environment

Landslide leave a lot of damage in their wake.

CHAPTER 2
Land Resources in Uganda

Uganda covers a total area of 241,550 Km^2. Approximately 41,743.2 Km2 or 17 percent of this area is covered by open water and swamps; and the remaining 197,610 Km^2, is land (UBOS 2011). It is estimated that 125,000 Km^2 or 62.5 percent of Uganda is arable, relatively fertile and receives sufficient rainfall for rain-fed cropping and pasture (IFPRI 2001, Olson and Berry 2003). Most of the arable land is under subsistence agriculture. Although Uganda's climate is conducive for production of a wide variety of crops, the country continues to experience problems of malnutrition, famine and hunger especially among vulnerable populations.

Only 71,000 Km^2 is under commercial farming, settlements and conservation as wildlife and forest conservation estates. The current size of the conservation estate is 45,222 Km^2 representing 18.7 percent of Uganda's total land area. According to UBOS (2011), the proportion of land covered by forests was 18.3 percent in 2005. This was a decline from the 21.3 percent forest cover in 1990.

Palm Oil grown at commercial level in Kalangala District.
Photo credit: Isabirye Moses

Recent studies indicate that up to 97 percent of Uganda's land area suffers from some form of human induced land degradation (Banadda 2010). The major types of land degradation in Uganda in order of priority include soil erosion, soil fertility loss and habitat degradation (MWE 2006). Land degradation and declining soil fertility limit crop yields and exacerbate household poverty. It is estimated that 4-12 percent of GNP is lost due to environmental degradation, 85 percent of this from soil erosion, nutrient loss and the forced switching of crops to lower value varieties (Olson and Berry 2003).

The absolute cost of land degradation was conservatively estimated at US$ 129.3 million per year (Moyini et al 2002). This loss is particularly caused by stagnated or declining food and cash crop yields (Olson 2004). Farmer yields have typically reduced to a third of potential yields found at research stations. The losses in agriculture are in spite of the fact that the sector dominates exports and employs approximately 66 percent of Uganda's total work force (UBOS 2011). The sector also supports several manufacturing and services industries in the country. Land degradation poses a risk to food security with impacts on human health.

The rate of forest loss or deforestation is occurring in tandem with the rate of land degradation in most parts of Uganda. Overall, except for coniferous plantations, forest cover declined between 1990 and the present. Currently tropical high forests, broadleaved plantations and coniferous plantations represent only 4 percent of Uganda down from 24 percent 20 years ago. Similarly the grasslands reduced by about 4 percent since 1990. The reduction in the grasslands is partly representative of the expansion in subsistence agriculture, built up areas, and tree planting in former grasslands. There is also evidence of increasing bare areas especially in Nakasongola and Nakaseke districts, further affecting the extent of grasslands. The reduction in the grasslands has implications on livestock keeping (NFA 2010).

State of the Land Resource

Land cover

Land is a fundamental natural resource whose productivity directly impacts on the economic growth and development of all Ugandans; most of whom derive their livelihoods from land-based economic activities including subsistence farming. Subsistence farms dominate the agricultural landscape covering up to 37 percent of Uganda's total land area. Large commercial farms occupy less than 1 percent. Previously commercial farms comprised of only sugar and tea estates. Lately commercial farms also include cotton, maize and coffee particularly in the districts of Kasese, Kabarole and Mubende respectively (NFA 2010).

The agricultural sector is therefore the largest driver of land cover change in Uganda. Most of the change however, is linked to biodiversity loss, deforestation and soil erosion. Forest cover loss due to agricultural expansion is high, estimated at 88,638 hectares per year (NFA 2010). There is also a gradual dominance of annual cropping over perennial cropping systems (Isabirye 2005), implying a significant reduction in overall above ground biomass. The next biggest land cover type is grassland and open water which constitute 16 and 15 percent respectively. Uganda's land cover composition is shown in Figure 2.1.

Land use

Land use is largely agricultural, particularly in the wetter parts of the country. There is less agricultural potential in the drier north and north-east where pastoralism dominates. Even there however, soil fertility levels are very good and crop agriculture generates good yields with the short rains and some irrigation.

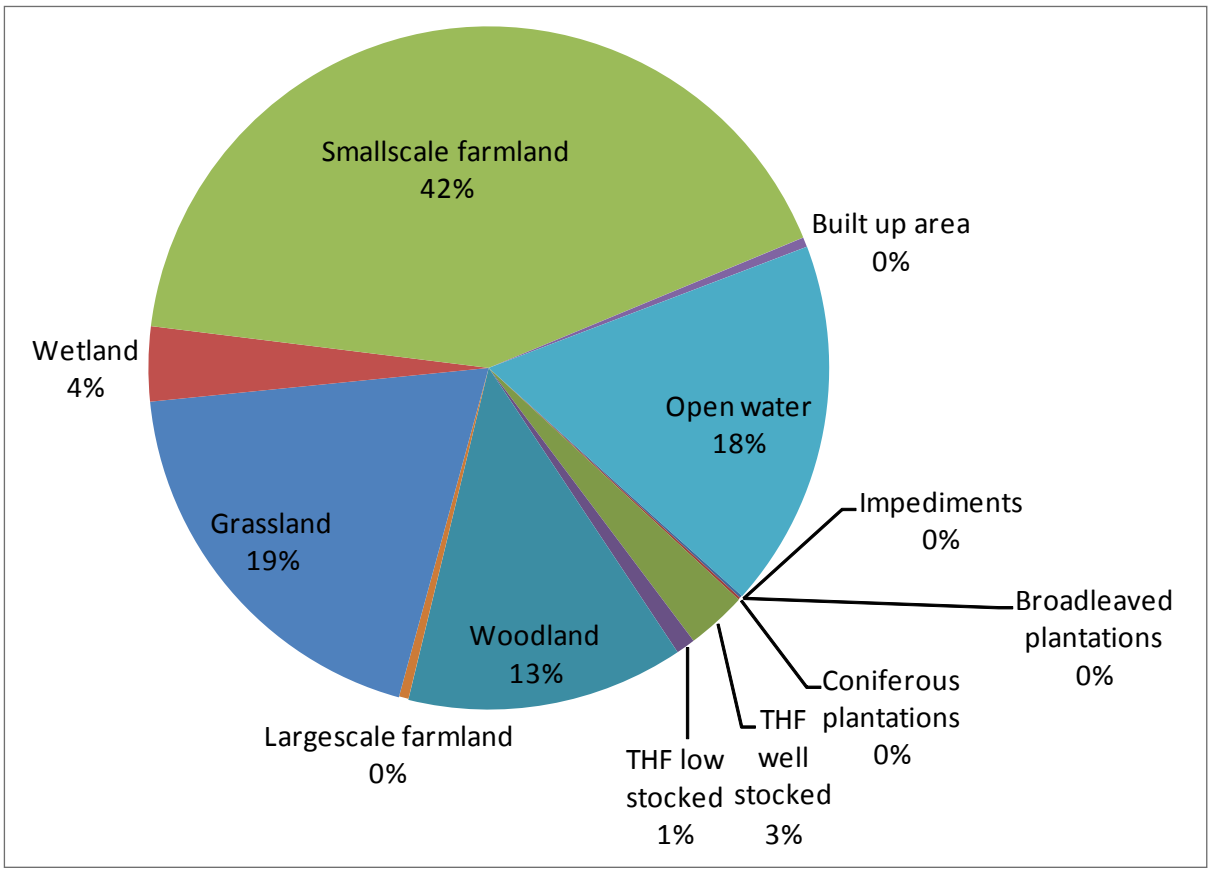


Figure 2.1: Land cover composition in Uganda
Source: NFA 2010

There are essentially three broad land use categories: agricultural land; built up areas; and land reserved for conservation. These categories are however, not exclusive and overlap in some areas to give the following seven land use combinations:

1. exclusive agriculture land (cultivation)
2. exclusive built up areas
3. exclusive forest and wildlife conservation areas
4. combination of built up and conservation areas (Jinja and Entebbe Municipalities which are also animal sanctuaries)
5. combination of agriculture and conservation (such as buffer zones in wildlife reserves and community wildlife management areas)
6. combination of agriculture and built up areas (urban farmlands)
7. combination of agricultural land and built up and conservation areas (like Entebbe and Jinja Municipalities).

The seven land use categories imply that there is potential for land use conflicts. Land use conflicts occur where there is overlap between two or three broad land use classes. They also occur where there is exclusive use, but mutually conflicting activities like pastoralism and crop agriculture. It is anticipated that further clarification of land tenure and formulation and implementation of a national land use plan will reduce potential conflicts and optimise allocation of land resources.

A maize garden at Kawanda Agricultural Research Station.
Photo credit: Isabirye Moses

Agriculture, Agro-ecological Zones and Agricultural Output

The agricultural sector in Uganda is composed of crop and animal production, forestry and fisheries and the associated trade and processing industries. Agriculture continued to dominate the Ugandan economy albeit at a continually declining level. Agricultural production contributed approximately 15.1 percent of total GDP in 2009 down from 15.7 percent in 2007/2008. At current market prices, agriculture contributed 22.5 percent of GDP in 2010 compared to 23.7 percent in 2008/09 and 21.2 percent in 2007/08. The sector's share of exports and employment however remained high at 90 and 80 percent respectively in 2009. The sector also constitutes about 40.0 percent of the manufacturing sector through food processing. The sector supports 24.6 million persons of the estimated total Ugandan population of 30.7 million. In addition, agriculture is important in stimulating economic growth through the supply of raw materials to agro-industries, supporting the development of food security systems, income enhancement and employment (UBOS 2010, UBOS 2011).

The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) in collaboration with UBOS carried out a Livestock Census in February 2008. Results from the census show that the northern region had the biggest share at 34.3 percent and 37.4 percent of cattle and goats respectively. The central region had the biggest share of 41.1 percent for pigs. Projections for 2009 livestock data indicated that on average, livestock numbers increased by about 3 percent as shown in Table 2.1

The increase in animal numbers, milk and beef production was in contrast to the decreasing quantity and quality of pasture and forage.

Livestock type	2008	2009
Cattle	11,409,000	11,751,000
Sheep	3,410,000	3,513,000
Goats	12,450,000	12,823,000
Pigs	3,184,000	3,280,000
Poultry	37,434,000	38,557,000

Table 2.1: Livestock numbers (2008-2009).
Source: UBOS 2010

As indicated earlier, the grassland area in Uganda shrunk by 4 percent since 1990. Various invasive alien species have also taken over large areas of previously valuable rangelands.

Grasslands in the Murchison Falls National Park.
Photo credit: NEMA

Due to inappropriate farming practices agriculture is the main cause of environmental degradation in the country. Ugandans still primarily practise extensive agriculture, which invariably leads to land degradation. The low level of technology, low yields and low prices further reinforce extensive agriculture. Cultivation is low input (mainly rain fed, uses manual labour as opposed to mechanisation and negligible input of agrochemicals) and low output. This also leads to extensive farming and poses a risk to food security. Extensive methods of cultivation have environmental impacts. These include shifting, excessive cultivation, over-grazing, land fragmentation, deforestation and bush burning. Though encouraged, agrochemical use is low. When utilized, it is often misused because of illiteracy and inadequate extension services. The consequence of this is pollution with effects on human health and the environment as described in Box 2.1.

The NEMA-World Bank composting project is expected to increase organic manure application in over 17 districts and municipalities by the end of 2012. The uptake of manure application and other agricultural technologies however remains low and extension workers have to upscale agricultural advisory services to ensure widespread adoption of new and innovative agricultural methods and applications.

Box 2.1: Pesticides, human health and the environment

There is a widespread occurrence of insects and diseases on many crops and livestock, facilitated by a warm humid climate throughout the year in Uganda. In order to control these pests, many farmers spray their crops with pesticides as a fast-acting pest control method.

Forty four pesticides are currently registered for use in Uganda. However many more find their way into the country and eventually into the environment. These include fertilizers, insecticides, fungicides, herbicides among others. All are potentially harmful if incorrectly used, and can be linked to adverse human health conditions including cancer, reproductive disorders, birth defects and more. Studies have indicated that 3 percent of all agricultural workers in developing countries are affected by pesticide poisoning each year. UBOS (2011) indicates that by industry, agriculture employed 66 percent of the working population. This would translate to about 650,000 cases in Uganda annually.

The risk posed by extensive pesticide use in particular has generated concern and as a response, organic farming and Integrated Pest Management (IPM) are now being promoted and incorporated into national agricultural policies and programmes.

Source: Bonabana-Wabbi and Taylor 2008, Jeyaratnam 1990.

Forests

The State of the Environment report for 2008 highlighted changes in the forest estate in the different regions of Uganda up to 2005. The total forest stock has decreased since then. As shown in table 2.2, in 2010 the total forest stock in Uganda was estimated at 3.3 million ha down from 3.6 million ha in 2005 (NFA 2010). The cause of this deforestation is mostly the conversion of forest land to other land use types such as agriculture. The pressures on forests are largely attributed to the growing population and associated demands for land for settlement, agriculture, medicines, wood, energy and other uses. As the population grows, the natural resources on which people depend are increasingly being depleted. This is clearly highlighted in figure 2.2 by the trends in per capita forested area from 1991 to 2025.

This very young population is presenting major challenges to the management of the land resources and without good planning it will constrain Uganda's short and medium term economic growth. Forests play a key role in national development. Indeed the forestry sector contributed about 12.02 percent to the country's GDP based on the national accounts figures for 2010 (NEMA 2011).

Summary	Total forested land	Broad leaved Plantation (Ha)	Conifer Plantation (Ha)	THF well stocked (Ha)	THF low stocked (Ha)	Woodland (Ha)
Opening stock (2005) (ha)	3,594,462	14,841	16,536	542,787	201,644	2,816,423
Annual rate of increase in forested area (%)	-0.02	0.13	0.13	-0.01	-0.02	-0.02
Est. change forested land area 2005-2010	-285,420	12,382	13,796	-29,248	-17,145	-262,974
Est.closing stock 2010	3,309,042	27,223	30,332	513,539	184,499	2,553,449

Table 2.2: Stock and changes in stock of forested land, 2005-2010
Source: NFA (2009) and FAO (2010) in NEMA 2011

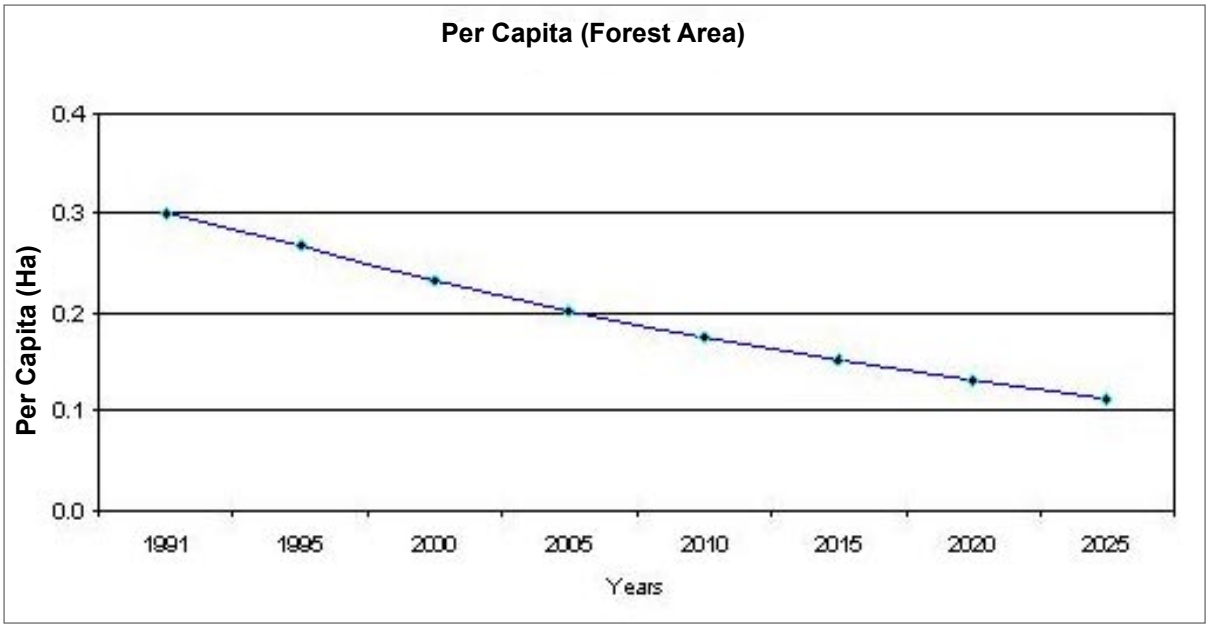


Figure 2.2: Current and projected per capita forest area 1991-2025
Source: NFA 2010

Some of the environmental impacts of deforestation include:

- Loss of water quality, including water used for domestic, commercial, agricultural and leisure purposes
- Degradation of aquatic habitats caused by erosion and turbidity and subsequent damage to fisheries
- Increased flooding during wet periods, and loss of water normally stored and released
- during dry periods
- Erosion of top soil and nutrient loss
- Climate change/climate variability such as an increase or decrease in local rainfall
- Decreased biodiversity and loss of habitat

Management of forests

Forests occur all over Uganda, under different management regimes as shown in table 2.1. The National Forestry and Tree Planting Act, 2003 decentralized the management of forestry activities. In Central Forest Reserves (CFRs), the mandate for management lies with the NFA; and management of National Parks and Wildlife Reserves is vested in the Uganda Wildlife Authority (UWA). At the sub-national level, the District Forest Service (DFS) is the main vehicle for the management of Local Forest Reserves (LFR) and supports the management of forests on private lands. The key actors in the DFS include the Local Government Councils, the District Forestry Departments, service providers and the farmers themselves.

The management regime accords different levels of protection to the forest estate. Indeed from the data shown in table 2.3, there is a marked difference in the degree of deforestation inside protected areas as compared to forests on private land. The annual rate of deforestation inside protected areas is 1.86 percent while that outside protected areas is 2.27 percent per annum (NFA 2010).

Statistic	1990	2005
Area of the country	24,155,245.00	24,155,348
Area of open water	3,720,511.20	3,706,732
Land area	20,434,034.20	20,448,616
Area of Protected Areas	3,105,761.20	3,106,364
Area under NFA	1,171,948.00	1,172,433
Area under UWA	1,839,250.30	1,839,278
Area under DJM	89,567.00	89,657
Area of private land (excluding water)	17,328,273.00	17,342,252
Area of forests in Pas	1,470,823.20	1,300,994
Area of forests under NFA	752,142.90	627,897
Area of forests under UWA	679,492.20	641,138
Area of forests under DJM	37,559.50	30,748
Area of forests under DFS	1,628.70	1,211
Area of forests in the country	4,933,746.00	3,594,550
Area of forests on private land	**3,462,922.80**	**2,293,468**

DJM – dual joint management; DFS – District Forestry Service; UWA – Uganda Wildlife Authority; NFA – National Forest Authority; PAs – Protected areas

Source: NFA 2010

Opportunities To Utilize the Land Resource Better

The land resource provides opportunities for agricultural expansion to supply markets and for food security, especially within the region. However these must be tempered with good environmental practices if they are to be sustainable.

Agricultural expansion, agro-processing and energy development

Most households in Uganda depend on land resources to sustain their livelihoods. Land resources and associated real estate property thus constitute the household's most important asset. The dependence on land ranges from growing of food, building homes to the myriad of goods and services that are essential for our survival. The UBOS household surveys indicate that about 50 percent of the wealth of most Ugandan households' is held in the form of land; and land provides the majority of employment opportunities. Approximately 85 per cent of Ugandans live in rural areas where land and land resources are central to their livelihoods (UBOS 2011).

The potential for land to further contribute to the livelihoods and food security of Ugandans is enormous. Uganda has large areas of arable land. However a large section of this area is not fully exploited due to limited access to appropriate farming technologies such as irrigation. There are several opportunities for empowerment of farmers through government programs aimed at modernizing agriculture like NAADS.

Uganda has an irrigation potential of 202,000 ha (MAAIF 2010) particularly in the Lake Kyoga catchment, in the western region, the Albert Nile valley and in Jinja and Iganga districts on the shores of Lake Victoria. According to MAAIF (2004), the area developed and utilized under formal irrigation systems was about 2,330 ha (under formal irrigation systems). Currently, 14,418 ha is under formal irrigation and 67,000 ha under informal irrigation, much of it for rice (MAAIF 2010). Some further potential has been exploited using informal small scale

technologies, on the fringes of wetlands (FAO 2007). Furthermore with only 22km3 of the total renewable water resources (over 66 km3) in Uganda being utilized (for both small and large scale initiatives), there is great potential to harness the available water in order to increase production and productivity (MAAIF 2010). The Agriculture Sector Development Strategy and Investment Plan 2010/11-2014/15 plans to develop water resources for agriculture on the basis of sustainable irrigation, among others.

At the local level there are also more opportunities for diversification as into livestock farming, private wildlife management as is already evident in parts of Karamoja. There is also potential for the large arable area to be exploited to feed the workers and beneficiaries in the oil and mineral industries. Further afield Uganda could easily become the regional food basket once her full irrigation potential is utilized.

Agro-processing and value addition should thus be prioritised as indicated in the National Development Plan. This should relate to and benefit from the rural electrification program and the increased knowledge on use of alternative forms of energy such as crop residues, and increment of trees for fuel wood and charcoal production.

A charcoal market in Ullepi Sub-county, Arua District. Trade in charcoal contributes to deforestation.
Photo credit: Arua District Environment Office

Exploitation of regional markets

Opportunities for trade at the regional level still remain to be fully exploited, especially in terms of agriculture and mineral exploitation. Currently markets for food staples account for nearly 75 per cent of the value of all agricultural commodities produced in Africa (Haggblade et al 2004 in IGAD 2007). Differentials in rainfall patterns across the sub-region give Uganda a comparative advantage for agriculture. For instance, earlier rains mean that Ugandan maize farmers can produce a maize crop earlier than farmers in Kenya enabling export of maize at seasonal peaks.

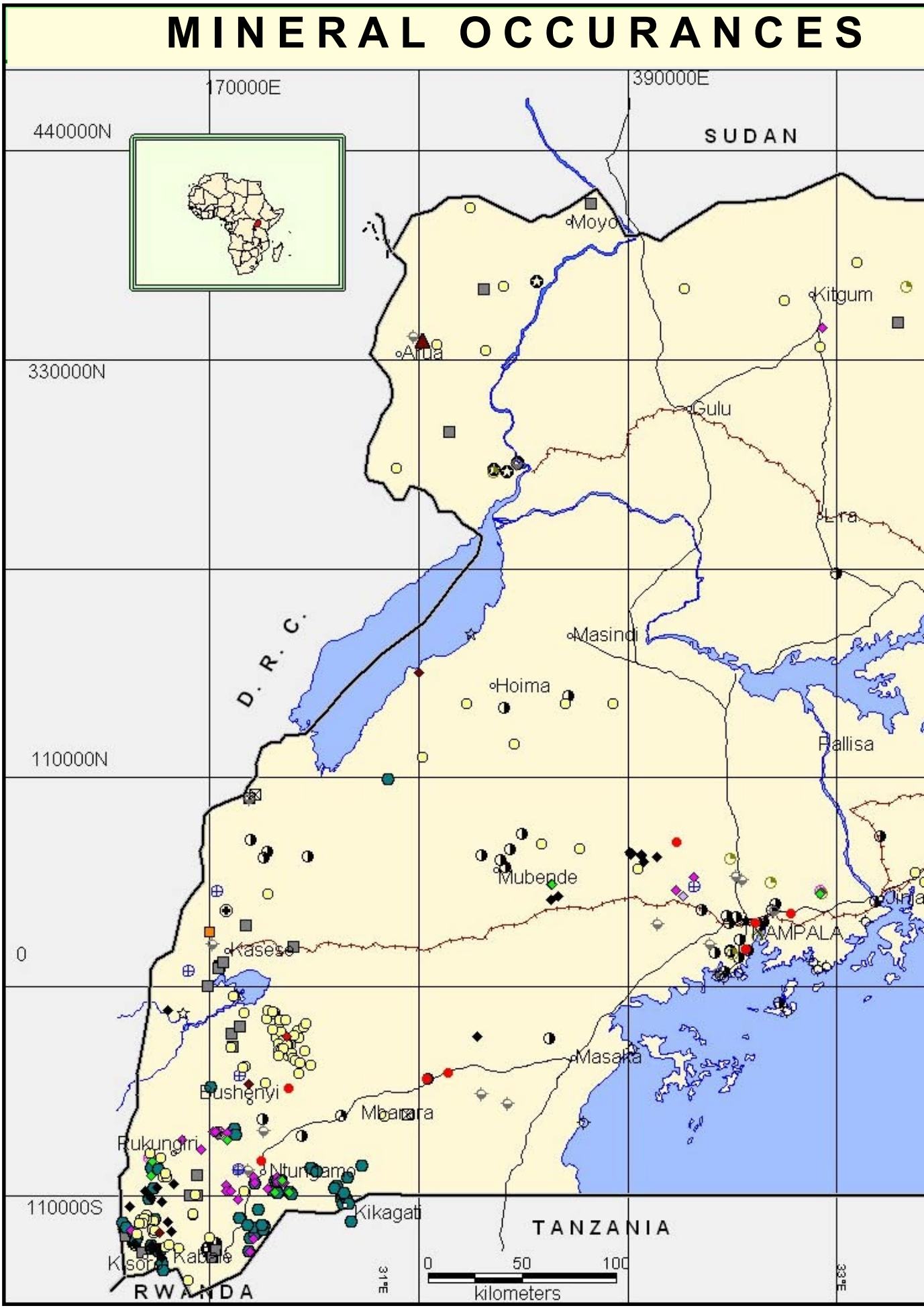
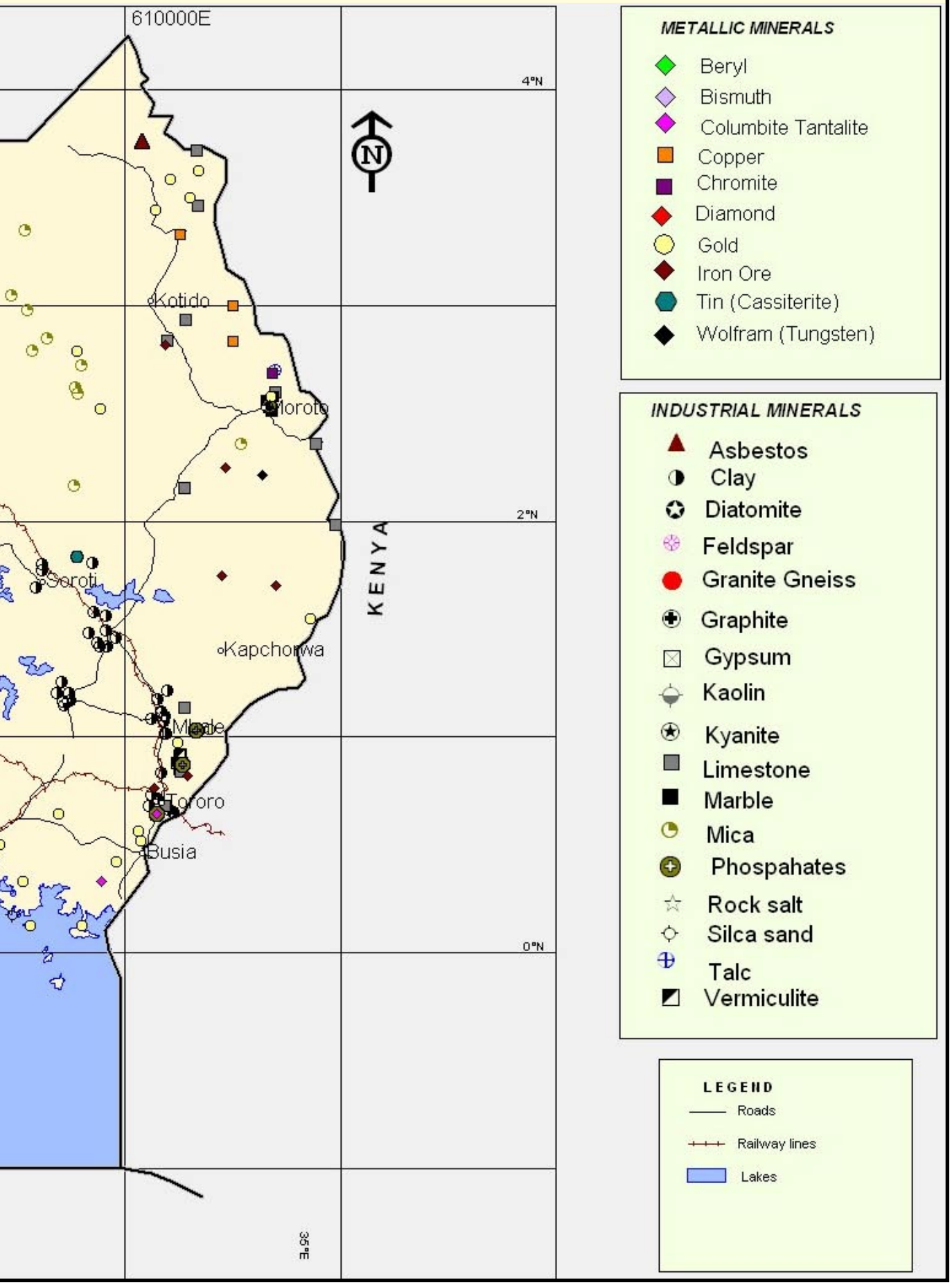


Figure 2.3: Mineral occurrences of Uganda. DGSM 2009

OF UGANDA


610000E
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Kotido
Moroto
Soroti
Kapchorwa
Mbale
Tororo
Busia
KENYA
METALLIC MINERALS
Beryl
Bismuth
Columbite Tantalite
Copper
Chromite
Diamond
Gold
Iron Ore
Tin (Cassiterite)
Wolfram (Tungsten)
INDUSTRIAL MINERALS
Asbestos
Clay
Diatomite
Feldspar
Granite Gneiss
Graphite
Gypsum
Kaolin
Kyanite
Limestone
Marble
Mica
Phospahates
Rock salt
Silca sand
Talc
Vermiculite
LEGEND
Roads
Railway lines
Lakes

In order to benefit from regional and international markets the country will have to adhere to strict agricultural (crop and livestock) standards. Production levels will also need to be increased. There is thus the opportunity to increase trade in food staples and reduce the regions dependence on food aid from outside the continent. Such markets include Southern Sudan and other countries of the East African Community.

Mineral Potential and Value Addition

Uganda has a large potential for mineral exploitation as shown in figure 2.3. Investments in the mineral sector as measured by increase in mineral exploration and development has grown from 220 to nearly 500 licenses and from US $ 5million in 2004 to US $ 70 million currently (Tumuheirwe 2009). The confirmation of commercial scale oil reserves in the Albertine Graben presents a huge opportunity for economic development and improved livelihoods for all Ugandans. Once oil extraction begins, some of the products of the downstream industry could include petrol, diesel, jet fuel, heating oil, asphalt, lubricants, synthetic rubber, plastics, fertilizers, antifreeze, pesticides and pharmaceuticals. The potential availability of locally produced fertilizer would have the potential to greatly boost agricultural productivity. The existence of large deposits of other sub-soil mineral assets including iron ore, tungsten, coltan, uranium and oil will further contribute to household incomes.

Much of the current mining activities occur at small-scale and artisanal level. The minerals produced are usually exported as concentrates without refining them. However there are plans under the Sustainable Management of Mineral Resource Project to train these small-scale miners in geology and exploration, mining methods, mineral processing, environment management, business skills, health and safety and social issues. The main aim is to increase revenues through mineral productivity, value addition and trade.

Traditional Indigenous Knowledge and Management of the Environment

Indigenous knowledge (IK) refers to a now large body of knowledge and skills that have developed outside the formal education system and that enables societies to survive. Indigenous knowledge, also referred to as 'traditional' or local knowledge, is embedded in the community and is unique to a given culture, location or society (UNCST 2006).

Indigenous knowledge in the environment management sphere therefore, refers to that body of knowledge that is primarily based on local experiences of a specific local community or society and has evolved over time. Indigenous knowledge is characteristically passed from generation to generation by word of mouth or by practice and involves little or no formal documentation, teaching or research. The main examples of traditional environmental management systems and practices include fallow cropping, minimum tillage and indigenous soil and water conservation practices, conservation and management of sacred grooves, traditional herbal medicines and health care and application of fire particularly in agriculture and pasture management (UNCST 2006).

Indigenous knowledge is characteristically location and culture specific, is not systematically documented and is generated within communities. It is often the basis for decision making and survival strategies and concerns critical issues of human and animal life including primary production and natural resource management. Although oral and rural in nature, indigenous knowledge is dynamic and based on innovation, adaptation and experimentation (UNCST 2006).

There are specific examples of the application of indigenous knowledge in Uganda. One of them is the use by local communities of the forest as a source of medicine, food and fodder. A survey around Budongo Forest Reserve indicated that local communities use over 63 species of plants for food, fodder or medicine (Eilu and Bukenya-Ziraba 2004). Community use of forest plants offers exceptional opportunities for landscape-scale conservation. The argument is that the benefits from the forests serve as motivational foundations to improve the management of the plants and their habitats.

Mparo cultural tomb in Hoima district.
Photo credit: NEMA

Fallow cropping and slash and burn practices are old methods of agriculture in Uganda. The use of fire is deeply embedded in these farming practices. Farmers burn to clear brush, release nutrients, kill pests, manage shade or to fell snags. Whereas fallow cropping significantly reduces the value of production, at least in the short run, many indigenous communities know that in the longer run, it contributes to productivity improvements by restoring soil fertility and reducing pests and diseases. Many farmers therefore use fire in their farming systems, but also to hunt, gather honey and create fire buffers. Villagers' burn around their grass thatched houses and un-harvested crops; and priests around sacred grooves to create fire belts to curtail the spread of hot late season fires. Broadcast burning as well as burning in heaps, are some of the techniques of burning developed by local people over the years.

Some of the practices are however, fraught with weaknesses. Inappropriate use of fire for instance has been blamed for causing deforestation, land degradation and green house gas emissions. Some medicinal plants face extinction because of over extraction. These weaknesses need to be addressed through cultural re-orientation and infusion of local practices with appropriate scientific knowledge and education.

Threats To The Land Resources

Deforestation

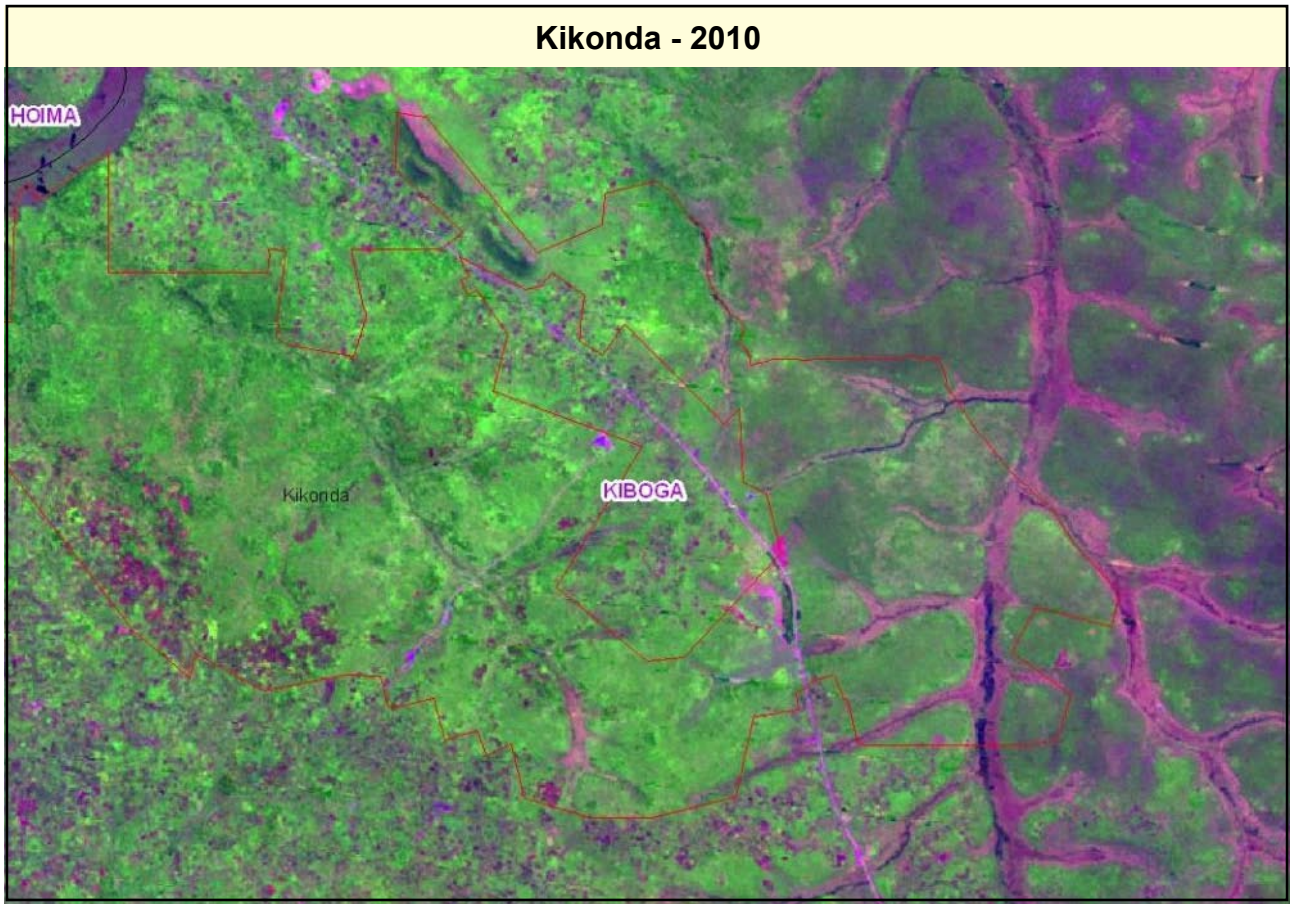
The key drivers of land degradation and deforestation in Uganda include lack of clearly defined ownership and tenure rights, unclear access controls (particularly for forests on private land), high population growth rates, unplanned economic growth and increased demand for forest products in a situation of a dwindling forest resource base.

The current rate of deforestation of 1.8 percent per annum (UBOS 2011) requires immediate intervention. Short of appropriate interventions, the economy and livelihoods of many Ugandans are at great risk. The key threats to the land resource for purposes of emphasis include land degradation from soil erosion and declining soil fertility, pollution and land cover change, low agricultural output from the low adoption of appropriate technologies, excessive pressure from livestock as a result of overstocking and the spread of invasive alien species that further reduce agricultural productivity.

Agriculture is the most important land use in Uganda. Although agriculture is not the only land use, poor performance of the sector affects the overall potential output from the land sector. Thirty seven percent of Uganda's land area is under small scale farming, having increased from 35 percent in 1990. This increase, coupled with the decline in agriculture's share of the GDP and the rising absorption of the labour force is a cause of concern. The changes suggest suffocation of the sector, rather than modernisation of the economy. Uganda's agriculture remains dominantly rain fed, productivity is low (UNDP 2007) and crop and livestock yields are only a quarter to half of what could be achieved, even with present technologies (NEMA 2008). Stagnant or declining unit productivity coupled with a rising population means that more land has to be converted to agriculture to meet the growing demand for food, locally and within the region. This trend is already causing problems of encroachment, land degradation, deforestation, wetland reclamation and transformation of grasslands and woodlands to agricultural use. In western Uganda, in particular there is evidence of deforestation and conversion of forests and woodlands for subsistence agriculture, especially in areas outside protected areas. This is clearly shown in the change pair images in Figure 2.4.

Forest animals and insects serve as hosts and vectors to a number of important diseases such as yellow fever, leishmaniasis, Ebola and Chagas disease, among others. Research has linked forest change, particularly deforestation and forest fragmentation, specifically with the emergence of HIV and Ebola, through increased contact between humans and primate carriers (WWF 2010). Land use changes affect various hosts and vectors differently, thus affecting human disease incidence. The threat of emergent diseases such as Ebola is worsened by its capacity to spread beyond forests. Some of the links between forests and health include:

- Smoke from fuelwood and forest fires causes significant human respiratory problems mainly among women and small children.
- Some forests plants are used medicinally and herbalists and other traditional healers are an important factor in the health sector in Uganda. For example the herbal remedy for malaria *Artemisia annua* that is now being grown in Western Uganda originated in the forests of China (WWF 2010).
- Pharmaceuticals of natural origin are sold each year. For example the bark of *Prunus africana* which is used in the treatment of prostate cancer Commercial production is in the districts of Kasese, Bundibugyo, Kabarole, Mukono, Jinja and Mbale (NEMA 2011).



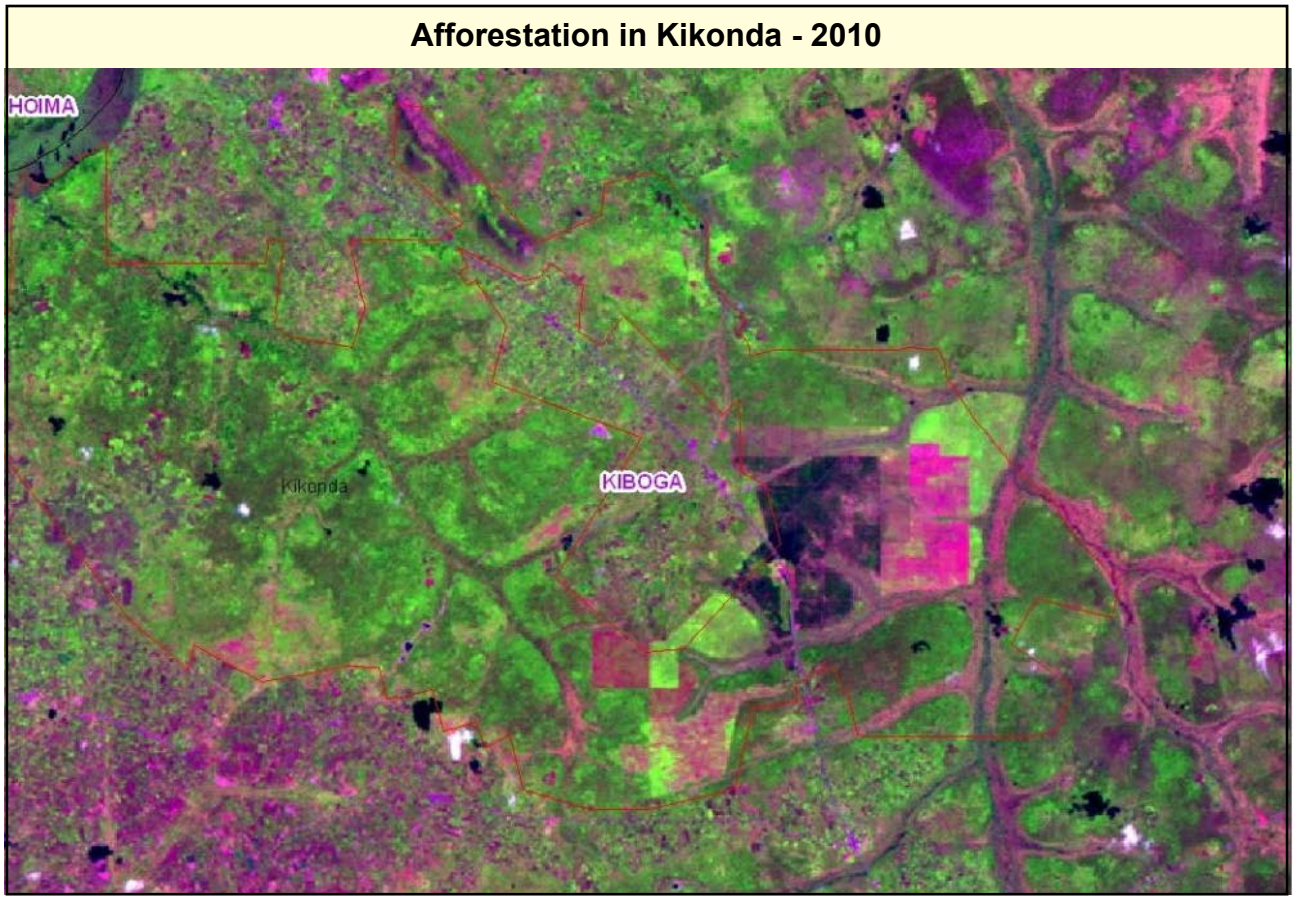


Figure 2.4: Change pair images of Kikonda area in 2004 and 2010 show the extent of deforestation
Source: NFA 2010

Addressing the issue of deforestation requires a greater number of programmes for planting trees and managing forests, as well as better coordination among the forest law enforcement agencies. For instance success has been rested in some areas including increase in the tree cover through afforestation and reforestation programmes and the Waste Composting pilot project under CDM done in 9 municipalities in partnership with NEMA.

Land Degradation

Land is a key strategic resource for Uganda. It is central to higher agricultural productivity, ecosystem stability, climate resilience and the sustained supply of both national and global environmental benefits (WB, 2010). Although land constitutes over 50 percent of the value of the 'asset basket' of poor Ugandans, current farming practices threaten soil fertility and prevent a significant share of the agriculture potential from being realized. The soils of sub-Saharan Africa lose considerable fertility through poor nutrient management. This problem is particularly pronounced in Uganda.

The key land degradation hotspots where soil erosion and infertility are especially rampart, have been identified in the Southwestern highlands, Lake Victoria Crescent, the Northwest and the Eastern Highlands as well as the Cattle Corridor. In these areas it is estimated that nitrogen, potassium and phosphorus are lost at the rate of 85, 75 and 10 kilograms per hectare per year respectively. Soil erosion is estimated at above 5 tons per hectare per year (World Bank 2010).

In addition to escalating soil erosion and soil fertility loss (soil nutrient depletion), other key land degradation problems are recognized, in many parts of Uganda. They include land use/land cover conversions and extensive loss of vegetation cover including deforestation, landslides and colonization of large expanses of land by invasive alien species including *Lantana camara, Parthenium hysterophorus,,and Cymbopogon nardus*. Uganda has a high deforestation rate of 80,000 hectares per year. Soil erosion and land degradation are pronounced with recent estimates putting the overall cost of environmental degradation at 17 percent of GDP of which 11 percent is due to soil degradation. Soil nutrient loss is estimated to cost US$ 625 million per annum. Box 2.2 discusses soil nutrient loss caused by deforestation.

Box 2.2: Soil nutrient losses from land use change: forests to agriculture

When forest cover is removed the loss of ground cover allows uncontrolled runoff, soil erosion and nutrient leaching during rains, making reforestation and farming difficult. Soil nutrient loss is a big issue given the importance of agriculture to the national economy, poverty eradication and household incomes. Studies have indicated that losses of NPK from farmlands surrounding tropical high forest and plantation areas were about 104.2 kg/ha/annum; while losses from farmlands surrounding woodlands were about 156.81 kg/ha/annum. The minerals Nitrogen (N), phosphorus (P), and potassium (K) are important for plant productivity and crop yields and can be used as a proxy for soil nutrients. The estimated monetary value of forest nutrient protection through avoided soil erosion in the area under forest cover was estimated at US $291 million or U.Sh 671 billion. The largest proportion of the losses was from soil erosion in woodlands especially from keeping large numbers of livestock, which trample the soil exacerbating soil erosion.

Source: NEMA 2011

Low Agricultural Output

National accounts data indicate that the agriculture under-performed in the last decade. The sector grew at an average annual rate of only 1.3 percent between 2003 and 2010. This was significantly lower than the government target of over 3.8 percent. The major causes of low output in the sector were soil erosion and soil fertility loss, loss of agro-biodiversity, soil nutrient depletion, inappropriate legal and regulatory framework and undue reliance on rain-fed agriculture.

Continuous farming on the soils without replenishment of nutrients has led to depletion of essential nutrients and low fertility of the soils. Indeed over much of Uganda, especially in the southwest, soils have undergone degradation due to over use. In some areas top soil losses of as much as 5 tonnes per hectare have been reported (MAAIF 2010). The main drivers include the ever-increasing population and climate change issues, among others. The population has increased from 9.5 million in 1969 to 32.9 in 2011 (UBOS 2011). Opportunities for opening up new land are much reduced thus pushing people into marginal areas. Furthermore the effects of climate change/climate variability (increasing temperatures, increased frequency and intensity of rainfall, heat waves, droughts, floods and storms) are likely to have implications on agricultural productivity. For example increasing temperatures could lead to a shift in the viability of coffee growing areas potentially wiping out 40 percent of export revenue, some US $265.8 million (MAAIF 2010).

The productivity levels for most crops continue to perform at below potential and investments in agricultural inputs receive limited returns. There is also limited adoption of appropriate technologies such as high-yielding crop varieties, fertilizer and manure application. The high cost of inputs and productive resources including credit and irrigation also undermine the potential improvements in the sector. Therefore enhanced productivity of land through sustainable management of soil and water resources cannot be over-emphasized. For example, loss of soil fertility can be greatly reversed if sound farming practices such as inter-cropping is practiced.

Increase In Livestock Population

Excessive pressure on the vegetation by animals is a crucial problem that has adversely affected the production potential and carrying capacity of the land. The growth of pastoralists population and the subsequent increase in livestock population have led to the extension of grazing activity into marginal lands and forests thereby causing severe degradation and reduced livestock productivity. The impact of grazing in the drier areas is most evident around watering points and settlement areas which are grazed until they are bare leading to weak animals or even livestock deaths. This is clearly evident in the dry cattle corridor districts of Nakasongola, Moroto and Nakapiripirit. The continued land degradation over the years has reduced the carrying capacity in all agro-ecological zones leading to accelerated soil erosion and depletion of the natural seed banks in the soil to the extent that even with adequate rainfall, little grass or other palatable vegetative material regenerates.

Illegal grazing inside the national parks, wildlife reserves and wetlands is common place among communities that neighbour protected areas such as the Basongora, the Karimojong and the Hima herdsmen. In most cases these intruders are not even deterred by fines. A number of other factors contribute to the intrusion into PAs - the wanton disregard of the law, failure to recognize the importance of protected areas and desperation due to lack of alternative pasture options.

