



THE REPUBLIC OF UGANDA

NATIONAL STATE OF THE ENVIRONMENT REPORT 2016/17

*Restoring the Environment for Livelihood Improvement
and Sustainable Economic Development*





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ACRONYMS

ASGM	Artisanal Scale Gold Mining	MWE	Ministry of Water and Environment
BAT	Best Available Techniques	N ₂ O	Nitrous Oxide
BEP	Best Environmental Practices	NAFIRRI	National Fisheries Resources Research Institute
BIOFIN	Biodiversity Finance Initiative	NAMAs	Nationally Appropriate Mitigation Actions
BOU	Bank of Uganda	NASA	National Aeronautics and Space Agency
BSTW	Bugolobi Sewerage Treatment Works	NBI	Nile Basin Initiative
CBD	Convention on Biological Diversity	NCSA	National Capacity Strategy Action
CBWRM	Catchment Based Water Resources Management	NDC	Nationally Determined Contributions
CFCs	Chloro Fluoro Carbons	NDP	National Development Plan
CH ₄	Methane	NEA	National Environment Act
CMC	Catchment Management Committee	NEAP	National Environment Action Plan
CMO	Catchment Management Organization	NEMA	National Environment Management Authority
CMPs	Catchment Management Plan	NEMP	National Environmental Management Policy
CO ₂	Carbon dioxide	NEPAD	New Partnership for Africa's Development
CSOs	Civil Society Organizations	NFA	National Forestry Authority
DEO	District Environment Officer	NGOs	Non-Government Organizations
DFR	Department of Fisheries Resources	NIP	National Implementation Plan
DPSIR	Driving Forces-Pressures-State-Impacts-Response	NPV	Net Present Value
DWRM	Directorate of Water Resource Management	NSDS	National Service Delivery Survey
EA	Environmental Audit	NSOER	National State of Environment Report
EAC	East African Community	NWSC	National Water and Sewerage Corporation
EACOP	East African Crude Oil Pipeline	PCB	Polychlorinated biphenyls
EADP	East African Dental Amalgam Phase	PES	Payment for Ecosystem Services
EIA	Environmental Impact Assessment	PPP	Private-Public Partnership
EITI	Extractive Industries and Transparency Initiative	RCP	Representative Concentration Pathways
EROS	Earth Resources Observation Science	REDD	Reducing Emissions from Deforestation and Forest Degradation
E-waste	Electronic waste	SDGs	Sustainable Development Goals
FAO	Food and Agriculture Organisation	SEA	Strategic Environmental Assessment
FLR	Forest Landscape Restoration	SIFM	Soil Fertility Management
GEF	Global Environmental Facility	SMMRP	Sustainable Management of Mineral Resources Project
GHG	Greenhouse gas	SOM	Soil Organic Matter
GNP	Gross National Product	SWM	Solid Waste Management
GOU	Government of Uganda	TSS	Total Suspended Solids
GRID	Global Resources Information Database	UBOS	Uganda Bureau of Statistics
IGA	Inter-Governmental Agreement	UNCCD	United Nations Convention to Combat Desertification and Drought
IPPU	Industrial Processes and Products Use	UNCED	UN Conference on Environment and Development
ISWM	Integrated Solid Waste Management	UNCST	Uganda National Council for Science and Technology
ITCZ	Inter-Tropical Convergence Zone	UNDP	United Nations Development Programme
IUU	Illegal, Unregulated or Unreported	UNEP	United Nations Environment Programme
KCCA	Kampala City Council Authority	UNESCO	United Nations Educational, Scientific and Cultural Organization
KCL	Kidepo Critical Landscape	UNFCCC	United Nations Framework Convention on Climate Change
KFSM	Kampala Fecal Sludge Management	UNHS	Uganda National Household Survey
LMNP	Lake Mburo National Park	UNIDO	United Nations Industrial Development Organisation
LPG	Liquefied Petroleum Gas	UNPS	United Nations Office for Project Services
LVEMP	Lake Victoria Environmental Management Project	URA	Uganda Revenue Authority
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries	USGS	U.S Geological Survey
MDA	Ministries Departments and Agencies	UWA	Uganda Wildlife Authority
MEA	Multilateral Environmental Agreements	WHO	World Health Organization
MEMD	Ministry of Energy and Mineral Development	WMZ	Wetland Management Zone
MPED	Ministry of Finance, Planning and Economic Development	WRs	Water Resources
MGLSD	Ministry of Gender, Labour and Social Development	WSSD	World Summit on Sustainable Development
MIA	Mercury Initiative Assessments	WWF	World Wildlife Fund
MOH	Ministry of Health		
MSWC	Municipal Solid Waste Compositing		
MTWA	Ministry of Tourism, Wildlife and Antiquities		
MW	Megawatts		

FOREWORD

The Ministry of Water and Environment with pleasure presents the 12th National State of Environment Report (NSOER) for Uganda 2016/17. The theme for the 2016/17 NSOER is **“Restoring the Environment for Livelihood Improvement and Sustainable Economic Development”**. This theme builds on the previous theme of the 2014 NSOER which addressed *“Harnessing our environment as infrastructure for sustainable livelihood and development”*. Both reports emphasize that environment and livelihood are interdependent on each other; and restoring the environment coupled with sustainable use of natural resources; will lead to livelihood development.

The National Environment Authority (NEMA) is mandated to prepare the NSOER. The report is developed periodically after two years in consultation and collaboration with the Environment Information Network (EIN) institutions from the Government Ministries, Departments and Agencies (MDAs).

NEMA collected data against the core environmental indicators that were developed during the 12th NSOER process. The continuous updating of indicator data has allowed for trend analysis, easy identification of emerging issues and a discussion on the future outlook.

The preparation used a thematic approach relevant to the sector-based management system in place; that explains the linkages between livelihood, economic development and the drivers that impact positively or negatively on the ecosystem services.

The Ministry of Water and Environment would like to congratulate NEMA on the successful documentation of the 2016/17 National State of the Environment Report for Uganda. I hereby invite all the people of Uganda and partners to implement the actions proposed in this report.

FOR GOD AND MY COUNTRY.



Hon. Cheptoris Sam
MINISTER OF WATER AND ENVIRONMENT



Hon. Cheptoris Sam

ACKNOWLEDGEMENTS

The National Environment Management Authority (NEMA) is according to the National Environment Act Cap 153, obliged to produce a state of the environment report every two years. The NSOER aims to inform the public about the state of the environment in the country, the importance of the environment and natural resources in the development process and their value to society, its trends and projections, the key issues and challenges and opportunities for improvement.

The NSOER is a key communication tool for information on environmental performance. It utilizes current scientific knowledge to support evidence-based policy for sustainable environment management. The report targets a wide audience, providing information to various stakeholders including policy and decision makers, the private sector, community leaders, universities and colleges, schools, libraries, researchers, the media and special interest groups.

NEMA would like to thank the Government of Uganda through the Ministry of Water and Environment for supporting the production of the State of the Environment reports. Notable contributions came from the various Ministries, Departments and Agencies (MDAs) particularly the institutions of the Environment Information Network (EIN) and districts that contributed data and information. We are grateful to the collaborating institutions and partners who participated in the technical reviews.

NEMA further acknowledges the technical and financial support from the United Nations Development Programme, UN-Environment, and UNEP-GRID. NEMA is further grateful to the Senior Geographical Information Systems & Remote Sensing Officer; Julius Muyizzi for effectively coordinating and guiding NEMA; and the stakeholders on behalf of Government. NEMA extends its appreciation to all staff that participated and supported the NSOER coordinator during the development of the 12th NSOER.

I look forward to continued collaboration of the contributors and readers of this report on using the NSOER 2016/17 for planning and decision making in order to enhance the management of our environment as infrastructure for sustainable livelihoods and development.

FOR GOD AND MY COUNTRY.



Dr. Tom O. Okurut
EXECUTIVE DIRECTOR, NATIONAL ENVIRONMENT
MANAGEMENT AUTHORITY



Dr. Tom O. Okurut

EXECUTIVE SUMMARY

The theme for this NSOER is ***Restoring the environment for livelihood improvement and sustainable economic development***. Using the Driving Forces-Pressures-State-Impacts-Response (DPSIR) approach, we assess changes in the environment, the forces driving those changes, how they have impacted livelihoods and also been harnessed to improve human wellbeing.

The NSOER has been separated into three sections; Part 1 providing the general overview of the environment sector, Part 2 providing the state and trends of the natural resources, Part 3 progression of environmental policies in Uganda and Part 4 focusing on scenarios. Below, we present the key messages and recommendations from each of these parts.

PART I

The institutional arrangements for environment and natural resource management at both the national and sub-national level provide the anchor for all other environment and natural resources related legislations. At the center of this framework are the institutional interactions and partnerships between NEMA and other ministries, departments and the District Local Governments.

The environment and natural resources sector contributed 28 percent to the Gross Domestic Product (GDP). Within the natural resources sector, services contributed the most (48%) followed by agriculture (Agriculture, forestry and fishing), which depends largely on the environment, with 23%.

The ENR sector is the largest source of employment and livelihoods in Uganda. 72 per cent of the labour force is employed in agriculture and forestry.

The high rate of population increase (3.5 per cent) coupled with Uganda's open boarder policy, have placed the environment at risk due to increased demand for natural resources. For example, over 96 per cent of the households in Uganda depend on biomass as source of cheap cooking and heating energy. There is also increased demand for basic services like good housing, lighting energy and safe water leading to increased deforestation for firewood and charcoal and conversion of virgin land into settlements. By 2014, the population in urban areas had increased to 7.4 from 2.9 million in 1991. Apart from natural population growth, urban population increase was also fuelled by rural-to-urban migration. The volume of goods manufactured in Uganda increased by 5.4 per cent in the 2016. This increase puts pressure on the environment e.g. through increased effluent from the factories leading to increased water and air pollution.

About 57 per cent of the household in the urban areas have access to electricity for lighting and in rural areas, 89 per cent have no access to electricity for lighting.

About 11 per cent of the population was at risk of suffering from waterborne diseases as compared to about 29 per cent among the population in rural area.

PART II: STATE OF THE ENVIRONMENT

Wetlands and rivers: Wetlands cover decreased from 13 per cent in 1990 to 8.6 per cent in 2015. It is estimated that Uganda loses 846 km² of its wetlands annually. At this rate, it is likely that there may be no wetlands left by 2040. Wetlands are habitats for fish and water birds e.g. Lemwa and Limoto are home to Cranes, Ducks, Egrets, Ibis and Storks.

Causes of wetland degradation include direct sewage release into wetlands, poor management of gravity water schemes, expanding settlements, sand mining, cultivation of river bank, excessive water abstraction for industrial use, clearance of vegetation, poor agricultural practices e.g. over grazing and cultivation on hilly terrain, agricultural chemicals, heavy run-off from the mountains and car washing depositing pollutants that affect aquatic life. These activities resulted in extensive soil erosion, reduced water quality and quantity due to siltation, change of a river's course e.g. River Semliki, proliferation of invasive species such as Water hyacinth (*Eichornia crassipes*) and Kariba weed (*Salvinia molesta*) weed, pollution from chemicals and eutrophication.

Lakes: Lakes were also affected by activities carried out in wetlands and along rivers and through direct use of the water resource. Inner Murchison bay is now heavily polluted and characterised by eutrophication, algal blooms, invasion by Water hyacinth and other water plants. Fish kills are dying due to toxic and anaerobic conditions. The deteriorating water quality now poses a threat to public and ecosystem health and requires costly advances in water treatment to reach standards where it is suitable for human consumption.

Interventions should include,

1. Government making deliberate effort to put in place funds for wetland, and river and lake banks restoration and management;
2. Cancellation of illegal land titles in the wetlands;
3. Increased vigilance in enforcement of the National Environmental Act; and,
4. Restoration by planting indigenous trees along the banks.

Fish resources: Fish contributes 3 per cent to national GDP and 12 per cent to agricultural GDP. Lake Kyoga used to rank second in contribution to the total fish production in Uganda but has now become depleted due to over fishing, use of illegal fishing gear and invasion of invasive species. Despite the general declining trend in fish exports, there was a registered increase in both quantities (by 85%) and value (by 26%) in 2015 compared to 2014. The quantities and value, however, declined in 2016 by 31% and 25% respectively. Fishing effort

(indicated as major fishing inputs and facilities at landing sites) increased by 89.2 per cent between 2000 and 2016 and the number of 'other gear' more than tripled between 2000 and 2016.

Invasive weeds (**Water hyacinth** and **Kariba weed**) are most abundant in the sheltered bays of Albert, Kyoga and Kwanja, blocking the water ways, which makes it difficult for fishermen to access to the fishing grounds. They also block sunlight from penetrating into the deeper parts of the lake preventing the underwater plants from photosynthesizing.

To ensure continued fish production,

1. breeding grounds should be zoned, gazetted and monitored;
2. fish farming and breeding of aquatic biodiversity should be based on established standards;
3. fisheries and other aquatic resources habitat destruction should be controlled, including fish waste management; and,
4. capacity should be built for better management and monitoring of fisheries resources.

Water resources: Based on assessment of rural water supplies in 45 districts, 41 % of rural water samples comply with national drinking water quality standards. The districts where compliance levels were below 60% (e.g. Adjumani, Arua, Isingiro, Mbale, Sironko and Hoima) are among the 15 cholera endemic districts listed by Ministry of Health. In the small towns, water quality is still below the target of 100% compliance level. This is because of supply of water without any treatment from production wells, poor operation and maintenance, lack of skilled manpower for water treatment, seasonal variations in water quality, abstraction of swamp water which is problematic to treat, lack of basic laboratory facilities to guide operations of the water works, lack of risk management, inadequate monitoring and supervision by regulators, and poor water source protection.

Water resources regulation improved during the reporting period (2015-2016), as evidenced by the increased number of clients applying for water use permits (from 203 to 313). Municipal wastewater effluents had a compliance level of 80% for BOD, and 0% for TSS. Industries had a compliance level of 43% for BOD and 29% for TSS. High organic matter, as indicated by high BOD values, has resulted in the proliferation of the water weed, a new pressure to the water resources. Between March 2015 and March 2016, a total of 260,874 metric tonnes of silt were collected from Nakivubo Channel.

Response to these challenges included the construction of the Lake Victoria Environmental Management Project (LVEMP) a wastewater treatment facility at Kirinya and the ongoing countrywide implementation of the Catchment Based Water Resources Management approach by DWRM.

Soil degradation: Soil fertility problems in Uganda are on the increase because of nutrient mining, loss of soil cover by in situ destruction or removal of crop residues, accelerated loss of soil organic matter, poor soil physical properties resulting in low rainfall infiltration and restricted rooting caused by soil compaction, and lack of proper soil management. At household level, there was a general increase in depletion of major nutrients, an indication of soil degradation. Some of the major causes of the depletion are poor farming systems and application of fertilizers leading to reduced soil productivity.

To avert the soil degradation trend, there is need to

1. promote use of inorganic fertilizers and manure within the Integrated Soil Fertility Management (SIFM) Framework;
2. promote adoption of Soil and Water management technologies;
3. control charcoal burning and fuel wood extraction; and,
4. where fertilizers must be used, train farmers in their proper use.

Crops: Area under crops increased from 9.1 m hectares in 1990 in to 10.5 million hectares in 2015 (15.4% increase). In the same period, forests cover reduced by about 48.3% and wetlands about 1.6%. Out of the 1.9 million hectares lost by forests and wetlands, about 80% of the land was converted to cropland.

About 52% of the area that was under crop land in 2015 was attributable to maize in mid-western, eastern and central Uganda, and sweet and Irish potatoes in South Western Uganda. Sugar cane growing constituted about 2% of the crop land, with most of it occurring in the Busoga region.

Livestock: Uganda's livestock sector contributes 4.3% to agricultural GDP. From 2014/15 to 2015/16, overall livestock farming reduced by 0.1%. Between 2001 and 2016, goats and cattle stock grew from 6,620 and 6,144 to 14,453 and 15,788 respectively. Also, Uganda has got production potential of 500,000 metric tons of honey per year but only produces 5000 metric tons are produced. This means that Uganda's potential for livestock farming is not yet realized.

Most diseases reported in animals from 2014 to 2016 are transboundary and Zoonoses (infections or diseases that are transmissible from animals to humans). The most prioritized transboundary animal diseases are Foot and Mouth Disease, African swine fever, Brucellosis and Contagious Bovine Pleuropneumonia. Whereas in 2016, Uganda had 12 outbreaks of Brucellosis in the different parts of the country, the outbreaks that affected the largest numbers was of the highly pathogenic influenza virus infection, which affected 2000 animals from several districts. To the environment, the main threat from livestock are overgrazing and increase in production of greenhouse gases.

To improve livestock production,

1. Restore degraded pastureland, especially in drought prone cattle corridor;
2. Develop feed management strategies to mitigate methane emissions from cattle;
3. Provided vaccines supplied to the local governments on time, and monitor actual vaccination;
4. Develop packages with information about varying grazing systems in different agro-ecological zones for farmers planting sustainable forages; and,
5. Scale up water harvesting infrastructure and provision of extension services.

Energy, Oil and Gas: Government policy to increase electricity generation capacity, transmission network and access led to the increase of installed generation capacity from 453 MW in 2006 to 925 in 2015. Large hydro accounted for 69% of installed capacity while thermal, co-generation and small hydro accounted for 15%, 9% and 7%, respectively.

Despite this effort, about 23.1 million Ugandans still need electricity for lighting. There is, therefore, need to develop more electricity sources.

Minerals and extractives: Exploited minerals include limestone, iron ore, sand, pozzolana and gold. Limestone, a raw material for production of cement, was the highest extracted mineral in terms of quantities although it decreased from 1,090,240 to 979,660 MT between 2014 and 2015.

Atmospheric resources: Rainfall, the most sensitive climate variable, decreased between 2011 and 2015. The decrease in rainfall in most of Uganda, combined with a significantly wetter December/January/February season, will result in significantly drier conditions for the rest of the year. Whereas annual rainfall for 2015 was highest on the eastern side of the country, in 2016, the high rainfall also covered the north western.

The occurrence of the extreme weather events, e.g. floods and landslides is having a significant impact on the incomes, assets and production of the households. Development prospects will only be reached if the impacts of climate change are mitigated. Although the cost of adaptation is high, estimated at around US\$406 m over the next five years (2015–2020), the cost of inaction will be 20 times greater.

Although greenhouse gases generated from various activities are still generally low, minerals processing/Livestock production and wastes have registered substantial amounts of carbon dioxide and methane. Cleaner production mechanisms should be used to reduce/control their production and mechanisms for their monitoring should also be put in place.

Tourism and wildlife: From 2015 to 2016, visitation to the National Parks grew by 14%. The category of Foreign Non-residents contributed most to this growth (24.3%). Resultant shared revenue increased from 6 billion Uganda shillings disbursed between 2011-2014 to over 7 billion between 2014-2016, reflecting a 15% increase. Sport hunting also generated over 3 billion shillings between 2014-2016.