Overstocking of rangelands can lead to land degradation.
Photo credit: Population Secretariat

Climate Change/Climate Variability

Increasingly variable weather and climate conditions exacerbated the problems of low crop yields, declining soil fertility and degraded soils. Average temperatures in Uganda are projected to increase by up to 1.5^0C in the next 20 years (DFID 2008). Rainfall is more variable and comes with increased intensity and ferocity. There is also an increased incidence of extreme dry spells, lightening strikes, floods and storms which all negatively impact on farm output. Droughts accelerate the degradation of land though lost vegetation cover, wind and sheet erosion.

Climate change has therefore emerged as the most evident impact of environmental degradation. As a human induced phenomenon, climate change calls for multi-sectoral partnerships in tackling the negative impacts, which include scarcity of energy, water, food and general community conflicts over natural resources. Such scarcities, which are cyclically linked to poverty and poor quality environment, have unacceptable manifestation on quality of life of the people.

Although Uganda's climate is favourable for the production of a wide array of crops, the increasingly variability in climate and the unstable economy at global and national levels are contributing to the problems of household food security, malnutrition, famine and hunger especially among the vulnerable populations like children under-5 and internally displaced people. The low prioritization and commitment for nutrition in the health sector in the past has led to inadequate resource allocation, both human and financial, to implement nutrition interventions at all levels. Nutrition is a cross cutting issue and requires the involvement and effective coordination of multiple sectors and stakeholders. The new Health Sector Support Programme III (2010/11-2014/15) includes plans to implement better systems for weather forecasting, disease surveillance and public health planning offer some protection for the affected populations. Given the current situation, there is a need to integrate issues of climate change/climate variability into Health Sector programmes.

Measuring the discharge at River Manafwa. The silt-covered grass on the river bank shows how high the river rose during peak floods.
Photo credit: NEMA.

Population Pressure, Waste Management and Land Productivity

The link between population growth, land degradation and soil fertility levels generates mixed feelings. Whereas a number of studies, (Clay et al 1994, UNEP/IISD 2005) confirm that large populations inevitably mine and export soil nutrients and hence rapidly deplete soil fertility, other studies refute this. Tukahirwa (2002) and Nkonya and Kaizzi (2003) argue that there is no significant direct link between human populations and their environments as elaborate cultural and organisational systems cushion most aspects of the interactions.

They variously argue that population and farm sizes are negatively related to nutrient balances and that large farms have higher levels of nutrient depletion than small farms. Beyond cultural and organizational interventions, this unlikely result has been attributed to the ability of larger farms to produce more marketable crop surplus, which exports soil nutrients off the farm without adequately replenishing such nutrient off-takes. Yet small farms produce far less for sale and buy food to supplement their subsistence needs, reducing soil nutrient depletion (Nkonya and Kaizzi 2003).

NEMA nonetheless recognises the need for nutrient replenishment for most soils in Uganda. The Authority, with support from the World Bank therefore initiated a Municipal Solid Waste Composting (MSWC) project in 2005 with the primary aim of managing municipal solid waste by turning the biodegradable section of the waste in into compost manure for agricultural use. The project covers the nine municipalities of Mukono, Jinja, Mbale, Soroti, Lira, Mbarara, Kasese, Kabale and Fort Portal. A further set of eight municipalities is being considered for the second phase of the project effective 2010 and include Masindi, Hoima, Mityana, Entebbe, Arua, Gulu and Tororo (NEMA 2011).

Solid waste management

One of the greatest challenges facing Uganda's rapidly growing urban centres, is solid waste or garbage. It is one of the most visible forms of land pollution. Most solid waste disposed of in Uganda is from municipal sources. It includes paper, plastic, glass, metal cans, food scraps, and yard trimmings, the greater proportion being degradable. For example in Kawempe division municipal solid waste 33 percent is non-degradable while 67 percent is biodegradable (Ssembajjwe and Mukunya undated).

The handling of solid waste is a problem because most disposal methods damage the environment. Open dumps are aesthetically unpleasant and are habitat for vermin and other disease-carrying animals. Both open dumps and landfills may contain toxins that seep into the soil, ground water or flow into streams and lakes. The uncontrolled burning of solid waste creates smoke and other air pollution. Even burning waste in incinerators can release toxic chemicals, ash, and harmful metals into the air.

Reducing the total amount of solid waste headed for the landfill, recycling and composting are pollution reducing strategies and plays a significant resource conservation role by recycling materials. NEMA is currently working with the Uganda Environment Protection Forum that collects materials for recycling. The value of materials recycled have increased from U.Sh6.3 million (US $2,423) in July 2011 to U.Sh 12 million (US $4,615) in October 2011. The waste collected includes PET bottles, jerry cans, plastic basins, aluminum, copper, brass, aluminum soda cans, steel, polybags, polythene, plastic shoes and old paper.
Under the Decentralization Act, the responsibility for waste management lies with Urban Councils. However in many cases services are poor or nonexistent. In response the communities have instituted their own waste management methods include waste recovery, recycling, re-use, and composting. The national strategy for solid waste management is failing because environmental management is not fully mainstreamed into local development plans and budgetary allocations for waste management are low. Waste management receives less than 10 percent of urban council budgets compared to other policy areas (Okot-Okumu and Nyenje 2011). There is urgent need for more financial and human resources capacity at the local government level for waste management.

Improving the Management of Land Resources

In spite of the challenges and constraints in the sector, many opportunities and benefits exist in the land management, agriculture and livestock sub-sectors in Uganda. Key opportunities and benefits in the sector revolve around the potential for sustainable land management, crop yield management, value addition and agricultural diversification, specialization and modernization.

Sustainable Land Management

Land degradation can be tackled through appropriate soil and water management strategies, reclamation of dry lands, protection of forests and other critical ecosystems, agro-forestry and promotion of conservation agriculture and water-harvesting technologies. Conservation agriculture promotes crop yields and agricultural sustainability.

Government therefore recently upgraded investments in the agricultural technologies and agricultural research sub-sectors and enhanced partnerships between agricultural research, agricultural advisory services and farmer groups. Government is also keen to support further integration of small-holder farmers in the agricultural value chains.

Increasing Agricultural Yields

Crop and livestock productivity is generally below optimal levels. Most crop yields, including yields of maize, sugar and bananas are one-tenth of global average. Tripling national average yields of major crop and livestock production systems is easily achievable through the adoption of appropriate technologies and promotion of promising integrated soil fertility management technologies and access to agricultural inputs and extension services. The National Development Plan aims to boost agricultural yields by increasing key production inputs to the sector. To that end, the Tororo Phosphates Plant will be built to provide fertilizers to farmers at competitive prices. Government will also increase the available of high yielding seed and promote mechanisation of agriculture. Increased yields could also be achieved through optimal use of unused land in the high- and medium-potential agricultural areas, particularly through irrigation. Figure 2.5 shows the soils of Uganda including their productivity levels.

Promotion of Farm Forestry and Forest Products

Forests and related forestry activities contribute to improved agricultural productivity through conserving soil and water and enhancing soil fertility. The destruction of forestland has contributed to increased rates of flooding as the percolation time is reduced on bare ground leading to landslides and siltation of rivers. Efforts in forestry development in the country should focus on expanding tree cover in industrial plantations, on-farm trees and urban forestry and in local forest reserves. Promoting on-farm forestry and conservation of natural environment should be enhanced.

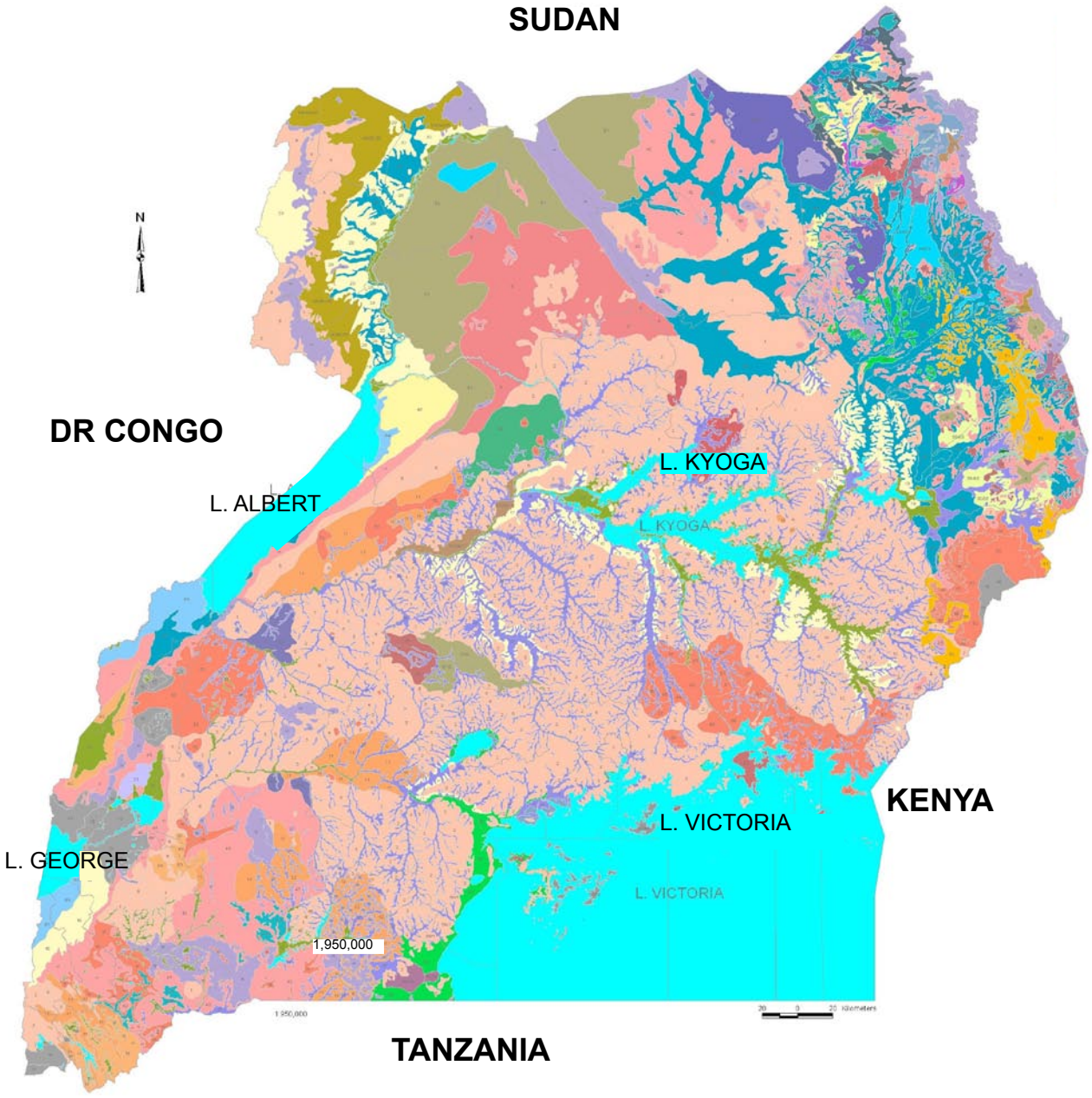
Government and private sector initiatives in the forestry sector are commendable, but could be further improved. Diversification of the species mix, in particular to promote indigenous tree planting and fruit farming remains broadly desirable.

Value Addition

Value addition includes processing, branding, quality certification and accreditation, as well as farm-level quality improvements that the market values. Most agricultural exports from Uganda are raw or semi-processed. This denies the country large amounts of foreign earnings from both the regional and internal export markets. The potential for adding value to products such as tea, coffee, milk, beef, fish, hides and skins, fruits and vegetables remains largely untapped. The National Development Plan has highlighted value addition and agro-processing as an area for strategic intervention in order to increasing earnings.

Organic agriculture is a growth area, with certified organic exports worth US $22.8 million in 2007/8 up from US $3.7 in 2003/4 (MAAIF 2009). Through organic farming the country also gains through mitigating climate change as GHG emissions per hectare are estimated to be on average 64 percent lower than emissions from conventional farms. In 2004, the Uganda Organic Standard was adopted and in 2007, Uganda joined the East African Organic Products Standard. A draft Organic Agriculture Policy was also developed in 2009. It describes organic agriculture as one of the avenues for delivering self-sustaining growth as it provides mechanisms for individual farmers to improve productivity, add value and access markets which is one of the growth areas of the National Development Plan.

The soils of Uganda including their productivity levels



Notes:

In 1959 a reconnaissance 1:250,000 soil survey was done for Uganda wherein soils were identified using species type of legend that is named using places where representative profiles were observed (Chenery, 1960; Ollier and Harrop, 1960; Ollier, 1960, Radwanski, 1960; Harrop, 1960). With this legend, a total of 138 soil units were identified, very many of them, having developed under similar conditions with identical properties but were in different places. Since there was no universal classification system at the time, Chenery (1960) reviewed 12 systems of soil classification and found D'Hoore and Sys's systems to be most appropriate for Uganda soils. Thus, the soils were classified and mapped at a scale of 1:1,500,000. The analogue soil maps 1:250,000 were digitized and the soil units correlated to the World Reference Base for Soil Resources (WRB). The original soil units can still be traced on the map while the legend can allow readers of the memoirs to easily correlate the original soil species type of Legend to the World Reference Base

Agricultural productivity rating refers to the ability of the soils to produce crops without amendments such as manures, fertilisers or irrigation and drainage but with the use of good husbandry techniques. It reflects the overall quality of soils for agricultural production

Map Compilation:

The following 1:250,000 soil map sheets (Department of Agriculture, 1971) were digitized:
Arua NA-36-1, Kitgum NA-36-2, Kaabong NA-36-3, Kaabong / Kenya NA-36-4,
Pakwach NA-36-5, Gulu NA-36-6, Aloi NA-36-7, Moroto NA-36-8, Hoima NA-36-9,
Masindi NA -36-10, Mbale NA-36-11, Kapenguria NA-36-12, Fortportal NA-36-13,
Kampala NA-36-14, Jinja NA-36-15, Mbarara SA-36-1, Masaka SA-36-2,
Homa Bay SA-36-3, Kabale SA-36-5

District boundary layer (Survey and mapping Department

Map digitizing was done with support of NEMA within the frame of the Environment Information Network (EIN)

Figure 2.5: The soils of Uganda including their productivity levels

ACRISOLS				**PRODUCTIVITY**
1	**Haplic Acrisols**	Leptic Acrisols	Eutric / Histic Gleysols	Medium
2	**Haplic Acrisols**	Petroplinthic Acrisols	Eutric Gleysols	Low
3	**Haplic Acrisols**	Petroplinthic Acrisols	Skeletic Acrisols	Medium
4	**Haplic Acrisols**	Haplic Ferralsols	Petroplinthic Acrisols	Low
5	**Haplic Acrisols**	Skeletic Leptosols	Eutric Gleysols	Medium
6	**Haplic Acrisols**	Leptic Luvisols	Haplic Gleysols	High
7	**Nitic Acrisols**	Petroplinthic Acrisols	Eutric Gleysols	Medium
8	**Petroplinthic Acrisols**	Haplic Acrisols	Eutric Gleysols	Medium
9	**Petroplinthic Acrisols**	Petroplinthic Lixisols	Skeletic Leptosols	Low
10	**Haplic Acrisols**	Lixic Ferralsols	Haplic Arenosols	Low
ALISOLS				
11	**Haplic Alisols**	Acric Ferralsols	Eutric Gleysols	Low
12	**Haplic Alisols**	Leptic Alisols	Histic Gleysols	Low
FERRALSOLS				
23	**Haplic Ferralsols**	Haplic Arenosols	Skeletic Leptosols	Low
24	**Lixic Ferralsols**	Skeletic Regosols	Eutric Gleysols	Low
25	**Lixic Ferralsols**	Skeletic Leptosols	Eutric Gleysols	Medium
26	**Lixic Ferralsols**	Petroplinthic Lixisols	Eutric Gleysols	Low
GLEYSOLS				
27	**Alic Gleysols**	Low		
28	**Arenic Gleysols**	Low		
29	**Eutric Gleysols**	Medium		
30	**Histic Gleysols**	Low		
HISTOSOLS				
31	**Fibric Histosols**	High		
32	**Leptic Histosols**	Nil		
33	**Thionic Histosols**	High		
LIXISOLS				
50	**Nitic Lixisols**		Eutric Gleysols	Medium
51	**Petroplinthic Lixisols**	Haplic Luvisols	Eutric Gleysols	Low
NITISOLS				
52	**Acric Nitisols**	Petroplinthic Acrisols	Eutric Gleysols	Medium
56	**Luvic Nitisols**	Lithic Leptosols	Eutric / Histic Gleysols	Medium
54	**Andic Nitisols**	Leptic Andosols		High
53	**Alic Nitisols**			Medium
57	**Lixic Nitisols**	Petroplinthic Lixisols	Eutric Gleysols	High
55	**Ferralic Nitisols**	Haplic Ferralsols	Eutric Gleysols	Medium
REGOSOLS				
60	**Haplic Regosols**			Low
61	**Haplic Regosols**	Leptic Regosols		High
62	**Petroplinthic Regosols**	Petroplinthic Lixisols		Low
SOLONETZ				
64	**Vertic Solonetz**	Stagnic Solonetz	Gleyic Solonetz	Low
63	**Gleyic Solonetz**	Vertic Solonetz	Stagnic Solonetz	Low

ANDOSOLS				**PRODUCTIVITY**
13	**Calcic Andosols**	Leptic Andosols		Medium
14	**Histic Andosols**	Leptic Andosols		Medium
15	**Leptic Andosols**	Andic Leptosols	Eutric Gleysols	Medium
16	**Mollic Andosols**	Leptic Andosols		High
ARENOSOLS				
17	**Haplic Arenosols**	Petroplinthic Arenosols	Petric Plinthosols	Medium
18	**Ferralic Arenosols**	Haplic Arenosols	Eutric Gleysols	High
19	**Haplic Arenosols**	Petroplinthic Arenosols	Eutric Gleysols	Low
20	**Haplic Arenosols**	Calcic Vertisols	Eutric Gleysols	High
CALCISOLS				
21	**Haplic Calcisols**			Low
FLUVISOLS				
22	**Calcic Fluvisols**	Eutric Gleysols		Medium
LEPTOSOLS				
34	**Skeletic Leptosols**	Skeletic Luvisols		Low
35	**Skeletic Leptosols**	Haplic Acrisols	Eutric Gleysols	Low
36	**Skeletic Leptosols**	Lixic Ferralsols	Eutric Gleysols	Nil
37	**Skeletic Leptosols**	Haplic Luvisols	Eutric Gleysols	Nil
38	**Skeletic Leptosols**	Petric Plinthosols	Eutric Gleysols	Medium
39	**Skeletic Leptosols**	Leptic Regosols	Eutric Gleysols	Nil
LUVISOLS				
43	**Calcic Luvisols**	Haplic Luvisols	Eutric Gleysols	Low
41	**Haplic Luvisols**		Eutric Gleysols	Low
42	**Haplic Luvisols**	Petroplinthic Acrisols	Eutric Gleysols	Medium
43	**Haplic Luvisols**	Leptic Luvisols	Histic Gleysols	Medium
44	**Haplic Luvisols**	Petroplinthic Lixisols	Eutric Gleysols	Medium
49	**Vertic Luvisols**		Eutric Gleysols	Medium
45	**Haplic Luvisols**	Petroplinthic Lixisols	Skeletic Luvisols	Medium
46	**Haplic Luvisols**	Arenic Planosols	Eutric Gleysols	Low
47	**Haplic Luvisols**	Petroplinthic Regosols	Eutric Gleysols	Low
48	**Nitic Luvisols**	Skeletic Luvisols	Eutric Gleysols	Nil
PLANOSOLS				
59	**Haplic Planosols**			Low
58	**Acric Planosols**	Haplic Arenosols	Eutric Gleysols	High
VERTISOLS				
65	**Calcic Vertisols**	Sodic Vertisols	Eutric Gleysols	Low
66	**Gleyic Vertisols**	Sodic Vertisols	Eutric Gleysols	Low

Correlation to FAO World Reference Base Soil Classification System

Amuria Catena, Bushenyi Series, Buwekula Catena, Katera Series, Lubumba Series, Mawogola Catena, Parombo Series 1

Bowa Catena, Buganda Catena, Buruli Catena, Kyebe Catena, Mbale Complex, Mirambi Catena, Mityana Catena, Ntendule Catena, Sesse Series, Zeu Catena 2

Buwekula Catena, Kabira Catena, Mawogola Catena 3

Moroto Series 4

Lukaya Catena, Mubende Catena, War Complex 5

Rukiri Complex 6

Bululu Series, Buyaga Catena 7

Yumbe Catena 8

Anaka Complex, Koboko Catena, Mwiri Catena 9

Mazimasa Complex 10

Hoima Catena, Mafuga Series, Makole Series, Nyabushozi Catena, Serere Catena 11

Nyabushozi Catena 12

Chambura Series, Nyakatonzi Series 13

Sabinio Series 14

Kyamutuma Complex, Masaba Series, Muko Series, Saka Series 15

Bubandi Series, Bufumbira Complex, Fort Portal Series 16

Lwampanga Series 17

Panyimur Series, Paraa series, Rwanga Series 18

Usuku Series 19

Laropi Series, Rogem Series, 20

Sebwe Series 21

Loyoro Series 22

Bugoma Series, Sesse Series 23

Lolekek Series 24

Kasolo Catena 25

Lokitanyala Series, Toror Complex 26

Bukora Series 27

Mulembo Series 28

Undifferentiated Alluvium 29, 66

Kaku Series, Kifu Series 30

Papyrus Peat 31, 33

Bujuku Complex 32

Kunyao Series, Lubare Series, Nzia Series, Sesse Series 34

Kazo Catena 35

Metu Complex 36

Katikekile Complex 37

Bugamba Catena 38

Tolero Series 39

Nadiket Complex 40

Bugangari Series, Kalapata Series, Morongole Series 41

Kigumba Catena, Pajule Catena 42

Mbarara Catena 43

Dokolo Series, Opopwa Series 44

Tororo Complex 45

Napak Series 48

Kasese Series, Siroko Series 49

Bututu Series 50

Palabek Complex, Panyagara Series 51

Kiamara Catena, Kitonya Catena 52

Benet 53

Bugusege Series 54

Kamusene Series, Kibula Series 55

Apedet Series, Cheptui Series, Ibanda Series, Nakabango Catena, Rugaga Series, Sipi Catena 56

Bududa Series, Buyaga Catena, Kabira Catena 57

Sango Series 58

Lorengikipi Series 59

Buwhezu Series, Kyansabo Series 60

Kabale Catena 61

Lomerimong Series 62

Ishasha Complex 63

Semliki Series, Weiga Complex 64

Kidepo Series, Ora Series, Pager Series, Sebei Series, Wasa Complex 65

Kiten Catena 44/65

Pakelle Complex 51/65

Okollo Complex 183625

rences:

Chesery, E.M., 1960. An Introduction to the Soils of the Uganda Protectorate - Memoir 1, Department of Agriculture; Kawanda Agricultural Research Station

Ollier, C.D., Harrop, J.F., 1960. The Soils of the Eastern Province - Memoir 2, Department of Agriculture, Kawanda Agricultural Research Station, Kampala

Ollier, C.D., 1960. The Soils of the Northern Province - Memoir 3, Department of Agriculture, Kawanda Agricultural Research Station, Kampala.

Radwanski, S.A., 1960. The Soils and Land Use of Buganda - Memoir 4, Department of Agriculture, Kawanda Agricultural Research Station, Kampala

Wilson, J.G., 1960. The Soils of Karamoja District- Memoir 5, Department of Agriculture; Kawanda Agricultural Research Station, Kampala

Harrop, J.F., 1960. The soils of Western Province - Memoir 6, Department of Agriculture; Kawanda Agricultural Research Station, Kampala

FAO-ISRIC-ISSS, 1998. World Reference Base for Soil Resources. World Soil Resources Reports No. 844, Food and Agriculture Organization of the United Nations, Rome

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Conclusion and Recommendations

Uganda's land resources are critical to national development and peoples well-being. Land supports agriculture, human settlements, industrialisation and important infrastructure. Rapid population growth and environmental degradation however pose a growing challenge to the continued productivity of the land resource. This chapter highlights the key issues in the land, agriculture and livestock sub-sectors and proposes a number of solutions to the salient problems in the sector. The key recommendations of the chapter focus on developing and implementing policies that promote soil and water management and ensure the sustainable management of critical ecosystems particularly wetlands. The chapter urges the private sector to develop and promote the use of environment friendly technology options for smallholders, particularly those that encourage sustainable natural resource management practices and lead to improved livelihoods.

References

Banadda N (2010). Gaps, barriers and bottlenecks to sustainable land management (SLM) adoption in Uganda. In: African Journal of Agricultural Research Vol 5 (25). Special Review.

Bikangaga, S., R. Arinaitwe, J., and Rukunya E. (1999). *Economic Valuation of the Water Hyacinth as an Environmental Problem in Uganda's Freshwater Resources and its Effect on Key Economic Activities*. Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), Uganda.

Bonabana-Wabbi, J. and Taylor D.B. (2008). *Health and Environmental Benefits of Reduced Pesticide Use in Uganda: An Experimental Economics Analysis*. A Paper presented at the joint annual meeting of the American Agricultural Economics Association and the American Council on Consumer Interests in Orlando Florida, July 27-29, 2008.

Clay C. D; Guizlo, M; and Wallace, S (1994). *Population and Land Degradation*. Working paper No. 14 Carrera-Hernandez, J.J. and Gaskin, S.J., 2007. Spatio temporal analysis of daily precipitation and temperature in the Basin of Mexico. N: Journal of Hydrology, 336(3-4): 231-249.

DGSM (2009). Mineral occurrences in Uganda. Department of Geological Surveys and Mines (DGSM), Entebbe. http://www.uganda-mining.go.ug/magnoliaPublic/en/GeologyMining/MineralOccurances/mainColumnParagraphs/0/content_files/file/MinOccMap.jpg

FAO (2007). *Country Support Strategic Framework 2010-2014*. Food and Agriculture Organisation of the United Nations, Kampala.

IFPRI (2001). *Development Pathways and Land Management in Uganda: Causes and Implications. Environment and Production Technology Division*. Discussion paper No85 International Food Policy Research Institute, Washington DC.

Isabirye M. (2005). *Land Evaluation Around Lake Victoria: Environmental Implications of Land Use Change*. PhD Thesis Catholic University of Leuven, Belgium.

Jeyaratnam J. Acute pesticide poisoning: a major global health problem. *World Health Stat Q* 1990; 43: 139-44. Jordan, G. et al., (2005). Historical land use changes and their impact on sediment fluxes in the Balaton Basin (Hungary). In: Agriculture, Ecosystems & Environment 108(2): 119-133.

Lal, R., (1984) Soil Erosion from Tropical Arable Lands and its Control. Academic Press. Inc In: Brady, N.C. (Ed.). Advances In *Agronomy*. , 37: 45- 51.

MAAIF (2002). *Potentials for Livestock and Crops integration in Arua, Kapchorwa, Mbarara and Kabarole Districts*, Uganda Land Management Project (ULAMP, Kampala.

MAAIF (2004). *Third National Report to the Conference of Parties on the implementation of the UN Convention to Combat Desertification in Uganda*. MAAIF, Kampala.

MAAIF (2010). *Agriculture Sector Development Strategy and Inestment Plan (2010/11-2014/15)*. Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), Kampala.

Moyini Y. et al (2002). *The Costs of Environmental degradation and Loss to the Ugandan Economy with Particular reference to Poverty Eradication*. Policy Brief 3 IUCN Nairobi, Kenya.

MWE (2009). Water and Environment Sector Performance Report October 2009. Ministry of Water and Environment, Kampala Uganda.

NARO (undated). *The Cost of Invasive Alien Species to Uganda*. A Briefing Paper. National Agricultural Research Organisation (NARO), Kampala, Uganda.

NEMA, (1999). *The National Soils Policy for Uganda*, National Environmental Management Authority (NEMA) Kampala.

NEMA (2007). *Pilot Integrated Ecosystem Assessment*. National Environment Management Authority and UNEP, Kampala, Uganda.
NEMA (2009a) *Fourth National Biodiversity Report, March 2009* . National Environment Management Authority (NEMA), Kampala.

NEMA (2009b) *Atlas of Uganda's Changing Environment*, National Environment Management Authority (NEMA).

NEMA (2011). *Contribution Of Forestry Sub-Sector To The National Economy: The Economic Value Of Forest Resources Of Uganda*. National Environment Management Authority (NEMA).

NFA (2010). *National Biomass Study Technical report 2009*. National Forestry Authority (NFA), Kampala, Uganda.

Okot-Okumu, J. And R. Nyenje (2011). Municipal solid waste management under decentralisation in Uganda. *Habitat International* (April 2011) doi:10.1016/j.habitatint.2011.03.003

Olson J.(2004). *The Spatial Patterns and Root Causes of Land Use Change in East Africa*. LUCID Project, International Livestock Research Institute, Nairobi Kenya.

Ssembajjwe, W.G. and Munkunya, F. (undated). *Solid Waste Management in Kawempe Division: Issues, Challenges and Emerging Options*. Network of Ugandan Researchers and Research Users (NURRU), Kampala.

Tukahirwa J. .M. B (2002). *Policies, People and Land Use Change in Uganda: A Case Study in Ntungamo, Lake Mburo and Sango Bay Sites*. Land Use Change Impacts and Dynamics Working Paper 17.

UBOS (2010). *Statistical Abstract 2010*. Uganda Bureau of Statistics (UBOS), Kampala.

UBOS (2011). *Statistical Abstract 2011*. Uganda Bureau of Statistics (UBOS), Kampala

UNCST (2006). *National Indigenous Knowledge Policy for Uganda*. Uganda National Council for Science and Technology (UNCST), Kampala.

UNDP (2007). *Millennium Development Goals. Uganda's Progress Report 2007*. United Nations Development Program, Kampala, Uganda.

UNEP/IISD (2005). *Connecting Poverty and Ecosystem Services*. Focus on Uganda. International Institute for Sustainable Development and United Nations Development Program, Nairobi, Kenya. http://www.unep.org

Tumuheirwe J.T. (2009). *Recent mineral sector Interventions and on-going activities in Uganda* Presented at: Symposium on Uganda Airborne Geophysical Surveys in Kampala 16-17 July 2009. Department of Geological Survey and Mines, Entebbe.

WWF (2010). *Arguments For Protection. Vital Sites: The Contribution of Protected Areas To Human Health*. A Research Report By WWF and Equilibrium Research. World Wildlife Fund for Nature (WWF), Gland, Switzerland.

Ice caps on one of the peaks of the Rwenzori Mountains.

CHAPTER 3
Atmosphere

Introduction

Uganda's atmospheric resources refer to the state and interactions among the key elements of the climate system and its component parts, the state of air, sunshine, atmospheric gases including ozone and the now evident frequency and intensity of climatic extremes. A large part of the Ugandan population is self employed in agriculture. A change in Uganda's atmospheric resources and climate system therefore, has significant implications for local livelihoods, human health and the national economy (Orindi and Eriksen 2005).

Climate change and development are inextricably linked. Economic development has contributed to an unsustainable rise in green house gas emissions that destabilise the climate system. There is on the other hand consensus that climate change also significantly impacts development too (Anderson 2011). Climate change is therefore a considerable contemporary environmental challenge. It poses serious threats to sustainable development and the negative impacts on ecosystems, water resources, food, health, industry and human settlements are yet to unfold. Many of the major diseases that are most sensitive to climate change – diarrhoea, vector-borne diseases like malaria, and infections associated with under-nutrition are preventable. Yet Uganda's resilience and disaster preparedness is relatively low (Oxfam 2008).

Uganda's concern is the increase and the frequency and intensity of climatic extremes, including monthly variation of rainfall amounts and seasonal variability. This combination has made it impossible for farmers to plan their annual cropping cycle. To mitigate these effects, improvements in the meteorological data is imperative. This calls for mitigation of green house gas emissions and adaptation to the adverse effects of climate change.

Reducing the impact of climate change on development however, will require concerted action on six fronts: investing in a stronger climate and poverty evidence base; articulating national adaptation needs, supporting nationally derived, integrated policies and programs; including the climate vulnerable poor in development strategies, and identifying how mitigation strategies can also reduce poverty and enable adaptation. The National Development Plan (NDP) therefore focuses on developing national capacity for coordination and implementation of climate change mitigation and adaptation activities through the formulation and implementation of a national policy on climate change, strengthening of the Climate Change Unit and re-orientation of the national development path to a low carbon economy (GOU 2010).

State of Atmospheric Resources

As indicated in NEMA (2008), the atmosphere provides vital but often poorly recognised life supporting resources that affect development opportunities, livelihoods, and human health. These include climate systems which form the basis for health, agriculture and energy.

The climate components of fresh air, rain, sun, wind and the ozone layer are all significant components supporting human wellbeing.

Overview of Uganda's Climate

According to EA et al (2007), the overall climate situation in Uganda is broadly sub-divided into three categories including the highland climate category which has cool temperatures and moderate rainfall (mean annual rainfall of over 900mm). This climate category mostly obtains in the Rwenzori mountains. The mountains have a permanent ice cap and experience temperatures below 0oC. The second climate category is the savannah tropical climate covering the Lake Victoria basin. This climate category has moderate temperatures averaging about 28oC with a high mean annual rainfall of over 1,200mm. The third category is the semi-arid climate category which has relatively high average temperatures ranging between 33.3 to 35.6oC. This climate category receives relatively low rainfall with mean annual rainfall ranging between 887mm in Moroto and 905mm in Mbarara.

Mean annual rainfall

Mean annual rainfall data is usually updated over long periods of time. The old mean annual rainfall map for Uganda was made in the early sixties using data up to 1965. The current map has been derived based on data for over 200 stations for the period 1943 to 1982. Figure 3.1 displays regions of relatively low rainfall (400 to 1000mm) and high rainfall (1400mm and above). There are two elongated areas of low rainfall. The cattle corridor axis (from the Karamoja region in the northeast, down to the Ankole region in the southwest) is the main low rainfall area. The other is along the western rift valley running through Lake Albert. The central and western parts of the Lake Victoria basin and over Mountain Elgon are the main areas of relatively high rainfall. The average long-term annual rainfall for Uganda is 1,318mm, which is adequate to support agricultural activities (EA et al 2007).

Uganda's climate is bimodal with two rainy seasons: March to June; and October/November to December/January. Generally, these two seasons have been relatively stable and predictable. The overall trends nonetheless show variation in the rainy seasons. The onset of rains is increasingly unreliable and the distribution more uneven. The rains are erratic, heavy and violent with considerably more thunder storms. Several cases of thunder strikes have been reported particularly in Hoima, Masindi, Kiryandongo, Aleptong and Luwero.

The western, northern and north-eastern districts experienced long droughts in the last part of 2010. The eastern region including Pallisa, Kumi, Soroti, Tororo, Busia and Bugiri however, received moderate rain. Figure 3.2a-c shows the cumulative monthly rainfall for selected stations in 2009 (DOM 2010).

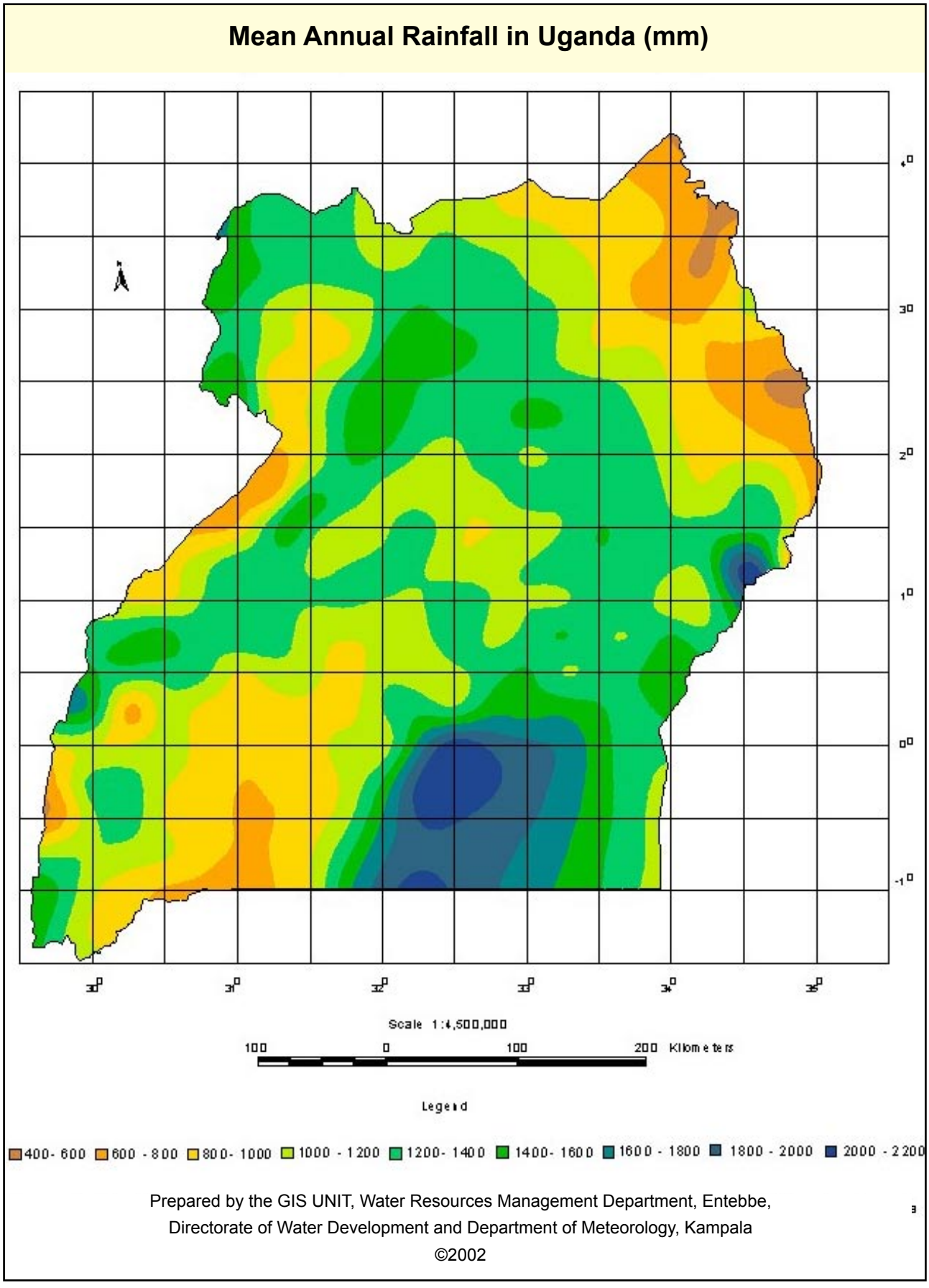

Figure 3.1: Mean Annual Rainfall in Uganda (mm)

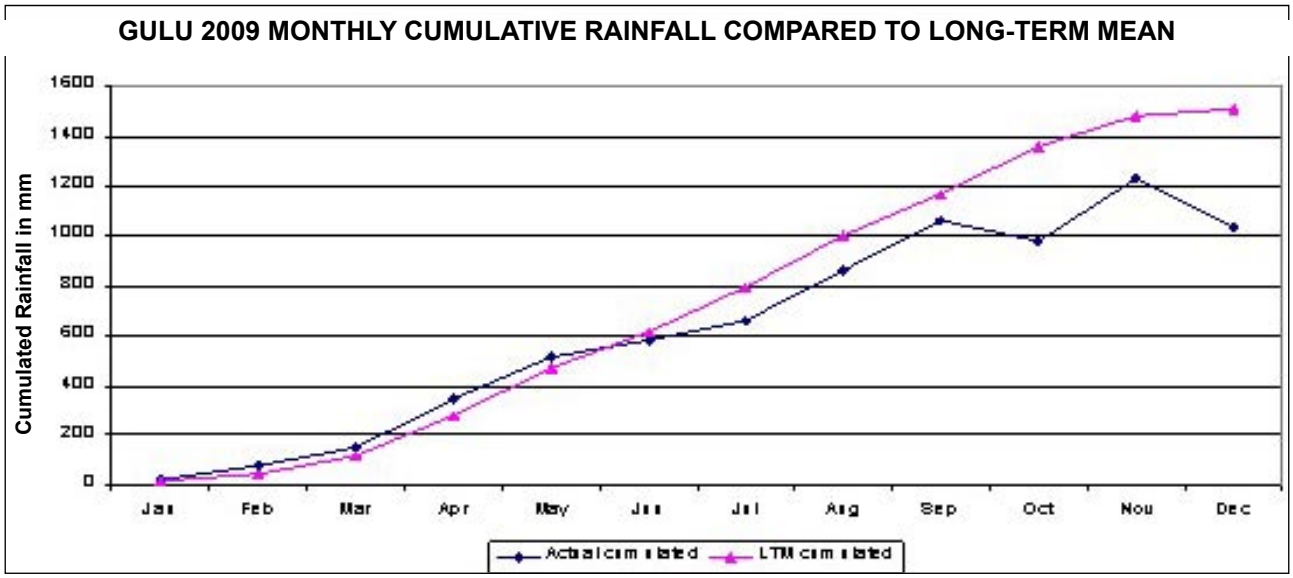

Figure 3.1a: Gulu 2009 Monthly Cumulative Rainfall compared to Long-Term Mean

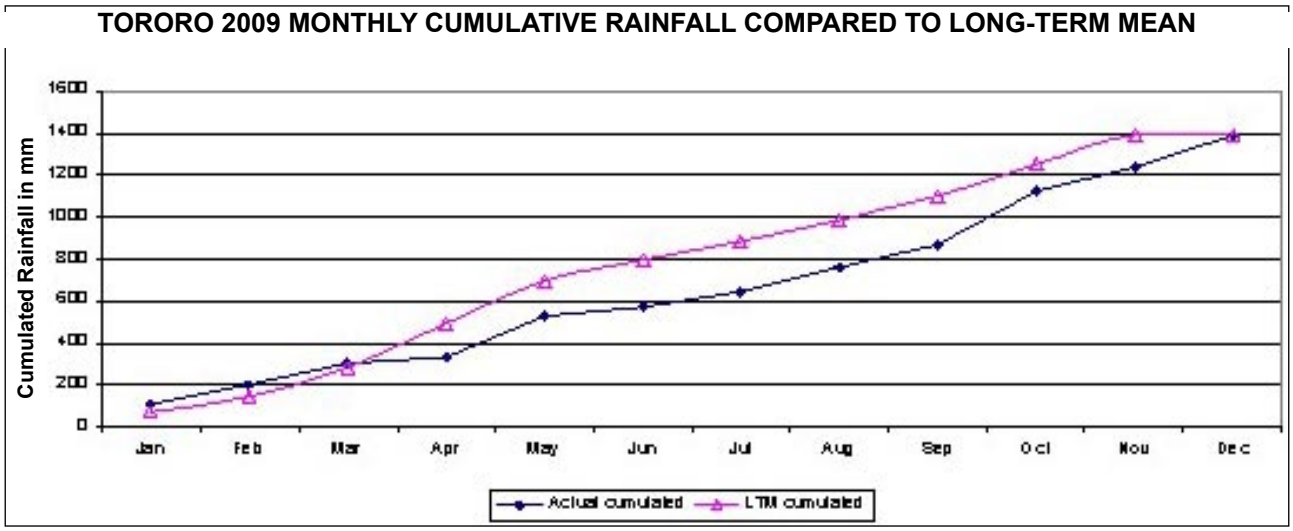

Figure 3.1b: Tororo 2009 Monthly Cumulative Rainfall compared to Long-Term Mean

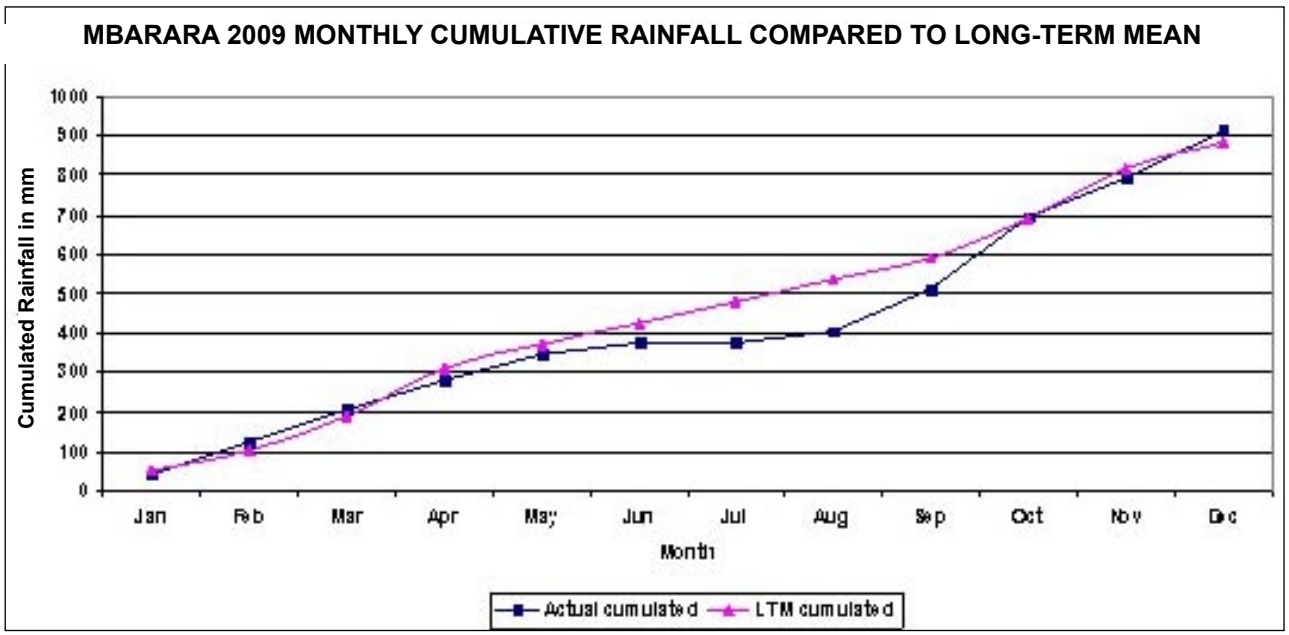

Fig 3.1c: Mbarara 2009 Monthly Cumulative Rainfall compared to Long-Term Mean

Source: DOM 2010

Rainfall (evaporation)

Data from DOM (2010) indicates there are wide spatial and seasonal variations in the 3-monthly seasonal rainfall (evaporation) data, which is broadly in line with the degree of spatial and seasonal wetness of the country (figure 3.3). The December-February season which is the driest season particularly over the northern and most parts of the central regions indicates very high rainfall deficits especially over the northern region. The March-May season, the main rainy season indicates net rainfall amounts extending from the central areas to the south-eastern areas of the country. The June-August season indicates net rainfall amounts especially over the Lake Kyoga basin and the north-western areas of the country. Rainfall deficits are rather high over the central and Southern parts of the country. Finally the September-December season indicates net rainfall amounts centred over the high grounds of the central parts of the western region. During this season the north-eastern region exhibits considerably high rainfall deficits.

Rainfall (evaporation) for the seasons December-February and March-May

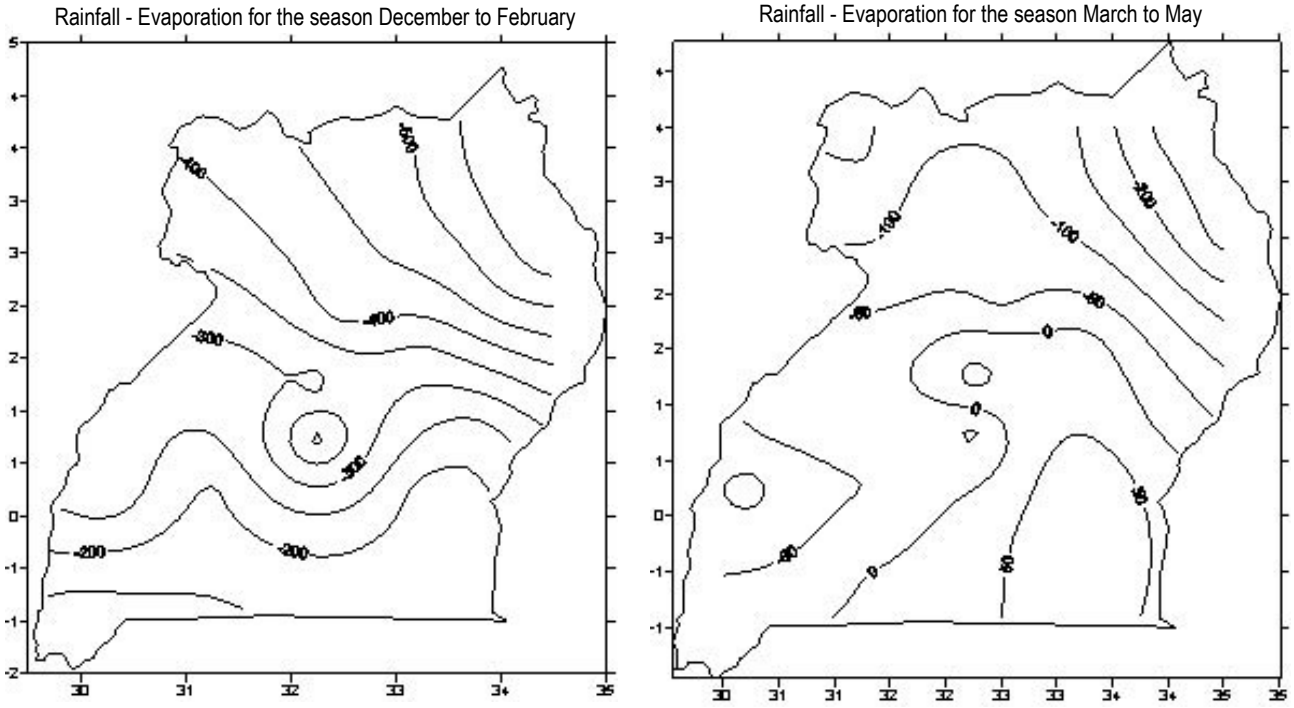

Fig. 3.3: Rainfall (evaporation) for the seasons December-February and March-May
Source: DOM 2010

Seasonal rainfall probabilities

Data for 3-monthly seasonal rainfall probabilities for normal, below and above normal categories is shown in the maps in figure 3.4. The normal range of rainfall is taken to be between 75-125 percent of the long term (preferably 30 years) mean rainfall. Below normal rainfall refers to rainfall below 75 percent while above normal rainfall is that above 125 percent.