Infrastructure and tourism attraction potential at cultural sites is still in its infancy. Of the 850 cultural heritage sites, one (01) is on the World Heritage List (Kasubi Royal Tombs) while Nine (09) sites are on the tentative list of UNESCO. Most of the cultural heritage sites lack or have inadequate visitor facilities. 10 sites were demarcated between 2014 and 2016 and the museum in Soroti was completed in 2016.

Within protected areas, animal numbers, for most species, have steadily increased since 1996 to date. This was attributed to the improved protected areas management coupled with the various initiatives including working with communities to establish ecotourism opportunities on private land.

Reported cases of human-wildlife conflicts generally increased between 2011 and 2016. The key wildlife species frequently reported as causing human-wildlife conflicts are elephants, hippos, buffaloes, crocodiles, leopards, baboons and monkeys. Drivers of human-wildlife conflicts include conversion of most of the Wildlife habitats outside

the PAs including wildlife corridors to agriculture, urban settlements, industrialization and encroachment on PAs.

Major threats to wildlife survival included agriculture expansion, infrastructure developments e.g. roads, oil and gas development and Hydropower development being implemented inside or at the fringes of protected areas. Other threats were illegal wildlife trade, and the spread of invasive species and other non-palatable species. For cultural sites, threats include stone quarrying, clearing for agriculture, erosion due to rock exposure, and loss of habitat associated wildlife.

To curb illegal wildlife trade, an intelligence Unit was created both at Headquarters and at each of the protected areas. Joint intelligence and investigation operations with Police, Army, INTERPOL and NRCN are conducted. A fully fledged Canine Unit with trained staff was established in 2016 at Entebbe International Airport.

To mitigate the observed challenges, various interventions need to be implemented,

1. For species that are showing a negative population trend e.g. zebra and impala in Lake Mburo NP, species specific conservation approaches should be developed to reverse the trend.
2. Although UWA has invested in a number of interventions to address the human-wildlife conflict, more innovations are required to further reduce the problem.
3. Revenue sharing for communities: Communities need to be guided better on how to invest the provided money in self-sustaining projects.
4. UWA has put in place guidelines for implementing developments in protected areas and ensures that they are adhered to. Sometimes, however, residual impacts that cannot be adequately addressed through the existing framework occur. More interventions are needed such as implementation of biodiversity offset.

Forestry: From 1990 to date, the natural forest cover has been declining. Although the coverage of big forests remained relatively stable between 2010 and 2015, most of the smaller forests significantly reduced in size and others were completely cleared. Drivers of forest change included clearing land for agriculture, increased charcoal and wood fuel demand, infrastructure development, and excessive harvesting of non-timber forest products. There was, however, increase in planted forest cover. Despite the general decline of forest cover, some areas e.g. Mabira FR are recovering. Most of the areas that had been encroached in 1990 have fully recovered.

To reduce the rate of forest decline, collaborative forest management should be scaled up and other payment for ecosystem services mechanisms should be explored.

Rangelands: Rangelands cover 44% of Uganda's land surface and they support 95% of the country's livestock. The rangelands are undergoing drastic changes ranging from conversion of grazing land to crop production, overgrazing, privatization of the communal rangelands, increase of invasive species and vegetation cover changes.

Charcoal burning is an added threat to rangeland survival. Subsistence farmland coverage in rangelands increased from 34% in 1995 to 41% in 2015. Changing land tenure system from communally owned land to private land has resulted in overgrazing of the remaining land that is not privatized, and in turn resulting in soil erosion and depletion of the seed bank.

To sustainably use rangelands and improve their productivity,

1. Invest in improved management of rangeland resources, especially in the dry season, to boost productivity and income;
2. Regularly collect data on rangelands to document extent of fires, rangeland productivity, invasive species spread and impact of charcoal burning;
3. Sensitize the herdsman on beneficial approaches of using fire to improve availability of forage and reverse degradation;
4. Investments on vector control;
5. Rangeland planning should be promoted in districts located within the rangeland areas. The planning in communal grazing lands should consider aspects like distribution of watering points to minimize overgrazing at few watering points;
6. The rangeland policy should be finalized; and,
7. Promote fodder production in enclosures.

Waste and environment health: Each person in Kampala is estimated to generate about 1 kg of waste per day which translates to 45,000 tons of waste per day. This was projected to increase by 43 per cent to 60,000 tons in 2017. Between 2014 and 2016, waste collection by KCCA increased by 11.4% and that of the private partners increased by 12.8%. Challenges of waste management include population growth leading to waste increase, especially in the urban centers, inaccessible unplanned settlements on the periphery of towns, lack of freely available land to use as landfills and the health risk of the methane generated from the landfills to the surrounding communities. By 2017, only 43 per cent of the faecal waste generated daily in Kampala was being emptied.

Government initiatives to manage waste include the Kampala Integrated Solid Waste Management (ISWM) plan, the Kampala Faecal Sludge Management (KFSM) Project, identification of a new landfill site and the Green Label Services Limited who collect Health Care Waste. Safe disposal of e-waste remains a serious public health concern. A policy to ensure the safe management and disposal of electronic equipment should be developed.

PART III: PROGRESSION OF ENVIRONMENTAL POLICIES IN UGANDA

Policy responses: There are several policy instruments that have been initiated or reviewed in response to the prevailing environmental challenges. These include,

1. The National Development Plan (NDP II), which defines the country's development priorities and strategic direction in the medium term (2015/16-2019/20);
2. Enforcement of the 1995 National Policy for the Conservation and Management of Wetland resources following the Cabinet Directive to cancel titles issued on wetlands;

3. The National Fisheries Policy 2014 was comprehensively reviewed to generate the National Fisheries and Aquaculture policy 2017; and,
4. **The Uganda National Climate Change Policy, 2015 aimed at** ensuring a harmonized and coordinated approach towards a climate resilient and low-carbon development path for sustainable development in Uganda.

Putting environment into a wider context: Coordination of Multilateral Environmental Agreements (MEAs)

1. United Nations Development Programme (UNDP) are implementing **a global initiative on biodiversity finance (BIOFIN)**. The ongoing review of the policy and institutions indicates that, the contribution of climate financing in biodiversity conservation should be strengthened and there should be a strong biodiversity conservation finance strategy with considerable multi-stakeholder consultation, participation, participation and commitment is required.
2. Review and updating of the National Implementation Plan of the Stockholm Convention (SC) on Persistent Organic Pollutants (POPs) in 2016.
3. To achieve Strategic Goal A, B, C, and D for the Aichi Targets 3 to 19, in line with the Vision 2040, the NDPII and the SGDs, under the **Kidepo Critical Landscape project**,
 - (a) 20 women enterprise groups were supported in a number of interventions on sustainable use options for shea butter trees and wildlife, and fourteen (14) women groups in Agago district were supported with four (4) cold and hot press machines
 - (b) A cost benefit analysis for shea butter use options in the districts of Abim, Agago and Kitgum indicated that the Net Present Value (NPV) of the shea oil use option is by far higher than the timber and charcoal production from this species.
 - (c) To mitigate human/wildlife conflict, two community groups of 30 members each (45 women and 15 men) in Agago District supported planting of sixty (60) acres of chilli received a bumper harvest and also reported fewer cases of elephant crop raid.

PART IV: FUTURE OUTLOOK

Scenarios (Forests): If no action is taken, Uganda will lose all its forest cover in 26 years. If, however, consumption behavior is controlled, the current forest cover will last about 76 years.

Rainfall Prediction

Prediction of monthly rainfall for the period 2012-2015 was modelled using trigonometric functions. The prediction shows that average monthly rainfall has a cyclic behavior which manifests after a period of about 5 months. The model further shows that the average monthly rainfall is higher in the first season but for a shorter period of time and lower in the second season for a longer period of time of about 7 months. This implies that for an agricultural country like Uganda, the first season would better for crops that require less rains and second season for crops that require more rains.



Limoto wetland system in Kibuku District fully recovers following intervention spearheaded by NEMA, Ministry of Water and Environment and Kibuku District Local Government, through community engagement, sensitization meetings and compliance enforcement.
Photo credit: Bob Nuwagira (NEMA 2016)

PART 1

CHAPTER 1: Introduction

INTRODUCTION

Background to State of the Environment Reporting

Restoring the environment for livelihood improvement and sustainable economic development is the theme for this twelfth edition of Uganda's State of the Environment report series.

It is premised on that the fact that Uganda's economy has a high dependence on its environmental and natural resources. For instance, in 2010 forest resource alone were reported to have contributed between 6 to 8 per cent of the national gross income the equivalent of \$1.3 billion annually (NEMA 2011). Similarly, extrapolation based on valuations conducted by Kakuru et al. (2013) showed that wetlands within the country may be contributing an estimated \$4.9 billion per year. Despite the considerable importance of these and other environmental and natural capital assets, Uganda continues to suffer considerable environmental degradation at great cost to livelihoods and the economy. By 2002, the cost of environmental degradation was conservatively estimated at between 2 and 4 per cent of the gross national product (GNP); while a decade earlier soil and land degradation alone were estimated to lead to a loss of 11 per cent loss of GNP (Moyini et al. 2002 and Slade and Weitz 1991).