March to May is the main stable rainy season over most parts of the country. The likelihood of receiving normal rainfall is generally over 80 percent except over the extreme north-eastern areas where the probability drops below 70 percent. The probability of below normal rainfall is low, around 10 percent over most parts of the country except over the extreme north-eastern areas where it goes up 20 percent. The probability of above normal rainfall is about 10 percent, over most areas of the country.

October-December is the most variable season of the rainy seasons in the year. The probability of getting the normal range of rainfall is between 70-80 percent over the western areas where the main rainy belt for this season is centred but drops to around 50 percent over most areas of the eastern region and extending into the central parts of the country. The probability of below normal rainfall is over 20 percent over most parts of the eastern region and to above 40 percent over the north-eastern areas. The probability of above normal rainfall is also fairly high (over 20 percent) over most parts of the eastern areas.

The variability of the October-December rainy season is most pronounced over the north-eastern areas of the country in particular but significant variability covers most parts of the eastern region and also extends to wide parts of the central region in general. The high variability of rainfall during this season translates into high incidences of droughts and floods especially over the eastern areas of the country and over the North-eastern in particular during this period. Quite often the droughts lead to famine conditions due to the wide scale crop failure and or poor performance.

The Threat of Climate Change

Climate change refers to a change in the state of climate that can be identified by changes in the mean and/or the variability of its properties. It persists for an extended period, typically decades or longer. Climate variability on the other hand, refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes among others) of the climate on all spatial and temporal scales beyond that of individual weather events. It may be due to natural internal processes within the climate system, or variations in natural or anthropogenic external forcings.

The level to which an economy, people and livelihoods will be negatively affected by the extreme weather events associated with climate change/climate variability relates to the levels of vulnerability of the economic, social or livelihood system. Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change/climate variability. It is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity. Vulnerability is thus the relationship between the degree of climate stress on population (exposure), the degree of responsiveness to stress (sensitivity) and the ability of the population to adjust to climate changes (adaptive capacity). Chapter 8 discusses the issue of vulnerability further.

All populations are vulnerable to the changing climate, but the health risks vary depending on where and how people live and how resilient they are to the impacts. Many of the major diseases that are most sensitive to climate change – diarrhoea, vector-borne diseases like malaria, and infections associated with under-nutrition are preventable. In fact MOH (2010) indicates that 75 percent of Uganda's disease burden is considered preventable as it is caused by poor hygiene and sanitation – issues that are exacerbated by the impacts of climate change/climate variability such as floods, droughts, storms and landslides.

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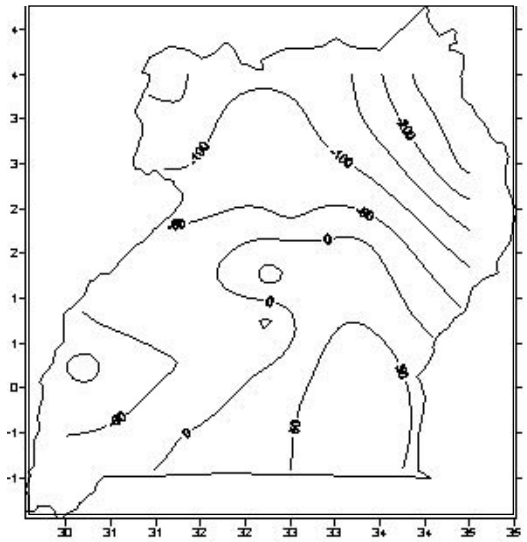
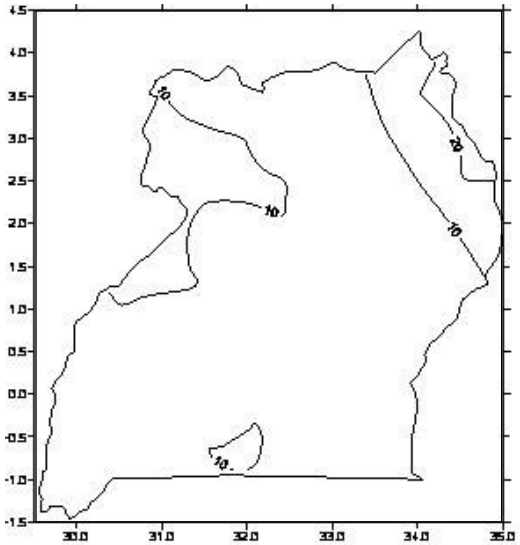
Figure 3.4: Probability of normal, below and above normal categories for March to May (above) & September to November seasons (below)

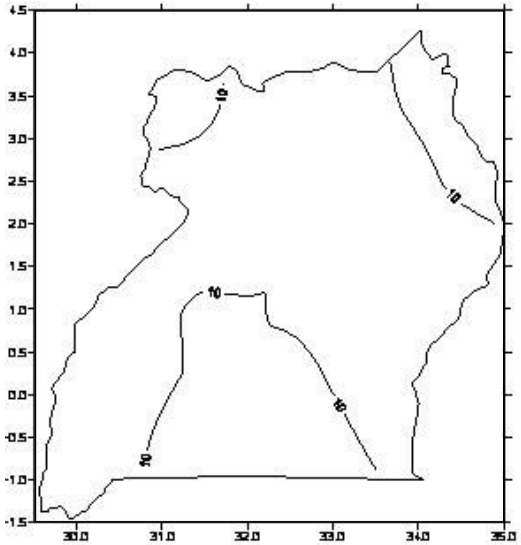
Probability of normal rainfall



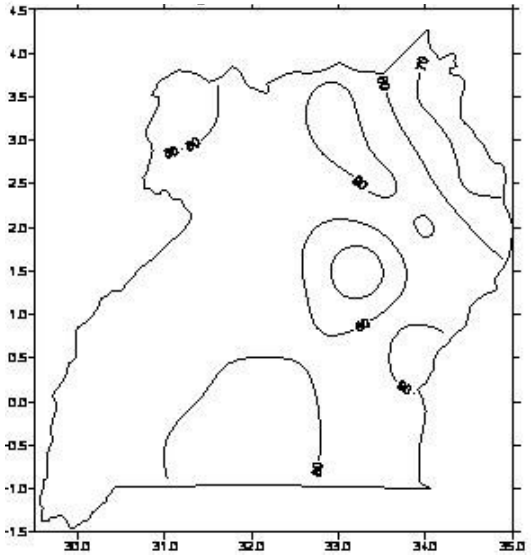
Probability of below normal rainfall



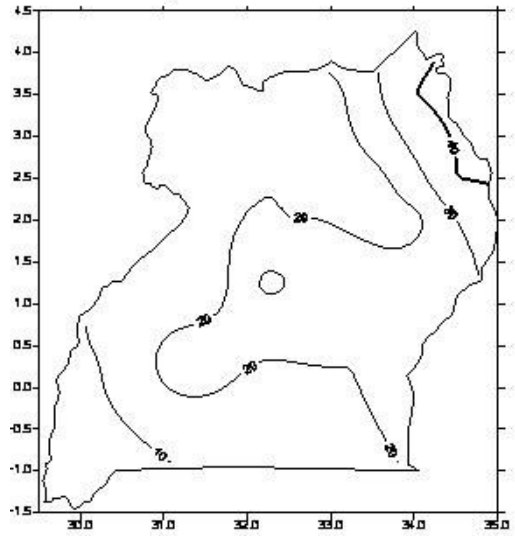
Probability of above normal rainfall



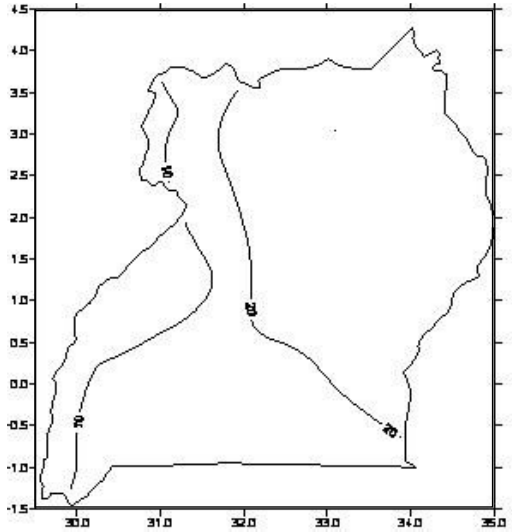
Probability of normal rainfall



Probability of below normal rainfall



Probability of above normal rainfall



Landslide leave a lot of damage in their wake.
Photo credit: NEMA

Evidence of Climate Change/Climate Variability

The most salient evidence of climate change at the global level includes persistent weather variations, global warming and rising sea levels. These phenomena provide the most concrete evidence of climate change at the global level. There is also a growing body of scientific experimental information confirming that the world persistently and consistently warmed over the last three decades. The effect of global warming can be easily seen in the effects of weather related disasters such as hurricanes and in sea level rise as a result of the melting of snow, glaciers and icecaps. The data indicates that since 1993, sea levels have risen at an average rate of 3.1 mm per year (IPCC 2007).

There is some evidence of climate change in Uganda as shown in box 3.1. On the whole, however, climate change in Uganda is rather difficult to analyze due to inadequate in-country research. For this reason, this chapter will assess climate variability and its effects. In Uganda, the major extreme weather events associated with climate change/climate variability include erratic rainfall, particularly in the March-June season which is increasingly associated with drought and low agricultural performance; and intense and destructive rainfall downpours in the September-November season which bring floods, landslides and soil erosion.

The above mentioned climate shocks undermine health and wellbeing, the economy and the overall development of the country. Food insecurity in Uganda is a major challenge and climate shocks are making food insecurity worse. Impacts are greatest on the lives of ordinary people, especially women, frustrating their efforts to overcome poverty. The impacts are also in relation to a small global temperature rise of less than 1oC rise above pre-industrial levels. As temperatures rise further, risks will be magnified (Oxfam 2008).

Box 3.1: Key indicators of climate change

Temperature

- Mean annual temperature has increased by 1.3°C since 1960, an average rate of 0.28°C per decade.
- The mean annual temperature is projected to increase by 1.0 to 3.1°C by the 2060s, and 1.4 to 4.9°C by the 2090s.

Precipitation

- Annual rainfall has decreased at an average rate of 3.4mm per month (3.5%) per decade, but this trend is strongly influenced by particularly high rainfall totals in 1960□61. MAM (March-April-May) rainfalls have decreased by 6.0mm per month per decade (4.7%).
- Projections of mean rainfall are broadly consistent in indicating increases in annual rainfall of 7-11mm by 2060; and of 13-14mm per decade by 2090.
- The models consistently project overall increases in the proportion of rainfall that falls in heavy events. The increases range from 0 to 15% in annual rainfall by the 2090s and affect the whole country throughout the year.

Source: McSweeney et al (2010).

Ice caps on one of the peaks of the Rwenzori Mountains.

Photo credit: UWA

Air Quality

Poor air quality is becoming an emerging issue in Uganda. However with no systematic study in place to indicate the exact nature and extent of the problem it is difficult to quantify. There are two main issues that contribute to poor air quality these include indoor air pollution and outdoor air pollution.

Indoor air pollution

More than 98 percent of households in Uganda rely on biomass energy for cooking and lighting. Some use poor quality fuel wood which generate hazardous pollutants, including suspended particulate matter, carbon monoxide, nitrogen dioxide, and other harmful gases. These are associated with considerable implications for the health of persons especially women and children. Lower and upper respiratory tract infections account for more than 37.4 percent of the national disease burden (Mbonye 2004). Air pollution is also associated with respiratory and eye diseases such as asthma, lung cancer and conjunctivitis, especially in the young and elderly (UNEP/WHO 1992, Patel 1994).

Exposure is determined by the choice of cooking fuel, where cooking takes place and is affected by common ventilation practices. There have been efforts at addressing some of these issues in Uganda through the introduction of improved cooking technologies. These technologies improve the ventilation situation and have knock on benefits for health burden, time saved spent on cooking, forest conservation and soil degradation. An example is the Rocket Lorena cook stove that is estimated to reduce the smoke in the kitchen, resulting in better health conditions for the family members resulting in savings of about US $7 million (U.Sh 1,760 million) in 2006 (Habermehl 2007). This is shown in Table 3.1.

Table 3.1: Economic benefits of using the Rocket Lorena cook stove in 2006
Source: Habermehl (2007)

Outdoor air pollution

Outdoor air pollution is rising especially in urban areas. Kampala City and other small urban centres in Uganda face growing air pollution problems due to rapidly increasing vehicle usage, congestion, dirty fuels, low technical standards, and a lack of inspection and maintenance. The intake of airborne particulates and other pollutants emitted by industry and vehicles contributes to health issues. There are also the residual effects of using leaded fuels. These include the possible consumption by heavy metals; and the health impacts of lead.

The exposure to these impacts is increased by the wider environmental impacts such as contamination of harvested rain water and other water bodies; contamination of roadside agricultural products from the residual lead from the legacy of leaded fuels; and the effects on climate.

Many other pollutants other than smoke are released into the atmosphere from both natural sources and human activities. The chemicals that are directly released from those sources are called 'primary pollutants'. Some of the primary pollutants go through chemical reactions in the atmosphere and form 'secondary pollutants'. The primary pollutants of greatest concern in Uganda include sulphur dioxide, nitrogen oxides, volatile organic compounds, Persistent Organic Compounds (POPS) and particulate matter. Secondary pollutants formed from these include smog, ground level ozone and peroxyacetyl nitrate. The major effects of secondary pollutants include poor visibility, soil and soil water acidification and soils and streams, and acid rain (US/EPA 1996).

What is leading to increased air pollution?

The driving force for increased indoor pollution is poor connectivity to the electricity grid and the ever-increasing cost of power. Recent short falls in the hydro-power generation have also required that diesel and heavy fuel generators supplement power supply. These installations supplied 30.5 percent of the total power to the national grid in 2009, increasing to 31.5 percent in 2010 (UBOS 2010, UBOS 2011). While this has had the positive effect of stabilizing supply, the use of diesel and heavy fuel oil in electricity generation can have a significant impact on the environment in terms of emissions. Electricity generation using thermal power implies an annual consumption of about 208,000 metric tonnes of heavy fuel oil (ERA 2008). The environmental implications are increased emissions from the generators and also from the increased number of road tankers that are required to transport the heavy fuel. In terms of transport logistics it implies more congestion on the roads, additional diesel required to fuel the road tankers and noise.

The national inventory of POPs in Uganda identified continued emission of dioxins and furans particularly from scrap metal processing factories. The factories process scrap metal at high temperatures which releases the above mentioned POPs. The review indicated that the pollutants are associated with contaminated scrap metal which is not cleaned prior to processing (NEMA 2008).

There are no air quality standards to control emissions from vehicles and factories which are increasing in number and worsening pollution. The draft air quality standards and regulations have never been gazetted. Whereas a law on the control of smoking in public places was enacted in 2008, the law is not enforced and nicotine pollution and the attendant health implications continue to afflict Ugandans. Indeed the Health Sector Support Programme III (2010/11-2014/15) proposes to tighten enforcement of protective legislation including pollution control, restricted smoking and fiscal policy for tobacco, among others. It is also proposed to promote the development and enforcement of byelaws by district local governments.

Opportunities Provided By Atmospheric Resources

Climate change/climate variability comes with a number of opportunities for adaptation and positive change particularly in the agriculture, water supply, energy, trade and commerce sectors. Climate change/climate variability also presents opportunities for the development of science and technology through targeted research and development programmes.

The Clean Development Mechanism

The Clean Development Mechanism (CDM) was established by the Kyoto Protocol with the double objective of assisting developing countries in achieving sustainable development, and assisting industrialised countries to meet emissions reduction commitments. Under CDM, projects that reduce green house gas emissions and contribute to sustainable development can generate Certified Emission Reductions (CERs), a tradable commodity in international carbon markets. The overall value of the emissions trading markets in 2007 was US$64 billion. Uganda has been slow to reap the benefits of CDM owing to lack of capacity to develop projects, limited number of attractive large scale projects, as well as to a generally poor investments climate. At the 12th Conference of Parties to the UNFCCC in Nairobi in 2006, a decision was made to support the equitable distribution of CDM projects in Africa under the Nairobi Framework. This has in part led to more action in the sector including the proposal of several projects under the mini hydro, co-generation, waste composting and afforestation sub-sectors. Specific donor support for CDM in Uganda is ongoing or in the pipeline from Austria, Sweden, Norway and Belgium. A National Climate Change Unit has also been established in the Ministry of Water and Environment with Danish support.

Voluntary Carbon Markets

Besides CDM, voluntary carbon markets are relevant to Uganda. This is especially true for land use, land use change and forestry (LULUCF) projects where voluntary carbon market methodologies are less demanding. The volumes of business transacted in the voluntary markets tripled between 2007 and 2009 with the total values of voluntary carbon markets in 2009 at US$350 million.

Uganda has a track record in this sector having previously participated in voluntary carbon activities through the FACE Foundation (Forests for Absorbing Carbon Emissions) and Plan Vivo schemes. Views on the value and potential contribution of these activities in Uganda, however, remains split with some people acknowledging enormous potential for the sector to contribute to sustainable development while others doubt benefits and complain that the prices are far too low. There are however four key barriers to progress in this sub-sector including lack of start up capital, low levels of indigenous technical capacity and experience, bureaucratic processes and high transaction costs.

Biofuels

Biofuels are defined as combustible fuels produced from biomass. There is a lot of interest around biofuels because of concerns about climate change and a possible reduction in the availability of traditional oil. It is believed that bio-fuels can be used as gasoline and in this way it can be a way of enhancing energy security. The emerging issue of biofuels is envisaged to bring many benefits for Uganda by providing access to clean energy services while providing alternative livelihoods (NEMA 2010).

However, the biofuels debate is a contentious issue. According to NEMA (2010), some of the issues include:

- Promotion of the biofuels industry is likely to encourage environmental degradation by increasing pressure on the gazetted areas and wetlands (for land to grow biofuels feedstock) with consequent potential loss of biodiversity.
- The potential competition for resources (arable land) between biofuels feedstocks and food crops is likely to have negative impacts on food security.

In fact already small scale sugarcane (a potential biofuel feedstock) production has been linked to decreased farm household food security, and encroachment on forest and wetlands in Uganda (Isabirye 2005).

- The potential for even more emissions of GHGs. Global models indicate that emissions from land-use change actually increase greenhouse emissions in the longterm. For example biofuels from switch grass, if grown on USA corn lands is estimated to increase emissions by 50 percent (Searchinger et al 2008 in NEMA 2010).
- Biofuel programmes have the potential to become unviable when world petroleum prices fall. As such there is a likelihood of accompanying loss of livelihoods. An alternative plan would thus be required to protect farmers and industrialists against such unfavorable economic changes.

There are very few start-up plantations of biofuels in Uganda although investments in the sector have been licensed by the national investment agency. There is however, a lot of discussion on the intended end use of the outputs from the new large sugar cane, oil palm and sun flower farms in the country.

There is no policy specifically on biofuels. However, their use is implied in the energy policy that advocates for increased research and use of modern renewable energy sources which it expects to increase from the current four per cent to 61 per cent of the total energy consumption by 2017. If this target is to be achieved, the country will need to develop a policy and technical guidance on biofuels as well as further research to support the biofuels industry as a priority. Controlling the potentially negative impacts of investment in biofuels will require robust environmental regulation by NEMA and its partners at local government level. Improved rigour in the review and approval process for Environment Impact Assessments (EIAs) and the monitoring and enforcement of EIA approval conditions are also a priority.

Uganda can learn from experience in other countries such as Brazil, France, Spain, United Kingdom, USA, Sudan and other countries in Southern Africa (NEMA 2010) to guide research on biofuels. However decision on policy would have to be taken.

Floods make the Butaleja-Mbale Road impassable hindering day-to-day activities and livelihoods.
Photo credit: NEMA.

Favourable Climate for Agriculture and Human Well-being

Climate is not only a natural resource, but a key determinant of the status of other natural resources, such as water resources, biodiversity, forest, fish, ecotourism, wildlife and agriculture. Agriculture is the backbone of Uganda's economy and production and yields in this sector are majorly influenced by climate. Indeed any decline in agricultural production can in part be attributed to climatic changes. For instance the decline in agricultural production at the turn of the millennium is partly explained by the 1999/2000 drought. Performance of the agricultural sector is thus a major determinant of changes in poverty levels, food security, foreign exchange earnings and employment and thus human welfare from year to year.

The fact that climate resources can be harnessed means that Uganda has the potential to expand participation in agricultural markets and ensure food security for citizens and the region. Given its rainfall patterns, Uganda can support a significant portion of cross-border trade in food staples with her neighbours. Earlier rains, for example, enable Ugandan maize farmers to produce a maize crop earlier than farmers in Kenya enabling export at seasonal peaks (IGAD 2007). Sourcing of food from districts with surpluses holds the potential to reduce the country's heavy dependence on external food aid, especially for parts of the country that are almost perpetually dependent on food aid. A typical example is in the arid areas of Karamoja where the World Food Programme (WFP) supplies virtually all the food (EA et al 2007).

Challenges Presented by Climate Change/Climate Variability

Impact of Climate Change/Climate Variability on the National Economy

The main threat to achieving the opportunities presented by the atmospheric resources in Uganda is the variability in climate. Large-scale atmospheric events, such as El Niño and La Niña, have been identified as the principal causes of climate-related disasters (WWAP 2006). These climate events result in droughts, floods, landslides, wind storms and hailstorms and contribute to well over 70 per cent of natural disasters in Uganda (WWAP 2006).

Uganda is highly vulnerable to climate variability. The economy and the well-being of its people are tightly bound to climate. Human induced climate change/climate variability in the coming century has the potential to halt or reverse the country's development trajectory. In particular, climate change/climate variability is likely to mean increased food insecurity; shifts in the spread of diseases like malaria: soil erosion and land degradation; flood damage to infrastructure and settlements and shifts in the productivity of agriculture and natural resources. It will be the poor and vulnerable who will feel these impacts the hardest, though climate change/climate variability has serious implications for the nation's economy (LTS International 2008).

Food security and nutritional status are key determinants of the health and wellbeing of the population. Malnutrition makes the population vulnerable to infections and other diseases and contributes to 60 percent of under-five deaths (MOH 2010). According to MOH (2010), over the past 5 years, nutrition interventions have led to a reduction in underweight and stunting from 23 to 16 percent and from 41 to 39 percent, respectively. Despite these advances, 62.1 percent of the population still falls below the recommended daily calorific intake of 2,200 kcal (UBOS 2010). This could be due in part to population growth during this period and to increased incidence of climate related disasters that continue to disrupt food production and incomes. Analysis of records from the World Food Programme reveals that climate-related nutritional insufficiency and burden among Ugandans is on the increase, especially in areas such as Karamoja region (UNDP/NEMA/UNEP 2009). Box 3.3 highlights some of the climate determinants of health and well-being.

The impacts of climate variability are multi-faceted and the inter-linkages can be felt in the various sectors of health, agriculture, human settlements and energy. Shortcomings in one sector make the situation even worse in other sectors. For instance flooding in the eastern part of the country has led to ill health, crop failure, poor roads, housing and life. In other urban areas like Kampala, heavy rain, coupled with poor settlements planning, has resulted in severe floods. Climate change/climate variability by exacerbating poverty and triggering migration as well as heightened competition over strategic water resources, could lead to insecurity.

Box 3.3: Climate determinants of human health and well-being

Air: Air quality is a growing issue in Uganda. Indoor and outdoor air pollution can affect people – directly through breathing polluted air; and indirectly by damaging the environment in which they live. Some of the health effects include diseases related to breathing unhealthy air such as allergies, eye and upper respiratory tract diseases; the possible consumption of heavy metals; and the health impacts of lead. The exposure to these impacts is increased by the effects of polluted area on the environment such as contamination of harvested rain water and other water bodies; contamination of roadside agricultural products from the residual lead from the legacy of leaded fuels; and the effects on climate.

Water: Changing rainfall patterns and increased rates of evaporation, combined with population and economic growth, are expected to increase the number of people living in water-stressed conditions. Over 75 percent of Uganda's disease burden is considered preventable as it is caused by poor hygiene and sanitation attributable to lack of access to safe water, sanitation (MOH 2010). Reductions in the availability and reliability of freshwater supplies are expected to amplify this hazard.

Shelter: The increasing frequency and intensity of rainfall storms, lighting strikes and related impacts is likely to increase the number of people exposed to floods and droughts. Repeated floods and droughts may force population displacement which is also related to a range of health effects from mental disorders such as depression to communicable diseases related to poor environmental conditions. 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. Other infrastructure such as bridges roads and buildings can also be destroyed limiting access to markets, health centres and other amenities.

Freedom from disease: Rising temperatures, shifting rainfall patterns and increasing humidity affect the transmission of diseases by vectors and through water and food. The increase in temperatures has an influence on the geographical range of diseases such as malaria and diarrhoeal related illnesses. According to UBOS (2011) malaria remained the leading cause of morbidity between 2006 and 2010 (with a morbidity rate of 48.2 percent). 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 (UNDP/NEMA/UNEP 2009).

Losses from Reduced Lake Levels and River Flows

Recent changes in lake and river water levels have been thought to affect the availability of water for hydro-electric power production. The changes also have negative impacts on the production of fish. The Owen Falls Dam in particular has operated at partial capacity since it was opened in 2000. The dam was designed to operate with the conditions of high average lake levels as seen between 1960 and 1990.

According to NEMA ((2009), extreme droughts have had significant negative effects on water resources, hydropower production, agriculture and the overall economy. The El Niño and La Niña phenomena are thought to have been the principal causes. 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. With the fall in water levels in Lake Victoria, the water available was not adequate to generate power at full capacity.

The combination of increasing demand for electricity and the possibility of lower lake levels in the future due to climate change/climate variability mean that it is extremely important to study climate change scenarios and their impacts on future lake levels and to consider them in the design of all new hydro-power facilities and electricity supply plans (Anderson 2011).

Increased extreme events and trends in lake temperature and levels associated with climate change/climate variability will also have impacts on domestic water supply intakes, water availability for lakeside irrigation, transportation and infrastructure. For example, temperature increases and increased pollution of lake water may increase the abundance of dangerous toxin releasing bacteria that occur where there are blue-green algae in the water. This will present a threat to domestic water supply as well as the ecology of the lake and its fishery. These bacteria have already been detected in some bays of Lake Victoria (LTS International 2008).

Algae bloom along the shores of Lake Victoria.
Photo credit: Fisheries Department.

Prospects For Alleviating The Challenges Facing Atmospheric Resources

The National Adaptation Plan of Action (NAPA)

Responses to climate change and climate variability in the framework of the National Adaptation Plan of Action (NAPA) fall in two categories. The first category is climate change mitigation, mostly focusing on reducing the emission of gases and elements that contribute to global warming. The second is adaptation which focuses on helping people make adjustments in response to changes in the climate system or resultant effects, which may impact livelihood opportunities or the economy.

A Climate Change Unit has been established within the Ministry of Water and Environment to coordinate all matter related to climate change in Uganda. The Unit will also act National Focal Point and Designated National Authority for CDM projects. For instance, NEMA together with the Department of Meteorology is supporting better management of municipal solid waste as a sub-project activity in Uganda working with 9 municipalities/towns (Mukono, Jinja, Soroti, Mbale, Lira, Fort Portal, Kasese, Kabale and Mbarara), composting plants for the solid waste generated in these towns are being set up. It is based on the premise that by composting the solid waste into manure, it will be possible to control green house gases like methane emissions and thereby be able to participate, through emission reductions (carbon) trading, in the Clean Development Mechanism of the Kyoto Protocol. This initiative is based on the grounds that landfill sites, with wastes undergoing a methanogenic stage of bio-decomposition, produce large volumes of landfill gas whose effects contribute to global warming.

The NAPA also addresses issues to do with climate-related human health and wellbeing. Uganda, as is the case with other countries, is experiencing important changes in disease patterns. For example, non-communicable diseases are an emerging problem and their increase is due to multiple factors including changes in the climate. Better systems for weather forecasting, disease surveillance and public health planning offer some protection for the affected populations. Given the current situation, there is a need to emphasize mitigation of adverse effects of climate change and ensuring the implementation of interventions that will control the spread of climate-related diseases.

Strategies to streamline climate change and improve adaptation within the health sector are included in the third National Health Sector Support Plan 2010/11-2014/15. These include:

- Developing guidelines on streamlining climate change in the health sector to improve adaptation to climate change impacts.
- Sensitizing staff at the Ministry of Health and local governments on climate change and adaptation.
- Developing early warning systems and disseminate weather forecasts to health managers to improve preparedness and response.
- Coordinating climate change response interventions in health sector and collaborate with relevant line ministries and agencies.

Updating the Air Quality Standards

Uganda has no gazetted air quality standards or regulations, though the state of air quality continues to attract attention. Draft air quality standards and regulations are however, available, but need review to address new issues associated with the upcoming oil and gas developments in the Albertine Graben.

The standards and regulations are therefore under review and should be available for public use by 2012. There are however, useful standards and guidelines in the occupational health and safety and public health sub-sectors which are currently applied to regulate ambient and outdoor emissions.

Conclusion and Recommendations

This chapter highlights the major climate resources of Uganda. The chapter notes that climate change/climate variability is real and will have negative impacts on all countries of the world, particularly the poorer ones including Uganda. The chapter further highlights the key challenges posed by climate change/climate variability to the national economy and people's livelihoods. It discusses the impacts in agriculture, water supply, health, transport, housing and personal safety and security.

Various measures to climate proof Uganda's economy are proposed particularly regarding research and forecasting, water storage and disaster risk reduction. The chapter urges all relevant stakeholders to join hands to address the identified capacity needs and develop strategies in support of the UNFCCC. Adaptation to adverse effects of climate change will require weather and climate information. Strengthening of meteorological services is therefore imperative and a priority action area. The challenge here is to develop a comprehensive capacity building framework. This framework must however address the broad development goals and plans for Uganda if it is to be effective.

References

Anderson, S (2011). *Climate Change and Poverty Reduction*. Policy Brief. Climate and Development Knowledge Network. International Institute for Environment and Development (IIED). United Kingdom.

DOM 2008. *Rainfall data*. Department of Meteorology (DOM), Kampala.

EA, GEF and UNEP (2007). *Climate Change. Uganda National Adaptation Programmes Of Action*. Environment Alert (EA), Global Environment Facility (GEF) and United Nations Environment Programme (UNEP), Kampala.

ERA (2008). *Determinants Of Fuel Supply Costs In Uganda*. Electricity Regulatory Authority (ERA), Kampala.

GOU (2010). *National Development Plan 2010/2011-2014/15*. Ministry of Finance Planning and Economic Development, Government of Uganda (GOU), Kampala.

Habermehl, H. (2007). *Economic evaluation of the improved household cooking stove dissemination programme in Uganda. Dissemination of the Rocket Lorena stove in the districts of Bushenyi and Rakai and dissemination of the improved charcoal stove in Kampala in the years 2005 and 2006*. Household Energy Programme, German Agency for Technical Cooperation (GTZ), Kampala.

IGAD (2007). *IGAD Environment Outlook. Our Environment, Our Wealth*. Intergovernmental Authority for Development (IGAD), Djibouti.

Isabirye, M. (2005) *Land evaluation around Lake Victoria: Environmental implications of land use change*. PhD thesis, Departement Landbeheer, Katholieke Universiteit Leuven, Leuven.

LTS International (2008). *Climate Change in Uganda: Understanding the Implications and Appraising the Response*. Scoping Mission for DFID Uganda. Kampala, Uganda.

Mbonye A. K. (2004). *Risk Factors for Diarrhoea and Upper Respiratory Tract Infections Among Children in a Rural Area of Uganda. Journal of Health, Population and Nutrition*. Vol 22 No 1, March 2004.

McSweeney, C., New, I. and Lizcano G. (2010). *UNDP Climate Change Country Profiles. Uganda*. United Nations Development Programme (UNDP).
http://country-profiles.geog.ox.ac.uk

NEMA (2008). *National Implementation Plan of the Stockholm Convention on Persistent Organic Pollutants in Uganda*. National Environment Management Authority (NEMA), Kampala.

.

NEMA (2010). *The potential of biofuels in Uganda. An Assesment of Land Resources for Bio-fuel Feedstock Suitability*. NARL-Kawanda and National Environment Management Authority (NEMA), Kampala.

Orindi A. V., and Eriksen S., (2005). *Mainstreaming Adaptation to Climate Change in the Development Process in Uganda. African Centre for Technology Studies (ACTS)*. Ecopolicy Series No. 15. Nairobi, Kenya.

OXFAM (2008). *Turning Up the Heat: Climate Change and Poverty in Uganda*. Oxfam GB, Oxford, UK.

UBOS (2010). *Statistical Abstract 2010*. Uganda Bureau of Statistics, Statistics House, Colville Street, Kampala, Uganda.

.

UBOS (2011). *Statistical Abstract 2011*. Uganda Bureau of Statistics, Statistics House, Colville Street, Kampala, Uganda.

UNDP/NEMA/UNEP (2009). *Enhancing the Contribution of Weather, Climate and Climate Change to Growth, Employment and Prosperity. Poverty Environment Initiative*. United Nations Development Programme (UNDP)/ National Environment Management Authority (NEMA)/United Nations Environment Programme (UNEP), Kampala

WWAP (2006). *Case Study: Uganda. National Water Development Report: Uganda*. Prepared for the 2nd UN World Water Development Report 'Water, A Shared Responsibility' UN-WATER/WWAP/2006/9. World Water Assessment Programme (WWAP).

A typical catch of the mixture of *Neobola bredoi* (tiny fishes) and *Brycinus nurse* (larger fishes) in the light fishery of Lake Albert.

CHAPTER 4
Freshwater Resources

Introduction

Water plays a key role in the development of people and economies. Investment in water management directly contributes to livelihood security, improved health, poverty alleviation and reduced societal vulnerability.

The quality and quantity of surface and ground water resources of Uganda are threatened by the ever increasing population growth the country is experiencing as well as the natural variability and climate change uncertainties. Surface water levels of some of the major water bodies, such as Lakes Victoria and Kyoga are on the decline. The recently completed ground water resources assessment also indicates a decline in groundwater levels. This has implications for the health and wellbeing of people, livelihoods and the economy.

Trends in Surface Water Resources

According to UBOS (2010), 17.3 percent of the surface area of Uganda is covered by open water and swamps; 15 percent is covered by open water. The country is divided into eight water catchment basins: Albert Nile, Kidepo, Aswa, Lake Kyoga, Victoria Nile, Lake Albert, Lake Edward and Lake Victoria. These vary in size from the catchment discharging into Lake Victoria with an area of 59,858 km^2, to the Kidepo Basin at the extreme north-eastern part of the country with an area of 3,129 km^2 as shown in Figure 4.1 below.

The following section discusses the state and trends of the surface waters in Uganda through three case studies namely: the River Ruizi, Lake Kyoga and Lake Victoria. It includes aspects of their wider catchment areas.

Lake Victoria

Lake Victoria is one of the major lakes in Uganda. The major source of recharge is precipitation with about 82 percent of the lake's water coming from direct precipitation (NEMA 2009). On average, the lake receives rainfall totals of 2,100 mm annually, falling over two main rainy seasons; March to May as the primary season, with September to December as a secondary season, with diminished rainfalls in June to July and January to February. During the primary rainy season, rainfall is greater than or equal to evaporation.

For the last 10 years the lake levels have shown a significant downward trend, as shown in Figure 4.2, with the current level close to the long-term average lake level. The long-term average lake level between 1900 and 2004 was 1,134.4m (amsl). Although the current levels are still within the natural fluctuating band of the lake (Figure 4.3), the rate at which they are receding is of concern. In 2006, the lake had reached an 80-year low (Figure 4.4). As the main source of inflow to Lakes Kyoga and Albert, any variations in the levels of Lake Victoria are also felt downstream.

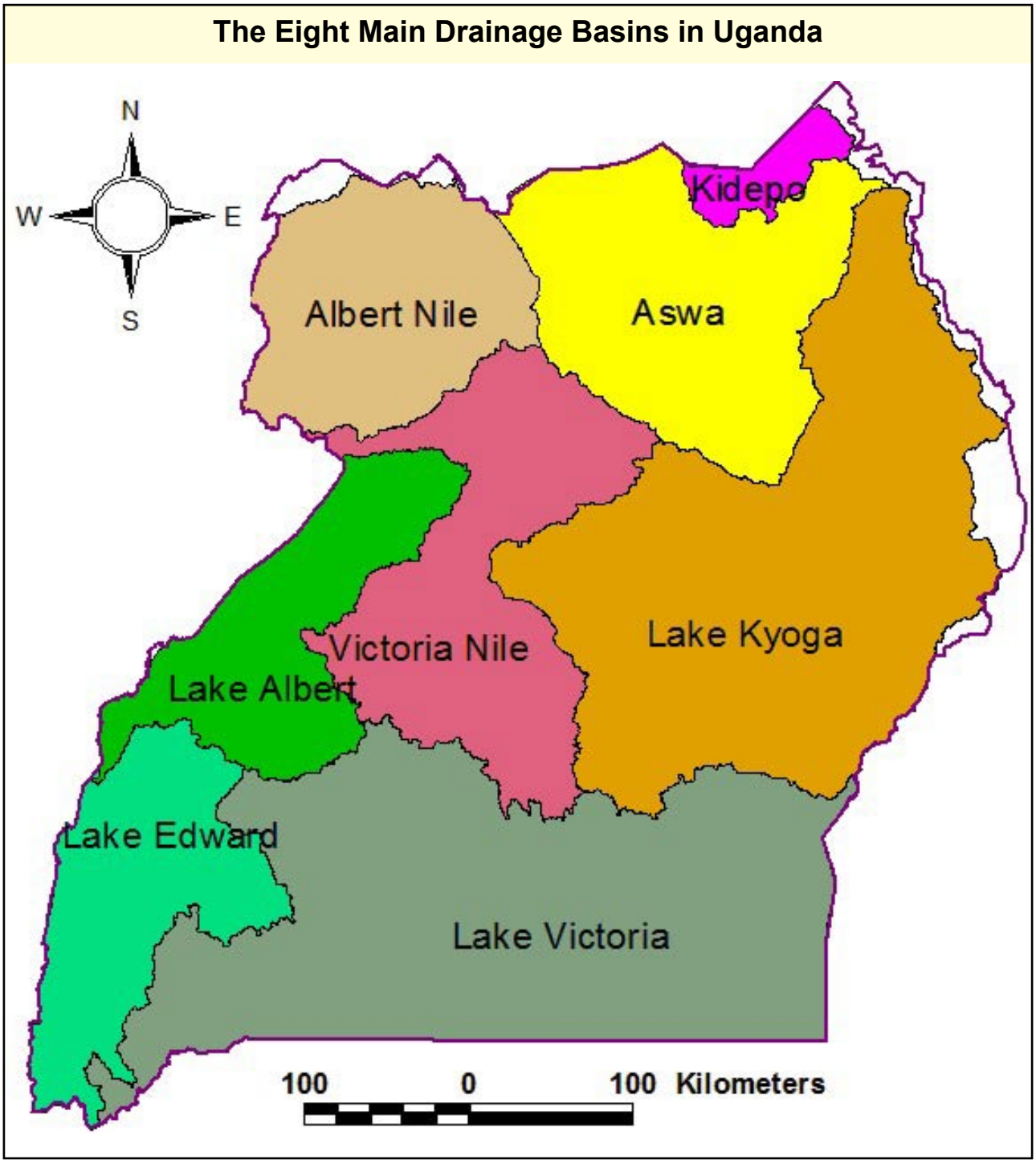


Figure 4.1: The eight main Drainage Basins in Uganda

The Lake Victoria basin provides water, energy, transport and supports many different industries including agriculture, trade, tourism, wildlife and fisheries. In so doing, it supports employment for about 30 million people. More than 80 percent of these are engaged in small-scale agriculture or livestock rearing. About 3 million people are involved directly or indirectly in subsistence and commercial fishing. The lake catchment is thus central to the livelihoods and economies of the region. As a result, the downward trends in the lake levels have been the cause of much public and political concern. The falling lake levels have resulted into reduced capacity for hydropower production which has contributed to increased load shedding in the country. The main power producer has resorted to severe power rationing, with some areas having electricity for less than five hours in a day. This has escalated operational costs for industrialists and may even result in job cuts. The falling lake levels have also impacted other

social economic activities such as docking of lake transport vessels, reduction in the areal extent of some wetlands fringing the lake, reduced fish catch and other activities that depend on the lake water resources.

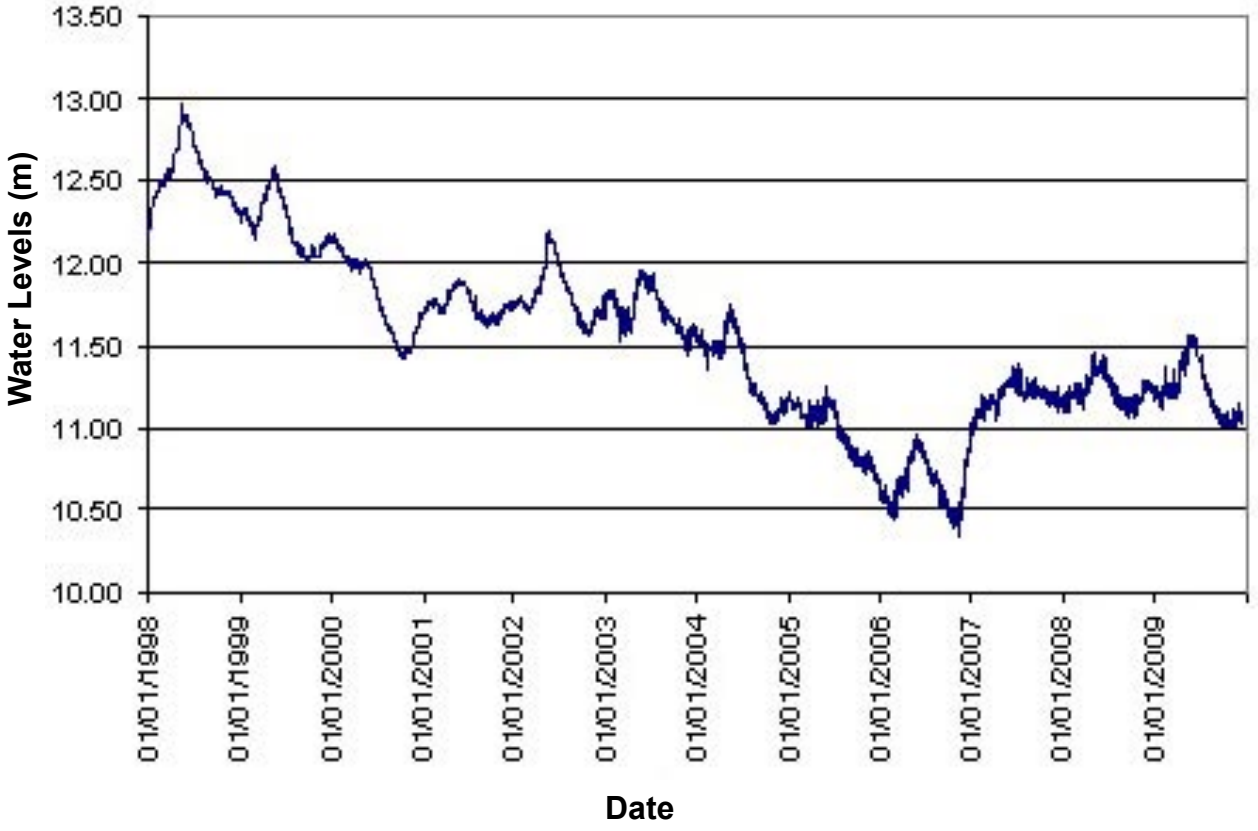


Figure 4.2: Fluctuation of Lake Victoria Water levels for the last 10 years.
Source: DWRM 2011a

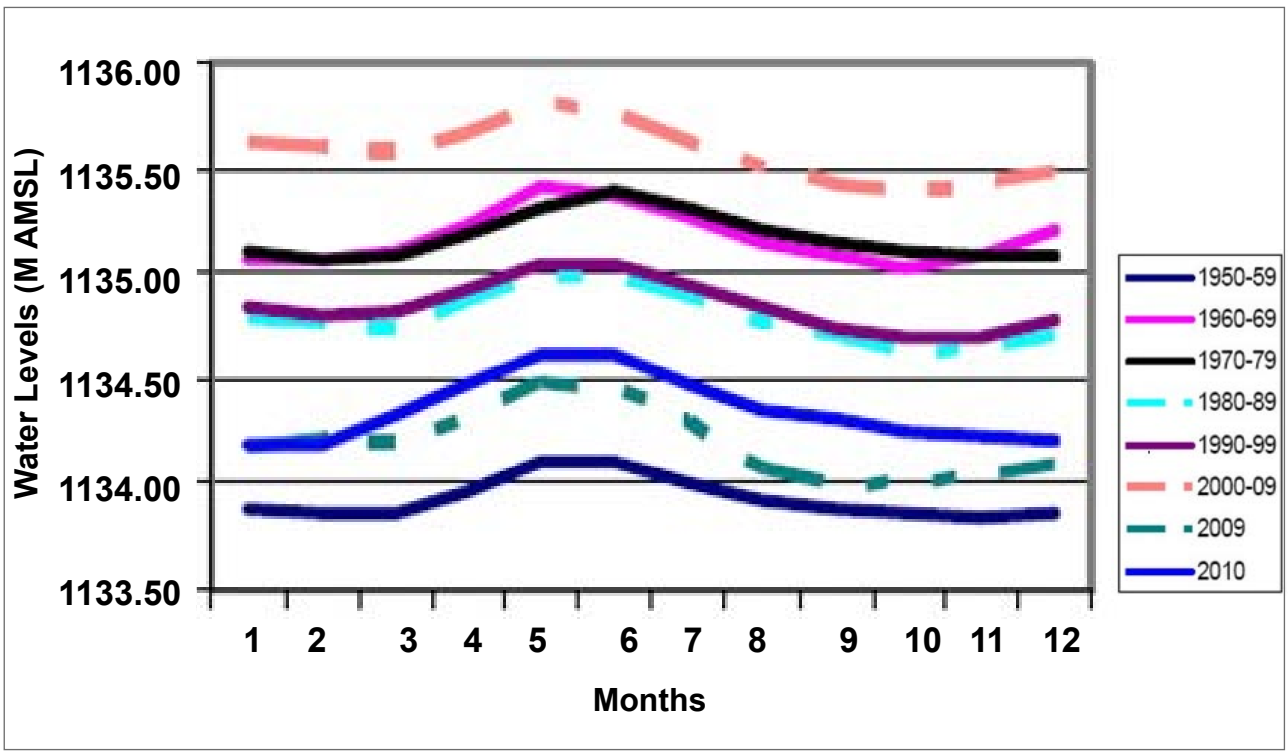


Figure 4.3: Mean monthly levels for Lake Victoria 1950-2010.
Source: DWRM 2011a

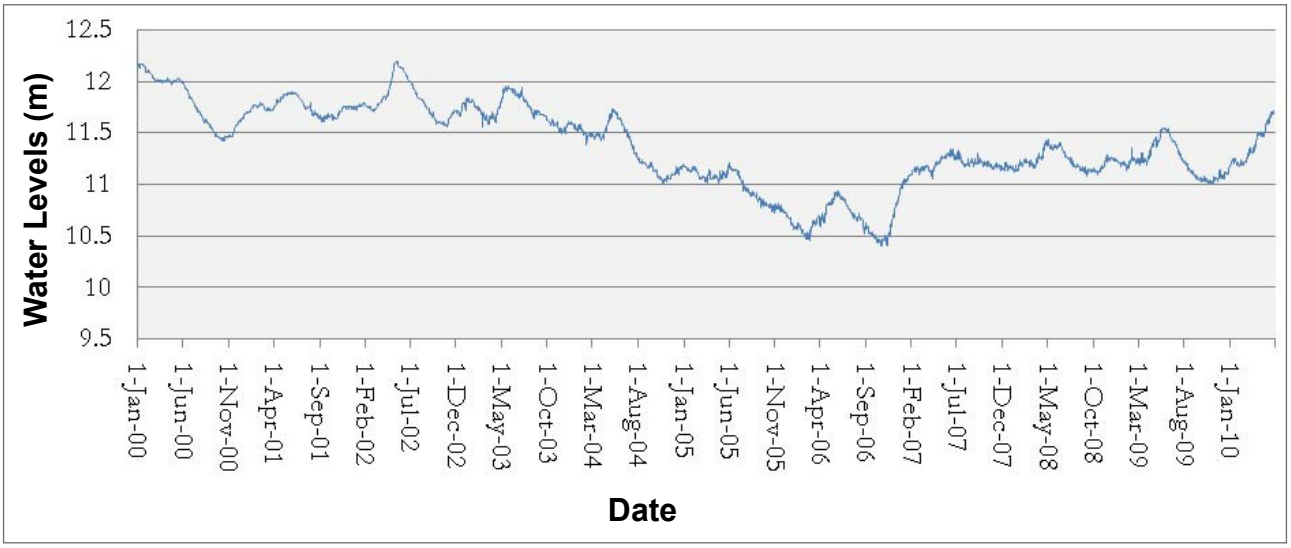


Figure 4.4: Water levels of Lake Victoria at the Jinja Pier (2000-2010).
Source: DWRM 2011a

Various reasons have been advanced to explain the declining trend including climate-related phenomena and over-release at the Owen Falls Dam. Another school of thought is that this is a natural phenomenon and that the lake is receding to its pre-1960 levels. Climate impacts include prolonged droughts, reduced rainfall in the catchment and increased evaporation in the dry season.

These impacts are not limited to Uganda. The state of the lake is of concern to the countries with which it is shared (Kenya and Tanzania). Furthermore, as part of the larger River Nile basin it is also important to the countries downstream. To that end, Uganda is a member of the Nile Basin Initiative and the Lake Victoria Basin Commission, both of which aim to ensure equitable and sustainable management of the respective water resources.

Lake Kyoga catchment

The Lake Kyoga basin is the largest catchment area in Uganda covering 57,233km^2 or 25 percent of the total area of the country (UN 2006). The basin contains 29 districts with a total population of 7.5 million. Its main industry is cattle breeding and agriculture such as cotton and coffee. The annual rainfall is approximately 600-1,400mm with relatively abundant water resources such as rivers, lakes, and groundwater. Three satellite lakes and surrounding wetlands located east of Lake Kyoga (Lakes Bisina, Nakuwa and Opeta) are gazetted under the Ramsar Convention. The lake itself is shallow with a surface area of 4,000 km^2. About 500,000 people live on the lake shores as well as on the sudds floating in the lake (UNEP 2009). These communities rely heavily on the lake for their livelihoods.

L. Kyoga is fed by the Victoria Nile from L. Victoria and as such, its water level fluctuations are greatly dependant on the water fluctuations in L. Victoria. Over the last 10 years the lake levels have shown a significant downward trend with the current level being around the long-term average lake level. The last 10 year average was 1,033.4 masl (DWRM 2011a). The current lake elevation is still in the natural fluctuation range of the lake but what is worrying, is the rate at which the levels are receding as shown in Figure 4.5

River Ruizi catchment

The Ruizi catchment covers a total area of 2,521 km2 with the altitude varying from 1,262-2,168 masl (DWRM 2011b). The river transects five districts located in Western Uganda and

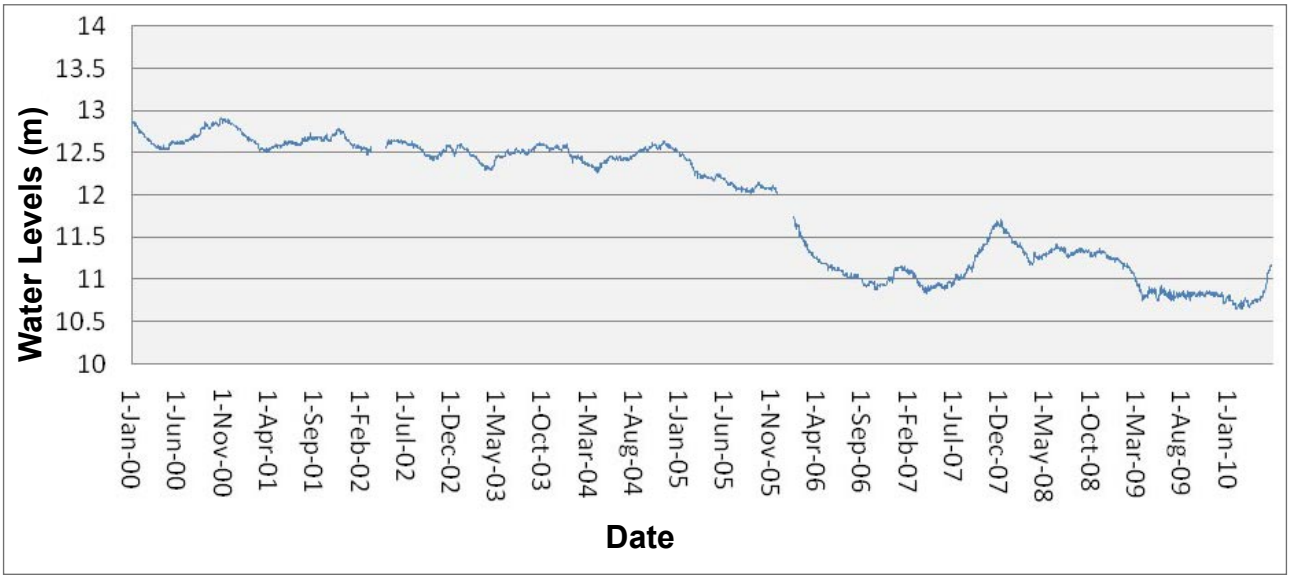


Figure 4.5: Water levels of Lake Kyoga at Bugondo.
Source: DWRM 2011a

is the major source of economic activities in these districts. These include cattle rearing; brick making; papyrus reed for making baskets, mats and art pieces; and farming and eucalyptus tree growing. These activities have contributed to deterioration in both the quantity and quality and drying up of the wetlands fringing the river.

In the last three years, there was no significant downward trend of River Ruizi water levels as seen in Figure 4.6. However, when the water year of 2010 is considered on its own, one could argue that downward trend is slowly setting in (Figure 4.7). The evidence points to increased degradation of the resources probably due to increased agriculture in the catchment, poor land and soil management systems and overgrazing all leading to increased soil erosion. The increase in prolonged drought events that lead to reduced rainfall and increased evaporation is also thought to be contributory. Although there has been a declining trend in the rainfall over the catchment, it cannot solely explain the decline in the water levels.

Trends in Groundwater Resources

The principal source of groundwater is precipitation. This depends on recharge and its mechanisms. The three principal aquifer systems in Uganda are the Fractured rock aquifer, Regolith aquifer and a combination of the Regolith-Fractured rock aquifer, the latter being the more commonly developed. Aquifers in Uganda are discrete, localized and discontinuous (DWRM 2011b).

Several factors impact the availability of ground water in an area. The hydro-geological condition, land use practices in the watershed that recharge the aquifers, groundwater recharge rates, areal rainfall and the topographical conditions are determinant factors of groundwater availability (DWRM 2011b). Anything that negatively impacts one of these factors will contribute to the decline in the ground water levels in the locality. The ground water resources appear to be on a declining trend, just as the surface waters. Data from the groundwater monitoring wells in Pallisa, Soroti, Rakai and Rwonyo (Mbarara District) all indicate declining trends (DWRM) 2011b.

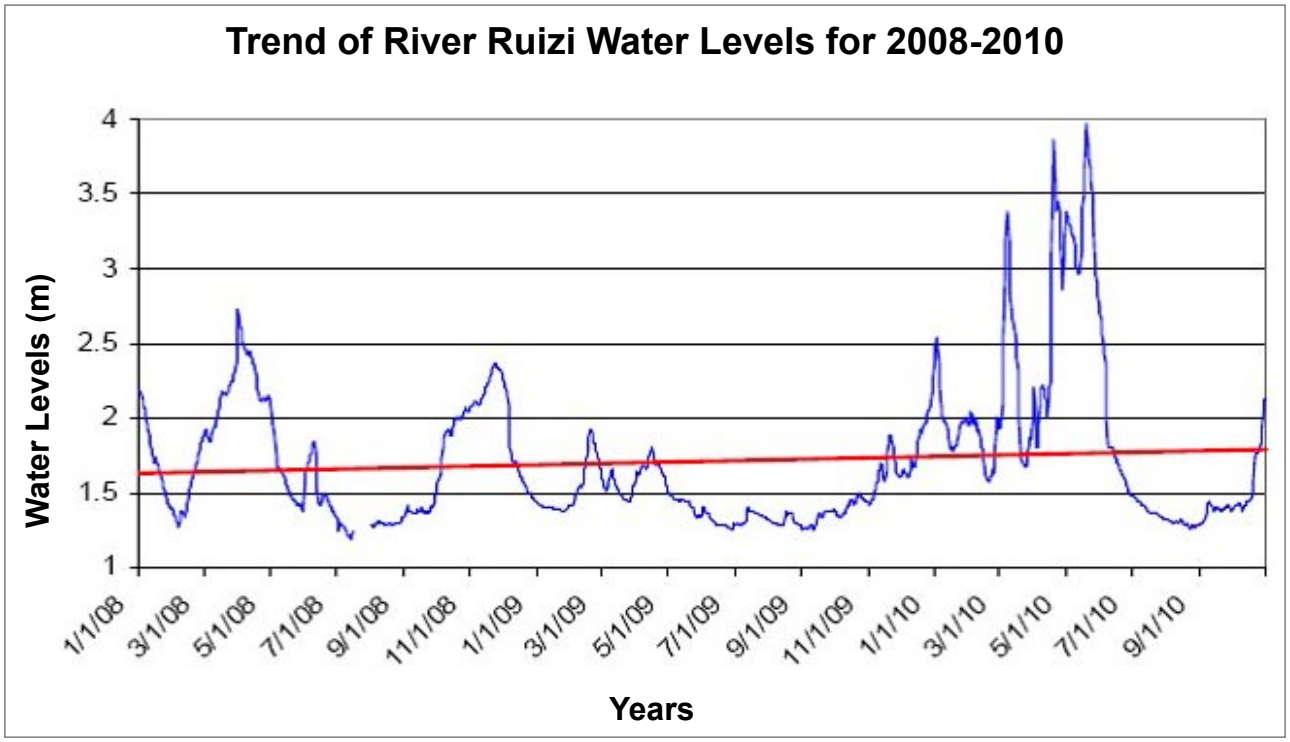


Figure 4.6:Trends in the levels of River Ruizi 2008-2010.
Source: DWRM 2011b

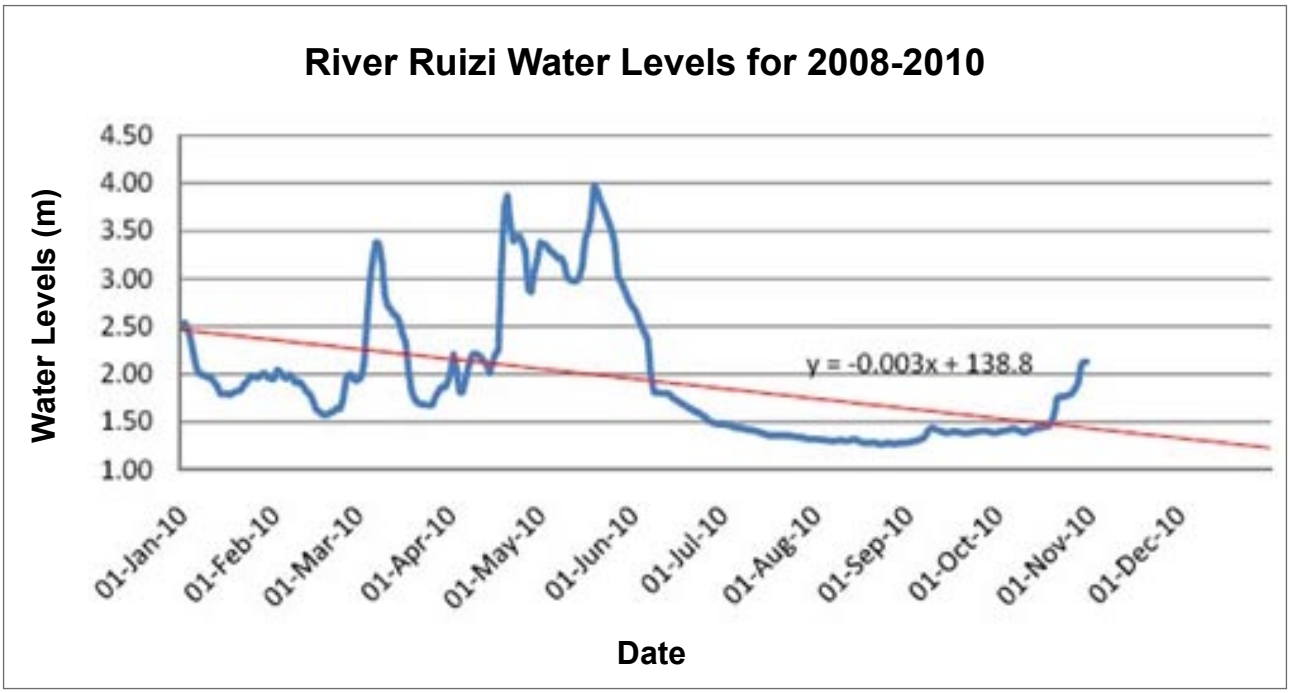


Figure 4.7: Water levels of River Ruizi for the year 2010.
Source: DWRM 2011b

In 2010, the Department of Water Resources Management assessed the available groundwater resources for the country. Estimates of the sustainable exploitable groundwater resources per district were also calculated (Figure 4.8 and Table 4.1). The exploitable groundwater resource represents the proportion of the renewable resource that can be exploited on a sustainable basis without unacceptable consequences for the environment. Despite the on-going efforts to study ground water resources, this area remains largely unknown; and this complicates the ability to adequately plan and manage the resources.

Estimated sustainable available ground water by district

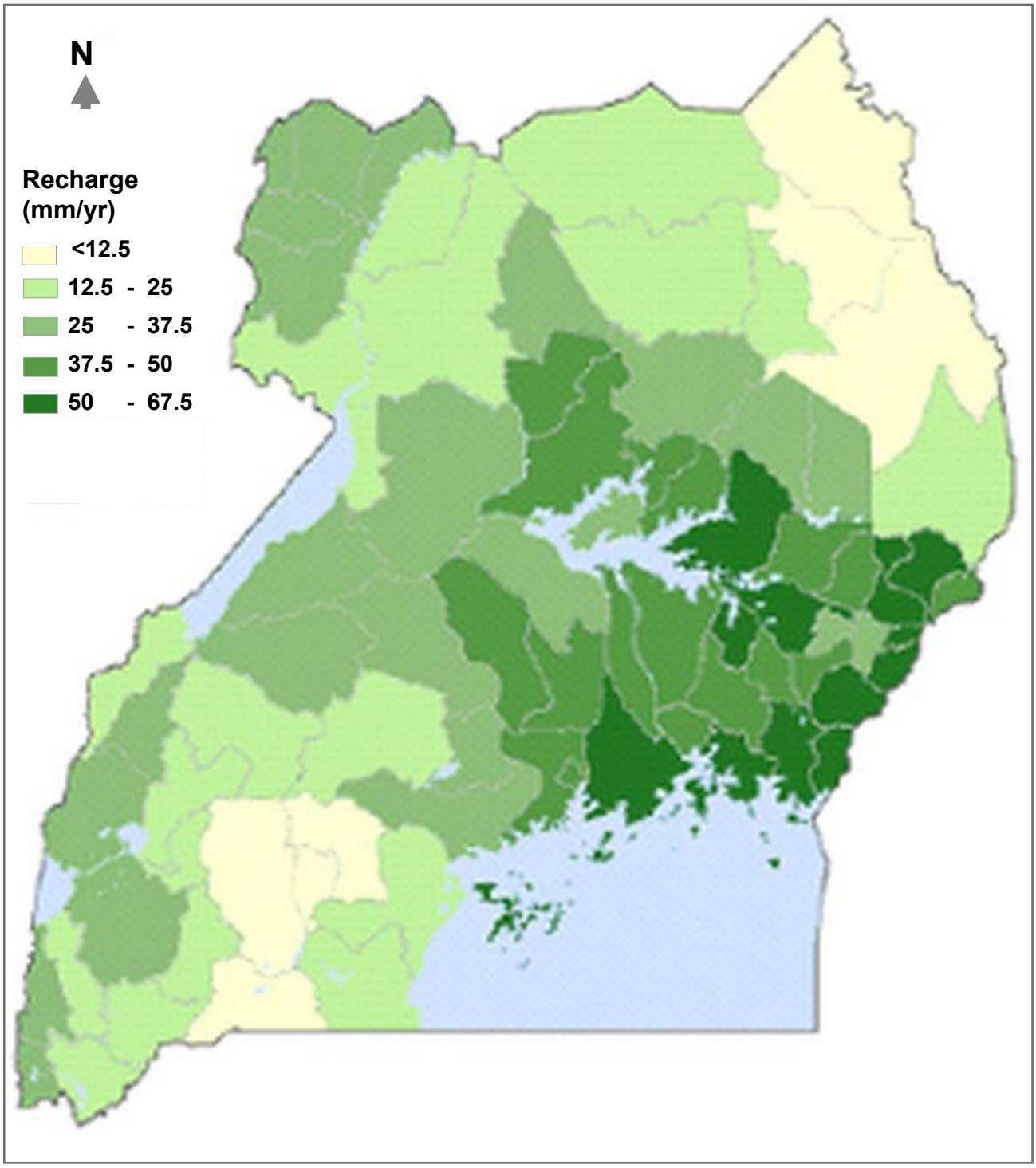


Figure 4.8: Estimated sustainable available ground water by district
Source: WMRD 2011b

Main river basin	Area (km^2)	Land area (km^2)	Av sustainable groundwater (mm/yr)
Lake Victoria	61,886	32,924	24.7
Lake Albert	18,079	14,882	23.7
Victoria Nile	27,961	27,807	39.9
Lake Kyoga	57,236	53,899	36.1
Albert Nile	20,727	20,484	24.4
Aswa	27,637	27,635	17.3
Kidepo	3,229	3,228	6.3
Miscellaneous	5,716	5,679	15

Table 4.1: Sustainable available ground water by basin
Source: WMRD 2011b

The main issues leading to the decline in ground water resources include changes in land use, climate variability; land degradation, deforestation upstream, poor watershed management. Overall, water levels in the different catchment areas declines with the dry season; with the lowest recorded levels occurring at the end of the dry season. The levels then rise following the onset of the rains. However with the onset of climatic change, the rains are no longer as predictable as they used to be thus limiting accurate hydrological forecasts. The solution may lie in better land use and management and the implementation of Integrated Water Resources Management (IWRM) approaches.

Water Quality

Monitoring water levels in a river in Uganda.
Photo credit: NEMA

All the environmental issues that are contributing to the declining water resources in the country are also a factor in determining water quality. In addition pressures from the increasing population and related human and economic activities are leading to the rapid degradation of the resources. Habitat conversion has adversely affected ecosystems such as forests, wetlands, rangelands and catchments leading to land and environmental degradation as well as variability in weather patterns. Poor disposal of industrial and domestic waste has resulted in extensive pollution of the aquatic systems.

Water quality is important to sustaining the fisheries resource, reducing the cost of treating domestic water supply and for environmental sustainability.

There are 119 monitoring stations in the National Water quality Monitoring Network. Recently 6 were added in the Greater Murchison Bay. The main source of pollution is waste water discharge from industry and the city. The largest quantity of this waste water is untreated sewage from Kampala. The level of compliance with national waste water discharge standards is estimated at only 40 percent (GOU 2010).

Aquatic Resources

Wetlands Resources

Uganda's wetlands are widespread and complex. About 10 percent of the country is covered by wetlands (swamps), of which about one-third is permanently flooded. In the south and west of the country, they form an extensive low gradient drainage system in steep V-shaped valley bottoms with a permanent wetland core and relatively narrow seasonal wetland edges. In the north, they mainly consist of broad flood plains. In the east, they exist as a network of small, vegetated valley bottoms in a slightly undulating landscape.

The wetlands in Uganda are hydrologically connected to rivers and lakes. The river network largely has wetlands especially where the gradient is low. A recent assessment by the Wetlands Management Department shows that vegetation in the wetlands ranges from the floating types, short grasses, tall grasses, reeds, sedges, shrubs to trees. The wetland types are often not a single species but tend to be a mosaic of two or more significant species. The most common wetland types are papyrus swamps, reed swamps and grass swamps. The wetlands that exhibit a high diversity of plant species are usually seasonal in nature. The wetlands with high water table (permanent wetlands) usually have one or two significant species dominating the wetland ecosystem. Table 4.2 shows the extent of permanent and seasonal wetlands while Figure 4.9 shows the classification of wetlands according to vegetation type.

Type of wetland	Area (km^2)		% of surface area		Loss (km^2)	% loss
	1994	2008	1994	2008		
Permanent	10390.9	5867.1	4.3	2.4	4523.8	43.5
Seasonal	27184.5	20440.7	11.3	8.5	6743.9	24.8
Total	37575.4	26307.7	15.6	10.9	11267.7	29.9

Table 4.2: Wetlands coverage by water regime
Source: WMD 2011

Hydrological functions of wetlands

In terms of the water sector, wetlands play a fundamental role in maintaining climatic and hydrological stability. Natural wetlands also provide life-supporting services by moderating local climate, regulating stream flow, improving water quality through sediment filtration and absorbing heavy metals and other toxic pollutants and reducing flood risk downstream. They also help to recharge ground water and augment stream flows. They recharge aquifers thereby raising the water table and making groundwater easily available for domestic and industrial use as well as for agricultural activities. Recharge in major wetlands occurs through rainfall. Thus, wetlands are important sources of clean water for human consumption, agriculture and watering of livestock and wildlife. Approximately 5 million people depend directly on wetlands for their water supply needs, valued at US$ 25 million per year (MFPED 2010). Encroachment into wetlands can impact local climates and precipitation regimes or even impede water supply functions. For instance if the Nabajjuzi wetland that provides water supply to Masaka municipality is encroached upon, the water supply function could be severely affected. In which case, the municipality would have to source water from Lake Nabugabo which is over 50 km away.

Condition of the wetlands

The total area of wetlands is estimated at about 26,000 km2 and they occur in all the 8 major drainage basins of Uganda (WMD 2011). It is estimated that about 30 per cent of the original wetlands area have been converted to other uses. The rate of conversion varies and ranges from as high as 53.8 percent in the Lake Victoria drainage basin to as low as 14.3 percent in the Lake Albert drainage basin (WMD 2011) as shown in Table 4.4. The reason for wide spread encroachment includes rice cultivation, dairy farming, industrial development, urban settlement, brick-making, sugar-cane plantation, floriculture and horticulture. The speed of development is higher than that of conservation and this difference has implications on the wetlands sector appearing as though there is no effort towards wetlands conservation.

Wetlands, water quality and human health

As already mentioned wetlands function as a natural wastewater treatment facility. The combination of substrate, plants, litter and the variety of micro-organisms found in wetlands, helps treat human and other biological waste. For example, Nakivubo wetland functions as a natural waste treatment plant for Kampala. It filters industrial effluents and domestic wastewater from 465,000 people (about 40 percent of Kampala's population), resulting in the discharge of less polluted water into Inner Murchison Bay of Lake Victoria (Emerton et al 1999).

In 2009/10, 30 percent of rural households in Uganda lacked adequate sanitation facilities and 35 percent of rural Ugandans did not have access to a safe water source within 1 km of an improved water sources (MWE 2010). The contribution of wetlands in filtering pollutants is thus crucial to public health. The use of contaminated water often leads to outbreaks of water-related diseases, resulting in illness and deaths. Water-related diseases accounted directly for 8 percent of deaths in 2002 and unclean water can be especially deadly for infants and young children. Diarrhoeal diseases are a major killer of children, and were responsible for 17 percent of all deaths of children under 5 years in Uganda.

The 1997 Kampala Declaration on Sanitation guides the promotion of hygiene and sanitation in Uganda but indicators are still poor for example national latrine coverage is at 62.4 percent, below the target of 70 percent at the end of the implementation of Uganda's second 5-year Health Sector Strategic Plan (HSSP II). The situation is worse in some districts such as

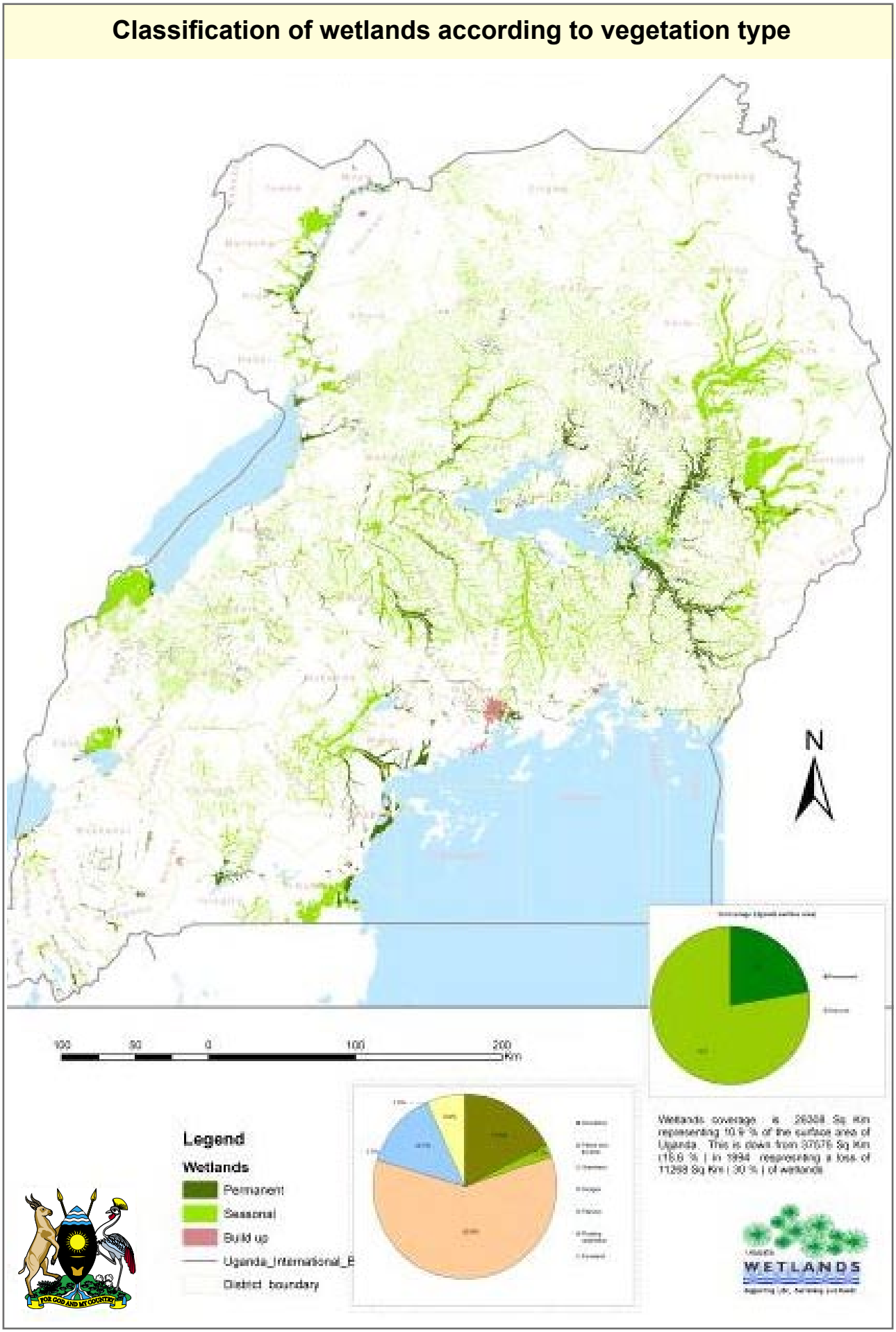


Figure 4.9: Classification of wetlands according to vegetation type

Source: WMD 2011

Abim, Kaabong, Kotido, Nakapiripirit and other rural and slum areas where latrine coverage is less than 10 percent. Inadequate resources, high levels of poverty, inadequate awareness, poor enforcement of public health bye-laws and cultural factors in some regions (such as in Karamoja) are major challenges that have affected the implementation of environmental health programmes.

Why are wetlands so vulnerable?

The relatively flat terrain associated with wetlands makes them easier to urbanize and 'develop' than upland areas, resulting in a concentration of human developments there. In urban areas, particularly Kampala, wetlands are seen as the cheapest areas for industrial development. Many wetlands have been converted to industrial or agricultural use, or have gradually been taken over by semi-slum residential housing and associated uses, such as cultivation, waste disposal or business sites for local manufacturing artisans (jua kali) (Kaggwa et al 2009). Examples are the houses and buildings that have been constructed in the drained off wetlands of Ndejje on the Kampala-Entebbe road, Kinawataka wetlands and along the Nakivubo channel wetlands. This is leading to major problems associated with pollution, drainage issues, habitat loss, overexploitation of wetland plant and animal species and the increased proliferation of alien invasive species. The Nakivubo wetland in Kampala is used by farmers to grow cocoyam and sugarcane. About eight percent of the residents around Nakivubo wetland, which includes a high number of urban poor, are engaged in subsistence or commercial activities related to the wetland. The resultant encroachment on wetlands and swamps in Kampala is largely responsible for the frequent floods, especially in Kalerwe, Bwaise, Kawempe, Zana, Ndeeba and Kanyanya suburbs that have caused both loss of property and lives.

Iyamuliro wetland in Kabale District, converted to agriculture.

Class Name	1994 Area (Km^2)	%	2008 Area (Km^2)	%	Change (Km^2)	% Loss/gain
Albert Nile						
Woodland	372.6	21	297.9	23.7	-74.7	20.1
Bush and thicket	74.6	4.3	64.2	5.11	-10.4	14
Grassland	629.4	36	532.1	42.4	-97.3	15.5
Papyrus and sedges	631.8	36	361	28.8	-270.8	42.9
Farmland	27.8	1.6		0	-27.8	100
Total	**1736.3**		**1255.2**		**-481.1**	**27.7**
Aswa						
Woodland	473.6	16	723.3	33.3	249.7	52.7
Bush and thicket	29.8	1	19.6	0.91	-10.2	34.2
Grassland	2,461.80	81	1405.2	64.8	-1,056.60	42.9
Papyrus and sedges	1	0	0	0	-1	100
Farmland	61.8	2	20.7	0.96	-41	66.4
Total	**3,028.00**		**2,168.90**		-859.1	**28.4**
Kidepo						
Woodland	48.5	29	40.8	20.7	-7.7	15.8
Bush and thicket	3.9	2.3	4.8	2.41	0.9	22.1
Grassland	115.7	69	151.7	76.9	35.9	31
Total	**168.1**		**197.2**		**29.1**	**17.3**
Lake Albert						
Woodland	897	32	872.3	36	-24.7	2.8
Bush and thicket	37.6	1.3	48.6	2.01	11.1	29.5
Grassland	723.3	25	1,041.80	43	318.5	44
Papyrus and sedges	1,157.80	41	456.4	18.8	-701.4	60.6
Farmland	23	0.8	2.6	0.11	-20.4	88.6
Total	**2,838.60**		**2,421.70**		**-416.9**	**14.7**
Lake Edward						
Woodland	779.7	47	496.9	45.3	-282.9	36.3
Bush and thicket	150.5	9	103.5	9.44	-47	31.2
Grassland	245.7	15	228.6	20.8	-17.1	7
Papyrus and sedges	364.4	22	179.3	16.4	-185.1	50.8
Farmland	130.8	7.8	88.1	8.03	-42.7	32.7
Total	**1,671.10**		**1,096.30**		**-574.8**	**34.4**
Lake Kyoga						
Woodland	1,206.00	8	1,290.30	11.7	84.3	7
Bush and thicket	364.6	2.4	251.9	2.28	112.6	30.9
Grassland	8,624.50	57	6,625.80	60.1	1,998.60	23.2
Papyrus and sedges	2,615.30	17	1,346.10	12.2	1,269.30	48.5
Farmland	2198	15	1,514.40	13.7	683.6	31.1
Total	**15008.3**		**11,028.50**		**3,979.80**	**26.5**
Lake Victoria						
Woodland	924.2	13	428	12.9	496.2	53.7
Bush and thicket	383	5.3	116.9	3.53	266.1	69.5
Grassland	4,544.90	63	2,163.60	65.4	2,381.30	52.4
Papyrus and sedges	1,102.10	15	490.6	14.8	611.4	55.5
Farmland	213.4	3	111	3.35	102.4	48
Total	**7,167.60**		**3,310.20**		**3,857.40**	**53.8**
Victoria Nile						
Woodland	1,147.90	20	448.5	9.29	699.3	60.9
Bush and thicket	75.4	1.3	0	0	75.4	100
Grassland	3,411.60	59	3,596.40	74.5		5.4
Papyrus and sedges	1,059.00	18	783.2	16.2	275.8	26
Farmland	92.5	1.6	1.3	0.03	91.2	98.6
Total	**5,786.30**		**4,829.40**		**957**	**16.5**

Table 4.3: Change in area covered by wetlands by drainage basin

Source: WMD 2011

The Fish Resource

The water bodies of Uganda are of importance to the national economy as natural assets. They support fish populations, provide support to the local economy by enabling a lucrative fishing and tourism industry, for instance, through sport fishing that is commonly done on Lake Victoria and in the Murchison Falls National Park.

Uganda produces 4 percent of the global inland fish production (FAO 2010). Fish is the country's second most important export, accounting for 6 percent of total export earnings (UEPB 2009); and contributing 2.5 percent to GDP at current economic prices in the 2009/2010 fiscal year or 2.3 percent in the 2009 calendar year (UBOS 2010). There are over 500,000 people working directly in the sector (The World Fish Centre 2011). As such it plays an important role in contributing to achieving the overall economic growth rate of 7.2 percent over the NDP planning period (2010/11-2014/15). Figures 4.10 and 4.11 show the value of fish exports and contribution to GDP over the 2002-2009 period.

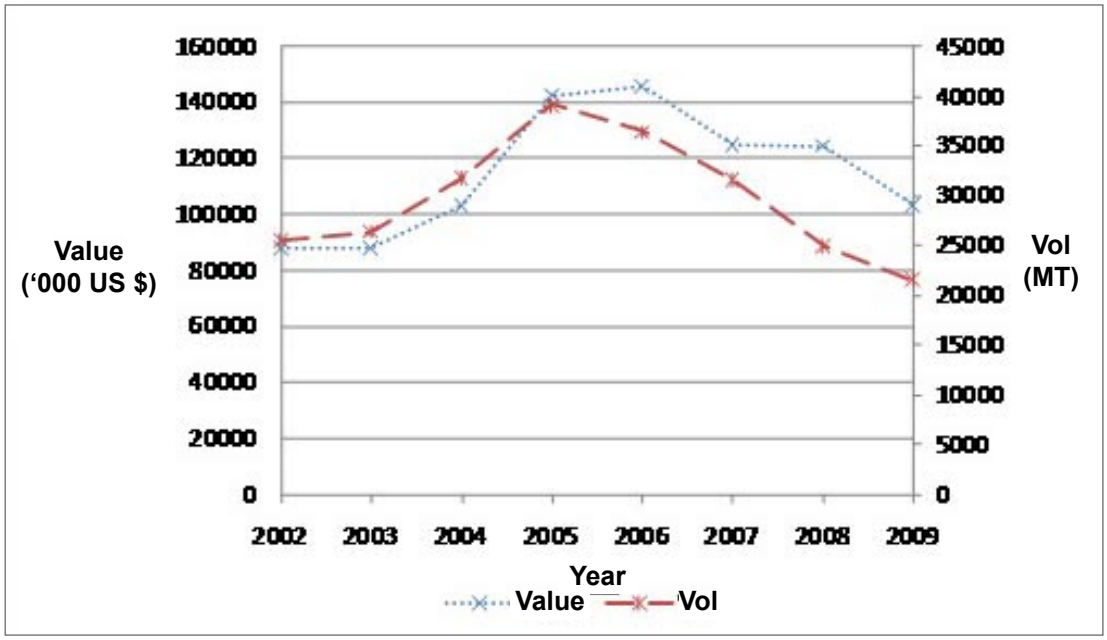


Figure 4.10: Fish export volumes (MT) and value (US $) 2002-2009
Source: UEPB 2009

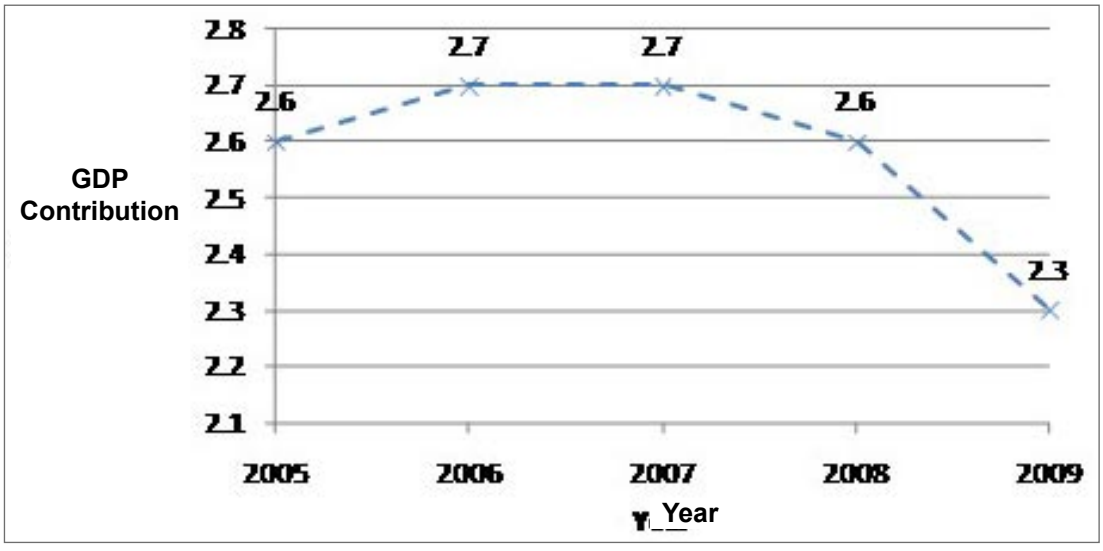


Figure 4.11: Fish contribution to GDP at current economic prices (calendar year)
Source: UEPB 2009

Lake Victoria dominates in terms of contribution to total fish catch with 61 percent of catch share; followed by Kyoga with 16 percent and then Lake Albert with 15 per cent in 2009 (UBOS 2010). Although there was no change in share of catch between 2008 and 2009 in real terms, there was an increment in fish catch especially from Lake Victoria (UBOS 2010). This unexpected recent growth in total production has happened despite increasing concerns about the environmental conditions of the wider watershed and the state of the fish stock. This can be explained by inadequate capacity of Beach Management Units (BMUs) in fisheries management, resurgence of water hyacinth and the emergence of new weeds, lack of species-specific management plans and lack of clear understanding on the economics of fisheries development. However there are efforts at the policy level to increase and sustain fish production and the health of the fish habitat.

The Ugandan fish sector has been experiencing an insidious decline of fish stock in the last few years (UEPB 2009). Total exported volumes dropped by over 14 percentage points (compared to 21 percent in 2008). Export earnings dropped 17 percent in the same year. There is a heightened demand from the different markets and the impact of this has been to stretch the local yields. This soaring demand has encouraged illegal fishing (undersized harvests), compounding the growing scarcity problem and by implication hurting the fish export trade. The dwindling stocks' challenge to the industry can only be averted by better management of fresh water resources.

The fish export industry is very sensitive to the standards in the local fishing industry. There needs to be efforts to ensure that the emerging oil industry does not impact negatively on the fisheries resource. Keeping in mind the disastrous effects of the use of poison and explosives to increase fish catch in the early 2000's, local fishers must guard against the temptation to resort to unethical fishing methods given the current decline in fish stock. The unethical fishing methods led to a ban on fish exports by the European Union market on grounds of health and hygiene in 2000. The Uganda Fish Exporters and Processors' Association (UFPEA) has worked to ensure self-discipline and coordination among members so as maintain high standards in the sector. The Department of Fisheries Resources is responsible for the formulation of Government policies in the fisheries sub-sector, the development of national plans and strategies to achieve set goals within the policy guidelines and to monitor and supervise the performance of the decentralized district authorities and the private sector.

Pressures affecting the fish sector

The pressures on the aquatic ecosystems and thus on the sustainability of their fisheries is considerable. The water bodies are subject to fluctuations in water level and habitats are degraded as a consequence of riparian activity especially agriculture.

The most important riparian activity in all eight major catchments of Uganda is agriculture. As indicated in Chapter 2, agriculture dominates the Ugandan economy and is largely dependent on small- and medium-scale farmers with average land holdings of 2.5 ha (FAO 2006). Agricultural activities have been blamed for 86-90 percent of environmental degradation in monetary terms (Isabirye 2005, Olson et al 2004). The changes in vegetation cover associated with agriculture have led to biodiversity loss, deforestation and soil erosion. Turbidity and sedimentation mainly due to excessive soil erosion resulting from deforestation and overgrazing is a common feature. This turbidity has negative impacts on the aquatic flora and fauna.

Freshwater ecosystems accumulate the impacts of human activities and consequently the quality of fish habitat depends to a large extent upon the density of the human population and its activities within the basin. The average population density in the Lake Victoria basin is 635

people per km^2; about 5 times higher than the national average of 124 people per km2 (UN-Habitat 2008). This puts a lot of pressure on the freshwater systems. Degraded environments have serious impacts on fisheries. Indeed if the country does not start to control and restore the key catchment and riparian processes, this will further hasten the decline of the fish resource.

Monitoring for compliance with the regulations governing fishing gear.
Photo credit: Fisheries Department.

Fishing pressure has added to the environmental stresses being endured by the fish populations and commercial catches have been detrimentally affected. Catchment degradation – cutting of trees along riverbanks and lake shores has increased pollution, reduced rainfall and reduced fish catch. The steady increase in urbanisation, industrial and agricultural land use occasions a tremendous increase in discharge of a wide variety of pollutants to receiving water bodies, with undesirable impacts on the quality of the aquatic ecosystem and on fisheries. Apart from the impacts on the agricultural economy of the loss of soil and thus natural fertility of the land, soil erosion leads to sedimentation and siltation of the water bodies. This is an issue that needs to be seriously addressed as it is likely to affect the fish industry. The Crocodile and Fish Act of 1964 does not specifically provide for this, so currently watershed issues are currently managed under the National Environment Act.

Pollution not only affects the water levels and turbidity, but also the amount of fish caught because of reducing numbers. The reduction in numbers can also be attributed to poor methods of fishing. Fishermen have been found with young fish. This affects the breeding processes. Indeed in 2009, for the first time in a long while, there were some arrests and prosecutions under the Fish and Crocodile Act of 1964 (UBOS 2010).

The waste profile in Uganda is becoming increasingly complex. There are new additions of chemical, electronic and radioactive waste, plastics and polythene materials, industrial and medical wastes in addition to the traditional wastes (MFPED 2010). Chemicals and heavy metals found in pesticide runoff and industrial effluents also damage aquatic and human health. Of increasing concern in Uganda are the persistent organic pollutants (POPs), which can be transported in the atmosphere and have become common in the water bodies. POPs tend to linger in living tissue and become more concentrated as they move up the food chain. Evidence links long-term, low-level exposure to certain POPs with reproductive, immunological, neurological, and other problems in marine organisms and humans.

A typical catch of the mixture of Neobola bredoi (tiny fishes) and Brycinus nurse (larger fishes) in the light fishery of Lake Albert.
Photo credit: Fisheries Department.

Threats To The Water Resource

Degradation of the Aquatic Ecosystems

One of the main threats to the water resources in Uganda are caused by the degradation of the catchment areas. This creates direct impacts such as the loss of the water resource or indirect challenges such as soil erosion, sedimentation, micro-climate modifications and the negative consequences the fisheries resource and on the health of the population. The main driver that leads to the degradation of the aquatic ecosystem is the high population growth.

Wetlands continue to be degraded and encroached upon and are being destroyed at an alarming rate. Increasing amounts of wetlands are coming under cultivation. While this may be thought of as contributing towards agriculture, and thus economic development, the clearance of forests and use of marginal lands is problematic. In Uganda's highlands, the source of many of the country's rivers, for instance, steep slopes are increasingly being cultivated. Deforestation together with the cultivation of these slopes and lack of soil conservation technologies is leading to soil erosion, land degradation and landslides. For instance as river Manafwa emerges from Mt. Elgon on Bududa district, it carries a clean stream of water. However, by the time it gets to Manafwa District, it is brown and turbid due to soil from the intensity of farming activity through Butaleja District into Manafwa District.

Oil and Gas has been discovered in the Lake Albert basin. Plans for its exploitation are in advanced stages. When fully operational, human activities are bound to increase and add pressure to already existing changes occurring on the lake ecosystem. Higher demand for resources from the lake and increased nutrient loading resulting from the build up in populations are likely

Local leaders and the community meet to agree on how to mitigate floods through observing the regulations on the management of River banks.
Photo credit: NEMA.

to affect the lake. Pollutants from oil wells and refineries will inevitably end up into the lake causing undesirable changes to habitats critical to fish survival on the lake. Accidental oils spills could be disastrous to the water bodies and wider catchment area.

The overall policy in capture fisheries is to increase and sustain fish production and the health of the fish habitat. The major resource sustainability and environmental concerns in capture fisheries fall under those factors that affect the fish stocks, the fisheries genetic resources especially biodiversity, and those factors that affect the fish habitat and aquatic ecosystem. The factors that directly affect the fish stocks include the use of destructive fishing gears and methods; destruction of breeding and nursery grounds; fishing in the fish-breeding grounds; capture of immature fish; introduction and transfer of alien invasive species like weeds or fish.

The factors that affect the health of the fish habitat include: nutrient enrichment due to activities in the catchment area; siltation of the water bodies from erosion from the catchment areas and pollution; and control of aquatic weeds; water extraction; degradation of riparian zones especially wetlands, lakeshores and river banks. These same factors have impacts on human health and livelihoods. There is evidence that the living and working conditions in fishing communities including lack of safe water, latrines and health care can make people vulnerable to diseases including HIV/AIDS. Such chronic illness' destroy livelihoods and incomes, undermine the skills base in the sector and reduces productivity. At household level, food security, health and education are impacted.

Population pressure

The exponentially rising rates of urbanization, demography and associated socio-economic activities are directly contributing to the loss and degradation of the aquatic ecosystem.
High human fertility rates and poverty have contributed to population increase.

Cultivation along riverbanks degrades the water ecosystems.
Photo credit: Fisheries Department.

The natural resources in these drainage basins are used as a source of food, energy, drinking and irrigation water, shelter, transport, and as a repository for human, agricultural and industrial waste. However if not managed well, these pressures can overwhelm the ability of the aquatic ecosystems to provide these services. The Lake Victoria basin, for instance, has an annual population growth rate of 3 per cent compared to the national growth rate of 3.2 per cent. This puts a lot of pressure on the freshwater and wetland resources.

According to UN-Habitat (2008), about 1.5 million people live in slums in Kampala with a population density of about 12 families occupying a single plot of land. The wetlands and swamps have been encroached upon to create room for residential areas and accommodation due to the increasing urban population. Despite their acknowledged importance, wetlands have not been captured in the national accounts. In order to increase the profile of wetlands, the scientists need to ensure that it is part of the public policy discourse.

Strategies To Improve Water Resources Management

Transboundary Management of Water

All Uganda's fresh water resources are located in transboundary watercourse systems and shared river basins. Management and protection of these shared basins is required through a strong commitment to regional collaboration within the East African Community (EAC) and the wider Nile Basin Initiative (NBI). Similarly, the environmental initiatives of the New Partnership for Africa's Development (NEPAD) include a framework for regional cooperation on water resources, as well as processes for the restoration of degraded ecosystem (including wetlands), the combating of desertification, drought relief, sustainable agricultural production, and biodiversity conservation. NEPAD's framework is thus a key initiative for improving water resource management for social, economic, and environmental security in Africa.

Catchment Based Water Resources Management

In view of the threats highlighted above and the inadequacies of the current management approaches, a policy shift towards managing the water resources at the catchment level has been proposed. This will involve the creation of Water Management Zones enabling water management at the catchment level. Catchment-based water resources planning, management, and development is the key to enhanced Integrated Water Resources Management in Uganda. It provides the opportunity for sustainable and integrated water resources management with the involvement of all stakeholders in water resources management.

The country has been divided into four water management zones namely: Kyoga (Eastern) Victoria (Central), Albert (Western) and the Upper Nile (Northern) Water Management Zones (DWRM 2010). These are shown in figure 4.10 below. This approach has been piloted and carried out since 2006 in the western water resources management zone and has proved effective. Catchment management plans are being proposed as the basis for all water sector planning.

Monitoring of Surface and Ground Water Trends

The natural fluctuations in the water resources are unpredictable and therefore need to be closely monitored. Monitoring of surface water trends plays a vital role in the management of water resources. It provides information that is useful in the design of water supply systems, management of water quality, regulation of flow, allocation of water and the operation of reservoirs. Monitoring the quantity and quality of water resources in the country is also one of

the strategies of the National Development Plan towards ensuring sustainable utilization of the water resources for present and future generations.

The Uganda Water Resources monitoring network comprises 81 hydrological stations (50 river, 7 lake levels, 5 for rainfall and 9 automatic weather stations) and 20 groundwater stations from which data is collected. In order to provide a basis for planning and management of water resources, the water assessment and monitoring networks for surface and groundwater quantity and quality need to be urgently rehabilitated and improved. Recently, there have been efforts to expand the monitoring network, especially to Northern Uganda, where previously the network was constrained by insecurity in some areas and lack of adequate financial resources to invest in the required infrastructure. However, a major problem is the theft and vandalism of monitoring installation which poses a challenge to maintenance of the infrastructure.