Uganda's long-term development framework is the Vision 2040 which is being operationalized through a series of six 5-year rolling plans – the National Development Plans (NDP). Since the publication of the last NSOER in 2014, the country began implementing the second National Development Plan – NDP II (2015/16 to 2019/20). Vision 2040 and the NDPs operate within the context of Uganda's Constitution. They also operate within the framework of the global environmental community which brings countries together to work towards common goals and targets for human wellbeing. The 2030 Sustainable Development Goals to which Uganda has signed up to aim to address a number of societal issues. To that end, the Uganda Green Growth Development Strategy (UGGDS) 2017/18 –2029/30 was developed to accelerate and ensure that the goals of the Uganda Vision 2040 and the NDPII 2015/16-2019/20 and the global goals of the SDGs are attained in a sustainable manner. The Green Growth strategy will allow Uganda to reaffirm its commitment to sustainable development and restore and rehabilitate the environment while transforming to a modern middle-income country by 2040.

Approach for Developing the National State of the Environment Report

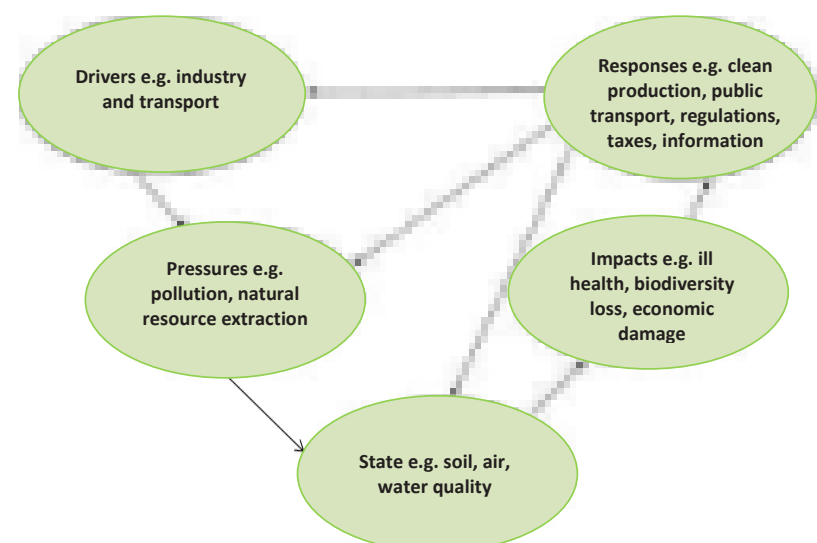
Preparing the NSOER was a collaborative process. It involved identification of key environmental issues and physical locations on the ground illustrating positive case studies (hope spots) or case studies on areas where environmental degradation is obvious (hotspots).

These were all done in a participatory manner. The synthesis was carried out following the Driving Forces-Pressures-State-Impacts-Response (DPSIR) approach to measure and assess how the environment was faring and to describe the conditions and trends. Satellite images, maps, graphs and ground photos were compiled to assist in the analysis and visualization of statistical and geospatial data.

DPSIR framework

The DPSIR framework is a useful analytical tool frequently used in state of the environment and outlook reporting. It is a well proven methodology for describing elements of the chain that links human activities to their impacts on the environment and the effectiveness of responses (Patricio et al. 2016).

Figure 1.1: DPSIR framework



Source: Segnestam (2002)

State of the environment reporting using the DPSIR framework tells the story of environmental change in an integrated manner. It pulls together information from different sectors to answer a series of questions whose answers will link cause and effect. The first question to be considered is **“What is happening to the environment?”** Three aspects of the DPSIR framework help to answer this. **Drivers** describe the socio-economic forces such as population growth, poverty and consumption that apply direct pressures on the environment. These pressures may be in the form of pollution and resource extraction. The **State** is a description of what the environmental conditions are in different areas or time lines. The second question is **“What are the consequences for the environment and humanity?”**

To answer this the impacts of the environmental problems on the country's ecosystem goods and services, society, the economy and human health and wellbeing are considered. The story concludes by considering the **responses** to these issues by answering **“What is being done and how effective is it?”**

The DPSIR framework can only be supported through a sound data and information foundation. Comparisons, assessments, valuations and conclusions are informed by data variables or indicators that provide a practical way of tracking the changes identified. The data and information for this report was gathered using:

- Extensive review of documents including the District State of Environment Reports, Sector Reports, scientific publications among others.
- Stakeholder consultations (which include an inception meeting and consultative workshops which were used for information gathering, hotspot and hope spot suggestions and for identification of potential sites for satellite image change pair analysis.
- Field visits especially to areas experiencing noticeable environmental change
- Technical review and validation workshops to solicit comments on draft chapters and validate the various drafts.
- Thematic working group meetings where technical officers from stakeholder organizations came together to analyze data and information under each of the thematic areas.

Hotspots and Hope spots

This edition of the NSOER is unique in that it uses ‘hotspots’ and ‘hope spots’ as areas where visible environmental change is occurring. An area where the environmental change is positive such as regeneration of a forest or restoration of a wetland is defined as a ‘hope spot’. If an area is highlighted as showing evidence of environmental degradation it will be categorized as a ‘hotspot’ (UNEP, 2013). It is shown visually using two or more satellite images or change pairs of different years so as to show the trends.

The analysis of the time-series satellite imagery was carried out in Sioux Falls at the United Nations Environment Programme Global Resources Information Database (GRID) Centre that is hosted by U.S Geological Survey (USGS) Earth Resources Observation Science (EROS).

Purpose, scope and flow of the NSOER

Production of NSOER's is a biennial requirement of the Government of Uganda (GOU) under the National Environment Act Cap 153. The NSOER report aims at informing the public about the state of the environment in the country, the importance of the environment and natural resources in the development process and their value to society, its trends and projections, the key issues and challenges and opportunities for improvement. It is therefore a method of communicating environmental performance. It also serves as an accurate and useful reference document to support environment management in the country.

The production of the document brings together all actors engaged in environment management such as regulators, managers, users and/or beneficiaries of the natural resources in the process to assess the state and concerns over the resources.

Structure of the document

This NSOER is divided into four parts. Part I provides the background to state of environment reporting and highlights the DPSIR approach used. It then discusses livelihoods and economic development in the context of the environment; as well as the drivers that influence ecosystem change in Uganda. Part II of the report is composed of 13 chapters each covering one of the natural resources in the country. These include Wetlands, River banks & Lakeshores; Fisheries; Water Resources; Soils degradation; Crops; Livestock; Energy, Oil and gas; Mineral and Extractives; Atmospheric Resources; Wildlife and Tourism; Forestry; Rangelands; Waste and Environmental Health. Part III focuses on policy, describing the different responses and actions that are being used to address some of the environmental problems identified. It also tries, where possible, to assess their success or failure as well as ongoing reviews and amendments. The fourth and last part of the document attempts to look into the future, since, present day actions also have consequences that reach far into the future. It highlights some of the environmental issues that are likely to require priority attention in the future.

Country Profile

Location and altitude

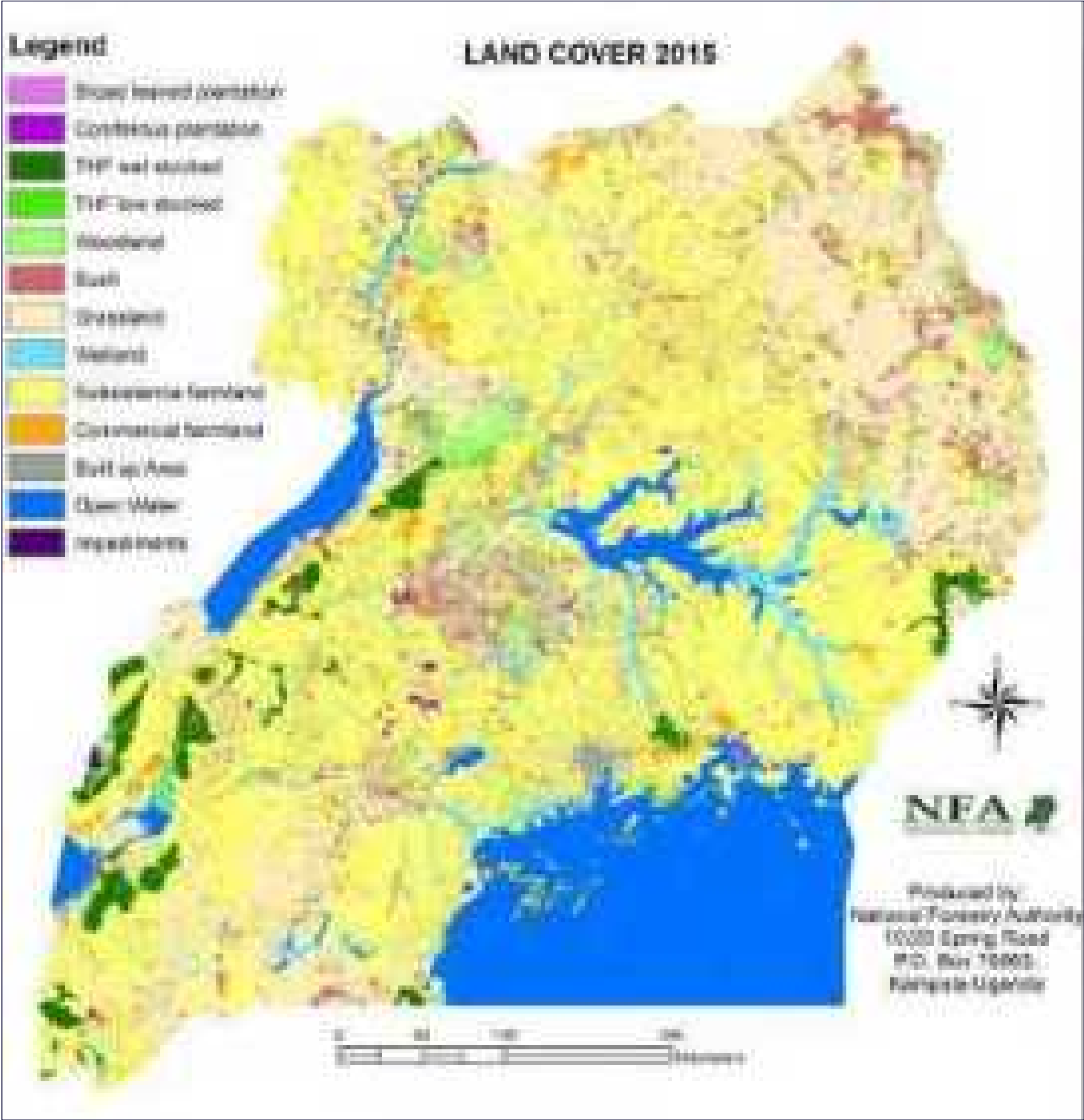
Uganda is located in East Africa and is bordered by five countries. Kenya in the east, South Sudan in the north, Tanzania in the south, Rwanda in the southwest and the Democratic Republic of Congo (DRC) in the west. The country has an area of 241,550.7 km² of which open water covers 36,864.07 km², wetlands 7,620.76km². The land area is 197,065.91 km². Uganda lies within latitudes of 4°12'N and 1°29'S, longitude of 29°34'E and 35°0'N (NEMA 2009).