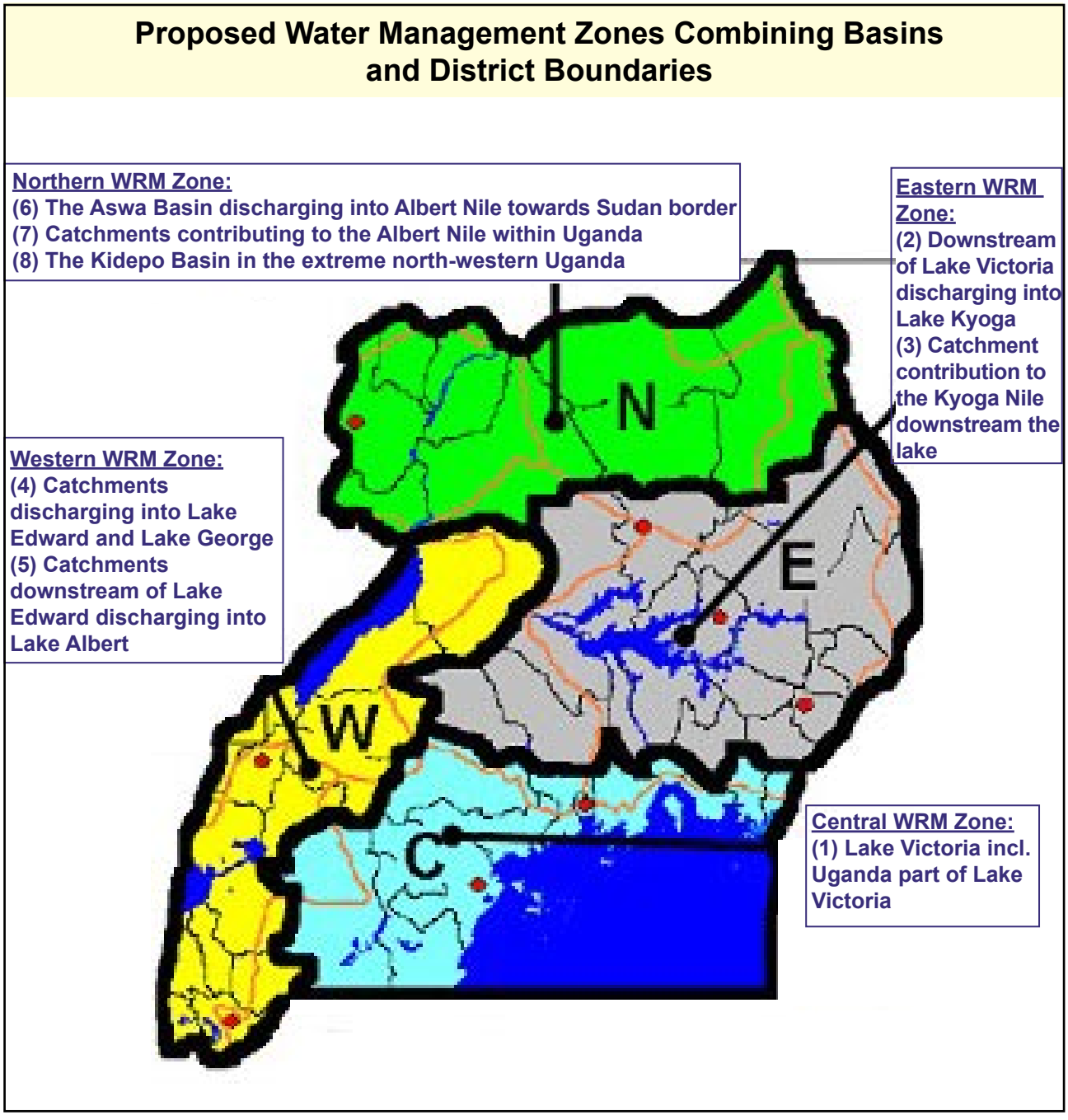


Figure 4.12: Proposed Water Management Zones combining basins and District boundaries.
Source: DWRM 2010

Integrated Planning For Wetlands Management

Institutional arrangements for wetlands management moved from being a central function to a decentralized function with the enactment of the Local Government Act in 1997. The districts have provision for Wetland Officers who are most of the cases Environment Officers. However, the wetlands are in remote areas and need to be monitored for compliance with existing rules and regulations. The Wetlands Management Department is currently considering getting focal persons to be based at the sub-counties but there is no policy or regulation that provides for the possibility. At the local level community policing has been proposed as an effective means of monitoring wetlands as described in Box 4.1.

Box 4.1: Community policing for better wetlands management

The community can be a good entry point for policing wetlands if they are sensitized on the benefits of wetlands. The Wetlands Management Department has been working with some communities to develop and implement community wetland management plans. In Kumi, a community wetland management plan was developed on Ojie wetland when there was a community conflict over its use. In the process of developing the community management plan, the people were sensitized and the wetland was zoned according to provisions in the regulations as well as using existing wetland resource use guidelines and the conflict was resolved. The community also produced their own bye-laws to manage the wetland and today it stands out as a model. There is need to have many more community management plans developed and implemented by communities. The handicap is the getting the districts to 'own' the exercise and fund it.

Source: WMD 2011

Support to the Fisheries Sector

The Department of Fisheries has put in a lot of effort into improving the quality and safety standards of fish production and export. This focus on quality over quantity is expensive in terms of finances and human resources required for monitoring. The subsector also faces problems of over-fishing, non-compliance with regulations and inadequate control of catches, illegal transportation of fish to some factors and to neighbouring countries. Post-harvest production facilities need to be improved and should include farm level storage, cold stores, fish fry centres and fish handling facilities.

The Icelandic Government has been assisting the government, through support to the Department of Fisheries Resources (DFR) of the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), in achieving its objectives of quality assurance of fisheries products for internal and international markets.

Interventions to reverse the declining trends and harness the existing potentials have been limited but lately the sustainable use of aquatic ecosystems and their resources especially fisheries is being emphasized, with the creation of no fishing zones and the use of Beach Management Units (with representatives from both government and the fisher communities) at every fish landing site to ensure adherence to the law and the principle of sustainable harvesting. The Department of Fisheries is seeking to improve the capacity of Beach Management Units in fisheries management through various training programmes.

To offset the reduction in traditional fish stocks, a large scale fish farming program in the Eastern and Northern regions of Uganda is planned. Initial districts involved are Bugiri, Butaleja, Iganga, Manafwa, Mayuge and Sironko. While this will increase the volumes of fish for export, it will not reduce the fishing pressures. The government needs to address this through some other means.

A typical fishing village in Uganda.
Photo credit: Fisheries Department

A Fish farm in Kabale District.
Photo credit: NEMA

Conclusion and Recommendations

The regular supply of clean and safe water for domestic, agricultural and industrial use remains a key development challenge in Uganda. Uganda is fairly well endowed with water resources. Many areas of the country however, suffer both temporal and spatial shortages of water. The water and sanitation statistics are therefore poor for most people. The degradation of wetlands has further exacerbated the water supply problem, first by undermining the water filtering function of wetlands, but also by reducing their water storage capacity.

The fish sector has also suffered insidious declines of fish stocks. The key negative forces in the sector include over-fishing, use of improper fishing gear and pollution. With the discovery of oil and gas in the Albertine Graben, the water and fisheries resources of Uganda may be at further risk.

The recommended actions in the aquatic resources, freshwater, fish and wetlands sub-sectors include effective management of water catchment areas by harmonising land use, forestry, agriculture, industry and environment policies in addition to investing in research and development in the water sector. A national wetland information management system and database should be established with a clear indication of the extent, uses and values of wetlands. The wider family of stakeholders in natural resource conservation needs to be more vigorously involved. Particular attention should be given to local authorities who directly benefit and interact on a daily basis with the natural resources in question.

References

DWRM (2010). *Operationalisation of Catchment based Water Resources management*. Department of Water Resources Management (DWRM), Ministry of Water and Environment, Kampala

DWRM (2011a). *Submission for the State of the Environment report for Uganda 2010*. Water Resources Monitoring & Assessment Division, Department of Monitoring and Assessment, Directorate of Water Resources Management (DWRM), Entebbe.

DWRM (2011b). *The declining trends of water resources in Uganda: A Case study of River Rwizi, Lake Wamala, Lake Victoria Catchments and representative Groundwater Monitoring stations*. Water Resources Monitoring & Assessment Division, Department of Monitoring and Assessment, Directorate of Water Resources Management (DWRM), Entebbe.

Emerton, L. Iyango, L., Luwum, P., and A. Malinga (1999). *The Economic Value of Nakivubo Urban Wetland, Uganda.* The World Conservation Union (IUCN), Eastern Africa Regional Office, Nairobi.

FAO (2006). *Uganda.* AQUASAT FAO's Information System on Water and Agriculture. Food and Agriculture Organisation of the United Nations (FAO), Rome. http://www.fao.org/nr/water/aquastat/countries_regions/uganda/index.stm

GOU (2010). *National Development Plan 2010/11 - 2014/15*. Government of Uganda (GOU), Kampala.

Isabirye, M. (2005) Land evaluation around Lake Victoria: Environmental implications of land use change. PhD thesis, Departement Landbeheer, Katholieke Universiteit Leuven, Leuven.

Kaggwa, R., Hogan, R., and Hall, B. (Eds). (2009). *Enhancing Wetlands' Contribution to Growth, Employment and Prosperity.* Environment and Natural Resources Report Series. UNDP/NEMA/UNEP Poverty Environment Initiative. United Nations Development Programme (UNDP), National Environment Management Authority (NEMA), United Nations Environment Programme (UNEP), Kampala.

MFPED (2010). *The State of Uganda Population Report 2010: Population and Sustainable Development: Emerging Challenges, Opportunities and Prospects.* Population Secretariat, Ministry of Finance and Economic Planning (MFPED), Kampala.

MWE (2010). *Sector Perfomance Report*, Ministry of Water and Environment (MWE), Kampala.

NEMA (2009). Uganda: Atlas of Our Changing Environment. National Environment Management Authority (NEMA), Kampala.

Olson M.J., Misana, S., Campbell, D.J., Mbonile, M and S. Mugisha. (2004). *The Spatial Patterns and root causes of land use change in East Africa*. LUCID Project Working Paper 47, Nairobi, Kenya

UBOS (2010), *Statistical Abstract*, Uganda Bureau of Statistics (UBOS), Kampala.

UEPB (2009). *Annual Report 2009*. Uganda Export Promotion Board (UEPB), Kampala.

UN (2006). *Uganda National Water Development Report, 2005*. Prepared for the 2nd UN World Water. UN-WATER/WWAP/2006/9. World Water Assessment Programme. United Nations.

UNEP (2009). *Atlas of Our Changing Environment*. United Nations Environment Programme (UNEP), Nairobi.

UN-Habitat (2008). *Promoting Biodiversity In And Around The Lake Victoria Basin*. United Nations Human Settlements Programme (UN-Habitat). United Nations (UN), Nairobi.

WMD (2011). *Submission for the State of the Environment Report 2010*. Wetlands Management Department (WMD), Ministry of Water and Environment, Kampala.

Gorillas in Bwindi National Park.

CHAPTER 5
Biodiversity Resources

Introduction

Uganda has a high level of biological diversity by virtue of the fact that the country is located in an area where seven of Africa's distinct biogeographic regions or phytochoria converge. Further, the country is located in a zone that includes the drier East African savannas and the more moist West African rain forests, combined with high altitude ranges the country has a high level of biological diversity. Uganda's rich biodiversity is distributed across both terrestrial and aquatic habitats. Most of the biodiversity can be found in natural forests, but a considerable amount is also found in other natural ecosystems such as mountains, savannahs, wetlands, lakes and rivers.

It is estimated that the total number of species is 18,783 - 7.5 percent of mammals, 10.2 percent of bird species, 6.8 percent of butterflies and 4.6 percent of dragonflies which are globally recognized (NEMA 2009). Some components of biodiversity in Uganda (for example below ground biodiversity) are poorly known. Work on these groups is only in the initial stages, being carried out mainly by Universities and Research Institutes which are constrained by shortage of research funds. Improved knowledge of such elements of biodiversity could raise the country's biodiversity importance far higher than reported above.

Biodiversity in Uganda provides a multitude of services that support economic growth, livelihoods and human health. The tourist sector is heavily dependent on well maintained biodiversity and ecosystems, such as forests and wetlands. For instance plant and animal genetic resources are the biological basis of food security and wildlife-based tourism and directly or indirectly support the livelihoods of all people. Furthermore biotechnology (in the traditional and modern sense) is being used to improve crops, fuels and health for human wellbeing.

There are threats facing biodiversity. These include habitat loss, lack of certain types of biodiversity information, threats from the development of the oil industry and alien invasive species. It is estimated that the country is losing its biodiversity at the rate of 1 percent per year due to these and other threats. Uganda is keen to address the threats affecting its biodiversity and has done so through implementing national and international environmental agreements.

The State of Uganda's Biodiversity and Opportunities Provided

Uganda's rich biodiversity provides a unique opportunity to support poverty eradication as part of a sustainable management and conservation strategy. The multiple roles performed by biodiversity encompass food security, agriculture (including the fishing, livestock and crop industry), tourism, wealth creation, serving cultural purposes and the supply of ecosystem

services. Ecotourism which is based on forest biodiversity is fast becoming a niche market product for Uganda. The continued loss and degradation of Uganda's biodiversity therefore presents a serious challenge to livelihoods, economic growth and human well being.

Forest Biodiversity

Forests are rich in biodiversity in terms of species richness and genetic potential especially for farmed or domesticated species (Howard 1995 in NEMA 2011). Assessments of the natural forest estate estimate stocks of 1,259 species of trees and shrubs, 1,011 species of birds, 75 species of rodents (small mammals), 1,245 species of butterflies, 115 species of hawk moth (large moths) and 96 species of silk moths (Forest Department 1996). The annual contribution of biodiversity is estimated to have decreased from US $5.097 million in 2005 to US $4.405 million in 2010 as shown in Table 5.1.

Description	Area ('000ha)		Rate (US$/ha/yr)	Value of biodiversity ('000US$)		Value of biodiversity ('000Ushs)	
	2005	2010		2005	2010	2005	2010
Natural forests	3,398	2,937	1.5	5,097	4,405	9,289,996.08	10,170,537.30

Table 5.1: Value of biodiversity in Uganda's forests

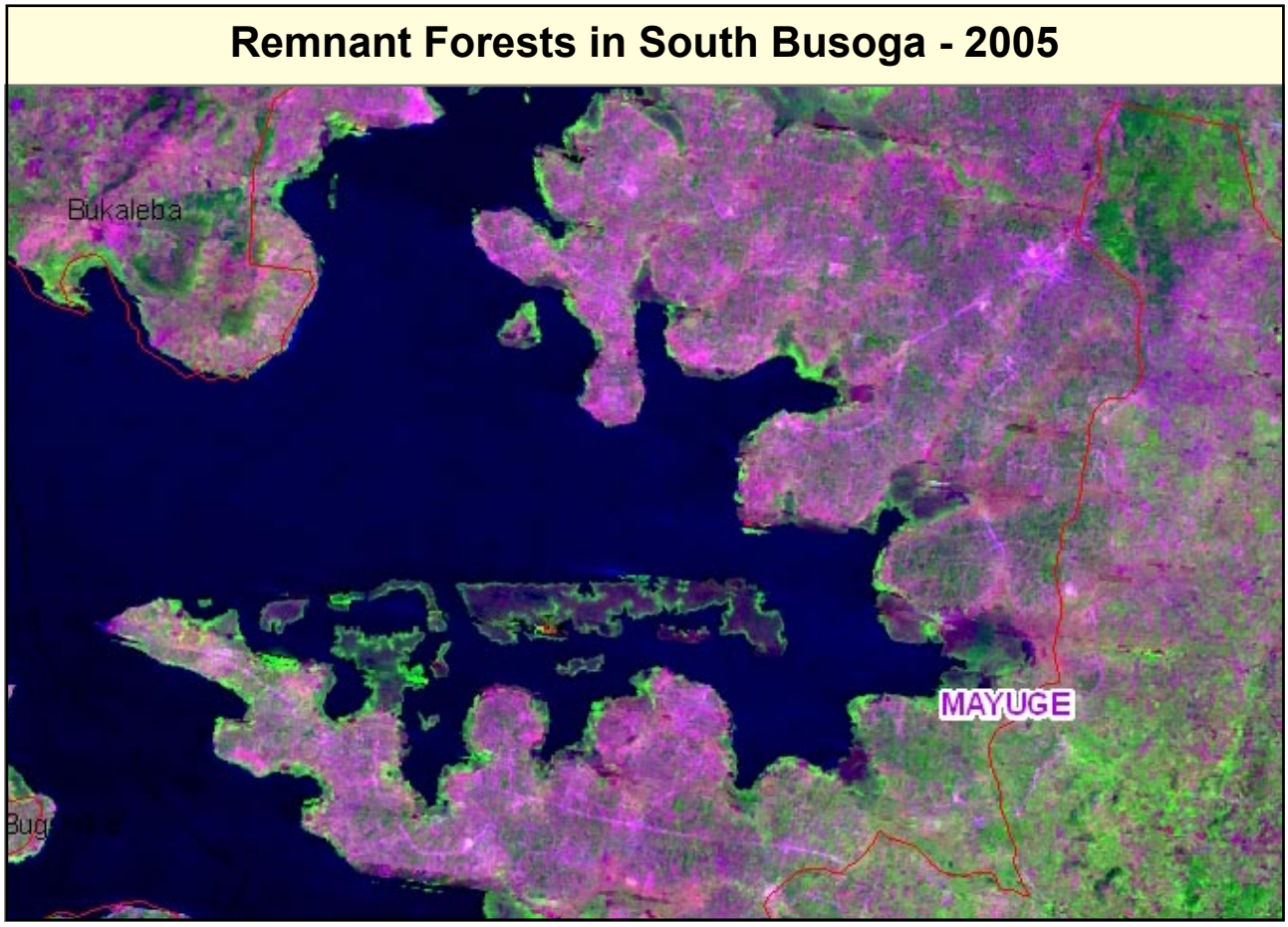
Source: FAO 2010, Moyini 2006 in NEMA 2011

The main reason for this decline in forest biodiversity is deforestation. Deforestation affects the resilience of the ecosystem and consequently the quality of goods and services accruing from the affected ecosystems. According to the NDP, the recommended level of national forest cover to have a stable ecological system is 30 percent (GOU 2010). Currently forest cover is only 18 percent (NFA 2009).

The major drivers of deforestation are pressure from the growing population leading to conversion of forest into agricultural and grazing land and over-harvesting for firewood, charcoal, timber and non-wood forest products. Deforestation due to energy demand for wood for fuel is a big issue. In 1994, charcoal production utilized 6 million m3 of round wood increasing to 11 million m3 in 2007. In 2007, 59.4 percent of the total wood production from forests was used as wood fuel (UBOS 2010). Currently the annual national consumption of firewood is estimated at 32.8 million m3 of woody biomass energy (GOU 2010). Furthermore even where households can afford alternative forms of energy, they tend to stick with wood fuel due to its ready availability and relative inexpensiveness. Wood fuel will thus continue to be the dominant source of energy for the foreseeable future, especially in the absence of policies designed to reduce consumption. With increasing population, the pressure on forests, which harbours a significant proportion of Uganda's biodiversity, will mount and there will ultimately be a direct relationship between biomass energy consumption and conservation of biodiversity.

The measures taken up to now regarding forest management, forest extension services, education and promotion of improved cooking devices are not sufficient. And given the future outlook on the use of wood fuel for energy in the country, the main challenge in the forest sector is therefore how to increase the biomass resource base as well as use the present resources more efficiently.

One of the targets of the NDP is to restore forest cover to 1900 levels by the year 2015 (an increase of 36.8 percent) and to promote commercial tree planting on private land. Other appropriate policy responses could include: enforcement targeted in environmentally sensitive areas, fee collection along the value chain, investments in tree planting, and efforts to develop viable and affordable alternatives (Khundi et al 2010). Implementation of the land use policy to mitigate the encroachment on forests and adequate land use planning through implementation of the Physical Planning Act.



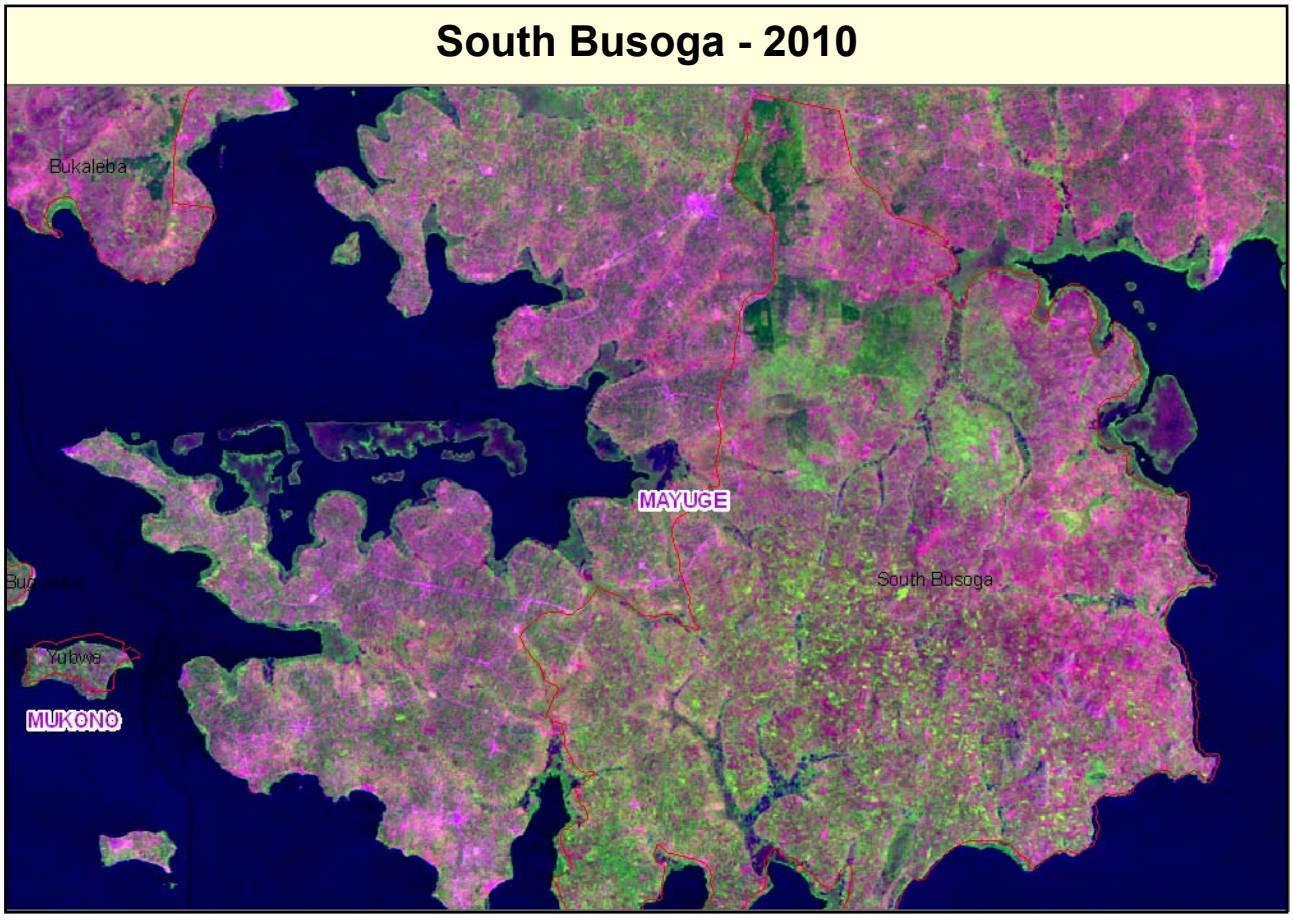


Figure 5.1: Remnant forests in South Busoga for 2005 and 2010
Source: NFA

Tourism

Tourism continues to make a large contribution to all sectors of the economy. The direct contribution of travel and tourism to GDP is expected to be U.Sh 1,363.8bn about US $536m (3.2 percent of total GDP) in 2011 (WTTC 2011). The wider contribution of the subsector to GDP (including wider effects from investment, the supply chain and induced income impacts) is expected to be U.Sh 3,256.8bn about US $1,280m in 2011 (7.6 percent of GDP). Local communities benefit through employment and the provision of goods and services; as do transport companies, tour operators, airlines, shops, mobile phone companies, hotels and restaurants.

Deforestation in Hoima District.
Photo credit: NFA

Uganda recorded a 6 percent decrease in the total arrivals registered in 2009 at the major border posts (Entebbe, Busia, Malaba, Mutukula, Western and Northern). A total of 806,658 tourists (non-resident arrivals) were registered in 2009 compared with 843,644 in 2008 (UBOS 2010). Local and foreign tourists contribute a lot to the livelihoods of the surrounding communities. However, visitors (local and foreign) to the national parks have been increasing over the last couple of years as shown in Table 5.2.

Communities have continued to benefit from existence of protected areas. The statutory 20 percent gate collection to National Parks and Wildlife Reserves has continued to increase. U.Sh 3.420 billion was the cumulative total collection as 'Statutory 20 percent of Gate Entrance' for the period 2002/2003 to July 30th 2008, and U.Sh 2.435 billion the cumulative total disbursed by the Uganda Wildlife Authority to local communities over the same period.

National Parks	2006	2007	2008	2009	2010
Murchison Falls	26,256	32,049	35,316	39,237	53,460
Queen Elizabeth	43,885	51,749	53,921	62,513	76,037
Kidepo Valley	959	795	1,633	2,924	3,208
Lake Mburo	12,508	14,264	16,539	17,521	20,966
Rwenzori Mountains	948	1,583	2,020	1,281	1,529
Bwindi Impenetrable	10,176	9,585	10,362	11,806	15,108
Mgahinga Gorilla	2,071	2,676	3,303	1,886	3,328
Semliki	1,942	1,342	1,732	2,701	3,393
Kibale	6,969	7,651	7,383	7,799	9,482
Mt. Elgon	2,964	3,472	3,708	2,943	2,660
Katonga	772	598	287	448	301
Toro Semliki	642	789	955	759	640
Total	110,092	126,553	137,159	151,818	190,112

Table 5.2: Visitors to National Parks (citizens and foreigners), 2006-2010
Source: UWA in UBOS 2011

The money is used for joint community-UWA management agreed project activities that contribute to livelihood improvement for the rural communities living adjacent to wildlife protected areas, including priority focus on addressing issues of community wildlife conflict along the boundaries. These include building of schools, health centres and road maintenance. Apart from revenue, communities extract other benefits from the protected areas. Several resource extraction agreements have been signed around Wildlife Protected Areas which have enabled communities to extract wildlife resources worth over U.Shs 10 billion annually. These resources include firewood, medicinal plants, crafts materials, thatching grass, fish and water for livestock among others.

Uganda's tourist sector is heavily dependent on well maintained biodiversity and ecosystems. The national parks and other protected areas such as wildlife reserves and central forest reserves are refuges for biodiversity conservation. Further, they are also recognized as economically valuable, by virtue of being relatively undisturbed. Indeed, assessments in South Africa indicate that unconverted, intact and conserved ecosystems are between 14-70 percent economically more valuable than ecosystems that have been converted for agriculture, forestry plantations or urban development (DEAT 2006 in NEMA 2009). Figure 5.1 shows the wildlife protected areas in Uganda.

Protected areas in Uganda do provide a multitude of services that support economic growth, livelihoods and human wellbeing. A study in the Murchison Falls conservation complex (Murchison Falls national park, Ugungu wildlife reserve, Karuma wildlife reserve and Budongo central forest reserve) provides an indication of the economic value of ecosystem and livelihood opportunities provided by such protected area units. For example the role of the Murchison Falls complex in providing households with necessities like firewood was estimated at US $2.5 million per year; food products (honey, mushrooms, fish and food additives and game meat) at US $2.9 million per year; and the value of watershed protection services at about US $14 million per year (see table 5.3). Despite these values, the protected areas have implications for human activities such as agriculture and settlements. For instance the communities are at times at risk through attack from wildlife to their crops, livestock or person estimated at US $1.3 million per year (Mwaura et al 2010).

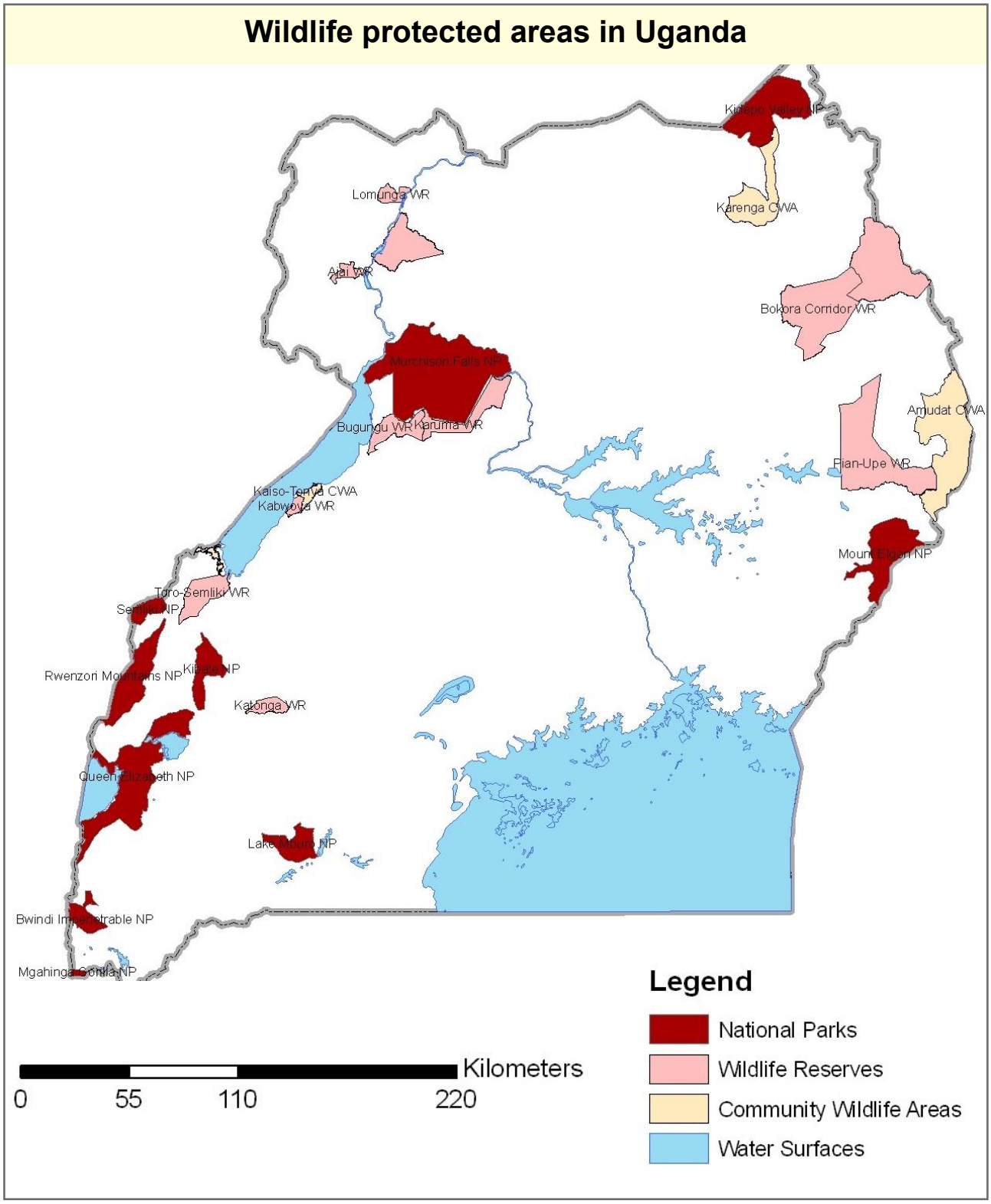


Figure 5.2: Wildlife protected areas in Uganda

Source: UWA 2010

An emerging issue is the management of protected areas in the oil rich Albertine graben. Protected areas occupy 20.9 percent of the total land area. Ten out of the total 22 national parks and wildlife reserves in Uganda are within the Albertine graben. Of these 10, two are World Heritage Sites: the Queen Elizabeth national park and Rwenzori Mountains national park. The protected areas inside and outside the graben form a relatively continuous system linked by wildlife corridors. Box 5.1 describes the biodiversity of the Albertine graben.

Tourists come from all over the world to view the breathtaking Murchsion Falls.

Ecosystem service	Value (million US $)	Ecosystem service	Value (million US $)
Timber stock	76.8	Watershed catchment and protection	13.9
Non-wood forest products (food)	2.9/year	Research and education	24,740
Non-timber products (mainly wood)	2.5/year	Opportunity costs (livestock husbandry)	2.5
Medicinal and pharmaceutical	1.1/year	Opportunity costs (sugarcane growing area)	10.5
Soil erosion control	7.2/year	Relocation and rehabilitation	60,000
Aesthetic value	58.1 (in 2008)	Costs to the community	1.3
Carbon sequestration and storage	2.0/year	Income of the MFCA	1.2 (in 2008)

Table 5.3: Value of ecosystem services of the Murchison Falls Conservation Area (MFCA)
Source: Mwaura et al (2010)

Plant and animal genetic resources

Plant and animal genetic resources are the biological basis of food security and wildlife-based tourism and directly or indirectly support the livelihoods of all people. Plant genetic resources in Uganda range from the indigenous to introduced ones. Some of the indigenous plants include millet and sorghum, while maize, tobacco, cotton and beans are introduced. Cash crops contributed 1.6 percent to GDP in 2009 down from 2.0 in 2008; while food crops contributed 14.0 percent in 2009 up from 11.9 percent in 2008.

In terms of domestic animal diversity, livestock are an integral part of the agricultural system in many parts of the country. Livestock contribution to GDP has been fairly constant over the years: at 1.6 percent in 2005 and 2008; and 1.5 percent in 2006, 2007 and 2009. The livestock include cattle, goats, pigs and chicken among others. The Livestock Census conducted in February 2008 indicated that many households are livestock keepers, but this varies across the country. The indigenous cattle and poultry breeds (93.3 percent and 87.7 percent) were dominant over the exotic ones (6.7 percent and 12.3 percent) in 2009 (UBOS 2010). Livestock also contributes to foreign exchange earnings, employment, nutrition and hides and skins.

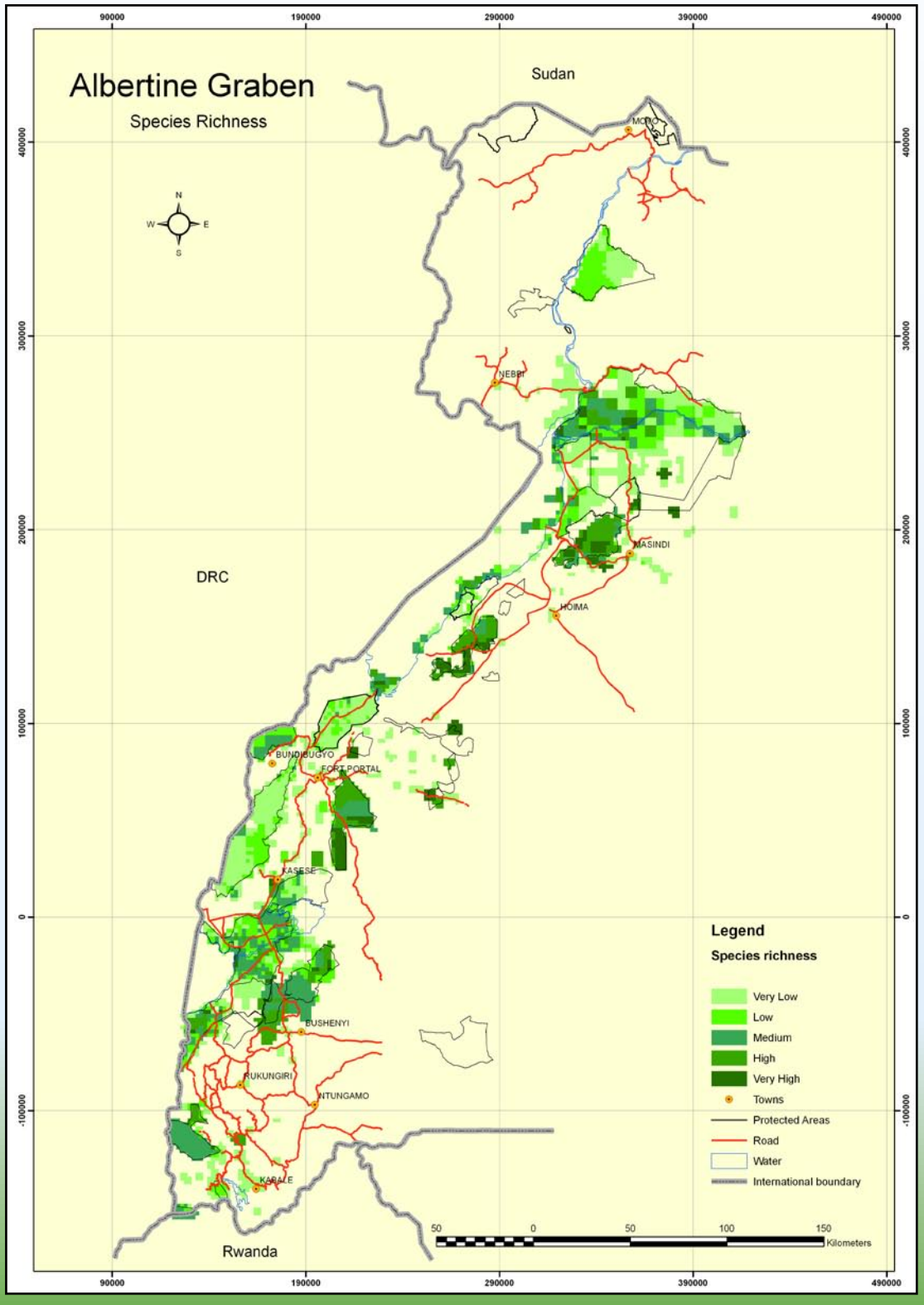
Plant and wildlife animal diversity yields direct benefits such as local and national income from tourism activities, and are a source of bush meat, food, medicine, wildlife hunting, cropping and ranching. Table 5.4 shows the population trends of some of the large mammal species across the country.

Species	1960s	1982-3	1995-6	1999-2003	2004-06	2007-10	Current status in Uganda
Buffalo	60,000	25,000	18,000	17,800	30,308	21,565	Population decreasing
Burchell's Zebra	10,000	5,500	3,200	2,800	4,374	11,814	Population increasing
Elephant	30,000	2,000	1,900	2,400	4,322	4,393	Population increasing
Rothschild's giraffe	2,500	350	250	240	259	984	Population increasing
Hartebeest	25,000	18,000	2,600	3,400	4,439	4,099	Population increasing
Hippo	26,000	13,000	4,500	5,300	7,542	6,580	Population stable
Impala	12,000	19,000	6,000	3,000	4,705	33,565	Population increasing
Topi	15,000	6,000	600	450	1,669	845	Population decreasing
Uganda kob	70,000	40,000	30,000	44,000	34,461	54,861	Population increasing
Waterbuck	10,000	8,000	3,500	6,000	6,493	12,925	Population increasing
Eland	4,500	1,500	500	450	309	1,409	Population increasing
Bright's gazelle	1,800	1,400	100	50	0		Very rare, precarious
Roan	700	300	15	7	0	5	Very rare, precarious
Oryx	2,000	200	0	0	0		Extinct
Black Rhino	400	150	0	0	0		Extinct
Derby's eland	300	0	0	0	0		Extinct
Crocodile							
White Rhino	300	20	0	0	0	11	2 at UWEC and 9 in the Ziwa Rhino ranch (3 young males, 3 mature females and 3 mature males

Table 5.4: Population trends of some key species across the country since 1960 to 2010
Source: UWA 2011

Box 5.1: Biodiversity in the Albertine Rift

The Albertine graben forms part of the western arm of the Great Rift Valley system in East Africa. It is classified as a global biodiversity hotspot. The rich biodiversity can be attributed to a number of factors including great contrasts in relief (from 620-5,100 masl), variable climatic conditions and diverse habitat types and ecosystems (NEMA 2010). The Albertine graben is naturally endowed with biodiversity in terms of species richness and abundance; species of high conservation value and a rich and varied landscape with many ecosystems. The ecosystems range from savannahs and wetlands to forests. The species biodiversity includes 14 percent of all African reptiles (175 species), 19 percent of Africa's amphibians (119 species), 35 percent of Africa's butterflies (1300 species), 52 percent of all African birds (1061 species), 39 percent of all African mammals (402 species of mammals) and about 128 species of fish. It has been described as being the most vertebrate species rich on the African continent. The species richness is shown below.



Source: NEMA 2010

Wetlands and livelihoods

Wetlands biodiversity have many uses and contributions to livelihoods as shown in figure 5.2. This calls for a high level of protection so that future values will benefit future generations. The wetland resources support subsistence and commercial incomes. For instance many people make a living out of clay bricks and pots; papyrus products; medicinal plants; fisheries and ornamentals. These incomes have not been captured in any form and this disadvantages the contribution of wetlands to the GDP of Uganda. In addition, there are a lot of commercial activities taking place in wetland areas that have been converted for rice, diary, horticulture, floriculture and fisheries. The only way to bring wetlands high up on the agenda of government is to ensure that the contribution of incomes is recorded and captured through socio-economic studies throughout the country.

Fish biodiversity

Uganda's extensive natural resources support over 350 fish species although the composition, relative abundance and distribution of the fishes in these water bodies has changed over the past two decades in tandem with the increase in the Nile perch stocks. Lake Victoria continues to be the most important water body in Uganda both in size and contribution to the total fish catch.

The shallow inshore habitats of many lakes support the biology and ecology of virtually all fish species and invertebrate fauna during their larval and juvenile life. This zone is prime habitat and therefore human activities in this region are likely to impact the fish. For example surveys have shown that in Lake Victoria, there are higher densities of Nile perch, Haplochromines and other species in the shallow inshore areas (Taabu et al 2010). Around Lake Albert, the oil development activities such as oil spills and other pollutants in these regions may affect the fish biodiversity and development of fish fry. Key impacts may include severe siltation, bio-accumulation of CFCs in fish tissue, change in water quality resulting from sewage and other oil related development activities. Other impacts from the oil development industry may include contamination of water sources for the residents of fish landing sites by oil spills on the lake, or the need for relocation of residents of fishing communities with attendant disruption of economic activities and livelihoods. Box 5.2 describes the diversity of fish in the Albertine graben.

Box 5.2: Fish biodiversity in the Albertine graben

All the lakes in the Albertine graben are rich in fish biodiversity. Fifty six fish species are reportedly endemic to lakes George and Edward (Plumptre et al 2007 in NEMA 2010 – sensitivity atlas). The region contributes 18.7 percent of the total national fish catch, with 15 percent of this contributed by Lake Albert alone. Fish processing has become an important activity on the lake, both at artisanal and industrial levels.

The most important sources of fish in the region are Lake Albert, Lake Edward, Lake George and rivers especially the Albert Nile, Waki, Wambabya, Semliki and Kazinga Channel. The commercially important fish species in the graben are: Oreochromis niloticus (Nile Tilapia), Bagrus docmak (Catfish), Protopterus aethiopicus (Lung fish) and Clarias gariepinus (Mud fish); and over 50 species of Haplochromine species dominating the fish biomass in all the lakes. Other fish species of less commercial importance but of high nutritional value, occurring in small numbers in all lakes of the graben include Barbus spp, Mormyrus spp and Labeo spp. In terms of fish species richness, Lake Albert ranks highest among the Albertine Graben lakes. Some species such as Alestes baremose, Malapterurus electricus (Electric Cat fish), Hydrocynus forskahlii (Tiger fish), Distichodus niloticus and Brycynus nurse are endemic to Lake Albert.

Source: NEMA 2010

Figure 5.3: The contribution of wetlands to livelihoods and the economy
Source: Wetlands Management Department

Ensuring the Sustainability of the Fisheries Resources

The overall policy in capture fisheries is to increase and sustain fish production and the health of the fish habitat. The major resource sustainability and environmental concerns in capture fisheries fall under those factors that affect the fish stocks, the fisheries genetic resources especially biodiversity, and those factors that affect the fish habitat and aquatic ecosystem. The factors that directly affect the fish stocks include: use of destructive fishing gears and methods; destruction of breeding and nursery grounds; fish in habitats critical to fish survival; capture of immature fish; introduction and transfer of alien fish species; stock enhancement/ restocking processes and proliferation of alien invasive weeds.

The factors that affect the health of the fish habitat include: nutrient enrichment due to activities in the catchment area; siltation of the water bodies from erosion from the catchment areas and pollution; and control of aquatic weeds; water extraction; destruction of riparian zones especially wetlands and the land-water interface.

Developing Aquaculture

As fish production from the five major lakes; Victoria, Kyoga, Albert, Edward and George continues to decline and fish prices on the local and international markets continue going up drastically, aquaculture is being promoted as an alternative source of fish protein and as a grassroots income earner which can reduce fishing pressure on the natural lakes. Uganda has a strong culture of fish consumption with fish forming 63 percent of animal protein consumed. Despite this, the country still has significant levels of undernourishment. Discussions in the foregoing chapters have pointed to a looming food security crisis in the country. Indeed the USDA Global Food Security Assessment 2010-2020 has projected that about 14 million Ugandans will become food insecurity in the next 10 years (The WorldFish Centre 2011). Fish farming has the potential to increase fish supply for consumers and maintain affordable prices and to contribute to food security.

The aquaculture industry in Uganda has growing rapidly. It has increased from a low base of 2,400 tons in 2002 to 52,000 tons in 2008/9 (The WorldFish Centre 2011). Efforts are being made to promote fish farming in the country. The Government, NGOs and international bodies such as the Food and Agriculture Organization (FAO) and the World Food Programme (WFP) have helped to set up fish farms in many parts of the country especially in areas close to and in wetlands where there are permanent sources of water supply using earthen ponds. Individuals have also set up ponds across the country including Arua, Koboko, Lira and Gulu districts. Future plans are geared to moving fish farming into cage culture in natural water bodies and establishment of aquaculture parks. However due diligence should be carried out before establishment.

Further development of the aquaculture industry calls for better planning, careful selection of fish enterprises and greater investment in infrastructure. Government should look into building fish processing plants that are closer to the grassroots farmer. This will enable them to add value to their harvest, prolong the shelf-life of the fish, and link the farmer directly to the market armed with value added products. Further, government guarantees would enable financial institutions to partner with fish farmers and provide them with soft loans to increase productivity.

Existing aquaculture regulations include Fish (Aquaculture) Rules 2003, which regulate aquaculture practices, especially at the commercial level; and there is also a National Aquaculture Development Strategy.

Biotechnology and biosafety

Biodiversity resources buttress all biotechnology processes. Biotechnology can be described as the use of living organisms or their products to modify human health and the human environment (Peters 1993). Traditional biotechnology uses the processes performed by living organisms such as fermentation; while modern biotechnology manipulates the genes in living organisms to bring about required traits. The science underpinning both traditional and modern biotechnology is the use of living organisms to improve crops, fuels and health for human well-being.

Ugandans have been using traditional biotechnology to select animals and plants with the best traits for breeding or cultivation purposes; and to make beer and other traditional foods. Currently in-country capacity is being built for modern biotechnology through the National Agricultural Biotechnology Center, the Universities and other institutions.

There are many arguments for and against the use of modern biotechnology. Traditional means of improving traits such as drought tolerance in some crops and the lack of conventional resistance genes against some pests and diseases through the usual breeding programmes take time and in some cases may even not be successful. These have the potential to put food security and livelihoods at risk, and thus present an argument for the use of biotechnology. For instance, conventional breeding of the disease resistant material for the Banana Bacteria Wilt (BBW) could take over 20 years due to the biological nature of bananas; and since cultural BBW control methods have had limited results, the option being explored is to develop transgenic bananas resistant to the disease. This case is discussed in Box 5.3.

Box 5.3: Using biotechnology against disease: The case of the Banana Wilt disease in Uganda

Bananas are a staple food and a source of income for smallholder farmers in many parts of Uganda. Uganda is the second largest producer of bananas in the world after India, with an estimated production of 10.6 million metric tonnes per year. It is also the world's largest consumer of bananas. Banana yields in the region have however been on the decline due to a number of diseases and pests. During the 1970s, yields were on average 15 to 20 tonnes per ha; and by 2000 yields had declined to 6 tonnes per ha.

In 2001, an outbreak of banana bacterial wilt (caused by Xanthomonas campestris pv musacearum) broke out. Banana bacterial wilt disease is spread mainly by insects and also by use of infected tools. Crops are severely diseased and often wilt before producing bunches or produce bunches with rotten fruits. The disease has had devastating effects on incomes and food security of the affected farmers. It has changed the cropping patterns of whole communities. There has also been significant increase in banana prices as a result of declining production of bananas due to the disease. It is estimated that US$35 million worth of crop was lost in 2005.

Knowledge and practice of traditional control methods by a few farmers have had some impact in reducing the spread. However, total eradication of the disease has not been achieved in any of the affected areas. Efforts are on-going through a public-private partnership to develop banana bacterial wilt-resistant transgenic bananas from the East African preferred germplasm.

Source: AATF 2009.

Threats To Biodiversity

Habitat Loss and Degradation

Habitat loss, modification and alteration are one of the biggest threats to biodiversity. It has been consistently reported in all previous editions of the State of the Environment report. The rate of biodiversity loss is high and was calculated in 2004 to be around 10-11 percent per decade or 1 percent per annum (Pomeroy and Tushabe 2004).

Population pressure is the main driver behind habitat loss. High population growth and densities are leading to pressure for land for settlement, industry and agriculture. This has led to extensive deforestation, encroachment on wetlands, soil erosion, uncontrolled utilization and over-harvesting, overgrazing and poor farming techniques such as shifting cultivation which contribute to extensive and unnecessary clearing of vegetation. In places such as Kabale and Kisoro, which are located within the Albertine Rift area, the increased demand for agricultural land has led to land fragmentation, which is a generalized pattern, observed across all of Uganda. In the eastern districts of Butaleja and Bududa, high fertility rates, fertile soils and reliable rainfall have combined to attract a growing population which is encroaching on the wetland ecosystem of River Manafwa. In Nakasongola, a district in Uganda's drylands ecosystem, in-migration and increased demand have caused over-fishing, which has depleted and degraded the Lake Kyoga fishery. Fishing is considered the most important economic activity by 30 percent of households in Nakasongola (NEMA 2008).

The conflict between development and environment management is increasingly contributing to habitat loss. There is ever growing demand for land for energy development (hydropower), mining and agriculture at all levels. In some cases land in protected areas is being degazetted for development. This degazettement will significantly impact on UWA operations, protected areas management and wildlife conservation in the coming years. The trend and form of impact will however greatly depend on how these developments are managed.

Implications of oil development

Protected areas such as national parks, wetlands and forest reserves face direct competition from land for agricultural production, mining operations or other uses. For instance in the Albertine graben the oil prospecting areas are the same areas of rich biodiversity. Sustainable exploitation of oil thus implies conserving the environment and biodiversity. Otherwise the magnitude and frequency of the disturbances will overwhelm the resilience of the natural ecosystems. Some of the possible impacts include noise and vibrations from equipment; vegetation clearance leading to soil erosion and possible changes in surface hydrology and drainage; disturbances to the local population and wildlife; contamination of soil, water and the air through discharges, flaring, emissions, chemicals used and wastes (PEPD 2011 - presentation).

Habitat fragmentation is likely to be an emerging issue from the oil industry. It eliminates connectivity between natural habitats negatively impacting on wildlife movements and can eventually lead to species becoming endangered or extinct. It involves a certain element of habitat destruction and thus contributes to loss of biodiversity. The causes are either natural (for example geological processes) or human (through land conversion for agriculture, settlement or even large projects like building of hydro-electric power dams). Essentially, the problem is that the smaller an area of habitat is, the fewer the species that tend to be found there.

Prospecting for oil in Western Uganda could expedite habitat fragmentation in the Albertine graben. The protected area system inside and outside the Graben currently forms a relatively continuous network linked by wildlife corridors as shown in figure 5.3. These corridors facilitate the movement of wildlife between habitats that are increasingly being fragmented by farmed and urban ecosystems. It is important that the government maintains the existing wildlife corridors to allow promote exchange of genes, allow animal interactions and to act as dispersal routes. The animal corridors also link Uganda's protected area system to the larger protected areas in the Democratic Republic of Congo. This can be mitigated by ensuring the areas are connected by wildlife corridors.