The largest part of the country lies between 900-1,500m but comprises of distinct landscape levels generally made up of plains, plateaus and mountains. The country's elevation extremes are 621 meters above sea level in Lake Albert, as the lowest point, and the Margarita peak on Mount Rwenzori at about 5,110 meters above sea level. (UWA 2017).

Climate

Uganda is located on the equator and this accounts for the tropical climate it experiences all year round. The annual rainfall ranges between 800 to 1,700 mm. Temperature ranges between 12°C to 32°C. The highest temperatures over 30°C are experienced in the north and north east of the country while temperatures as low as 4°C are experienced in the highlands of the southwest. Temperatures below 0°C have been recorded on Mountains Rwenzori and Elgon. The Rwenzori Mountains have a permanent ice cap, whose size is currently reducing presumably due to global warming (Uganda dept. 2000; UBOS 2006).

Figure 1.2: Land cover of Uganda



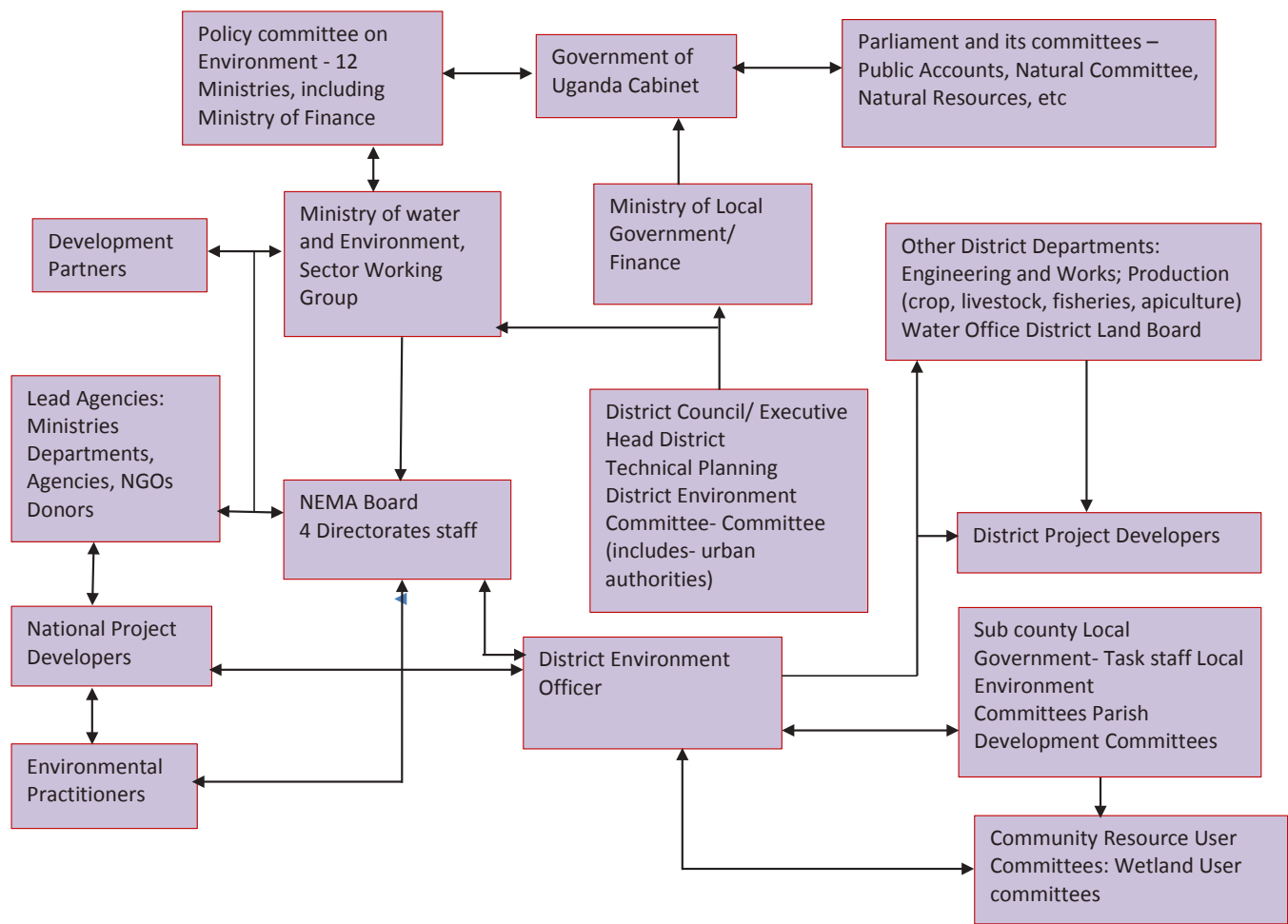
Source: NFA 2016

Institutional arrangements for environment and natural resource management

The institutional arrangements for environment and natural resource management include a national and sub-national system which is built based on the requirements of the Constitution of Uganda (1995), the Local Government Act Cap 243, and the National Environment Act Cap 153. The Constitution established a decentralized system of

governance to support the Central Government. Figure 4 outlines the current institutional arrangements as stipulated under the National Environment Act Cap 153. This arrangement provides the anchor for all other environment and natural related legislations. At the centre of this framework are the institutional interactions, partnerships between NEMA and other ministries and departments and the District Local Governments.

Figure 1.3: Institutional arrangements for Environmental Management



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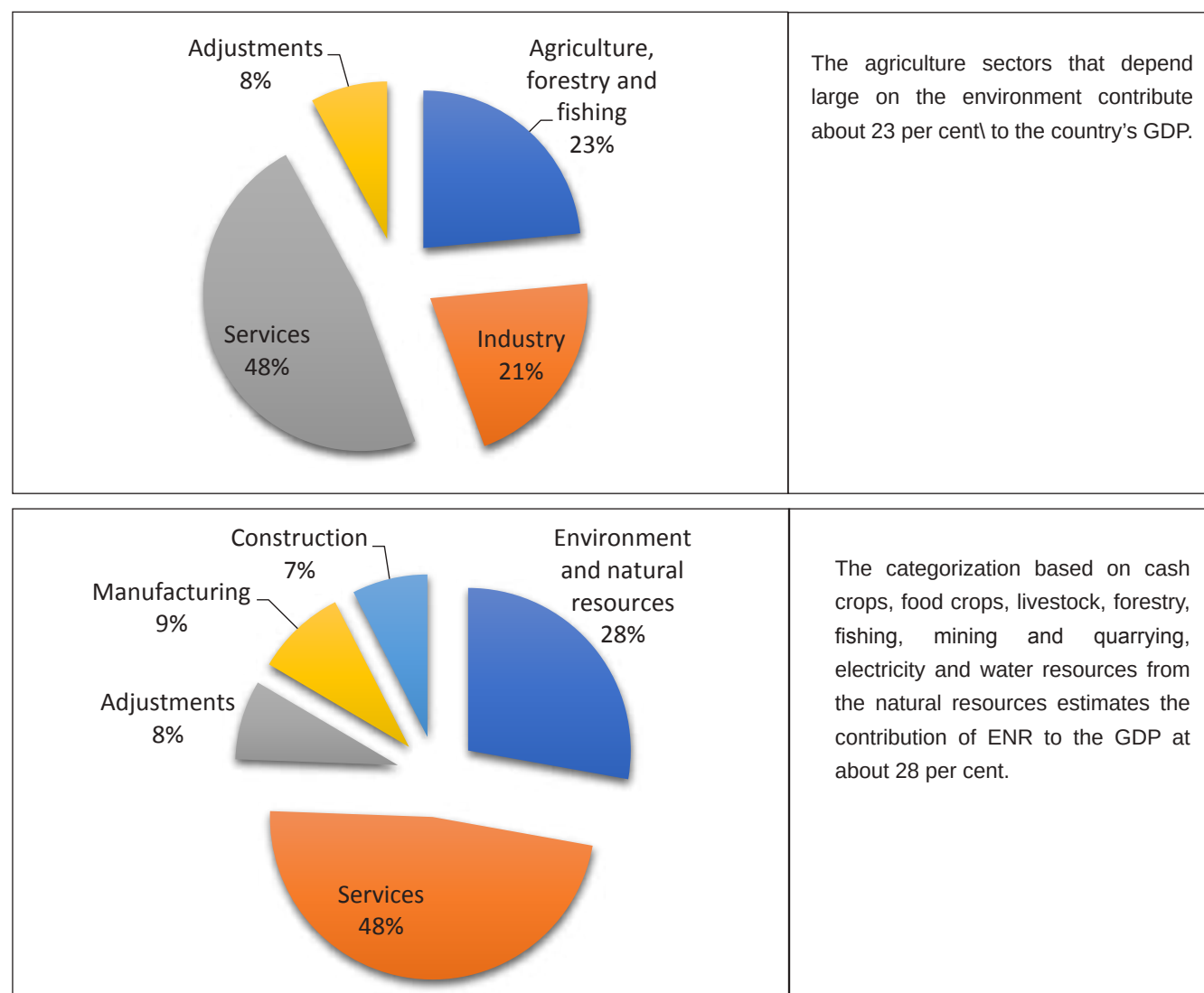
CHAPTER 2: Drivers of Ecosystem Change - Human wellbeing, Livelihoods and Economic Development

Livelihoods, economic development and the environment

Gross Domestic Product (GDP), at the end of the 2016 calendar year was estimated at UGX 86.8 trillion (UBOS, 2017). The contribution to the GDP is classified into three broad sectors Agriculture, Forestry and Fishing; Industry; and Services (UBOS 2015). Agriculture, forestry and fishing are composed of cash crops, food crops, livestock, agriculture support services, forestry and fishing. Industry includes mining and quarrying, manufacturing, electricity, water supply and construction.

Services sector consist of trade and repairs, transportation and storage, accommodation and food service activities, information and communication, financial and insurance activities, professional, scientific and technical activities, public administration, education, human health, social work activities, arts, entertainment and recreation, other service activities and activities of households as employers. In the national accounts, there is a further category of adjustments which consists only of taxes on products and services (UBOS, 2016). Figure 2.1 shows the percentage contribution to GDP for each of the broad sectors and the classification based on environment and natural resources in Uganda.

Figure 2.1: Contribution of Environment and Natural resources to GDP 2016



Source: Authors computation from UBOS data, 2016

The environment and natural resource sector contributes 28 per cent towards GDP meaning that ignoring it would grossly undermine economic growth. The inclusion of environment and natural resources in the computation of GDP is in line with Sustainable Development Goal (SDG) 8, which seeks to *promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all*.

Poverty and environment

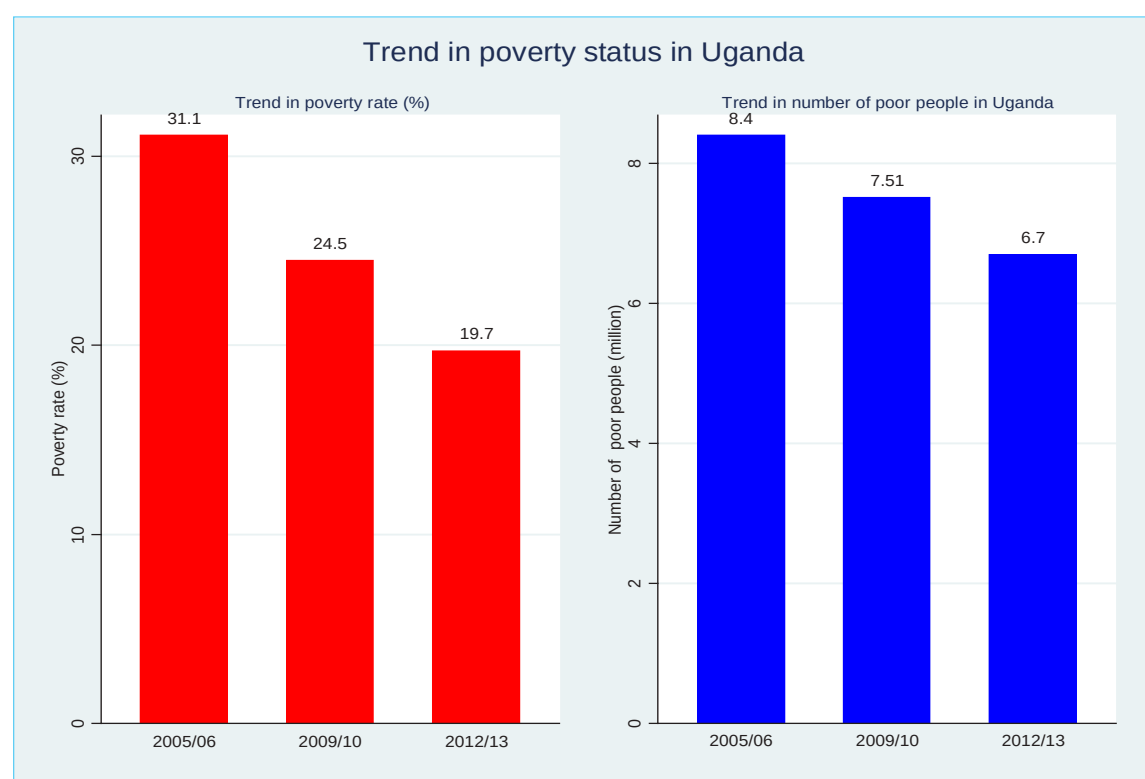
According to UBOS, 2017, the proportion of the population that cannot afford the basics of life in 2012/13 was about 19.7 per cent translating in about 6.7 million people. Poverty levels and the absolute number of poor people seem to be on the decline. However, the number of poor people who largely depend on the environment for their livelihood is still high. Figure 2.2 shows the trend in poverty rate and the population below the poverty line in Uganda.

Results show that factors like poverty, changes in climate, inadequate land for agriculture, charcoal burning, lack of proper garbage disposal facilities, lack of proper drainage, encroachment on the land for construction of buildings, congestion, lack of market for agricultural produce and lack of sensitization account for about 17 per cent of the observed degradation of natural resources. Currently over 70 per cent of the labor force depends on the natural resources for their livelihood. If Uganda is to achieve SDG 15, that seeks to *protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss*, efforts should be put in place that address poverty and livelihood for the poor households.

Environment and livelihoods

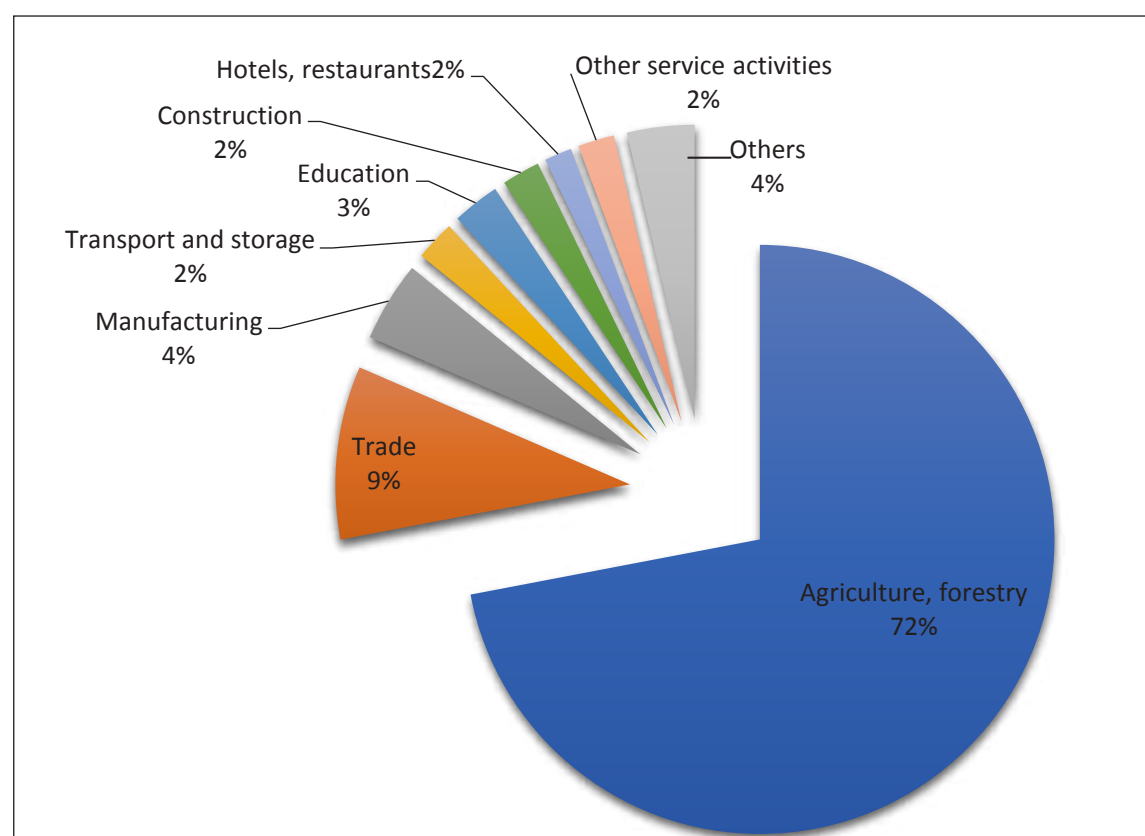
The ENR sector is the largest source of employment and livelihoods in Uganda and is directly proportional to population increase. The majority of Uganda's population is dependent on natural resources as source of livelihood.

Figure 2.2: Trend and status of poverty in Uganda 2005/6-2009/10



Source: Authors computation from UBOS data, 2017

Figure 2.3 Distribution of the labour force by sector in Uganda 2016



Source: Authors computation from UBOS data, 2017

For example, 72 per cent of the labour force is employed in agriculture and forestry, while 43.2 per cent of the working population are engaged in subsistence farming as source of food and livelihood (UBOS, 2017). For sustainable employment and livelihoods, the environment and natural resources must be managed well to maintain the current production levels in line with SDG 8.