Implications of loss of forest biodiversity

The reduction in forest cover has negatively affected the supply of forest products and services, resulting in social stress. Threats to forest biodiversity include overharvesting, alien invasive species, encroachment and population pressure. Poor planning, weak enforcement of laws and inappropriate processing technology has resulted in unsustainable harvesting of forest products and the degradation of the resource base. Population pressure continues to grow and evolve. For example, the education policy on free education has led to increasing demand from schools that rely almost exclusively on firewood for cooking as does about 90 percent of the population (CBD 4th report). Livelihoods have also been negatively affected partly as a result of this decline in vegetation cover. Growth in monetary agricultural food production declined from 2.4 percent in 2008/9 to 1.7 percent in 2009/10 (UBOS 2010) in part due to soil nutrient depletion and unpredictable climate variations.

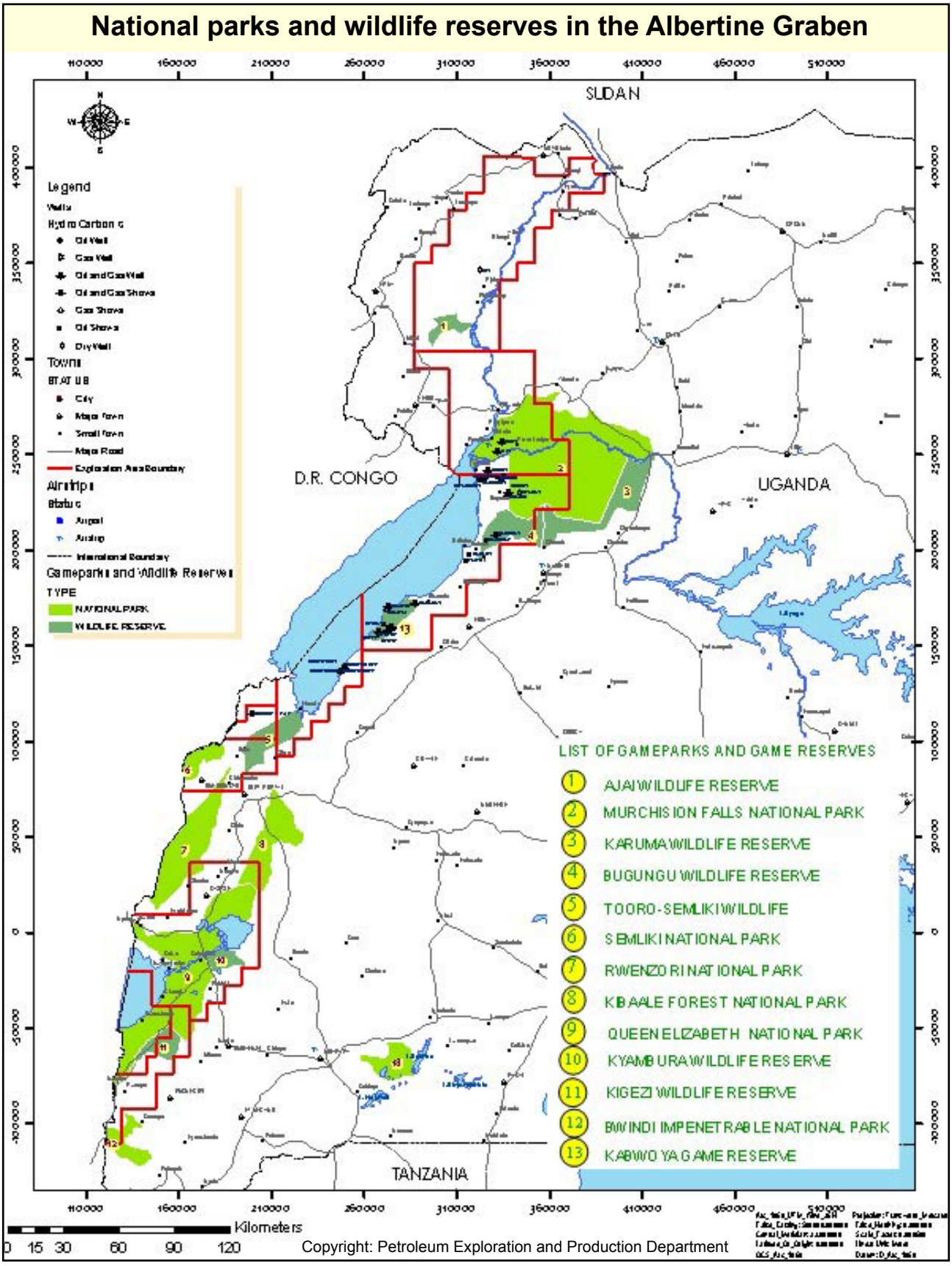


Figure 5.4: National parks and wildlife reserves in the Albertine Graben

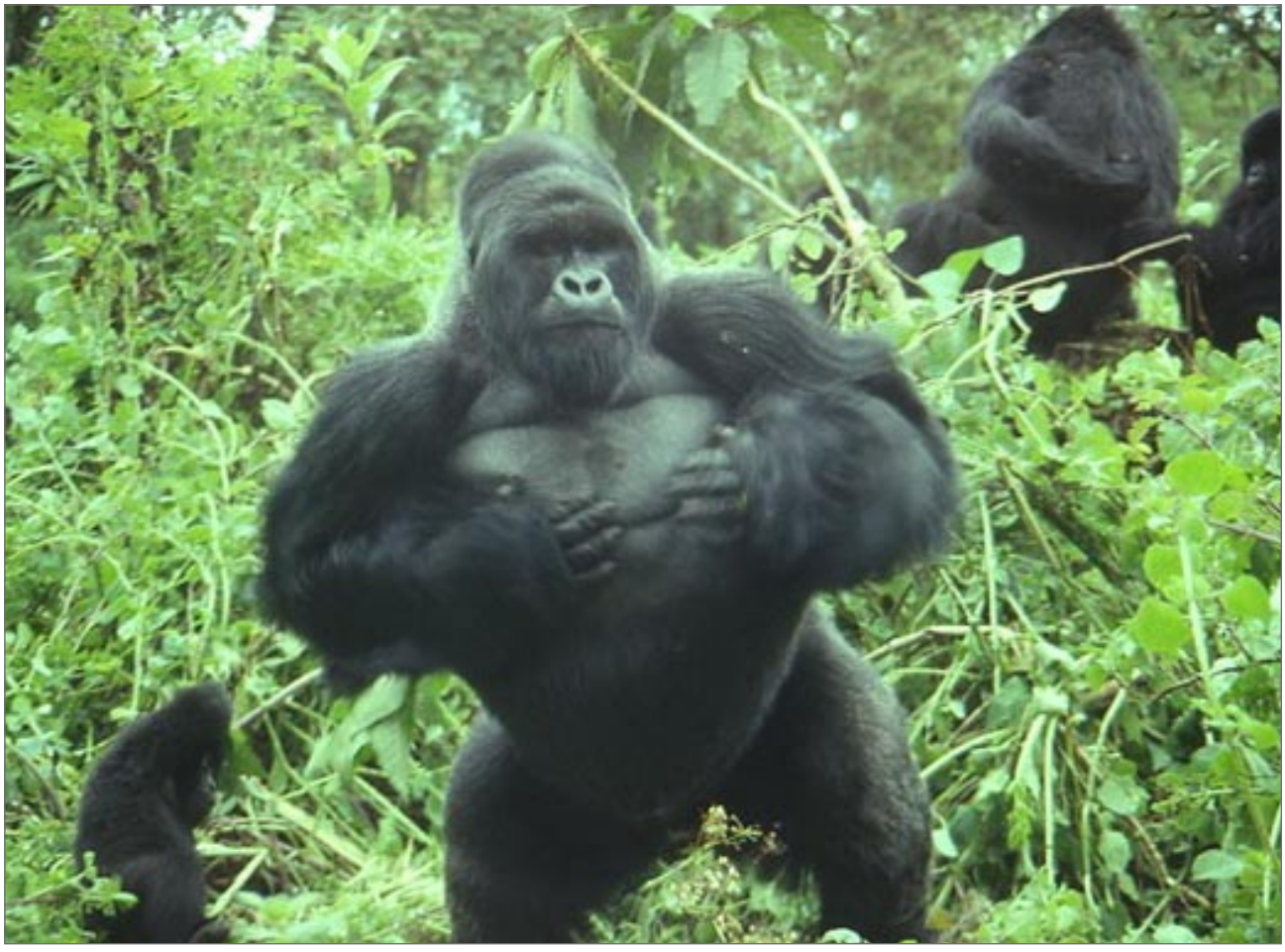
Implications to human health

Activities that lead to loss of habitat such as deforestation; land use change; reclamation of wetlands; water management activities such as irrigation and building of dams; uncontrolled urbanisation; and climate change all lead to changes in the environment. Such environmental

changes for instance in climate contribute to problems of malnutrition, famine and hunger especially among vulnerable populations. They also contribute to changes in disease patterns. For example prolonged drought may lead to food insecurity and malnutrition, further predisposing populations to illnesses. The higher temperatures and increased rainfall associated with climate change may extend the range of disease vectors, for instance the malaria causing mosquito thus increasing transmission of malaria in highland areas in Uganda.

These impacts could be mitigated through better systems for weather forecasting and enhanced management of natural resources. Other methods could include the use of pesticides and other chemicals used to control certain disease vectors. But these are controversial as they are thought to have environmental implications as highlighted by the current discussion regarding the use of DDT for malaria control in Uganda.

Deforestation is in some cases affecting human and animal health. It brings people into closer contact with wildlife and thus allows for transmission of disease from wildlife to humans or their livestock and vice versa. As habitat shrinks for wild species, they are more likely to come into contact with each other, domesticated animals, and people, possibly increasing the chance that infections may spread between them and us. Wildlife, such as buffalo have been found to harbor the parasite that causes Nagana in domestic animals. HIV and Ebola are also thought to have entered humans via primates. On the other hand, the prevalence of scabies among the habituated gorilla population in Bwindi Impenetrable Forest is thought to come from human beings (UWA 2010). The Conservation through Public Health initiative in Bwindi is an example of a program that aims to integrate health, public health and family planning with conservation activities. Issues affecting the interplay among wildlife health, the health of domestic animals, and human health are receiving inadequate attention from protected area managers.



Gorillas in Bwindi National Park.
Photo credit: UWA

Invasive Alien Species

Invasive alien species (IAS) include those plants, animals or micro-organisms living outside their natural range that rapidly spread without man's assistance and have negative economic, environmental and health effects. IAS continue to be a great threat to Uganda's biodiversity and the economy at large.

The Nile Perch in the 1950s and the Water hyacinth in the 1930s are examples of introduced species that have negatively impacted local biodiversity, aquatic ecosystems and the economy. But these are not the only invasive species. Forest biodiversity is also under threat from alien invasive species such as *Lantana camara* in eastern Uganda and *Senna spectabilis* in Budongo forest reserve in the North West. Others include Striga which reduces cereal yields (see box 5.4); and *Cybopogon nardus* that diminishes the productivity of grazing lands. Other invasive species of economic significance include *Acacia hockii, Mimosa pigra*, *Chromolaena odorata* among others. Unfortunately new infestations are continuing to happen. The Congress weed (*Parthenium hysterophorus*) has recently invaded the country. The population of this weed is still small and its spread localised, which makes eradication a distinct possibility. It adversely affects food security, biodiversity, and human as well as livestock health, in eastern Africa. Specifically, contact with this plant causes dermatitis and respiratory malfunction in humans, dermatitis in cattle and domestic animals, due to the presence of toxin parthenin (ISSG 2011).

IAS's are introduced as a result of human activities – for ornamental purposes, through ignorance or for specific purposes like tree planting. For instance the tree planting activities of NFA are focused on introduced species (*Eucalyptus* sp, *Pinus* sp. and *Grevillea robusta*). Although useful to meet short terms needs for timber, they could threaten the survival of native species if there are no guidelines for private tree planting. Moreover, the National Agricultural Advisory Services (NAADS) program has a focus on 'improved varieties' in a bid to modernize agriculture in line with the Plan for Modernization of Agriculture (PMA) (NEMA 2009). Native species are ignored by these efforts. The good news is that the integration of natural resource management is becoming important in the NAADS programs and offers opportunity for addressing this anomaly.

The impact and management costs of invasive plant species are estimated to run into billions of shillings annually in the form of low productivity and revenue from agriculture, forestry, fisheries, trade, transport and other ecological consequences. For example an estimate of annual losses due to the water hyacinth (to fisheries, health, water supply, power generation and transport) is put at US $112 million (Bikangaga et al 1999). In fact currently ESKOM, the Electricity Generation Company still spends US $5,000 per month to mechanically remove the water hyacinth from the Owen Falls Dam (NARO 2008). The annual cost of implementing control measures that could reduce these losses to negligible levels is approximately US $1 million giving a cost benefit ratio of about 100:1 clearly justifying the need for IAS control programs across the country (NARO undated). With *Cymbopogon*, the average cost of not managing it is US $175 per hectare compared with US $25 per hectare. In fact recent estimates put the potential net cost of *Cymbopogon* infestation to the economy at US$ 497 million per annum by 2029 (NARO undated).

Control methods for alien invasive species are still being investigated (NARO 2009). One of the main challenges to managing such alien invasive species for a long time has been the lack of effective strategy for their prevention and management. One of the major advantages of early detection and rapid response mechanisms is reduced costs of controlling them at stages when they are most amenable to control, when populations are still small and localized.

Box 5.4: The case of Striga-infected maize in eastern Uganda

Maize is widely grown all over Uganda and is gaining importance not only as a major food security crop alongside bananas, cassava and sweet potatoes, but also as a source of cash income for small-scale farmers in Uganda. Maize production is being threatened by a parasitic weed called Striga (Witch weed). It is estimated that 62,000ha of farmland is infested with Striga causing an economic loss of US $ 8 million a year. Striga is also the cause of yield losses that range between 10-100 percent.

Striga also parasitizes other crops in the grass family such as sorghum, millet, rice and sugarcane and is, therefore, one of the most severe constraints to cereal production in Sub-Saharan Africa.

The recommended control measures include hand pulling, manuring, hoe weeding, use of trap and catch crops, intercropping, crop rotation, fertilizers, seed treatments, chemical stimulants, and development of tolerant lines. However, most of these known strategies have proved ineffective and have limited impact on the control of Striga for small–scale farmers in Uganda. Controlling Striga through cultural practices alone is difficult due to the high reproductive potential of the parasites, and the below ground damage inflicted on crops where the Striga roots enter the host, feeding on nutrients and moisture, and releasing toxins into the plant causing twisted, discoloured and stunted growth.

Striga's spread and persistence has proved to be one of the most difficult challenges in modern pest management. During the last decade, scientists have developed and evaluated a technology utilizing herbicide-resistant maize to control Striga. The researchers employed conventional breeding to develop Imazapyr-resistant (IR) maize varieties, the seed of which can be coated with the Imazapyr herbicide without affecting the growth of the maize plant. The herbicide coat kills sprouting Striga seedlings as they attempt to attach themselves to the maize roots, protecting the crop and reducing the weed's seed bank in the soil.

Source: AATF 2009.

Poor Information Management for Biodiversity

The lack of a set of approved indicators for monitoring of biodiversity (species, genetic and ecosystem) has impacted the effective monitoring of biodiversity. Some of the challenges have been that at times research data is inappropriate for decision making; a lack of biodiversity monitoring outside protected areas; inadequate data to support decision making. Such information would be of practical use to managers in order to inform policy based on substantive data. Further biodiversity assessments need to be extended to areas outside protected areas. Most data obtained is from inside protected areas. Data acquisition therefore needs to be carried out in the data-deficient areas so as to provide a complete picture of the different levels of biodiversity.

Endangered species in the Albertine Graben.

Strategies For Better Management Of Biodiversity

Managing Alien Invasive Species

There is no overall invasive species policy in Uganda, although a number of polices do make some reference to invasive species either directly or indirectly. These are the National Environment Management Policy 1994; Fisheries Policy 2000; Uganda Forestry Policy 2001; and the Agriculture Policy 2003. Two national planning frameworks - the National Environment Action Plan 1994; and the National Biodiversity Strategy and Action Plan 2002 include reference to invasive species. Some of the legislation that includes reference to alien invasive species includes:

1. The Plant Protection Act 1962, Cap 244
2. Wildlife Act Cap 200 (1996)
3. The Plant Protection and Health Bill (2003)
4. National Forestry And Tree Planting Act (2003)
5. The National Environment Act Cap 153 (1995)
6. The Seed and Plant Act 2006
7. The Agricultural Chemicals (Control) Act 2006.
8. The National Forestry and Tree Planting Act 200

Government has made some progress in setting up a legal and policy framework for the management of alien invasive species. A National Invasive Species Strategy, Action Plan and Policy Guidelines have been developed. Box 5.5 highlights some of its objectives.

Box: 5.5: Objectives of the National Invasive Species Strategy and Action Plan and Policy Guidelines

- Increase awareness about invasive species as a major issue affecting Uganda's socio economic development
- Encourage prevention of alien invasive species introductions as a priority issue requiring national action.
- Ensure that intentional introductions, including those for biological control purposes, are properly evaluated in advance, with full regard to their potential impacts on environment and economic development.
- Promote the development and implementation of eradication and control programmes for invasive species.
- Strengthen necessary research and the development and sharing of an adequate knowledge base to address the problem of invasive species and
- Enhance the development of a comprehensive framework for national legislation and international cooperation to regulate the introduction of alien species.

The Lantana camara (*left)*; The Water Hyacinth on Lake Victoria (*right*).
Source: Net photos.

Using Indicators for Biodiversity Monitoring

Biodiversity indicators are vital for effective conservation, sustainable use and equitable sharing of biodiversity resources. They raise awareness of the interlinkages between biodiversity and key development issues such as economic growth, poverty and climate change. Well developed and relevant indicators can facilitate the regular collection of data ultimately used to answer priority national questions for policy and monitoring.

There has been very little use of biodiversity indicators at all levels in Uganda. However efforts are underway to ensure their mainstreaming and use across national and sectoral targets. The Biodiversity Databank at the Makerere University Institute of Environment and Natural Resources (MUIENR) is the lead agency on biodiversity in the Uganda Environment Information Network (EIN). The EIN, a programme spearheaded by NEMA has the overall goal of developing a sound data foundation in support of information for development.

MUIENR selected nine indicators (Bubb et al 2010) for development using the Pressure-State-Impact-Response framework. These are listed below:

- *Uganda Habitat Cover Index* – an indicator of the average change in the extent of wetlands and forests with 1970 as the base year.
- *Uganda Species Population Index* – a weighted population data for groups of species
- *Uganda Big Six Index* – an indicator of the average change in the population abundance of Uganda's 'Big Six' (mountain gorilla, chimpanzee, Uganda Kob, Rothschild's giraffe, elephant and lion) which are important for wildlife tourism.
- *Uganda Species Richness Index* – an indicator of the total number of species in the country
- *Uganda Primate Index*
- *Uganda Albertine Rift Index*
- *Uganda Grey Crowned Cranes Index*
- *Living Uganda Index 2010* – an indicator of all Ugandan vertebrate species with population data for direct comparison with the global Living Planet Index combining all data for species populations

Implementing a Legal and Policy Framework for Biotechnology

There are always concerns when new technologies are being introduced. Therefore risk assessment and management in relation to environmental health and safety needs to be a major factor in regulating the development and use of GMOs. Appropriate procedures, laws and regulations should be applied and stakeholder concerns, such as with the terminator technology, taken into consideration. The government has a clear vision on how to deal with the emerging technologies in agriculture. This is well articulated in the National Agricultural Research Policy 2003 and the Plan for the Modernization of Agriculture (PMA) and by the establishment of the National Agricultural Biotechnology Center. Further a National Policy on Biotechnology and Biosafety was approved in 2008 and draft Biosafety Regulations and Guidelines developed. The National Biotechnology and Biosafety Bill is being finalised.

Conclusion and Recommendations

Uganda's rich biodiversity provides a unique opportunity to support poverty eradication as part of a sustainable management and conservation strategy. The multiple roles performed by biodiversity encompass food security, agriculture (including the fishing, livestock and crop industry), tourism, wealth creation, serving cultural purposes and the supply of ecosystem services. Ecotourism which is based on forest biodiversity is fast becoming a niche market product for Uganda. The continued loss and degradation of Uganda's biodiversity therefore presents a serious challenge to livelihoods, economic growth and human well being.

The key recommendations include increased protection of forest habitats to reduce deforestation induced biodiversity loss; further implementation of the National Land Use Policy to address issues of encroachment on forests, wetlands and other fragile but biodiversity rich ecosystems; and better management of invasive alien species.

References

AATF (2009). *Feasibility study on technologies for improving bananas for resistance against Bacterial Wilt in Sub-Saharan Africa*. African Agricultural Technology Foundation (AATF), Nairobi.

Bikangaga, S., R. Alinaitwe, J., and Rukunya E. (1999). *Economic Valuation of the Water Hyacinth as an Environmental Problem in Uganda's Freshwater Resources and its Effect on Key Economic Activities*. MAAIF, Uganda.

Bubb, P., Chenery, A. and Stanwell-Smith, D. (2010). *Biodiversity Indicators Capacity Strengthening: Experiences from Africa*. UNEP-WCMC World Conservation Monitoring Centre, UK.

Environment Alert (2008). *Inventory of Critical Issues in the Forestry Sector that require urgent attention for sustainable forestry in Uganda 2008*. Environment Alert, Kampala.

FAO (2010). *The State of the Worlds Fisheries and Aquaculture 2010*. Food and Agricultural Organisation of the United Nations (FAO), Rome.

Forest Department (1996). *Biodiversity Reports for National Forest Reserves in Uganda*. Forest Department, Ministry of Water Lands and Environment, Kampala.

GOU (2010). *National Development Plan 2010/11-2014/15*. Government of Uganda (GOU), Kampala.

ISSG (2011). *Parthenium hysterophorus (herb)*. Global Invasive Species Database. Invasive Species Specialist Group (ISSG) of the IUCN Species Survival Commission.
http://www.issg.org/database/species/ecology.asp?fr=1&si=153&sts

Khundi, F., Jagger, P. Shively G., and D. Sserunkuuma (2010). *Income, Poverty and Charcoal Production in Western Uganda.* 2010-05. Basis Briefs. Assets and Market Acess CRSP. Department of Agricultural and Applied Economics. University of Wisconsin, Madison, USA.

Mwaura, F., Muramira, T.E., Ogwal, F., and M. Guloba (2010). Valuation of protected areas in Uganda: A case study of Mruchison Falls Conservation Complex. In: Okeyo-Owuor, J.B., Kipkoech, A., Osano, O., and E. Okwousa (Eds) (2010). *Payment for Environmental Services for environmental conservation and wealth creation*. Proceedings of the conference on payment of ecosystem services in eartern and central Africa region. 20-22 October 2010. Vol.1. Jinja

NARO (2008). *Management of invasive alien plant species in Uganda*. Risk analysis procedures and early detection and rapid response systems for quarantine authorities in Uganda. National Agricultural Research Organisation (NARO), Kawanda.
http://www.naro.go.ug/Invasivespecies/Reports/1-Risk%20analysis%20Procedures%20and%20early%20detection%20and%20rapid%20response.pdf

NARO (2009). *Removing Barriers to Invasive Plant Management in Africa*. GEF-UNEP regional project National Agricultural Research Organization (NARO), Kawanda.

NARO (Undated). *The cost of Invasive Alien Species to Uganda*. A briefing paper. National Agricultural Research Organisation (NARO), Kawanda.
http://www.naro.go.ug/Invasivespecies/Reports/Cost%20of%20Invasive%20Alien%20Species%20to%20Uganda.pdf

NFA (2009). *National Biomass Study Technical Report 2009*. National Forestry Authority (NFA), Kampala.

NEMA (2008). *Integrated Ecosystem Assessment of the Lake Kyoga Catchment Area*. National Environment Management Authority (NEMA), Kampala.

NEMA (2009). *Fourth National Report to the Convention on Biological Diversity*. National Environment Management Authority (NEMA), Kampala

NEMA (2010). *Environmental Sensitivity Atlas for the Albertine Graben*. 2nd Edition 2010. National Environment Management Authority (NEMA), Kampala.

NEMA (2011). *Contribution of forestry sub-sector to the national economy: the economic value of forest resources of Uganda*. National Environment Management Authority (NEMA), Kampala.

Pamela Peters (1993). W*hat is biotechnology? from Biotechnology: A Guide To Genetic Engineering*. Wm. C. Brown Publishers, Inc., 1993.
http://www.accessexcellence.org/RC/AB/BC/what_is_biotechnology.php

Pomeroy, D. and H. Tushabe (2008). *The State of Uganda's Biodiversity 2008. National Biodiversity* Databank, Makerere University Institute of Environment and Natural Resources, Kampala.

Taabu, A.M., Kayanda R., Nyamweya, C.S, Ezekiel, C., Wabeya, U., Odada, E., and G. Magezi (2010). *Report of the Lake Wide hydro acoustic and environmental survey*. 17 Mar-16 Apr 2010. Implementation of a Fisheries Management Plan Project for Lake Victoria. EDF Project No.8 ACP ROR 029. Lake Victoria Fisheries Organisation of the East African Community.

UBOS 2010). *Statistical Abstract 2010*. Uganda Bureau of Statistics (UBOS), Kampala.

UEPB (2009). *Annual report 2009*. Uganda Export Promotion Board (UEPB), Kampala.

UWA (2011). *Submission to the State of the Evnironment Report for 2010*. Uganda Wildlife Authority (UWA), Kampala.

Kasande, V. (2009). *International environmental law and the question of banned chemicals: the legal implications of the use of DDT in Uganda*. MSc dissertation. Makerere University, Kampala.

WTTC (2011). *Uganda: Key facts at a glance*. World Travel and Tourism Council (WTTC), London, UK.
http://www.wttc.org/eng/Tourism_Research/Economic_Research/Country_Reports/Uganda_/

Sempaya Hot Springs.

CHAPTER 6
Energy Resources

Introduction

Uganda's energy sector comprises of both locally produced and imported traditional and conventional sources of energy. Fuel-wood and charcoal dominate the locally produced traditional energy sources in the country. The two are the most prevalent energy sources at both supply and demand levels. Electricity, petroleum products and renewable energy are the key sources of conventional energy in the country. All petroleum products are imported, while electricity is locally generated except for very limited off-set/inter-connection imports from Kenya and Rwanda (UBOS 2010).

Uganda's internal energy potential is high but comprises of largely undeveloped hydro, mini-hydro, solar, biomass, geothermal and peat resources. Biomass accounts for more than 92 percent of Uganda's primary energy supplies, while imported fossil fuels and electricity supply only 4.1 and 1.3 percent respectively. Uganda is therefore an energy poor nation with limited access to modern sources of energy particularly electricity. Uganda's high dependence and escalated harvesting of biomass puts a lot of pressure on the country's natural vegetation and has triggered massive deforestation. The pattern of energy consumption is also a major threat to the country's economic development. FAO estimates that Uganda looses 50,000 hectares (0.8 percent) of its forests every year. This is particularly a big problem in the forests outside the protected area estate (FAO 2005).

As the forests on private lands disappear, pressure is turned on forests inside protected areas. Although the data indicates no sign of deforestation in the central forest reserves, this situation may not last in the face of ever increasing electricity tariffs. Already the NFA (2007) points to an increasing trend in the number of encroachers (for rural settlements, agriculture and urban expansion) in Central Forest Reserves (from 180,000 people in 2004/05 to 220,000 a year later). Figure 6.1 highlights this situation.

Following prolonged drought and the subsequent drop in the water levels in Lake Victoria in 2006, Government diversified its energy supplies to off-set the short-falls in hydro power generation and avert an energy crisis. New hydro, co-generation and fossil fuel electric generators have hence come online since 2007. The mini hydro-power stations include Mubuku 3 operated by Kasese Cobalt Company Limited (KCCL), Mubuku 1 operated by Kilembe Mines Limited, Bugoye operated by Tronder Power Limited and Mpanga operated by Africa Energy Management Systems while bagasse co-generators are found at Kakira, Lugazi and Kinyara Sugar factories. Three thermal generators are also in use and are found at Kiira, Namanve and Mutundwe.

Commercial scale oil reserves have also been confirmed in the Albertine graben in western Uganda. Test drill information indicates reasonably high prospects with single wells like the Buffalo prospect estimated to hold over 400 million barrels of oil with an estimated value

15 times Uganda's current expenditure (NEMA 2010). Although power demand still outstrips current supplies, the energy sector developments should sustain the brisk economic growth rate enjoyed during the last two decades. The developments should also broaden access to modern energy supplies and ease pressure on Uganda's environment and natural resource base.

Energy Sources And Options

The energy sector in Uganda relies on several local and imported sources of energy. The key sources include locally generated electricity, biomass, imported petroleum products, solar insolation, wind power, thermal energy, biogas and bagasse. Biomass sources of energy are the most widely used sources of energy although hydro-electricity is most popular. Previously, Uganda solely depended on two hydro-power plants at Kiira and Owen Falls dam to generate power. Lately the sector has expanded and diversified. Uganda however, still suffers an energy supply deficit in spite of the huge renewable energy development potential estimated at 5,300MW. The recent discoveries of oil in western Uganda and focus on developing geothermal, mini hydro and solar energy alternatives shall off-set the deficit and help Uganda to sustain positive economic growth (GOU 2002).

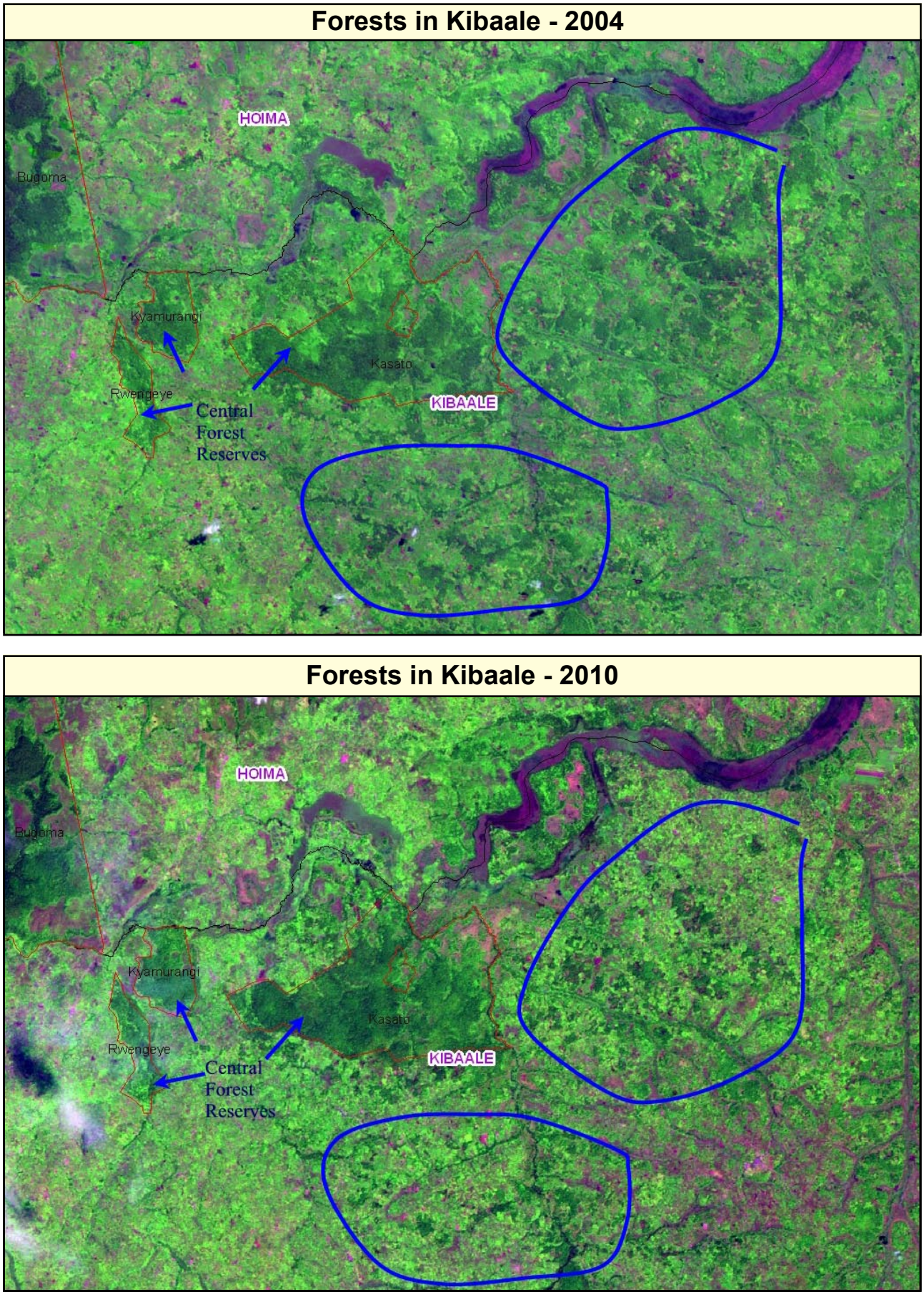
Electricity (Power Sub-sector)

The electricity sub-sector in Uganda involves both on-grid and off-grid players in more or less equal proportions. The total installed power generation capacity (table 6.1) for all on the on-grid electricity generators was estimated at 492 MegaWatts (MW) in 2010. Hydro-electric power generators contributed 66.7 percent, while thermal and co-generated power contributed 30.5 and 2.8 percent of total on-grid power respectively (UBOS 2010). Power generated at the Kiira and Nalubaale dams accounts for 91 percent of the total hydro power generated in the country, while 9 percent is collectively contributed by the various mini hydro power plants across the country. The new Bujagali hydro-power plant is expected to further boost hydro-power generation by another 50 megawatts by October 2011. This will increase to 250 MW once all the turbines are switched on in 2012.

Whereas the total installed power generation capacity for on-grid generation is 492MW, the maximum possible power supply is 387 MW against a maximum power demand of 391MW. This power supply shortage has necessitated chronic load shedding of several electricity users across the country (JICA 2011). Load shedding has various socio-economic implications including lost productivity, unemployment and increased crime. Together with other sectors, energy (or the lack of it) has impacts on the health sector. Electricity allows round-the clock care and the use of essential equipment. These include the cooling systems required for the safe keeping of vaccines. About 24 percent of health facilities - and only 14 percent of Health Centre IIs - have electricity or a backup generator with fuel routinely available during service hours (MFPED 2010).

In addition to the main electricity generators therefore, several mini and micro hydro electricity plants have come online. These include mini hydro dams like Mubuku III operated by Kasese Cobalt Company Limited (10MW), Mubuku I operated by Kilembe Mines Limited (5.4MW) and Mpanga operated by South Asia Energy Management Systems (18MW). The mini hydro dams that mostly do not feed into the main grid but supply power to surrounding areas include Kisiizi Hospital (0.06MW), Kuluva Hospital (0.12MW), Kagando Hospital (0.06MW) and Maziba (1.0MW) which is currently out of operation (ERA 2007).

The mini and micro hydro power stations are in addition to thermal power generators at Kihihi and the West Nile Rural Electrification Company (WENRECO) among others (UBOS 2010).



Blue circles show areas that had patches of forests on private land in 2004. By 2010 most of these forests had been cleared. Over the same period, there were no signs of deforestation in the central forest reserves (blue arrows).

Figure 6.1: Comparing deforestation: Forests in protected areas and on private land in Buyaga and Bugangaizi counties in Kibaale District
Source: NFA

Other off-grid players generate power using autonomous diesel and petrol generator sets (gensets). Many more people use hundreds of thousands of dry cells and batteries to light, run machinery and household equipment. In addition to the high cost of running autonomous generator sets, a lot of electricity is wasted due to under-utilized capacity in the absence of the necessary legislative frameworks to facilitate the sale of electricity by autonomous small scale generators to the national grid or other willing buyers.

The government views the power sector as an important stimulant to economic growth (GOU 2010). It therefore aims to increase power supply using domestic energy sources, mainly hydro-power and to expand the electrification rate from the present 10 to 20 percent by 2015.

There is therefore, a short, medium and long-term plan to ensure that electricity supply meets demand starting 2010 by increasing generation capacity using thermal generators and at least two new large hydro-power dams. Government also plans to enhance the development of renewable energy sources and to implement energy efficiency measures. An energy fund was also established to facilitate the smooth implementation of the planned investments in the power sector (JICA 2011).

The Renewable Energy Policy for Uganda (2007) states that the development potential of renewable energy such as large scale hydro, mini hydro, solar, biomass, geothermal, peat and wind power is estimated at 5,300 in total. The potential contributions are indicated in Table 6.1.

Plant name	2008	2009	2010
Installed capacity	527	492	492
Hydro electricity	315	328	328
Kiira	120	120	120
Nalubale	180	180	180
Kasese Cobalt	10	10	10
Kilembe Mines	5	5	5
Bugoye Tronder Power	-	13	13
Thermal Electricity	200	150	150
Lugogo	50	-	-
Kiira	50	50	50
Namanve	50	50	50
Mutundwe	50	50	50
Bagasse Electricity	12	14	14
Kakira	12	12	12
Kinyara	-	2	2

Table 6.1: Installed electricity generation capacity (MW) 2010
Source: UETCL

Petroleum Resources

Uganda is currently a net importer of all petroleum products. The products including petrol, heavy fuel oil, aviation fuel, kerosene, diesel and liquefied petrol gas (LPG) are imported through Mombasa or Dar-es Salaam port (UBOS 2010). The value of petroleum, petroleum products and related materials imports was more than US$800 million in 2010 representing over 18.5 percent of the total import bill for that year (UBOS 2010).

The turbulence in the global oil market therefore exposed Uganda to serious price shocks and economic challenges including imported inflation and exchange rate instability. Inflation for instance rose from 5.2 in January 2010 to at least 16 percent by December 2010 (BOU 2010). The prices of all oil products remained high with average pump prices at Ushs 3,500 and Ushs 3,700 for diesel and petrol respectively. The implication therefore was that the cost of production and transport in Uganda escalated making the overall cost of doing business extremely high (PSFU 2010).

The high global oil prices emphasize the need to develop the local oil production potential in Uganda. The on-going oil exploration and development activities are therefore important land mark achievements. In line with the overall policy framework of value addition, Government plans to develop an inland oil refinery at Kabaale (Hoima district) in the Albertine Graben. A feasibility study in this respect was done and the phase of promoting the development of the refinery under a Private-Public Partnership (PPP) arrangement will commence soon.

The current estimate of Uganda's oil potential is over 2 billion barrels, capable of supporting a production output level of between 100,000-150,000 barrels per day (bpd) over a 25 year period (JICA 2011). This energy production rate could support an additional theoretical electrical energy generation potential (thermal) of at least 500MW in addition to significantly off-setting the current energy import bill (JICA 2011).

A number of legal, policy and institutional reforms have been elaborated to ensure sustainable and safe exploitation of Uganda's oil and gas resources. Several environmental impact studies have been undertaken to ensure that the exploration and extraction phases of oil and gas developments do not negatively impact the environment and natural resource base.

A National Oil and Gas Policy was passed in 2008. The policy recognizes the competences of various government agencies and departments including NEMA and assigns them specific roles. It also proposes an autonomous Petroleum Authority of Uganda with the role of regulating the various players in the sector (Muramira and Manyindo 2008).

The policy charges the Uganda Revenue Authority (URA) with collection and recovery of oil revenue in line with relevant laws. It also charges the Central Bank with the management of the Petroleum Fund and ensuring that oil and gas activities do not negatively impact Uganda's monetary policy and macro-economic stability. The policy further charges the Ministry of Finance, Planning and Economic Development with ensuring the proper management of petroleum revenues (Muramira and Manyindo 2008).

Officials from the Ministry of Water and Environment and the National Environment Management Authority (NEMA) tour an Oil well at Mpuuta village, Hoima District.
Photo credit: NEMA

The revenue management aspects of the policy will be enforced through targeted sections of the Public Finance and Accountability Act. A position paper to guide the amendment of the Act is being drafted. The Petroleum Exploration and Production Department is also preparing a Resource Management Law and Value Addition Bill to ensure the sustainable management of the oil and gas resources in Uganda. The essential elements of all the proposed laws aim at ensuring that oil revenues are prudently utilized to preclude an oil curse.

The oil curse theory portends that some oil rich countries sink all their development effort in the oil sector at the cost of other industries and government programs including agriculture, environment, health care and education. This causes a series of chain reactions which impede or even stall economic development.

NEMA with financial support from the oil for development program of the Government of Norway is engaged in a series of activities to ensure that environment management remains at the forefront of oil development activities. NEMA with this support has prepared an Environmental Sensitivity Atlas for the Albertine Graben to provide environmental planners and oil and gas developers with tools to identify the social, environmental and economic resources at risk, establish protection priorities and identify timely appropriate responses and clean up strategies. The atlas is supported by elaborate environmental monitoring indicators and monitoring frameworks (NEMA 2010)

Charcoal, Wood Fuel and Farm Residues

Most Ugandans live beyond the reach of electricity and therefore rely on wood fuel (firewood and charcoal) and farm residues as their primary source of energy for heating, cooking and lighting. The National Biomass Energy Demand Strategy 2001-2010 estimated that firewood, charcoal and residues met more than 97 percent of the total energy requirements in Uganda. This represented a rise in demand of 7 percent since 2008. The demand for biomass energy has risen apace with the country's population estimated to increase at a rate of 3.6 percent per year in 2008 (UBOS 2010).

The National Biomass Energy Demand Strategy 2001-2010 also noted that 81.8 percent of Ugandan households (22.4 percent urban households and 91.4 percent of rural households) use firewood for cooking and another 15.2 percent charcoal (66.6 urban households and 7.0 percent of rural households). Combined this amounts to 97 percent of Ugandans using wood, residues or charcoal (89 percent urban households and 98.4 percent of rural households) (GOU 2001).

The dominant use of biomass for household energy supply is the single most important cause of deforestation in Uganda. It is also a major factor in terms of household productivity as deforestation leads to increases in the distance and time required to gather wood-fuel. Recent studies indicate that between 1992 and 2010, the average distance traveled to gather fuel-wood significantly increased (it was 0.06 km in 1992 and 0.73 in 2000) (Saundry 2009).

The biomass sector is therefore under threat because forests as the primary source of biomass are being decimated without corresponding investments in biomass production for energy supply. There is also very little effort to process and add value to the large amounts of agricultural residues left to rot in the fields. Most biomass is used in its traditional and unprocessed from resulting in significant wastage (Byakola and Mukheibir 2009).

The heavy dependence on biomass threatens the energy security of many rural poor households. It also increases the share of the burden on women and children who bear the primary responsibility of collecting fuel-wood. The WHO estimates that nearly 20,000 deaths are caused by indoor air pollution due to use of biomass for cooking annually. It is estimated that in door air pollution is responsible for 4.9 percent of Uganda's national burden of disease. With deforestation and increased scarcity of wood, biomass resources have to be transported over longer distances thus further increasing the already high cost of energy to households (Byakola and Mukheibir 2009).

In an effort to address the increasing challenge of air pollution in urban areas the Eastern Africa Regional Framework Agreement on Air Pollution (Nairobi Agreement-2008) outlines actionable targets in addressing air pollution in the key areas of transport, industry and mining, household waste, vegetation fires, urban planning and management and regional and national environmental governance.

Biomass resources are also a main source of energy for small and medium scale industries and commercial activities including bakeries, tea processors, tobacco curing, lime and brick making, fish smoking, jaggeries and distilleries (MEMD 2006). The commercial woody biomass is therefore very important in that respect.

Charcoal trade is a thriving industry: Charcoal bags ready for sale in Nakasongola, Nakaseke and Luweero Districts.
Photo credit: NFA

Charcoal production and trade has become a critical part of the rural economy (revenues, taxes and direct household incomes). Local Governments collect about USh 2 billion on charcoal movement alone. The NFA collects between USh 2.3 and 5.3 billion in terms of permits and licenses. This importance of forests, however, is not reflected in national economic policy statements or the national accounts (NEMA 2011). It is estimated that participation in charcoal production translates into a US $319 increase in household income per adult per year and reduces the likelihood of households falling below the poverty line by approximately 14 percent (Khundi et al 2010). However, unless regulated, the combined effect of deforestation and high consumption is likely to lead to a national fuel wood deficit.

The biomass energy sector saves the country tens of millions of US$ in foreign exchange annually. If all Ugandan industries currently using wood converted to petroleum products, Uganda's energy import bill would increase by over US$150 million a year. Biomass resources supply thirty times as much energy as petroleum and electricity combined on an end user basis. This is approximately five times in financial value terms. Biomass resources also supply four times as much final energy to industrial and commercial sectors, as petroleum and electricity combined (GOU 2001, NFA 2009). Recent studies note that biomass energy resources will continue to dominate the energy mix for Uganda for the foreseeable future. Even if the entire hydro-electric potential of the country of 2000MW is fully utilized, wood supplies will still contribute more than 75 percent of total energy consumption in year 2015.

Solar

The National Energy Policy for Uganda 2002, notes that Uganda is richly endowed with solar energy resources. Uganda has plenty of sunshine giving solar radiation of about 4-5 kWh/m2/day. This level of insolation is sufficient to run most solar technology applications. Solar energy applications in Uganda include solar photovoltaic cells (PV), solar water heaters, solar cooling systems and solar driers including direct crop drying (Saundry 2009).

Photo voltaic cells are generally required for applications where modest power needs exist mainly in areas that are not served by the grid. They provide power for lighting, telecommunications, vaccine and blood refrigeration and for playing radio and television sets. This technology has also proven application in remote areas including islands and mountainous areas where the national grid will remain inaccessible for the foreseeable future (Saundry 2009). Government and several NGOs are currently implementing solar voltaic projects with credit financing components to increase the adoption of this technology. The key benefit of the technology transfer is get some households and small commercial enterprises off the grid particularly at peak hours. A proposed 50MW solar thermal project is also under study at Namungona in Wakiso district (Saundry 2009).

Hydro-geothermal Energy

Hydro-geothermal resources are another source of renewable energy alongside biomass, solar power and wind energy. Uganda's hydro-geothermal energy resources have a potential to generate up to 450MW of electrical power accounting for approximately 8.5 percent of the total potential electrical power generation in Uganda (Busingye 2009). The major geothermal sites in Uganda include Buranga in Bundibugyo, Katwe in Kasese and Kibiro in Hoima.

The National Energy Policy for Uganda (2002) states that the policy objective of developing geothermal energy resources is to complement hydro and thermal power sources to meet the country's energy demand and particularly for rural areas far away from the current grid network. Hydro-geothermal resources are also important for providing power in the long-term.

Hydro-geothermal resources are particularly important in Uganda due to their location in remote areas with no grid network. These resources provide the only viable network for developments in such areas. The development of remote geothermal based independent grid networks would pre-empt the problems of long transmission distances and the associated energy losses. They would also further climate proof the energy sector in view of their resilience and stability compared to hydro-power systems. Hydro-geothermal resources are also environmentally benign.

Wind Energy

The average wind speed in Uganda is about 3 metres per second. In flatter areas especially around Lake Victoria and the Karamoja region as well as tops of hilly areas, the speed may go higher than 6 meters per second. This wind regime is good enough to support wind technology applications in the country. However, these wind speeds have been recorded at low heights for purposes of predicting weather. No measurements have been made at appropriate heights (over 10 m) for wind turbine design.

The most dominant application of wind technology in Uganda is still experimental with a few windmills set up for street lighting in Kampala and for pumping water in Karamoja. Programs to establish the true potential of this resource and to promote its use have now been initiated with assistance from the African Development Bank and several private sector initiatives.

Sempaya Hot Springs.
Photo credit: UWA

Bagasse Based Cogeneration

Cogeneration is the simultaneous production of energy, heat and power from a single energy system. It is also known as combined heat and power (CHP) technology. The technology has been used for some time by the three main sugar processing companies in Uganda namely Kakira Sugar Works Ltd (KSWL), Kinyara Sugar Ltd and Sugar Corporation of Uganda Ltd (SCOUL) to generate electricity for own use. Following the reforms in the electricity sector, KSWL and Kinyara Sugar Ltd started producing surplus power which they export to the national grid.

The current cogeneration capacities for the two factories are 22MW for KSWL and 9.5MW for Kinyara Sugar Ltd respectively. These could be expanded to 50 MW for KSWL and 30 MW for Kinyara once an appropriate feed-in tariff and necessary financing are secured.

Biogas

Biogas (a mixture of approximately 60 percent methane and 40 percent carbon dioxide) is a well established fuel that can supplement or even replace wood as an energy source in Uganda. The fuel is a cheap and clean source of energy that is mainly used for cooking and lighting. It is generated by the anaerobic digestion of organic waste including human excreta, cattle, chicken and other animal dung. Table 6.3 below shows some of the typical applications and equivalents for a cubic metre of biogas.

Application	$1m^3$ biogas equivalent
Lighting	Equal to 60-100 watt bulb for 6 hours
Cooking	Can cook 3 meals for a family of 5-6
Fuel replacement	0.7kg of petrol
Shaft power	Can run 1 hp motor for 2 hours
Electricity generation	Can generate 1.25kWh of electricity

Table 6.3: Biogas applications

Most biogas digesters in Uganda use cow dung as feedstock. This has falsely made most people believe that biogas may only be derived from cow dung. There is therefore a widespread constraint on the supply of feedstock. Cow dung also yields much less gas than other feedstock. These constraints can be overcome by mixing cow dung with other wastes including piggery waste or human excreta (Kasisira and Muyiiya 2009).

Cattle grazing on the banks of River Semliki.
Photo credit: NEMA

Nuclear Power

The development potential for nuclear power depends on the possibilities around procurement of nuclear fuel including uranium and plutonium and the technical possibilities for disposing nuclear waste and spent fuel. It is therefore difficult to accurately estimate the development potential for nuclear power in Uganda at this time. The hydro-power Development Master Plan Study however put the development potential for nuclear power for Uganda at between 600-2000MW.