Industrialization and environment

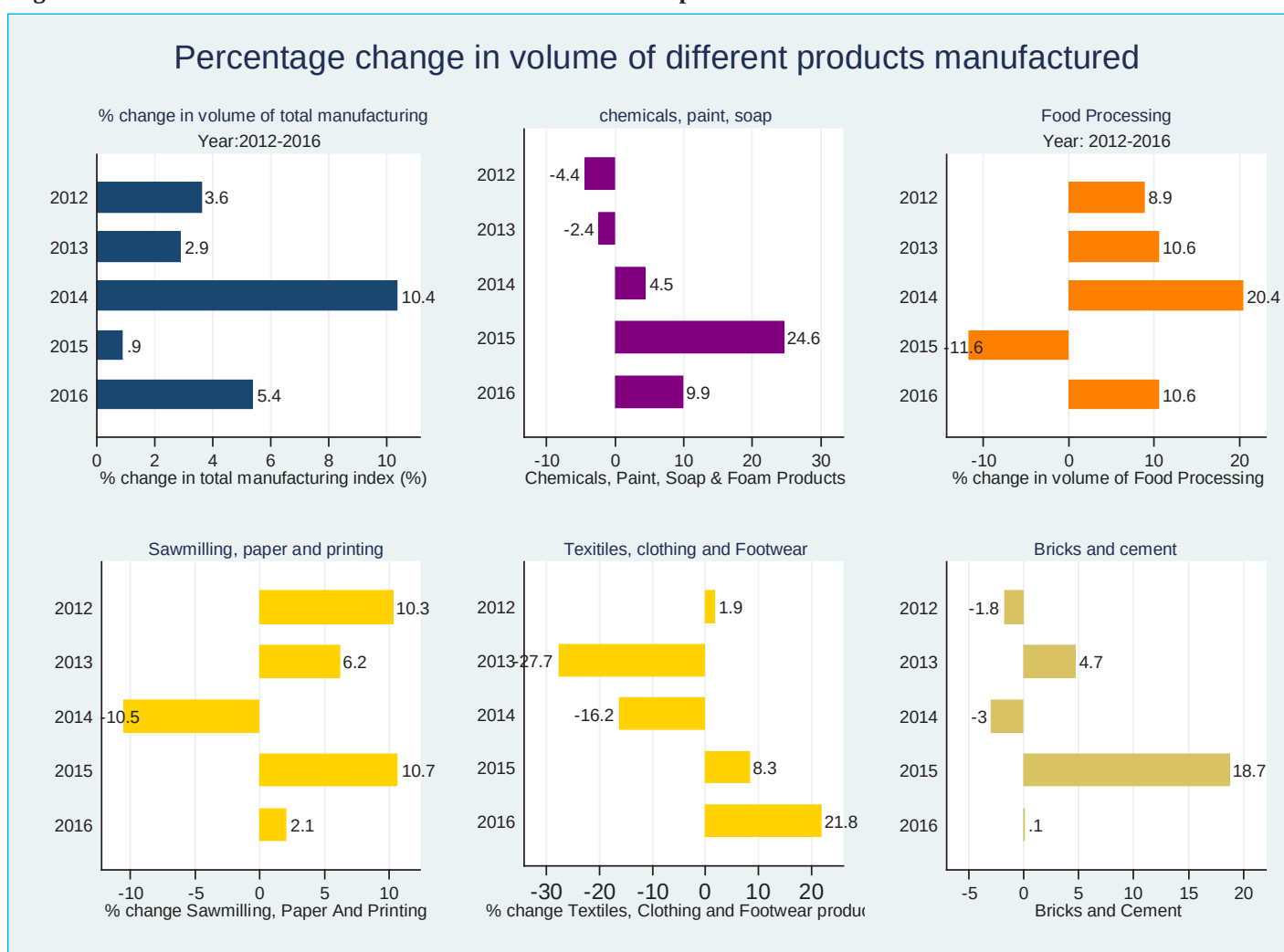
Industrialization is one of the drivers of economic development in Uganda and contributes about 21 per cent of the country's GDP (UBOS, 2017). Manufacturing, as one of the indicators of industrialization, contributes about 9 per cent of the country's GDP and employs about 4 per cent of the labour force. Figure 2.4 shows the trend in the volume of selected products manufactured for the period 2012-2016. The volume of goods manufactured in Uganda has shown an increasing trend over the years. For example, in the 2016 there was a 5.4 per cent increase in the volume of goods manufactured such as food processing, chemicals, paints and soap, textile clothing and footwear (UBOS, 2017).

The increase in the volume of good manufactured puts pressure on the environment in several ways. Increased effluent from the factories

might lead to increased water and air pollution. Point and non-point source pollution has put much pressure on Lake Victoria resulting in the transformation of the lake vegetation and loss of important livelihoods for fisheries, water transport and the loss of the tourism industry, among others.

Secondly, it might also increase the consumption of natural resources such as water, sand and biomass resources thus leading to over extraction and environmental degradation. Poor regulation and/or inability to adequately monitor and control pollution activity of industries along water ways has resulted in untreated wastewater being discharged from industries in contravention of existing pollution control regulations. If Uganda is to achieve SDG 9 which seeks to **build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation**, greater monitoring is required.

Figure 2.4: Trend in industrialization of different manufactured products



Source: Author's computation from UBOS data, 2017

Urbanization and environment

Urbanization is the process that leads to the growth of urban centers. In Uganda, urbanization is realized by growth of townships, town councils, municipalities and cities resulting from economic development and industrialization. The country is experiencing rapid growth in urban centers. For example, the number of municipalities has almost tripled from 13 in 2002 to 33 in 2014 (UBOS, 2014). Similarly, the number of town councils and townships also tripled in the same period. Figure 1.3 shows the growth in the number of urban centers in Uganda for the period 1991-2014.

The population residing in urban areas has also increased. For example, in 2002 the population in urban areas was about 2.9 million people with an urbanization rate of about 12.1 per cent (UBOS, 2014). This has increased by almost three times to 7.4 million people translating into an urbanization rate of about 21 per cent (UBOS, 2014). Apart from natural population growth, this increase is also fuelled by rural-to-urban migration. In 1969, about 7 per cent of the population was living in urban areas. The proportion of the population living in urban areas has been increasing and currently about 18 per cent. Figure 1.4 shows the growth in the population in urban areas and the urbanization rate between 1991 and 2014.

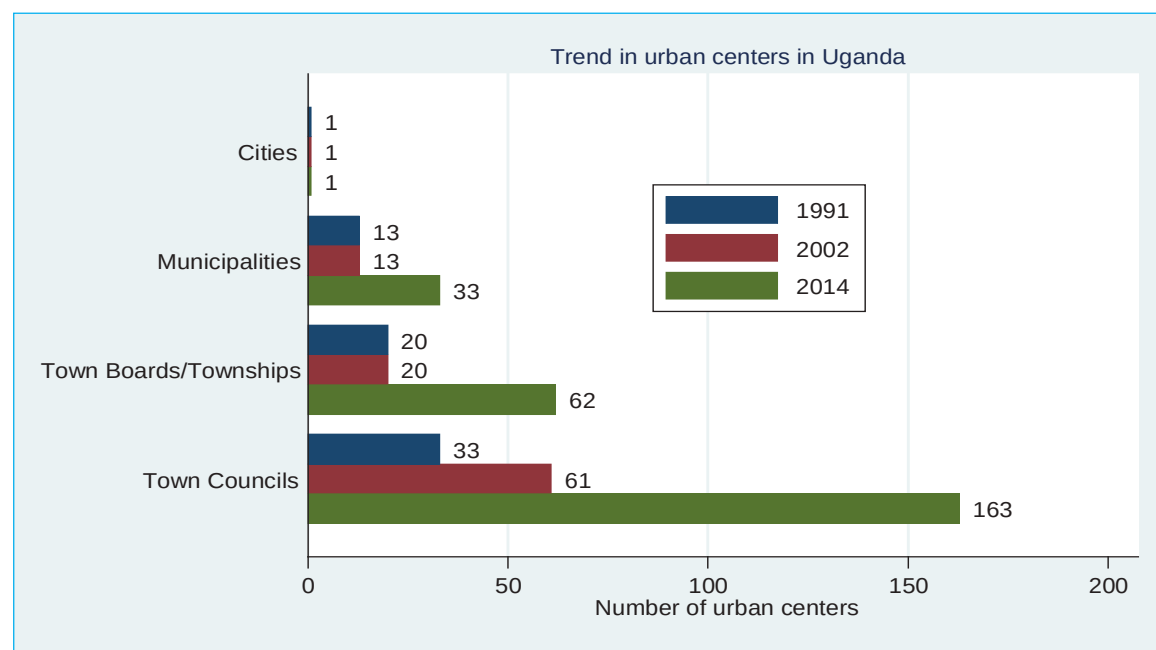
Urbanization is expected to continue growing at an average rate of 5.7 per cent per year. If not controlled, this is likely to put much pressure on the environment. Already uncontrolled urbanization has led

to shortage of decent housing resulting in establishment of informal settlements like Katanga, poor air and water quality, poor disposal of solid waste around the urban centres and excessive pollution of water bodies such as in the Inner Murchison Bay. These challenges are likely to affect the achievement of SDG 11 which seeks to **make cities and human settlements inclusive, safe, resilient and sustainable**.