A nuclear power law (Atomic Energy Act, Cap. 143) was passed by Parliament in 2008. The law is expected to strengthen technical cooperation between Uganda and the International Atomic Energy Agency (IAEA) particularly in nuclear power developments and application in medicine and agricultural research, before venturing into electricity power generation. Despite the arguments in favour of nuclear energy, there are risks. These include possible human health impacts from contact with radioactive materials. Exposure to such radiation can cause physical, mental and even genetic changes in people; and also contaminate the soil and water.

The recent nuclear accident in Japan however, put a big question mark on nuclear safety and disaster risk management. These questions may negatively influence the speed at which Uganda will develop towards nuclear energy capability.

Opportunities For A Sustainable Energy Supply

Renewable Energy Resources

Uganda is well endowed with a variety of renewable energy resources. The key renewable energy resources include geothermal, biomass based cogeneration, small hydro, biogas and wind. Most of Uganda's renewable energy resources have never been fully developed. Some are only partially developed. Once developed, Uganda's geothermal and cogeneration potential can play a vital role in contributing to the country's energy mix. They would also create employment opportunities for the population.

Karekezi et al (1997) specifically pointed out that small hydro projects can significantly contribute to economic development of rural areas. They have tremendous potential and hold the promise of improving rural productivity. Renewable energy resources offer a great potential in supporting interventions that will reduce rural poverty and over dependence on natural vegetation. Their decentralized nature also promotes the emergence of micro and small businesses and health services necessary in helping communities to cope with climate change and extreme weather conditions.

In addition, Uganda is heavily endowed with forests, rivers and lakes which although threatened by the current unsustainable levels of consumption are of great social and economic value to the country (Byakola 2007).

Developing the Oil and Gas Industry

Uganda also has a high petroleum potential. Of the 34 oil and gas wells that were drilled in the last ten years, 32 had good oil prospects, with a total estimated yield of 2 billion barrels. The size of the reserves can sustain production for over 25 years (NEMA 2010).

Key Challenges In The Energy Sector In Uganda

The energy sector in Uganda is riddled with many challenges. Some of the challenges are structural and anthropogenic, while some are natural and long-term. The key challenges include decreased hydro-power generation capacity due to reduced lake and river water levels, high fossil fuel prices, deforestation and a growing shortage of fuel-wood and increased health problems associated with indoor air pollution.

Decreasing Hydro-power Generation Capacity

The first key challenge has been the prolonged drought over the last 5 years. This reduced lake water levels and grossly affected the hydro-power generation potential at both the Kiira and Nalubaale Power Stations in Jinja. The total installed power generation capacity at the Nalubaale Dam of 380MW has been used at only 140MW implying acute shortages of power. This has necessitated switching to expensive thermal power generators at a comparative price disadvantage of over USh 300/kWh.

Power demand increased in recent years, given robust economic growth, and is currently estimated at 382 MW during peak hours (6pm-midnight), 280MW during shoulder time (6am-6pm) and 203MW during off-peak hours (midnight-6am) Available supply however, is only 246MW during peak hours and shoulder time, and 132 MW during off-peak time. This results in load shedding at peak periods of around 140MW.

Deforestation

The national energy mix is dominated by biomass resources which account for 92 percent of total energy supply. This huge dependence and escalated harvesting of biomass puts a lot of stress on the country's natural vegetation and has resulted in massive deforestation.

The electricity industry in Uganda is based on the main supply points in Jinja. This system depends on highly centralized electricity supply infrastructure. The centralized nature of the supply system makes distribution expensive and highly vulnerable to disruptions. These challenges have meant that poor people in rural areas cannot afford electricity resulting in an access level of only 3 percent and a low per capita consumption of 62kWh per year.

The conventional energy sector including electricity and petroleum consumes the bulk of energy investments in Uganda. The sector however, caters for a small section of Ugandans (3 percent of the total population). Not much investment has been mobilized to improve the other segments of the sector. This leaves the country open to external fuel price shocks and vulnerabilities.

Health and Environmental Impacts of the Oil and Gas Sector

It is well documented that oil has many benefits and indeed the energy is necessary to support livelihoods and human wellbeing. But each stage in the life cycle (oil exploration, drilling, extraction, transport, refining and combustion of oil) carries risks for humans, wildlife and ecosystems. Table 6.4 summaries some of these health impacts.

Effect	Subcategory
Deforestation	Emerging infectious diseases
Chronic environmental degradation	Discharges of hydrocarbons, water and mud; increased concentrations of naturally occurring radioactive materials
Physical fouling	• Reduction of fisheries • Reduced air quality resulting from flaring and evaporation • Soil contamination • Morbidity and mortality of biodiversity
Habitat disruption	• Noise effects on humans and animals • Pipeline traversing landscapes and water bodies
Occupational hazards	Injury, dermatitis, lung disease, mental health impacts, cancer
Livestock destruction	
Spills	• Destruction of farmland, terrestrial and freshwater communities • Contamination of groundwater • Death of vegetation • Disruption of food chain
Environmental damage	• Hydrocarbons • Thermal pollution • Noise pollution, ecosystem disruption
Hazardous material	• Chronic lung disease
Exposure	• Mental disturbance • Neoplasms
Accidents	• Direct damages from fires, explosions, chemical leaks and spills
Air pollution	• Particulates • Ground level ozone
Acid rain	• NO_x, SO_x • Acidification of soil • Eutrophication of aquatic ecosystems
Climate change	Global warming and extreme weather events with associated impacts on agriculture infrastructure and human health

Table 6.4: Health and environmental impacts of the Oil and Gas sector
Source: Epstein and Selber undated

Strategies For Better Management Of Uganda's Energy Resources

Policy Initiatives

A number of policy level initiatives are in place to enhance energy security in Uganda. The main thrust of the initiatives is to broaden the fuel mix, reduce the demand for energy and increase energy use efficiency (UNEP 2007).

The specific policy initiatives include increased efficiency of both electricity and biomass energy use; focus on developing renewable sources of energy particularly for electricity generation and energy demand forecasting and planning.

The Ministry of Energy and Mineral Development (MEMD) initiated and implemented activities to improve efficiency in energy conversion and use in households and small scale industries in Kampala, Soroti, Adjumani, Kabale and Tororo. It promoted sustainable charcoal production

in Luwero, Nakasongola and Masindi and lime production in Kasese, Kisoro and Tororo. The Ministry also developed and is implementing sub-sector strategies and an Energy Information System to operationalise the National Energy Policy 2002 and the National Renewable Energy Policy for Uganda 2007.

A National Biomass Energy Demand Strategy has been implemented with the specific objective of removing barriers to increasing energy efficiency in households and small scale industries in rural and peri-urban areas. The strategy led to increased electricity co-generation by sugar factories and increased use of energy saving cook-stove technologies by households and institutions.

Energy Research

Considerable resources have been invested in geothermal energy research and prospecting and several mini hydro-power plants are scheduled or under construction. Mpanga Mini Hydro Power Station, an 18 MW station was commissioned in March 2011. The purpose of these investments is to substitute thermal power generation, reduce the cost of power generation while also reducing Uganda's carbon footprint in addition to improving the development opportunities for rural Ugandan's.

Conclusion and Recommendations

Uganda is an energy poor country. Less than 5 percent of Ugandans have access to electricity, making Uganda's per capita energy consumption one of the lowest worldwide. Combined with chronic electricity shortages, problems in the energy sector continue to greatly affect the country's prospects for economic growth. The shortage of electricity affects all sectors of the economy.

While it is critical to further invest in the modern energy sector, specific investment focus should be given to the new and renewable energy sub-sector. Solar, wind, bio-energy, geothermal and small hydropower should be prioritized in this respect. Incentives should be provided to encourage investments in this area.

Renewable energy sources have the potential to lift the burden off Uganda's forests. They could also provide the much needed power for irrigation and support coping mechanisms for communities faced with the dire impacts of climate change and extreme weather conditions. Renewable energy sources would also provide cleaner energy and reduce the health impacts associated with biomass energy based indoor air pollution.

References

Busingye L. (2009). *Geothermal Development in Uganda*. An Overview. Paper Presented at a NUFFIC Conference. NUFFIC, Kampala.

Byakola T. and Mukheibir (2009). *Energy Systems Vulnerability, Adaptation and Resilience Report for Uganda*. Helio International.

Epstein P.R. and J. Selber (Eds) (undated). *Oil: A life cycle analysis of its health and environmental impacts*. Executive Summary. Center for Health and the Global Environment Harvard Medical School. Also available on:
http://chge.med.harvard.edu/publications/documents/oilreportex.pdf

ERA (2007). S*mall HydroPower Development in Uganda*. Electricity Regulatory Authority (ERA), Kampala.

FAO (2005). *Global Forest Resources Assessment Country Reports: Uganda*. Forest Resources Assessment Program. Food and Agriculture Organization of the United Nations (FAO), Rome.

GOU (2001). *The National Biomass Energy Demand Strategy for Uganda 2001-2010*. Ministry of Energy and Mineral Development, Government of Uganda (GOU), Kampala.

GOU (2002). *Energy Policy for Uganda*. Ministry of Energy and Mineral Development, Government of Uganda (GOU), Kampala.

GOU (2007). *The Renewable Energy Policy for Uganda*. Ministry of Energy and Mineral Development, Government of Uganda (GOU), Kampala.

GOU (2010). *National Development Plan 2010/11-2014/15*. Ministry of Finance Planning and Economic Development, Kampala.

JICA(2011). *Project for Master Plan Study on Hydro-Power Development in the Republic of Uganda*. Final Report. Japan International Cooperation Agency (JICA). Ministry of Energy and Mineral Development, Kampala.

Kasisira L. L. and Muyiiya D.D. (2009). *Assessment of the Effect of Mixing Pig and Cow Dung on Biogas Yield*. In: Agricultural Engineering International: The CIGR Ejournal. VolXI, 2009.

MEMD (2008). *Renewable Energy Investment Plan for Uganda (draft)*. Ministry of Energy and Mineral development, Kampala.

MFPED (2010). *Uganda MDG 2010 Report*. Ministry of Finance Economic Planning and Development (MFPED), Kampala.

Muramira T.E. and Manyindo J. (2008). *Sharing Oil and Gas Revenue in Uganda*. Uganda Wildlife Society (UWS), Kampala.

NEMA (2008). *National Implementation Plan of the Stockholm Convention on Persistent Organic Pollutants in Uganda*, National Environment Management Authority, Kampala.

NEMA (2010). *Environmental Sensitivity Atlas for the Albertine Graben*. Second Edition 2010. Kampala.

NEMA (2011). *Contribution of the Forestry Sub-Sector to the National Economy: The Economic Value of Forest Resources of Uganda*. Draft Report. National Environment Management Authority (NEMA), Kampala.

NFA (2009). *National Biomass Study. Technical Report December 2009*. National Forestry Authority (NFA), Kampala.

PSFU (2010). *Quarterly Economic Report on the State of the Ugandan Economy-February 2010*. Private Sector Foundation Uganda Policy Advocacy Unit, Kampala.

Saundry, P (2009). *Energy Profile for Uganda*. Energy Information Administration and Library of Congress. http://www.eoearth.org/article/Energy_profile_of_Uganda

UBOS (2010). *Statistical Abstract 2010*. Uganda Bureau of Statistics (UBOS), Kampala.

UNEP (2007). *Analysing Our Energy Future. Some Pointers for Policy Makers*. United Nations Environment Program (UNEP, Nairobi.

Landslides disaster in mountainous Bududa District, 2010

CHAPTER 7
Environmental Vulnerability

Defining Environmental Vulnerability

Environmental vulnerability is the degree to which an environmental system is susceptible to, and unable to cope with the adverse effects of human induced changes and other exogenic factors such as climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of change and variation to which a system is exposed, its sensitivity and its adaptive capacity. It is regarded as a function of exposure, sensitivity to impacts and the ability or lack of ability to cope or adapt. The exposure can be to hazards such as drought, conflict or extreme price fluctuations, and also underlying socio-economic and institutional situation. The severity of the impacts not only depend on the exposure, but also on the sensitivity of the specific unit exposed (such as a watershed, an island, a household, a village, a city or a country) and on the capacity to cope or adapt. The concept of vulnerability is an important extension of traditional risk analysis, which focused primarily on natural hazards (Turner et al 2003, Schneider et al 2007, Jäger and Kok 2008, Leichenko and O'Brien 2002).

Why Focus On Environmental Vulnerability?

Like many other developing countries, Uganda's economy and human livelihood is directly underpinned by the integrity of the environment. Indeed 87 percent of people's needs are met through direct access to the natural resources (assets). Environmental vulnerability therefore has direct correlation to human vulnerability in the country as it dovetails into social, economic and physical vulnerability in the medium and long run.

Environmental vulnerability assumes that the greater the degradation, the higher the vulnerability of the natural assets. So a high level of deforestation means a high level of vulnerability to increased rainfall. Rain falling on exposed soil can lead to soil erosion, landslides, floods and siltation. Furthermore building houses in high risk places makes people more vulnerable. For example building in wetlands can alter the hydrology of the swamp leading to floods, increased exposure to diseases such as malaria and reduces the ability of the ecosystem to perform functions like water purification.

The poverty that compels people to build in marginal areas like wetlands or steep mountain slopes is called *economic vulnerability*. Changes in weather patterns can increase *human vulnerability* directly or indirectly through the ensuing impacts on water, air and food quality such as the increased risk of disease epidemics. Social vulnerability is affected by aspects of governance including efficiency of government processes, quality of regulation and the rule of law among others. The state and condition of the infrastructure around us can increase *physical vulnerability*. For example, a wooden house is sometimes less likely to collapse in an earthquake, but it may be more vulnerable in the event of a bush fire.

The state of the environment (physical, chemical or biological components of the earth's systems, biosphere, basin, etc) is induced by driving forces (economic and human activities) through pressures (emissions, wastes); and this affects the normal functioning of ecosystems and the welfare of human beings (UNEP 2010). Environmental and other impacts are sector or ecosystem-specific. The next sections discuss some of these impacts in relation to the economy, health, food security and agriculture.

Siltation and flooding can damage food crops and roads and lead to contamination of water source especially boreholes increasing vulnerability

Environmental Vulnerability and the Economy

Uganda's economy is largely agrarian, mainly supported by subsistence farmers who still rely on natural fertility of the soils to raise crops. According to UBOS (2011), the contribution of agriculture to total GDP has been declining over the years, but the sector is still important to the economy and peoples livelihoods. In 2010, it contributed approximately 21 percent of the total GDP at current prices and approximately 46 percent of the total export earnings. About 66 percent of the working population is employed in the agriculture sector. Furthermore the 85 percent of the population that live in the rural areas derive their livelihood from the agricultural sector. As such anything that negatively impacts on agriculture increases the vulnerability of the people and of the sector as well, including those which are income generating.

In general, an economy is vulnerable when it shows a high sensitivity to extrinsic shocks associated with extensive trade liberalization or a heavy reliance on foreign capital or foreign investment flows (O'Connel 2001 in ECLAC 2002, Destremau and Salam 2001 in ECLAC 2002). In the past the most common impacts on the economies of developing countries such as

Uganda were mainly trade-related and were linked to fluctuations in the demand and prices for their main exports. At present, though, financial shocks have become the predominant problem (Ocampo 2001). The ability of the country to build up defences in terms of its financial structure and the functioning of the economy is what makes it vulnerable or resilient to external shocks such as the global economic meltdown (Ocampo 2001). If the response capacity fails, there is still the option of adapting, which means that vulnerability can be moderated or neutralized in the medium and long term, if mechanisms for structural change are used to reallocate resources, reorganize production and find alternative sources of financing.

Although Uganda's economy has proved quite resilient towards the recent global financial meltdown it has had some effects. According to Sewanyana et al (2009) direct impacts include the negative impact on the stock exchange and on portfolio flows. Export volumes and prices have gone down: even regional-bound exports that were thought to cushion the economy have not been spared. Imports have shot up on account of the depreciation of the Uganda shilling, cutting into the profits of domestic firms. With foreign capital and other inflows like aid (at least non-official development assistance) and remittances going down, coupled with reduced revenue collections, the budget deficit will increase and expenditure on priority areas may be affected. To mitigate these problems, it is important that the government reduces wasteful spending and targets its expenditure at productivity-enhancing sectors that may fiscally stimulate the economy (Sewanyana et al 2009).

Coupled with reduced inflows, the rising food prices have led to an increase in annual inflation - from 15.8 percent in June 2011 to 18.7 percent in July 2011 (BOU 2011). Headline inflation rose due to a sharp increase in food prices - in particular prices for maize flour, sugar and sweet potatoes. Annual food price inflation rose to 40.6 percent in July 2011. The high food price inflation has been caused by supply side shocks both within Uganda and the neighbouring countries, occasioned by frequent crop failures as a result of extreme climatic events, which have reduced the availability of food on the markets. Rises in food prices create vulnerabilities amongst the population such as more people falling into poverty as well as impacts on nutrition, health and wellbeing. In Mbarara for example hailstorm in 2009 greatly affected the production of bananas in the region leading to a shortage in the staple food and a spike in food prices and other consumer commodities.

Further at the local level, people's livelihoods are also impacted by local economic conditions such as limited market information, research and technology and high transport costs among others. Investments in raising environmentally sustainable agricultural production, better risk-management tools, less food intensive biofuels technologies and climate change adaptation can help to mitigate the impact of food price volatility on the most vulnerable.

Poverty and hunger reduce the ability of individuals to respond and adapt to changes in the environment. The proportion of Ugandans living below the absolute poverty line declined from 39 percent in 2002/03 to 31.1 percent in 2005/06 to 24.5 percent in 2009/10 as shown in table 7.1. In absolute numbers, 7.5 million people were living in poverty in 2009/10. On average, inequality of income increased from 0.408 in 2005/6 to 0.426 in 2009/10 (UBOS 2011). The gaps in poverty levels are rural (27.2 percent) and urban (9.1 percent). The regional disparities are northern 61 percent, eastern 36 percent, western 20.5 percent and central 16.4 percent. The most vulnerable groups to poverty have been found to be women and children-headed households, IDPs, crop farming households, and the unemployed (GOU 2010). In Uganda, income poverty reduction is more responsive to changes in growth than to changes in income distribution. Research has shown that it is possible for poverty targets, such as the MDG 1 (of halving poverty to 28 percent by 2015) to be achieved. However national growth would need to be at least 7 per cent per annum; while household incomes would need to grow by at least

4 percent per annum and also be distributed more equitably (Ssewanyana and Bategeka 2010). According to UBOS (2011), Uganda seems to have met the MDG 1 of halving poverty earlier than 2015; however the worsening distribution of income and the high population growth are likely to reverse these trends if not addressed.

Residence	2002/03	2005/06	2009/10
Rural	42.7	34.2	27.2
Urban	14.4	13.7	9.1
Central	22.3	16.4	10.7
Eastern	46	35.9	24.3
Northern	63	60.7	46.2
Western	32.9	20.5	21.8
National	38.8	31.1	24.5

Table 7.1: Proportion of population living in poverty by residence
Source: UBOS 2011

Environmental Vulnerability and Food Security

The mean caloric intake per person per day increased from 2,066 kcal in 2002/03 to 2,190 kcal in 2005/06 (UBOS 2010). The recommended daily intake is 2,200 kcal (UBOS 2010). Acholi, Lango and Karamoja sub-regions had the least mean daily caloric intake and the highest proportion of food insecure households during 2005/06. This is probably as a result of a combination of adverse environmental factors and the war situation in the areas. Generally, the prevalence of food insecurity is higher in urban areas although the incidence of income poverty is higher in rural areas. About 38 percent of the children under five in Uganda are stunted, while 6 percent were wasted, and 16 percent were under weight (GOU 2010). These indicators, though not encouraging, have shown some improvement reducing from 83.4 percent, to 58.7 percent, to 63.5 percent and to 68.5 percent in 1992, 1999, 2002, and 2006 respectively.

As indicated above, there is currently a food crisis in Uganda. And despite the suitable climate, productivity levels for most crops remains low as a result of widespread soil degradation, and the country continues to experience problems of malnutrition, famine and hunger especially among vulnerable populations such as underweight among under-five children (MOH 2010). About 40 percent of deaths among children in Uganda are due to malnutrition (MFPED 2009). The rate of infant mortality is approximately 76 per thousand live births while the overall life expectancy is 50.4 years for both sexes: 52.0 for females and 48.8 for males at 2002 figures (UBOS 2010). This can be attributed to the global and national economic instability, low prioritization of nutrition in the health sector in the past and, to a certain extent, the changing climate. The fact that Uganda's annual population growth rate is 3.2 percent while the annual growth rate of food production is only about 1.5 percent does not present an encouraging outlook for food security. This implies that if food production levels do not increase, food scarcity will become more severe in the near future; making the population even more vulnerable.

Government is implementing a Food and Nutrition Policy to help improve the nutrition indicators. The investments in mitigating the impacts of environmental degradation and climate change should also help increase agricultural output and enhance the chances of meeting this target. The policy provides for the establishment of the National Food and Nutrition Council which has the responsibility of coordinating food and nutrition activities in the country.

Environmental Vulnerability and Health

Good health is the foundation for productivity, education and individual growth. Ill health reduces the capacity to adapt to environmental and other changes. The Ministry of Health estimates that about 75 percent of the overall burden of disease, both communicable and non-communicable, can be avoided (MOH 2010) through environmental sanitation. But the health sector is facing new challenges in the form of climate change. The direct impacts include changing weather patterns such as in temperature, precipitation and the frequency and intensity of extreme climate-related events; while the indirect impacts are felt through changes in water, air and food quality and changes in ecosystems, agriculture, industry, settlements and the economy. The effects, though small at this stage, are likely to increase with time.

Increases in temperature, for instance, is extending the range of disease vectors and allowing diseases to take hold where they were once unheard of. A good example is malaria which is now being reported in the highland areas of Uganda. Malaria has been the highest ranked cause of morbidity in Uganda over the past five years, with a morbidity rate of 48.2 percent; and progress towards achieving MDG target on malaria is slow (UBOS 2011). The impacts of malaria on households are severe. Recent estimates indicate that the direct cost of a single episode of malaria to a household in Uganda was about US $4.8 (WHO 2006). Furthermore it has been estimated that malaria could be responsible for an average annual reduction of 1.3 percent in economic growth in Africa with many families spending a significant portion of their income on malaria treatment.

Environmental degradation remains one of the main causes of poor health in Uganda. Many diseases have links to various cultural practices and to the state of the living environment including poorly ventilated houses, poor waste disposal and sanitation facilities, access to safe water, inadequate nutrition and climate change (NEMA 2008).

There are attempts to address some of these issues. For example NEMA is currently in the process of developing and updating the draft air quality standards. Further a National Climate Change Policy and Implementation Strategy are being developed. These will clearly link to the regional climate change policy for the East African Community (EAC).

Environmental Vulnerability and Agriculture

Soil erosion has been identified as a major issue increasing the vulnerability of the agricultural sector. Changes in vegetation cover have been linked to loss of biodiversity, deforestation and soil erosion, with the agricultural sector blamed for 86-90 percent of the environmental degradation in monetary terms. Land that has a high density of vegetation cover (forested or tree-based perennial crops) is less likely to be degraded or less likely to be at risk of soil erosion than land that is bare. Research shows that between 2005 and 2010, the land area under high density of vegetation decreased by 8 percent (Isabirye 2011).

Currently, more than half (56 percent) of the country is vulnerable to a high potential risk of soil erosion (>25 tons/ha/yr); 10 percent has medium rates (12 – 25 tons/ha/year); and 15 per cent of Uganda is classified as having low risk of soil erosion (0-12 tons/ha/yr) (Isabirye 2011). The overall annual cost of soil erosion is US $ 90,977,344 with a per capita cost of US $2.9. This is very high given that 8.4 million Ugandans live on less than US $ 1 a day. Soil erosion leads to the loss of fertile top soil and implies greater inputs in terms of fertilizer by the farm in an attempt to restore the soil nutrient levels. Figure 7.1 shows the vulnerability to soil erosion risk in Uganda.

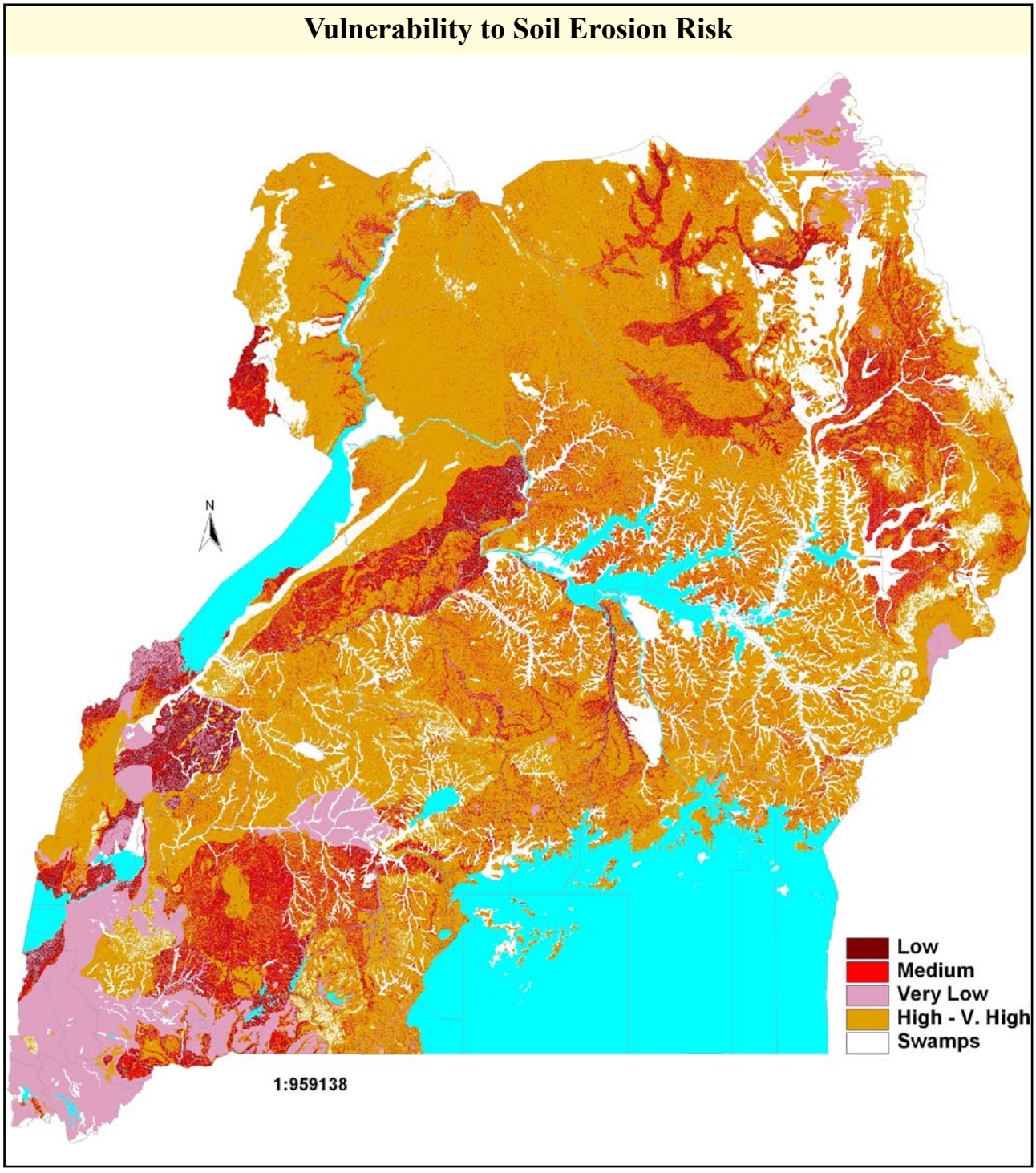


Figure 7.1: Vulnerability to soil erosion risk
Source: Isabirye 2011

Natural Disasters in Uganda

Over the past two decades, environmental disasters have wreaked havoc on Uganda's economy and human livelihoods. The most frequent environmental disasters in Uganda include droughts, floods, landslides, wind- and hail-storms. These account for over 70 percent of the natural disasters in the country. Between 2000 and 2005, approximately 65.7 percent of households countrywide experienced at least one type of disaster. The distribution of these was 88.7 percent in the northern region, 65.4 western, 63.6 eastern and 53.3 in central (GOU 2010).

In Uganda, flood and landslide disasters have been known to occur in Teso, Butaleja, Sironko, Tororo, Mbale, Bududa and Manafwa districts/regions. Landslides are triggered by prolonged rainfall and are accompanied by hydro-meteorological events such as floods. Landslides usually occur on the steep slopes of the highlands and floods in the lower lying areas.

Vulnerable people and communities in most parts of Uganda such as the slopes of Mt Elgon and the flood plains of Lake Kyoga, among others, are victims of environmental degradation, climate change and other risks. However, it is becoming apparent that many vulnerable communities have the capacities to anticipate and cope with these risks. For example, in flood-prone areas, many communities construct houses on raised grounds or constructed mounds which keep the houses safe until the floods subside. However, if the flooding is too frequent, too severe or occurs during the major cropping seasons, and communities are less able to obtain key crops, their capacities could be exceeded and they could suffer serious consequences, as has happened in eastern Uganda in the last ten years. These consequences are influenced by overall ecosystem health; areas with degraded wetlands have been less able to provide a buffer against the flash flooding, exacerbating the problem.

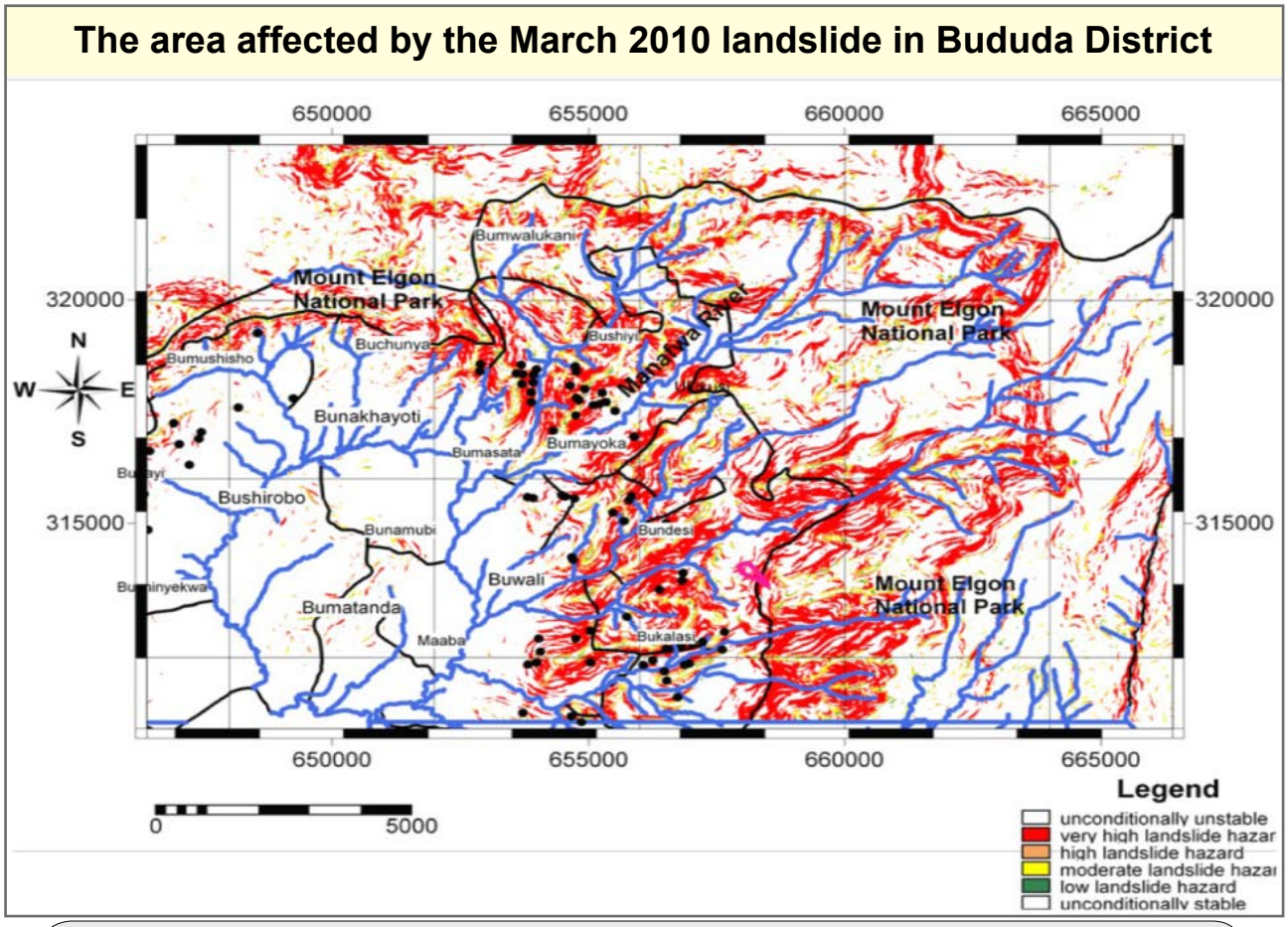
A case study of environmental vulnerability: Landslides in Bududa District

In March 2010, Bududa district in the Mt. Elgon region experienced a major landslide (see figure 7.2). The landslide was triggered by heavy rains lasting over three months. It buried three villages - Kubehwo, Namakansa and Nametsi in Bumayoka sub-county, with a population of more than 3,000 people. About 400 people died and approximately 5,000 others were displaced (Kitutu 2011). Heavy rains led to flooding, water logging and landslides. The impacts were felt on humans, property and the environment. Some of the affected districts included Bududa, Butaleja, Katakwi, Amuria, Pallisa, Mbale, Moroto, Nakapiripirit, Sironko, wManafwa, Bukwo and Budaka. The districts lower down the mountain, such as Budaka and Butaleja were affected by floods. In total more than 33,000 people were affected.

Displacement is one of the major impacts of a landslide. After the disaster, government established an Internally Displaced People's (IDP) camp at Bulucheke about 7 km from the disaster site; and a number of organizations moved in to provide emergency interventions including provision of water, food, clothing, blankets and sanitation facilities. However, the camp quickly became over-crowded; housing more than twice the number it had been planned for.

Access to safe water and sanitation became a major concern. Although sanitation and hygiene needs at the camp were quickly established, these were grossly inadequate. The population per latrine ratio in the camp was 217 people per latrine stance, far below the Minimum Sphere Standard which requires a maximum of 50 people per latrine in areas where there are no latrines initially (like in this case) and decreasing to 20 people per latrine stance as soon as possible (Atuyambe et al 2011). The lack of adequate sanitation facilities exposes people to communicable diseases like diarrhea and cholera through pollution of water sources. Other contributing factors include latrine location, proximity to water sources and topography. The high water table in the area affected the sinking levels of the latrine pits which were built on the upper side of the water sources (river and unprotected water springs). Given the steep topography of the area and the fact that it was constantly raining, the risk of contaminating the water sources was high.

Flooding in the low lands resulted into submerging of latrines with an increased risk of water borne diseases, poor health conditions, destruction of roads and bridges causing inaccessibility problems, damaging of crops and harvests from farm yields thus exposing the affected communities to famine.



- Areas that are red, brown and yellow are prone to landslides. Areas that are white have low landslide hazard but can also be risky if they are in valleys below which landslides are likely to occur.
- The black dots are locations of the landslides in 1997.
- About 50 percent of the area covered by Mt. Elgon National Park in Bududa district is prone to landslides.

Figure 7.2: The area affected by the March 2010 landslide in Bududa District
Map production: Mary Goretti Kitutu

Social vulnerabilities are normally associated with demographic characteristics and other features such as poverty and environmental degradation. In Bududa population density is high fuelled by a high total fertility rate of 7.4 percent (national average is 7 percent) and there are corresponding increasing needs for daily life (UBOS 2002, MFPED 2010). Over the last 11 years, the population density in Bududa has increased by over 30 percent reaching 534 people per km2 (NEMA 2008). The steep mountain slopes are now heavily settled and intensively cultivated. High population growth contributes to vulnerability through reduction in farm sizes; expansion of cultivation in marginal areas; encroachment of wetlands; overharvesting, degradation and deforestation of forests; and siltation of the water bodies through soil erosion. This situation has undercut the functioning of the ecosystem resources provided by Mt. Elgon and surrounding catchment in general.

Poverty limits efforts towards sustainable environment and land management. Poverty in this area is greater than 55 percent (UBOS and ILRI 2003). The reality is that individual farmers do not have the resources to embark on large infrastructure developments such as embankments and terraces to control soil erosion. Research shows that about half the soil lost in a landslide ends up in the stream network (Knapen et al 2005). Even before the landslide, evidence of

siltation was clear from the brown colour of the Manafwa River as it flowed through Bududa and Butaleja districts. This soil material can cause damming of rivers, resulting in major damage to property and other infrastructure, siltation and pollution of streams.

It is likely that enforcement of sustainable development and environment management strategies could have prevented the disaster. There have long been plans to remove people from ecologically fragile areas to more stable ones. However inadequacies at both the national and local government levels including weak enforcement of environmental laws such as the regulations governing the management of hilly and mountainous areas, government bureaucracy, land disputes, and institutional conflicts combined to preclude this. For instance delays and disputes between the Sironko and Kapchorwa local governments characterized the process of allocation of land for resettlement of the Bududa landslide IDPs who were eventually settled in Kiryandongo.

In 2012, there are plans by the Office of the Prime Minister to start implementation of a five year resettlement scheme that will avail homes for all people living in disaster prone areas. The future risks are known and already there are natural and acquired abilities to increase resilience both by the government and the communities. The environmental regulator, NEMA has also warned of a deepening crack on the part of Mt. Elgon that runs 40km from River Lwakhakha on the Uganda-Kenya border through Manafwa, Bududa, Mbale, Sironko and Kapchorwa districts. These warnings are supported by earlier geological surveys carried out in July 2010, close to where the Nametsi landslide occurred (Gorokhovich and Doocy 2010). The next rains could trigger another massive landslide. Landslide prediction is not an exact science, however given the steepness of the slopes, the vulnerability of the environment in that area and the approaching rainy season it is only a matter of time. Detailed landslide risk assessments or landslide monitoring programs should be implemented throughout areas at risk.

Challenges To Managing Vulnerability

There are a number of challenges facing the country that increase environmental vulnerability and reduce resilience. These include environmental governance, the fast growing population and a weak disaster management sector.

Environmental Governance

Since 1993, Uganda has been pursuing a decentralized mode of governance. Through the Decentralisation Statute (of 1993) and later the Local Government Act Cap 243 (of 1997), control of environment management was localized to promote greater participation in decision making at the lower levels. The country has a well developed environment management policy and legal framework, but the capacity and political will for enforcement remains mixed. If well implemented these laws provide a multitude of opportunities to reduce vulnerability.

The integration of environment management functions within the local authorities should have allowed NEMA, as the national organisation for environmental policy and regulation, to step back and play a more strategic role in coordinating and monitoring all environmental issues country-wide. However this has not exactly happened as the local authorities are not as effective as they should be. The reasons for this lack of effectiveness are simple. As one moves from the centre to the local level, there is more emphasis placed on the provision of social services as opposed to environment management programmes (Turyatunga 1998, Gowa 2009). Despite efforts to train and equip institutions for environment management there are still challenges. Lack of funding to operationalise some of the governance functions is still an issue (both at national and local government level). Many local authorities do not provide funds for environmental

management in their budgets, and have continued to voice the need for conditional grants (NEMA 2008). The number of districts has increased lately, making the task of operationalising decentralized environmental governance systems extremely challenging. However civil society, community-based groups are actively involved in environment management.

Damage caused by the Bulambuli landslide, August 2011.
Photo credit: NEMA

Access to information is critical in reducing vulnerability. Indeed an empowered community at a sub-county, parish or village will be better able to pass on development messages or to participate in monitoring and management of the environment. Uganda has a literacy rate of 69 per cent in 2005/06 (UBOS 2010) meaning that many Ugandans cannot access environment information because of language or geographical barriers such as physical distance or location. Despite this realisation, the Environment Officers still face challenges in access funds to enhance public awareness at that level.

The Fast Growing Population

The demographics of a country are one of the key drivers of vulnerability; but they can also be the solution to addressing the various elements of vulnerability thus increasing resilience. The size and structural factors (poverty, low status of women, gender inequality, limited access to health, education and economic opportunities, development pressures, poor planning and changing consumption patterns) of a population are some of the factors that need to be addressed. Population structure and migration patterns, driven by social and political factors, are closely linked to inequality and poverty. Poverty and inequality influence vulnerability in important ways. They define production and consumption patterns, and the manner in which

natural resources are used. Furthermore they reinforce the high fertility rates and displace people with limited opportunities and rights to marginal lands increasing their vulnerability. But ensuring economic growth and a healthy population requires strong and sustained progress in human development with equal focus on both men and women.

Government needs to invest in the people to guarantee that everybody can participate in the economy, increase their productivity and enhance their competitiveness. The fast growing population presents challenges in the form of poverty reduction, the quality of education, housing and health care provisions. One of the objectives of the National Development plan is to develop a sustainable population in terms of health and quality. To this end reproductive health services need to be reflected much higher up on the political agenda. Without this, the environmental, social and economic opportunities provided by a growing population will not be realized.

Poor Preparedness Disaster Management Sector

The Department of Disaster Preparedness and Refugees in the Office of the Prime Minister is the lead agency in disaster preparedness and management in Uganda. There is a District Disaster Management Committee at local government level; and the District council has responsibility for by-laws and policies concerning disaster preparedness and management at that level. Key development plans like the National Development Plan also include aspects of disaster management.

Despite what appears to be an effective institutional setup, disaster management in Uganda is not as effective as it could be. There is an issue of capacity at all levels and the lack of strong baseline information to support a disaster risk reduction strategy. Early warning systems are weak, especially those that deal with hydro-meteorological data. Without adequate information for planning there is a tendency to be reactive, other than proactive. When the 2010 landslides in Bududa district struck, it appears as though the government was caught off-guard. Early detection and preliminary action would have eliminated or reduced the losses. To this end, the Office of the Prime Minister is undertaking a hazard, risk and vulnerability mapping process for the whole country. So far Teso, Lango and Acholi sub-regions have been covered, with Oxfam covering Karamoja, Elgon and Rwenzori regions.

To further improve hazards management, a disaster trend database should be developed and regularly updated to improve and adequately support forecasting, monitoring and implementation programmes. Without regularly updated and shared information on coordination and implementation of emergency humanitarian activities, it becomes difficult to identify emerging problems and priorities and to address them in a timely manner.

Strategies To Increase Resilience

There are a number of responses the government can undertake to improve the resilience of Ugandans. These include strengthening the policy and legal framework and building capacity for vulnerability assessment.

Improving the Policy and Legal Framework

The country does not yet have a comprehensive law to deal with disaster situations, however, a National Disaster Preparedness and Management Policy is being formulated. The Draft Policy seeks to set guidelines for disaster preparedness, mitigation and man¬agement; and should also lay the groundwork for the enactment of a disaster management law.

Other policies and laws that deal with disasters include:

- Draft Bill for the establishment of a National Emergency Standby Fund. Once established, this will be used to maintain adequate minimum stock of emergency food relief items.
- Draft Disaster Preparedness and Management Act
- The National Policy on Internally Displaced People (IDP) 2004
- Policy on pastoralists in Karamoja

At the international level, Uganda has ratified a number of international and regional legal instruments relevant to disaster response. These include the 2005 Hyogo Framework for Action. The draft National Policy on Disaster Preparedness and Management and the institution of a National Platform for disaster risk reduction are both initiatives that comply with the recommendations of the Hyogo Framework.

Damage caused by the Bududa landslide, 2010.
Photo credit: NEMA

Building Capacity for Vulnerability Assessment

Vulnerability assessment is an emerging field that could complement the already existing methodologies for monitoring and ensuring better environment management. Building capacity for vulnerability assessment at all levels and across sectors is an opportunity to be seized for the long term. It would encourage networking and a more integrated approach to vulnerability management and implicitly environment management. Creating better synergies between environment and development presents opportunities for interlinked economics-environment, health-environment or poverty-environment initiatives that could build resilience in communities. The Lake Kyoga ecosystem assessment carried out by NEMA in 2007 is an example where such interlinkages are addressed. The next step would now be to include

vulnerability risk assessment. Apart from investing in capacity, improved funding and the development of an effective monitoring and compliance programme is essential.

In the short term, training of district officials on disaster risk management would equip them with knowledge and skills to mainstream disaster risk reduction into their monthly and yearly work plans; and thus be more immediately equipped for response.

Other strategies or areas for intervention could include adaptation strategies to climate change which is seen as a main trigger to the main natural disasters; hazard mapping and risk assessment, rural energy management; improved water and soil management practices; integrated watershed management and forestry management (including community forestry).

Conclusion and Recommendations

Vulnerability is directly linked to the extent to which populations in a region are vulnerable to the impacts of the disaster. Vulnerability management is a critical part of strategies for sustainable development. It focuses not only on conditions today, but also in the future. The key vulnerabilities in Uganda include environmental, economic, social and physical vulnerabilities. All of these have to do with reduced ability of the respective systems to withstand shock. Environmental vulnerability refers for instance to the reduced ability of ecosystems to withstand shocks like heavy rainfall, drought or windstorms.

Although many people are victims of environmental degradation, climate change or other risks, it is becoming apparent that many communities have the capacities to anticipate or cope with these risks. However, if the disasters are too frequent, too severe or occur during the major cropping seasons, then communities are less able to obtain key crops, their capacities could be exceeded and they could suffer serious consequences.

The key strategies to increase resilience therefore include strict adherence to land use plans, conservation and sustainable use of the natural resource base, development and implementation of the requisite policy and legal framework on disaster risk reduction and management. Capacity development for vulnerability assessment and an early warning system are important ingredients of a good strategy for increased resilience.

The specific actions and interventions in this area however, include national adaptation plans of action to climate change, hazard mapping and risk assessment, rural energy management, improved water and soil management and integrated forest and watershed management.

References

Atuyambe, L., Ediau, M., Orach, C., Musenero, M., and W. Bazeyo (2011). Land slide disaster in eastern Uganda: rapid assessment of water, sanitation and hygiene situation in Bulucheke camp, Bududa district. In : *Environmental Health 2011*, 10:38. Also available on:
http://www.ehjournal.net/content/10/1/38

BOU (2011). *Monetary Policy Statement for August 2011*. Bank of Uganda (BOU), Kampala.

Destremau and Salam (2001) in ECLAC (2002). *Socio-demographic vulnerability: old and new risks for communities, households and individuals*. LC/W.3 24 December 2002. Latin American and Caribbean Demographic Centre (ECLAC), Brasilia. Also available on
http://www.eclac.org/publicaciones/xml/4/11884/LCW3-Vulnerability.PDF

Gorokhovich, Y. and S. Doocy (2010). *Preliminary Results of the Bududa Landslide Geologic and Survey and Needs at Bulecheke Camp for the Displaced Populatio*n. City University of New York Lehman College and Johns Hopkins School of Public Health, USA.

GOU (2010). *National Development Report 2010/2011-2014/2015*. Government of Uganda (GOU), Kampala.

Gowa, E (2009). *Best Practices in Environmental Management in Africa. The Uganda Case study*. United Nations Environment Prgoramme (UNEP)/ Global Resource Information Database (GRID)-Arendal, Norway.

Isabirye, M. (2011). *Costing Soil Erosion In Uganda*. A submission on for the State of the Environment Report for Uganda 2010.

Knapen, A., Kitutu, M.G., Poesen, J., Breugelmans, W., Deckers, J. and Muwanga, A., (2005). *Landslides in a Densely Populated County at the Footslopes of Mount Elgon (Uganda): Characteristics and causal factors*.

MFPED (2009). *The State of Uganda Population Report 2009. Addressing the Effects of Climate Change on Migration patterns and women*. Population Secretariat. Ministry of Finance and Economic Planning (MFEPD), Kampala.

MOH (2010). *Health Sector Strategic Plan III 2010/11-2014/15*. Ministry of Health (MOH), Entebbe.

NEMA (2007). *Lake Kyoga Ecosystems Assessment.* National Environment Management Authority (NEMA), Kampala.

NEMA (2008). *State of the Environment Report for Uganda 2008/2009*. National Environment Management Authority (NEMA), Kampala.

O'Connel (2001) in ECLAC (2002). *Socio-demographic vulnerability: old and new risks for communities, households and individuals*. LC/W.3 24 December 2002. Latin American and Caribbean Demographic Centre (ECLAC), Brasilia. Also available on
http://www.eclac.org/publicaciones/xml/4/11884/LCW3-Vulnerability.PDF

Ocampo (2001) in Sewanyana, S., Bategeka, L., Twimukye, E. and Nabiddo, W. (2009). *Global Financial Crisis Discussion Series Paper 9*. Uganda1. Overseas Development Institute (ODI) , London.

Ssewanyana, S and L. Bategeka (2010). *Global Financial Crisis Discussion Series Paper 21.* Uganda Phase 21. Overseas Development Institute (ODI), London.

Sewanyana, S., Bategeka, L., Twimukye, E. and Nabiddo, W. (2009). *Global Financial Crisis Discussion Series Paper 9*. Uganda1. Overseas Development Institute (ODI), London.

Turyatunga, F.R. (1998). *Uganda Case Study: The National Environmental Management Authority*. World Resources Institute, Washington D.C. Also available on

http://pdf.wri.org/ncsd_uganda.pdf

UBOS (2010). *Statistical Abstract 2010*. Uganda Bureau of Statistics (UBOS), Kampala

UBOS (2011). *Statistical Abstract 2011*. Uganda Bureau of Statistics (UBOS), Kampala

UBOS and ILRI (2003). *Where are the poor? Mapping patterns of wellbeing in Uganda*. Uganda Bureau of Statistics (UBOS) and International Livestock Research Institute (ILRI), Kenya.

PART III
Future Outlook and Policy

Hippos in Murchison National Park

CHAPTER 8
Scenarios

Introduction

Scenarios have been in use in Uganda for some time now. They have been incorporated as part of the state of environment reporting process since 2000 (NEMA 2000). Scenarios are a useful tool that helps us think about the future and to prepare for any eventualities. They also help us to learn from past experiences. Scenarios are not predictions, but they can help us imagine what the future will look like. In other words, they help policy makers answer questions on *how to prepare for the developments in Uganda's environmental system that will emerge in the coming years?* If the country really wishes to become a middle income country as articulated in the National Development Plan this question should be of great concern. Will the gains made so far enable the country to move forward to prosperity and modernity as aspired to in the National Development Plan? Or will Uganda's development stagnate or even decline? The quality of decision-making is what will enable the country reach the target of the Vision 2040 or not.

Realizing Vision 2040

Uganda's overarching policy goal as guided by Vision 2040 is to transform the country into an industrialized middle income nation by year 2040. The aim is to ensure that all Ugandans have a high quality life in a clean and healthy environment. The vision will be incrementally achieved through a series of five year medium-term rolling plans, the first of which covers the period 2010-2015. The theme of this first medium-term plan is *'growth, employment and socio-economic transformation for prosperity'*.

Underlying this vision is the policy objective of development that is sustainable and takes cognizance of environmental and natural resource management issues. Indeed the National Development Plan recognizes environment management a component of the **enabling sector** essential for the efficient performance of all sectors of the economy. This sector also includes defence, climate change, justice, law and order, legislature, public sector management, public administration, accountability, statistics, water resources management, disaster management and meteorology. The other sectors are the **primary growth sector** that actually produce goods and services such as agriculture, forestry, tourism, oil, ICT and housing development; the **complementary sector** that provides institutional and infrastructure support to the other two sectors and includes transport, energy, urban planning, trade, science and technology; and the **social sector** that provides the services required to maintain a healthy and quality population (GOU 2010).

The sectors under the Vision 2040 are all interlinked and have social, economic and environmental implications which have to be balanced if development is to be sustainable.

The major developments anticipated under Vision 2040 will ultimately rely on the exploitation of natural resources. This will affect pollution levels and generate larger quantities of solid waste than at present. These changes are likely to put pressure on the already declining natural resources base and the fragile environment requiring effective management to ensure sustainability.

The politicians, policy makers and the people of Uganda all aspire to a certain level of development so while we acknowledge that development is desirable; it comes with its drawbacks. This chapter will seek to enhance our understanding of some of these drawbacks through a discussion of two future scenarios. The two scenarios are quite simple. If everything works to perfection – this is the *Best Case Scenario*; while if business continues as usual (the downward spiral of degradation) that is the *Worst Case Scenario*.

Hippos are a key attraction in Uganda's National Parks.
Tourism is one of the primary growth sectors of the NDP.
Photo credit: UWA.

The Scenario Descriptions

Worst Case Scenario

The basic assumption in the Worst Case Scenario is an almost complete collapse in social systems coupled with unprecedented economic crises. In this scenario, a select few take control of the greater part of national environmental assets at the expense of the majority. There is reckless pillage of natural resources; deepening of poverty; escalation in conflicts over natural resources; and continuing environmental degradation. Further exacerbating the situation are

inefficient institutions. Policy formulation is weak and the regulatory organisations ineffective. There is little attention paid to the degrading environment until the resources are almost depleted. The economy is characterised by slow growth, unemployment and poverty. The assumptions include:

- Economy controlled by few people
- Inequity predominates
- Negative ethnicity and significant fault lines in governance
- Poor development of infrastructure
- Excessive vulnerability to climate change and poor or non-existent adaptation strategies
- Massive pillage of environmental resources motivated by greed and impunity
- Inefficient and ineffective public institutions
- Deficient market infrastructure and market barriers
- A policy environment that hinders modernization and transformation

Best Case Scenario

This scenario is a hopeful one that sees Uganda achieving middle income country status by 2040. The country's environmental assets are managed in a responsible manner. Policy and institutional arrangements are fully functional and environment management is integrated into development planning at national and local levels. Government departments are effective and provide adequate support to environment management, agriculture and market development. Market barriers are reduced, infrastructure improved and the prevailing policy environment facilitates environmentally sensitive innovation in both urban and rural economies. The impact of climate change is adequately addressed through various adaptation strategies. Agriculture is modernised resulting in increased yields and high levels of food security Overall there are political, social and economic reforms in line with the Vision 2040 targets. The assumptions include:

- Dynamic economy with employment and income generating opportunities for the growing population
- Equity predominates
- A more unified society with greater trust in leaders and national institutions
- Good provision of social services and infrastructure
- Resilience to climate change is enhanced;
- Decline in environmental degradation as seen by a slowing in deforestation rates
- Environmental management is mainstreamed into all levels of governance
- A policy, legal and institutional environment that facilitates modernization and transformation

How Useful is this Best Case/Worse Case Analysis?

There are two ways in which the results from this analysis can be utilized by decision makers.

First, the difference or comparison between the best-case and worst-case 'option' can be used as a measure of environmental risk of a particular decision or policy choice. For instance by analysing a policy option, it is possible to obtain estimates of the range and likelihood of hazard, exposure, risk or even wellbeing or protection. Obviously the range should be higher for more environmentally risky decisions; and lower for more eco-friendly choices.

Secondly, this sort of analysis could also be used to better determine ramifications of a poor policy decision by looking at the result of the worst case outcome. Decision makers often want to know who is at risk and by how much. So by looking at the outcome of the worst possible case, it is possible to understand how different sectors (economy, social and environmental) will be impacted and what factors a decision maker could take to address these.

The Drivers

Driving forces are the mechanisms that lead to changes in the environment (UNEP 2002). A standard set of driving forces was developed by the earlier SOE processes and will be used for this analysis. The drivers will be tracked along different paths giving different social, economic and environmental outcomes. This discussion will consider the following driving forces: population, economic growth, social issues, technology, environment and governance. Table 8.1 shows aspects of these different drivers.

Demography	*Economy*	*Social Change*
• Population growth rate • Population density • Population distribution • International and internal migration • Age structure and gender • Birth rate and life expectancy • Fertility rate	• Economic growth rate • GDP • Sector contribution to GDP • Commodity prices • Level of industrialization • Access to micro-credit • Inflation • Poverty levels	• Gender balance • Consumption patterns • Security and conflict • Literacy/illiteracy • Health issues including HIV/AIDS • Media influence • Land tenure systems
Technology	*Environment*	*Governance*
• Development of CDMs • Dissemination for new and improved technologies for agriculture, construction and environmental conservation. • ICT development	• Indigenous knowledge • Climate change/variability • Environment legislation • Natural disasters (floods, landslides) • Land degradation • Soil erosion and fertility loss • Deforestation • Agricultural expansion	• Decentralization • Political will • Civil society involvement • Public-private participation • Transboundary and regional integration • Conflict resolution and management • Corruption

Table 8.1: Drivers for Uganda's environmental scenarios
Source: NEMA 2008

Integrated Inalysis Of The Different Scenarios

Population

Uganda's population is growing at a very high rate. The national total fertility rate is 6.7 percent and in some areas such as eastern and northern Uganda it is as high as 7.5 percent (MFPED 2010). The foregoing chapters have all highlighted population pressure as the key driving force behind environmental degradation, including deforestation, loss of biodiversity, land pressures, vulnerability to disease and an overall decline in ecosystem health. Environmental degradation has serious consequences on the economy and the livelihoods of the people, especially the poor who excessively depend on natural resources for income and life sustenance.

The current demands placed on the natural resources in order to extract sustenance and livelihoods for the people are unsustainable. These demands are further exacerbated by the high rate of growth of the labour force. Unskilled labour is growing at 3.7 percent per annum and there is a corresponding inability to absorb them in the modern sectors (GOU 2010). These people end up being engaged in the agricultural sector which due to their unskilled nature ends up undermining the growth potential of the sector and the economy at large. In 2011, 66 percent of the labour force was directly employed in the agriculture sector, although with 85 percent of the population living in the rural areas (UBOS 2011), this figure is likely to be higher.

Implications for the decision maker

In order to achieve the 2040 target of social transformation, the decision maker will have to make certain policy choices regarding the quality of the population and its rate of growth.

Under both scenarios, the population will continue to grow, but at different rates. Under a *Best Case Scenario* slowing population growth would be the cornerstone of policy. This would include, but not be limited to, meeting Uganda's unmet needs for family planning. However, even under this scenario the high fertility rate coupled with the young population means that the population will continue rising even if fertility declines. After about 15 years, population growth should start to slow, but this intervention would require sustained political support right from the top. Under a *Worst Case Scenario* government policy action on fertility levels means that the population continues to grow, doubling every 20 years. By 2040 the population is in the region of 100 million.

Poverty is likely to increase under the *Worst Case Scenario*. In urban areas, the rising cost of living, growing numbers of unemployed and the harsh urban environment could lead to increasing incidents of civil unrest. The next ten years could be tough ones for the country if not enough jobs are created for the ever increasing population. As poverty deepens in the rural areas, migration to urban areas is stepped up as people seek opportunities in the towns. Those who stay in the rural areas are likely to be faced with ever smaller less fertile parcels of land; and they can ill afford the fertilizers required to maintain productivity levels resulting in increasing levels of food insecurity.

Although a big population may be considered a big market for goods and services, it is the quality that matters. A non-productive population does not have the skills and tools required to participate in the socio-economic transformation process and neither do they have the income required to be a market. The government has the opportunity to turn this situation into a *Best Case Scenario* by investing in human capital as indicated under the Social Sector of the National Development Plan. This will require investments in health, education, housing, gender equality and environment management. For instance educational programmes could be redesigned to include much more traditional environmental knowledge with indigenous peoples recruited as teachers. Sustainable wealth and employment can only be created if the concept of environment protection underpins innovation.

Forests

While the population is growing, the natural resources asset base on which they depend is decreasing. For instance, recent assessments by the National Forestry Authority (NFA) estimate the current national forest cover at 3,554,594 ha in 2010 having declined from 4,933,375 ha in 1990 (NFA 2008). Per capita access to the forest resource in 2010 stood at 0.111ha (MFPED 2010) down from 3.588 ha per capita in 1990. At current growth rates per capita forest access is likely to decrease to about 0.043 ha by 2040 as shown in table 8.2.

In order to accommodate the large and growing population, at current growth rates, the economy will have to sustain continuous expansion in order to keep pace with and provide sufficient jobs and livelihoods alternatives for the growing population. Without alternatives, the population will continue to encroach on and deplete the natural resources.

	Population (million) in 2040*	Per capita forest in 2040
High population option	82.4	0.043
Medium population option	76.4	0.047
Low population option	70.5	0.05

Table 8.2: Estimated per capita forest access (ha) under the different population scenarios
Source: Adapted from UN Statistical Database* and MFPED 2010

Implications for the decision maker

Even under a Best Case Scenario per capita forest access will decline to 0.05 ha by 2040. This is because given the relative youth of the population (77 percent are under 30 years [UBOS 2002]) the growth momentum would continue for several decades. This is likely to present serious management challenges to the regulatory authorities in charge of these resources such as NEMA, NFA and UWA among others. Indeed if transformative policies to address this issue are not put in place as under a *Worst Case Scenario* it is estimated that by 2020 Uganda will even have to start importing fuel wood. Figure 8.1 shows the impact of the growing population on some of the key natural resources; while table 8.3 highlights some of the impacts of lack of investment in forestry under a *Worst Case Scenario*.

The link between population and environmental degradation is well documented. In order to achieve any real decline in the rate of environmental degradation, the government will have to adopt a more interlinked approach that integrates policy actions in other sectors to environment management. This would be the *Best Case Scenario*. One of the reasons why the population is growing at the fast rate of over 3 percent per annum is because of the high fertility rate. As such, in order to realistically address environmental degradation, the population issue would have to be addressed. Political will to support current population policies would also go a long way in achieving environmental targets.

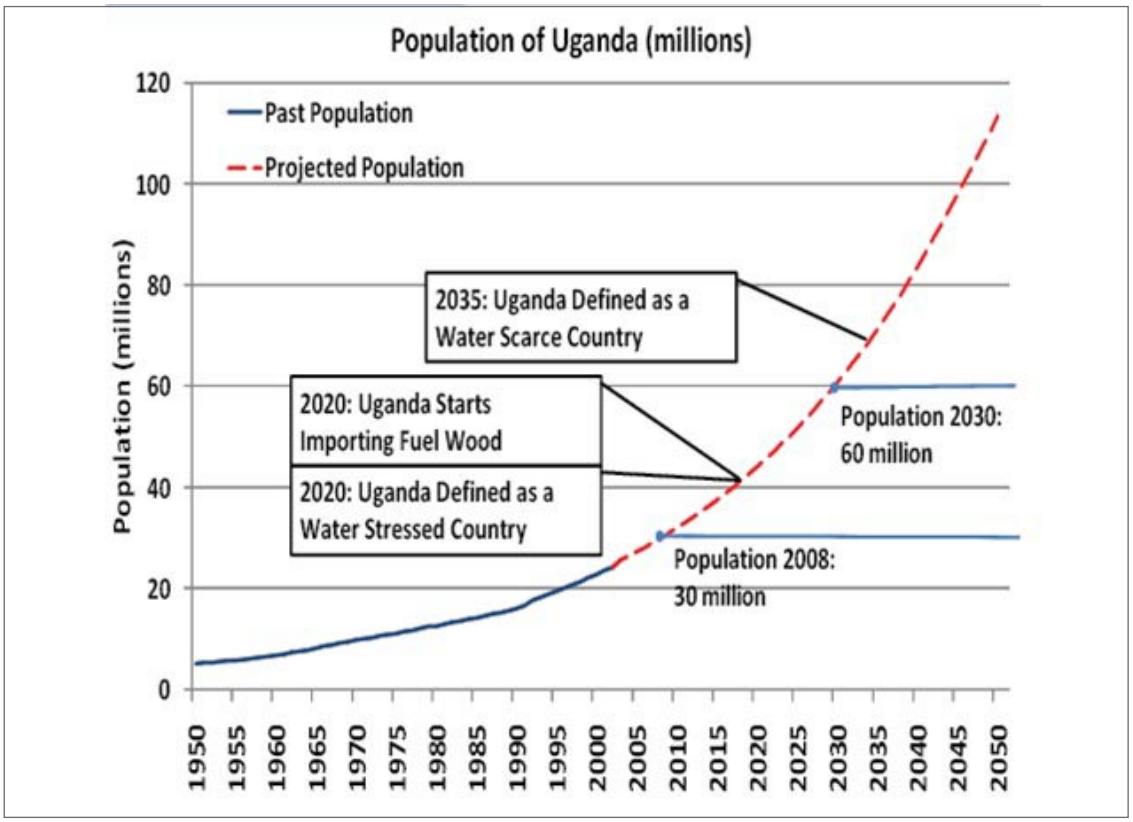


Figure 8.1: Linkages between population and natural resources
Source: MFPED 2010

Result	Impact
Private and community forests will be wiped out first and the forests in protected areas would follow suit.	Forests in protected areas would be rendered vulnerable and human life would be threatened. Current hostilities are already meaning that staff protecting the
Serious shortage of raw materials especially timber for construction.	Undermining the fast-growing construction industry. This would directly alter the economic growth and employment opportunities.
Scarcity of wood fuel for domestic and small scale processing industries and institutions.	Increased costs of production and thus lowering of Uganda's competitive edge in the region. It is projected that by 2020, Uganda will be importing wood fuel.
Escalating import bills.	It is estimated that if kerosene is substitute for charcoal in urban households it would result in an increase in the national import bill by US $180 million annually. However, kerosene would not be affordable thus the majority of
Increased hardships for the poor including reduced crop yields and poor	Social unrest.
Reduced energy supply, especially hydropower which depends on the water regulated by watersheds.	High costs of substitution with petroleum fuels would make Uganda's goods more expensive and therefore less competitive in the region.
Negative impacts of climate change	Increasingly dry to desert conditions, high incidences of floods and the
Reduced and low quality water supply for domestic and industrial use.	Limited recharge of ground water and thus water tables would become lower leading to drying up of wells, springs and boreholes and the consequent increased costs of providing water to the population and livestock. The whole
The environment in the fast-growing urban areas would become more stuffy and a danger to the health of the people.	Increased costs of providing health care, higher incidences of respiratory diseases and the consequent increased misery for the poor living in urban areas.

Table 8.3: Impact of lack of investment in forestry as might happen under the Worst Case Scenario
Source: MWE 2009

Local leaders discuss the flood situation in Hamutu sub-county, Butaleja District.
Photo credit: NEMA.

Climate Change

Climate change is emerging as the single most important driver of environmental change in Uganda. Agriculture is often cited as one of the most vulnerable sectors because of the prominence and importance of subsistence farming. Although its contribution to GDP is not so great, it is the biggest employer at 67 percent as shown in table 8.4 Furthermore agriculture in Uganda is mainly rain-fed; and with 85 percent of the people living in the rural areas and depending on agriculture this leaves them very vulnerable to the vagaries of climate.

Sector	Share of GDP*	% growth rate		Employment in %
		2009/10	2010/11	
Industry	25.4	6.5	7.5	5.5
Service	46.2	7.4	8	24.5
Agriculture	23.8	2.4	0.9	67

Table 8.4: Growth rates of selected sectors in 2010/2011
*** share to total GDP at current prices**
Source: UBOS 2011

Given the importance of this sector to livelihoods, it is important for government to put in place alternatives that would allow the people to be more resilient to the impacts of climate change. The following case study taken from Eitzinger et al (2011) on the impact of different climate scenarios on tea growing areas in Uganda is used to illustrate this point.

Climate change and tea growing scenarios in Uganda to 2050

Tea is one of the long-term cash crops introduced into Uganda long ago. The others include coffee, tobacco and cotton. Production of tea as shown by procurement figures has been growing over the years as shown in figure 8.2.

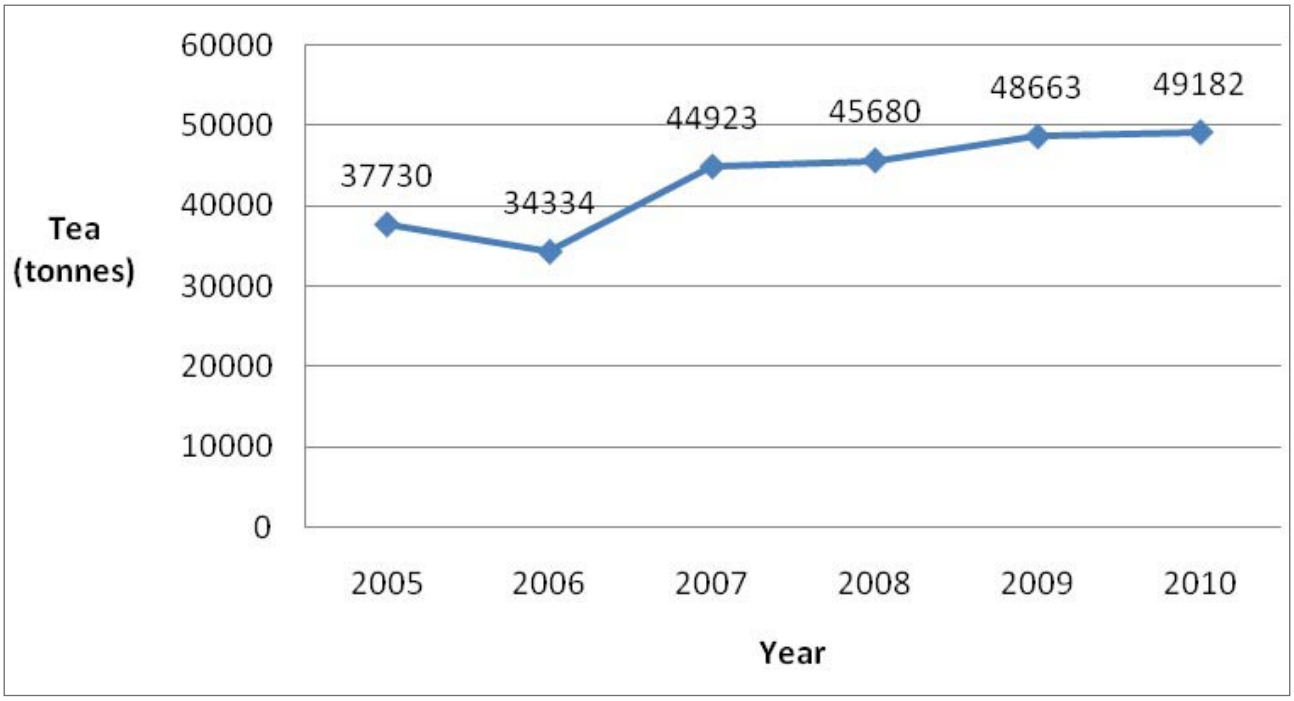


Figure 8.2: Procurement of tea (tonnes) 2005-2010
Source: UBOS 2011

Currently tea is grown around Lake Victoria in the districts of Mukono, Mubende, Mityana, Masaka and Wakiso; the lower slopes of Rwenzori Mountains in Kabarole district; and above the Western Rift Valley in the districts of Bushenyi, Kyenjojo, Kibaale, Hoima and Kanungu as shown in Figure 8.3.

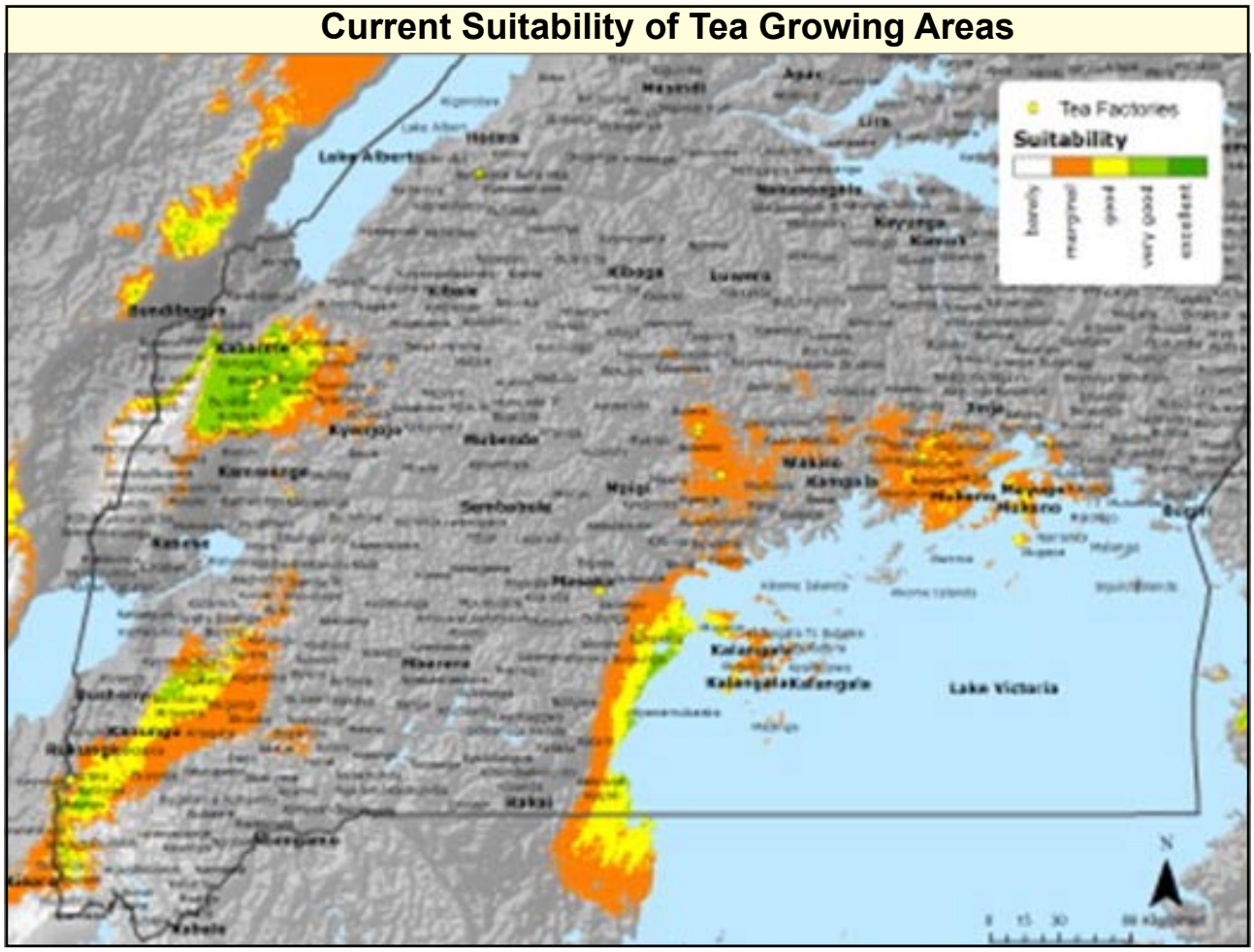


Figure 8.3: Current suitability of Tea growing areas

The climate predictions as discussed by Eitzinger et al (2011) indicate that the yearly and monthly rainfall will increase and the yearly and monthly minimum and maximum temperatures will increase moderately by 2020 and progressively increase by 2050. The overall climate will become less seasonal in terms of variation through the year in temperature with temperature in specific districts increasing by about 1ºC by 2020 and 2.3ºC by 2050 and more seasonal in precipitation with the maximum number of cumulative dry month staying constant at 3 months. Rainfall is likely to increase from 1,324 mm in 2011 to 1,358 in 2020 and 1,394 mm in 2050. These changes in climate mean the amount of land suitable for growing tea will decrease towards 2050. These scenarios (Eitzinger et al 2011) are shown in figures 8.4a and b.

Implications for decision makers

The implications for decision makers are that the distribution of suitability's within the current tea-growing areas in Uganda for tea production in general will decrease quite seriously by 2050. The suitable areas will migrate up the altitudinal gradient. The current optimum altitude for tea production is 1450-1650 masl. To compensate for increases in temperature, the optimal altitude for tea production will migrate to between 1550-1650 masl by 2050. Areas that retain some suitability will see decreases of between 20-40 percent, compared with today's suitability of 60-80 percent (Eitzinger et al 2011). However, there is not much land available at higher altitudes in Uganda and therefore the reality is that the total land area available for tea cultivation will ultimately decrease.

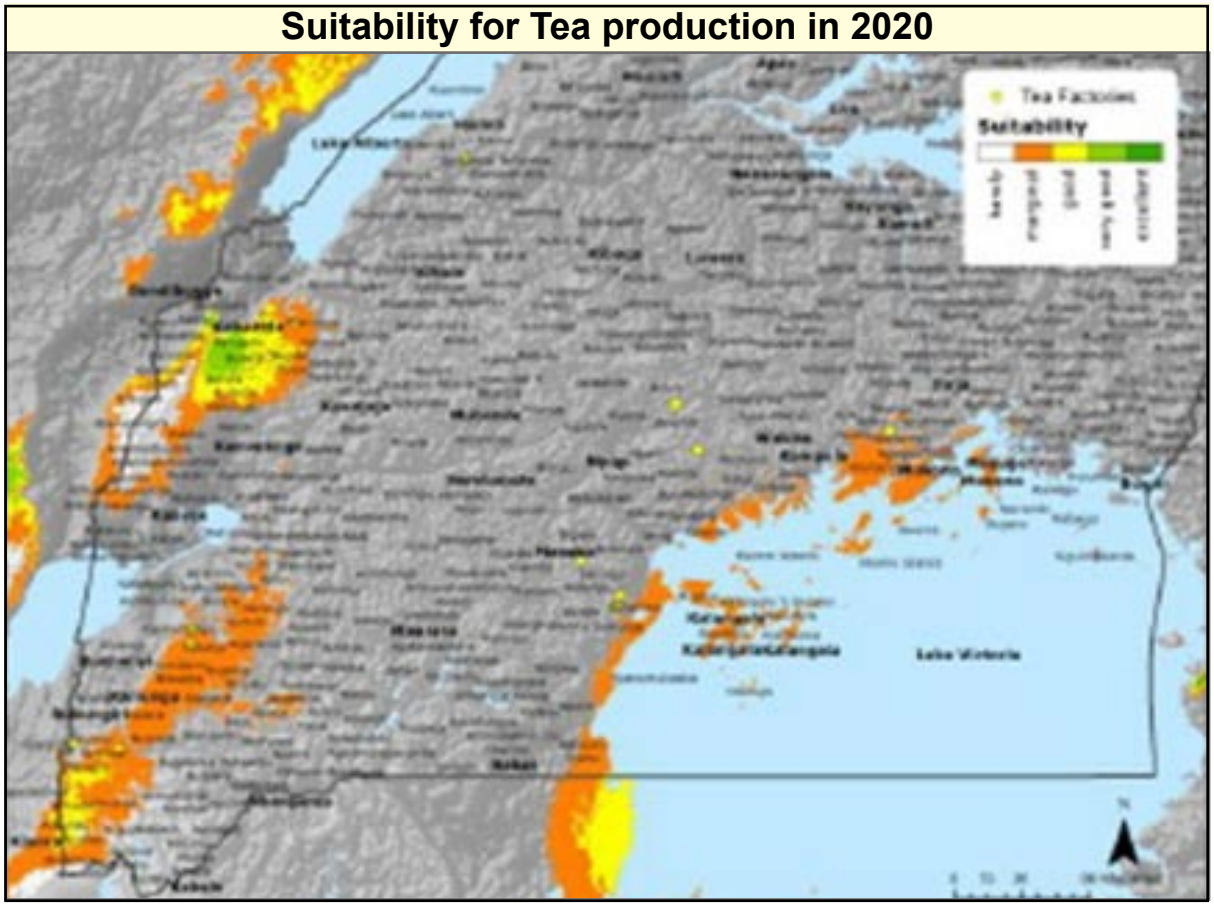


Figure 8.4a: Suitability for Tea production in 2020
Source: Eitzinger et al 2011

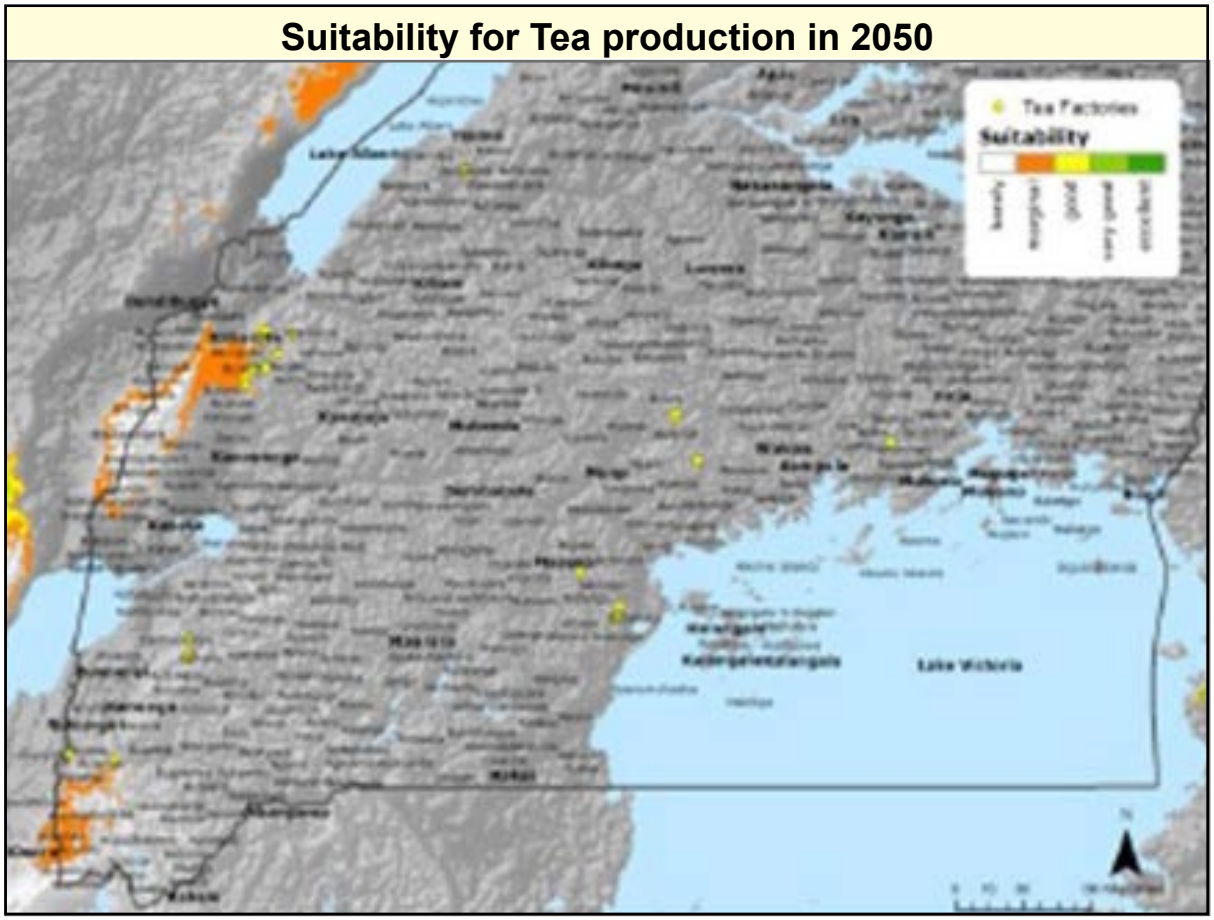


Figure 8.4a: Suitability for Tea production in 2050
Source: Eitzinger et al 2011

As such under a *Best Case Scenario*, policy makers take cognizance of the possibility of serious loss of land suitability for tea production to future climate predictions. They attach great importance to policies that encourage crop diversification especially for the tea farmer. Crops that could be considered to replace tea include maize, passion fruit, banana, cassava, pineapple or citrus. Of course further assessments would need to be undertaken to judge their suitability.

Under a *Worst Case Scenario*, business continues as usual and the tea industry loses potential earnings. Those not directly involved in tea farming are somehow linked to it through its forward and backward linkages through sectors such as transportation, forestry, manufacturing and social sectors such as education and health that depend on the positive performance of the sector to grow and provide the services required to communities. As such the wider ramifications of such this scenario would be huge.

Conclusion and Recommendations

Uganda's overarching policy goal as guided by Vision 2040 is to transform the country into an industrialized middle income nation by year 2040. The aim is to ensure that all Ugandans have a high quality life in a clean and healthy environment.

Using the example of the link between population growth, environment degradation and economic growth, the *Best Case Scenario* will be when government adopts a more inter-linked approach that integrates policy actions in the three sectors above, with policy actions in the other sectors including agriculture, land management and rural development, water, energy, minerals among others. Well managed population dynamics would go a long way to aiding progress towards achieving environmental sustainability.

An emerging lesson from this discussion is the need to take a long-term view of trends in the environmental arena. For instance the far reaching implications that the combined effects of land use change and climatic uncertainty are likely to have for the people and ecosystems. Implementation of appropriate policies, legal frameworks are necessary and need to be based on traditional knowledge and sound scientific evidence. To this end, the last chapter of this report provides various recommendations for policy to address some of the identified issues.

Oil exploration at Butiaba

References

Eitzinger, A., Läderach, P., Quiroga, A., Pantoja, A. and J. Gordon (2011). *Future Climate Scenarios for Uganda's Tea growing areas*. Final Report. International Centre for Tropical Agriculture (CIAT), Cali, Colombia.

Khan, Shane, Sarah E.K. Bradley, Joy Fishel, and Vinod Mishra (2008). *Unmet Need and the Demand for Family Planning in Uganda: Further Analysis of the Uganda Demographic and Health Surveys, 1995-2006*. Calverton, Maryland, USA: Macro International Inc.

MFPED (2010). *The State Of Uganda Population Report 2010. Population and Sustainable Development – Emerging Challenges, Opportunities and Prospects*. Ministry of Finance, Planning and Economic Development (MFPED), Kampala.

MWE (2009). *Water and Environment News*. A newsletter produced by the Ministry of Water and Environment. Issue No.1 December 2009. Ministry of Water and Environment (MWE), Kampala.

NEMA (2000). *State of the Environment Report for Uganda 2000/2001*. National Environment Management Authority (NEMA), Kampala.

NFA (2009). *National Biomass Study Technical Report 2009*. National Forestry Authority (NFA), Kampala.

UBOS (2011). *Statistical Abstract 2011*. Uganda Bureau of Statistics (UBOS), Kampala.

UNEP (2002). *Africa Environment Outlook. Past, present and future perspectives*. United Nations Environment Programme (UNEP), Nairobi

A wetland near Kampala City

CHAPTER 9
Policy

Introduction

The underlying theme for this NSOER is ***Environment Sustainability and Health***. The theme for the NSOER 2008 was sustainable ***Environment For Prosperity For All*** while that for the NSOER 2006 was ***Planning For Re-emerging Opportunities and Threats From The Environment***. This report's focus on health and environment underlines the growing recognition of the link between environmental sustainability and health outcomes for Africa in general and Uganda in particular. The focus is dual faced. First, several health management activities have considerable environmental implications including the environmental impacts of medical waste management, the use of pesticides particularly DDT for disease vector control. The other face is the health implications of poorly managed environments including the risk of environmental diseases, increased vulnerabilities due to climate change and the cost of managing otherwise avoidable environmental diseases.

The Report identifies and discusses key emerging issues in the economy; the state, threats, opportunities and strategies for managing land, agriculture and forest resources in Uganda. It also discusses climate change and pollution; aquatic, freshwater, fish and wetland resources and biodiversity and energy resources in the country. The report further examines the key environmental vulnerabilities particularly with respect to environmental degradation and the reduced potential of land, forests, wetlands and water ecosystems to support both extractive and non-extractive uses of these ecosystems. The other key vulnerabilities relate to climate change and the increased frequency and severity of extreme weather conditions.

The key message from the report is that environmental degradation costs the national economy colossal amounts of money through otherwise avoidable expenditure on curative health care, water treatment and purification, re-settlement of environmental refugees, emergency food aid and restoration of degraded ecosystems. These costs will increase in view of the exacerbating effects of climate change and increased vulnerability. The report however, notes that immense opportunities to correct or even augment the contribution of Uganda's environmental resources to economic progress and human well-being exist. The report therefore recommends various strategic actions for improving the state, opportunities and outcomes from the environment and natural resource base in Uganda.

The following section highlights the key conclusions, policy recommendations and strategies the report proposes for each issue and sector.

Key Conclusions By Theme

Environment and Economic Development

Uganda's current development path is not sustainable. The country faces severe environmental problems including soil erosion and declining soil fertility, deforestation, pollution of land, water and air resources, loss of biodiversity and over-harvesting of forests, fisheries and water resources. This continued liquidation of the country's natural capital undermines long-term economic progress and will aggravate poverty.

The National Development Plan 2010/11-2014/15 includes various aspects of the environment in all the sectoral categorisations it lists for implementation. They are included in the primary growth sectors category and in the complimentary, social and enabling sectors. To spur the contribution of environmental resources to national economic development therefore, it will be necessary to improve environmental governance with specific focus on compliance and enforcement as well as the participation of all stakeholders. It is also important to provide timely information for effective policy making, particularly in view of climate change, extreme weather events and vulnerabilities. As a starting point, there will be need to develop relevant environment indicators for inclusion in national household surveys and subsequently Uganda's National Accounts. The recent assessment of Uganda's forest resources and proposed study of soil degradation are therefore positive steps in this regard. The inclusion of environmental data in national economic indicator systems will re-prioritise and mainstream them into the national development agenda.

Land, Agriculture and Forests

Land and forests are very important resources for Uganda. Their continued degradation therefore does not augur well for the economic development and long-term prosperity of Ugandans. Extensive land degradation has been observed in the high potential highlands of eastern and south-western Uganda. Similar levels of degradation are clearly evident in the cattle corridor areas in the north-east, west and south. Besides the problem of degradation, land also remains largely under-utilised particularly for agricultural production. Most arable land (37 percent of total land area) is under rain-fed subsistence agriculture of low production potential. Typical crop and livestock yields are only a quarter to half of what could be achieved even with present technologies.

Whereas agriculture was identified as a key primary growth sector in the National Development Plan, the sector needs to be transformed into an innovative commercially oriented and modern sector. Investments in improved seeds, modern crop and animal husbandry, irrigation, soil and water conservation, soil replenishment using both organic manure and inorganic fertilisers need to be made. The major entry point for government however, should be policy and regulatory to ensure that the sector remains largely demand and private sector driven. This will ensure that land is put to optimal use and that appropriate and sustainable land use practices will be adapted.

Climate Change

Climate resources remain an important asset to Uganda's economy. Uganda's agricultural sector predominantly relies on rain-fed agriculture, while a good and stable climate system minimises disruptions in transport and communication and other economic activities.

This NSOER noted that climate change is real and will have negative impacts on Uganda. The most vulnerable sectors include agriculture, water supply, health, transport, housing and

A Tea estate in Kabarole.
Photo credit: NEMA

personal safety and security. The main elements of concern include extreme weather events including frequent droughts, heavy rainfall events and floods, landslides, thunderstorms and heat waves and the associated problems of food shortages, diseases and internal displacements of people. Mean rainfall projections consistently indicate overall increases in the proportion of rainfall that will fall in heavy events. The mean annual temperature is also projected to increase by 1.0-3.0oC by 2060 with a large frequency of hot days.

The main actions to climate proof Uganda's economy include improved weather research and forecasting, water storage, agricultural research and capacity development in all sectors of the economy to handle and withstand disasters and climate shocks.

Fresh Water and Aquatic Resources

The regular supply of clean and safe water for domestic, agricultural and industrial use remains a key development challenge in Uganda. Uganda is fairly well endowed with water resources. Many areas of the country however, suffer both temporal and spatial shortages of water. The water and sanitation statistics are therefore poor for most people. The degradation of wetlands has further exacerbated the water supply problem, first by undermining the water filtering function of wetlands, but also by reducing their water storage capacity.

The fish sector has also suffered insidious declines of fish stocks. The key negative forces in the sector include over-fishing, use of improper fishing gear and pollution. With the discovery of oil and gas in the Albertine Graben, the water and fisheries resources of Uganda may be at further risk.

The recommended actions in the aquatic resources, freshwater, fish and wetlands sub-sectors include effective management of water catchment areas by harmonising land use, forestry, agriculture, industry and environment policies in addition to investing in research and development in the water sector. A national wetland information management system and database should be established with a clear indication of the extent, uses and values of wetlands.

The wider family of stakeholders in natural resource conservation needs to be more vigorously involved. Particular attention should be given to local authorities who directly benefit and interact on a daily basis with the natural resources in question.

Papyrus growing in a wetland.
Photo: NEMA

Biodiversity Resources

Uganda has a high level of biological diversity. The country has more than 18,783 species of known plants, animals and micro-organisms. Some components of biodiversity, particularly below ground micro-organisms however, remain unknown. Studies of these groups are only in initial stages. Biodiversity resources therefore, underpin both the social and economic well-being of Ugandans.

Several threats however, face biodiversity. They include habitat loss, lack of information, land use conflicts particularly in the Albertine Graben and alien invasive species. A number of actions need to be implemented to reverse current tends in biodiversity loss.

The first action is increased protection of forest habitats to reduce deforestation induced biodiversity loss. Natural forests need stronger protection and afforestation should be stepped up to achieve a national forest cover of at least 30 percent or 1900 levels. Afforestation will need to be complimented with energy efficient technologies particularly in the biomass energy sub-sector.

The National Land Use Policy needs to be further implemented to mitigate encroachment on forests, wetlands and other fragile but biodiversity rich ecosystems. A number of tenure issues, including demarcation and gazetting of wetlands need to also be sorted out.

Degradation of wetlands is endangering some species such as the Shoe bill stork.
Photo credit: UWA

Alien invasive species continue to pose a great threat to biodiversity and the national economy. Whereas the management costs and other impacts of these species is very large, little information on the matter reaches policy makers. Increased awareness and lobbying for more investment in preventive measures needs to be done.

Energy Resources

Uganda is an energy poor country. Less than 5 percent of Ugandans have access to electricity, making Uganda's per capita energy consumption one of the lowest worldwide. Combined with chronic electricity shortages, problems in the energy sector continue to greatly affect the country's prospects for economic growth. The shortage of electricity affects all sectors of the economy.

While it is critical to further invest in the modern energy sector, specific investment focus should be given to the new and renewable energy sub-sector. Solar, wind, bio-energy, geothermal and small hydropower should be prioritized in this respect. Incentives should be provided to encourage investments in this area.

Renewable energy sources have the potential to lift the burden off Uganda's forests. They could also provide the much needed power for irrigation and support coping mechanisms for communities faced with the dire impacts of climate change and extreme weather conditions. Renewable energy sources would also provide cleaner energy and reduce the health impacts associated with biomass energy based indoor air pollution.

Vulnerability

Vulnerability refers to the extent to which exposure to a hazard causes a humanitarian disaster. Vulnerability is directly linked to the extent to which populations in a region are vulnerable to the impacts of the disaster. Vulnerability refers to the tendency for livelihoods to be damaged or disrupted, while resilience refers to the ability for people's livelihoods to withstand or recover from such damage. Vulnerability management is a critical part of of strategies for sustainable development. It focuses not only on conditions today, but also in the future.

The key vulnerabilities in Uganda include environmental, economic, social and physical vulnerabilities. All of these have to do with reduced ability of the respective systems to withstand shock. Environmental vulnerability refers for instance to the reduced ability of ecosystems to withstand shocks like heavy rainfall, drought or windstorms.

The key strategies to increase resilience therefore include strict adherence to land use plans, conservation and sustainable use of the natural resource base, development and implementation of the requisite policy and legal framework on disaster risk reduction and management. Capacity development for vulnerability assessment and an early warning system are important ingredients of a good strategy for increased resilience.

The specific actions and interventions in this area however, include national adaptation plans of action to climate change, hazard mapping and risk assessment, rural energy management, improved water and soil management and integrated forest and watershed management.

Future Outlook and Scenarios

Scenario development has been part of the NSOER process since 2000. Scenario development is a useful tool that helps us to think about the future. It also helps us to prepare for changing circumstances and eventualities. Scenarios also help us to learn from past experiences.

Scenarios are not predictions. They are realistic simulations of the future. They help us to answer various questions including how we will respond to new choices, whether such choices will help us to move forward to prosperity and modernity or will cause stagnation or even decline.

Uganda's overarching policy goal as guided by Vision 2040 is to transform the country into an industrialized middle income nation by year 2040. The aim is to ensure that all Ugandans have a high quality life in a clean and healthy environment. The theme is growth employment and socio-economic transformation for prosperity.

Using the example of the link between population growth, environment degradation and economic growth, the best case scenario will be achieved when government adopts a more inter-linked approach that integrates policy actions in the three sectors above, with policy actions in the other sectors including agriculture, land management and rural development, water, energy, minerals among others. Well managed population dynamics would go a long way in achieving environmental targets.

The best case scenario is a very optimistic scenario that sees Uganda achieving middle income country status by 2040. The country's environmental assets are sustainably managed. Policy and institutional arrangements are fully functional and environment management is integrated into national and local government development planning. Well-functioning public institutions support environmental management, agriculture and market development. Market barriers are reduced, infrastructure improved and the prevailing policy environment facilitates environmentally sensitive innovation in both urban and rural economies. The impact of climate change is adequately addressed through low carbon growth, vibrant adaptation strategies and technologies.

Policy Options For Action

Environment and Development

- Further integrate the MDGs in the national Development Plan and medium term expenditure framework to ensure inclusion of both income and human poverty issues in national development
- Enhance the synergies and harness inter-sectoral linkages between the three components of sustainable development
- Ensure sound economic and public financial management, corporate governance and accountability.
- Strengthen the policy and institutional frameworks on science, technology and innovation for sustainable development.

Land, Agriculture and Forests

- Improve the management of water and soil resources and promote the use of improved technologies including high yielding seeds.

- Develop and implement food security strategies in the context of poverty eradication and net exportation of agricultural products
- Increase the national budget allocation to agriculture and forestry with the aim of increasing productivity and promoting value addition
- Further strengthen the position of forestry in the National Development Plan by undertaking regular forest valuation and forest-environment accounting studies.

Climate Change

- Development robust policies and regulatory responses on climate change adaptation and mitigation and the use of biofuels.
- Identify and implement measures that have both mitigation/adaptation and poverty reduction co-benefits.
- Improve disaster risk management and response to extreme weather events including floods, landslides, droughts and thunderstorms and their associated health implications.
- Further strengthen national capacity to systematically collect, analyse, model and forecast the impacts of weather variability and climate change on agriculture, water resources management, health, fisheries, transport and communication and national development.

Aquatic Resources: Fresh Water, Fish and Wetlands

- Promote integrated watershed management programmes aimed at reducing depletion and pollution of water resources in light of the anticipated impacts of climate change.
- Establish river and lake catchment and basin organisations and lake monitoring systems.
- Develop and implement long-term strategies and plans for investment in and the development of urban and rural water and sanitation infrastructure.
- Strongly enforce local bye-laws, ordinances and regulations on sanitation and hygiene.
- Strengthen management, monitoring, control and surveillance capacity of the fisheries department with particular focus on the Albertine Graben.

The delta in Murchison Falls National Park.
Photo credit: Edema Maurice

Biodiversity Resources

- Further integrate the National Biodiversity Strategy and Action Plan (NBSAP) into the National Development Plan.
- Implement national programmes and networks for information sharing and collaboration in order to scale up conservation activities and address cross-border biodiversity issues.
- Ensure the effective participation of civil society, local communities and indigenous peoples' in national programmes/processes on biodiversity conservation so that they are afforded the opportunities to influence decisions that impact on their livelihoods.
- Review and update the NBSAP and promote a synergistic approach to the implementation of the plan with respect to other Rio conventions (National Forests Programmes, NAPAs for climate change, and National Adaptation Plans for Drought and Desertification).

Energy Resources

- Increase access to modern energy resources particularly using off-grid systems with the aim of supporting the development of productive and income generating activities and entrepreneurship.
- Commit commensurate financial resources to the development of biomass energy which supports the energy needs of up to 91 percent of the population – charcoal, biogas and fuel wood.
- Provide an attractive national investment climate for both domestic and foreign investors in the energy sector.
- Promote use of energy efficient and low-carbon energy access technologies.

Vulnerability

- Mainstream vulnerability issues into the development agenda so as to improve budgetary allocations to the sector.
- Develop and implement adaptation strategies to climate change which is seen as a main trigger to the main natural disasters.
- Build capacity for vulnerability risk assessment and hazard mapping at all levels and across sectors to encourage a more integrated approach to vulnerability and disaster management.

Scenarios

- Implement the flagship projects that have been identified in the National Development Plan to help the country achieved the desired best case development in a sustainable manner.
- Enhance integration of sustainable indicators into the National Development Plan through green accounting, valuation of natural resources and strategic environmental assessment.

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