Population and environment

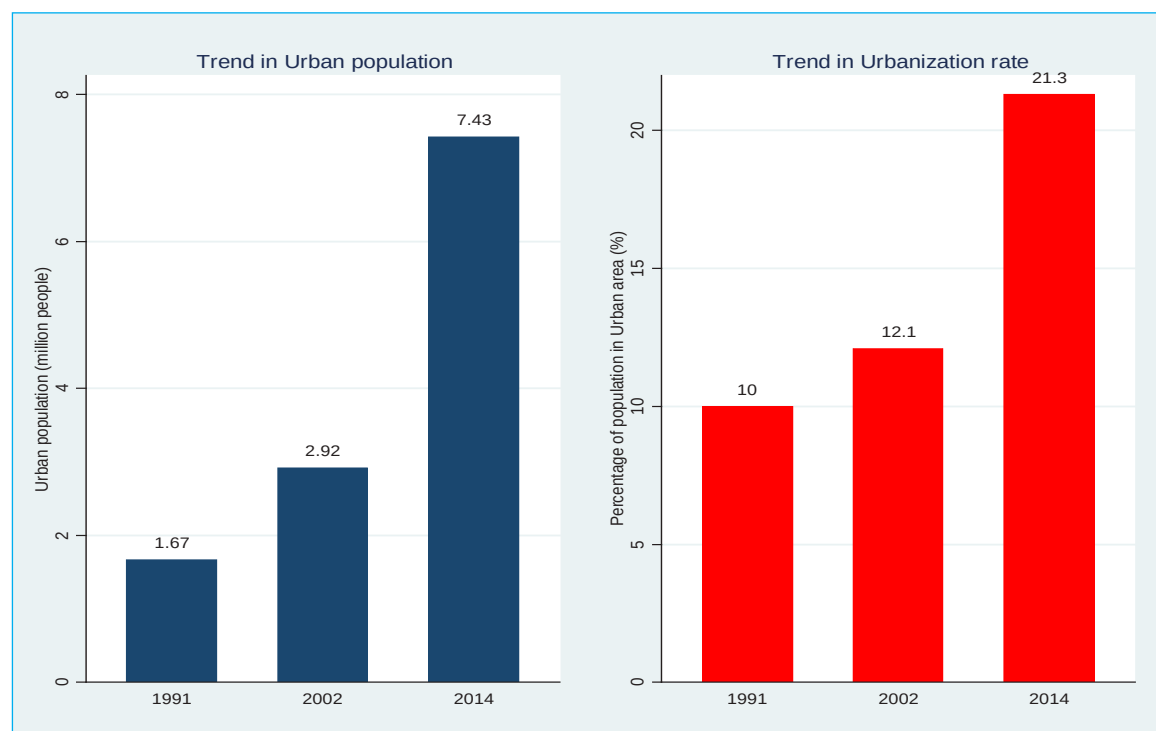
People depend on the environment for their livelihood mainly through demand and supply of ecosystem services. Ecosystems services are affected or affect the state of the environment in an attempt to provide

Figure 2.5: Growth of urban centers in Uganda 1991-2014



Source: Author's computation from UBOS census data, 2014

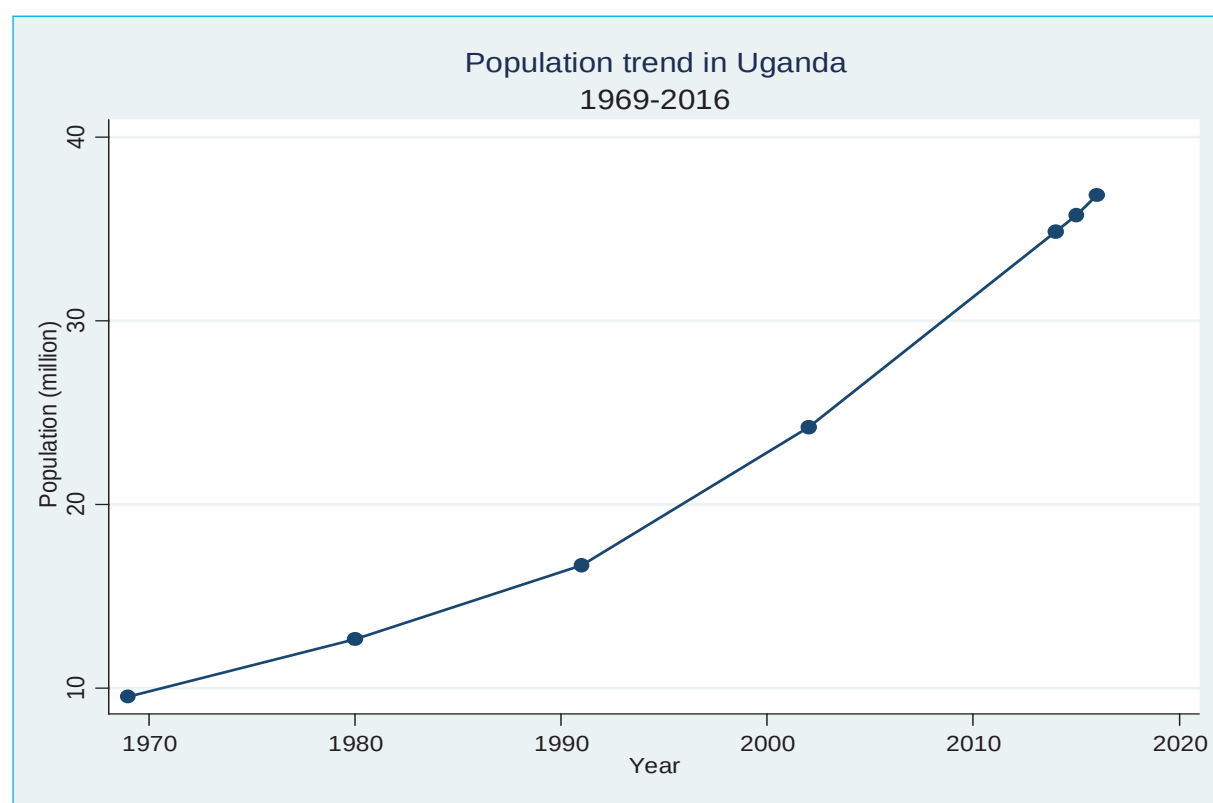
Figure 2.6: Population growth in urban areas and urbanization rate



Source: Author's computation from UBOS census data, 2014

for human population needs such as lighting, heating and cooking. Currently the population of Uganda is estimated at about 36.9 million and increasing at an average rate of about 3.5 per cent (UBOS, 2016). The National Service Delivery Survey (NSDS) carried out in 2015 to assess the causes of ecosystem and environmental degradation in Uganda established that about 40 per cent of the observed degradation of environment was attributed to the current population growth (UBOS, 2016). The increasing population is an indicator for increased demand for basic services like good housing, cooking and lighting energy and safe water among others and is likely to exert even more pressure on the available natural resources. Figure 2.6 shows the growth in the population of Uganda for the period 1969-2016.

Figure 2.7: Population growth trends 1969-2016



Source: Author's computation from UBOS data, 2016

The population of Uganda is increasing and is expected to reach about 50.2 million people by 2026 (UBOS, 2016). Population density in 2016 was 183 persons per km². Land fragmentation, food insecurity, malnutrition, poor housing and high dependency ratio are some of the impacts of a fast-growing population.

Refugees

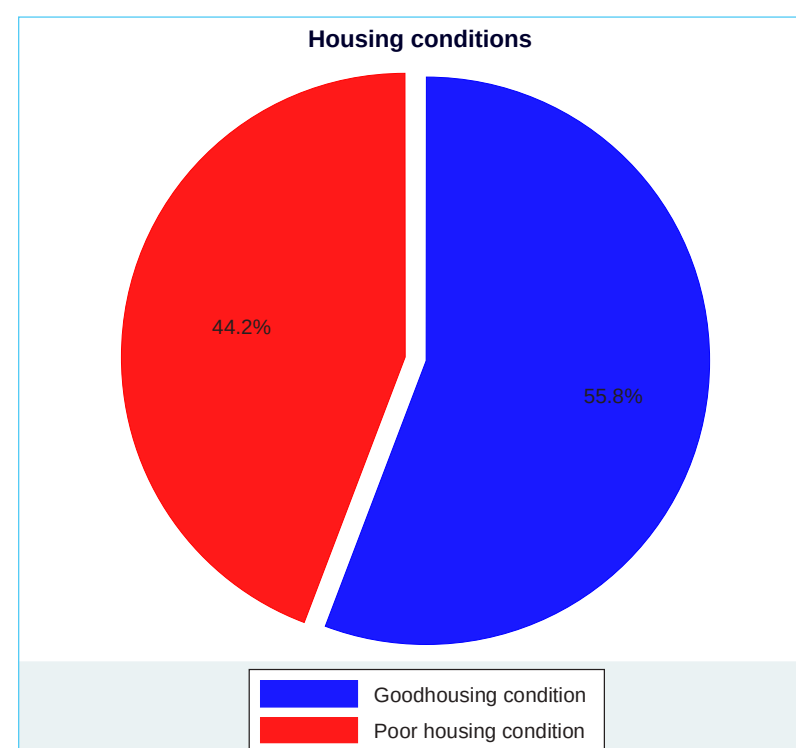
According to the United Nations High Commission for Refugees, Uganda ranks among the top three refugee hosting countries in the world and largest in Africa. Bidibidi settlement in Northwestern Uganda is home to about 276,000 refugees and is considered Africa's largest refugee settlement (UBOS, 2016). The number of refugees from South Sudan is estimated to be around one million. The refugees from South Sudan are hosted in the West Nile Districts of Yumbe and Moyo Districts and it has been estimated that financial resources amounting to US\$ 8 billion will be needed to cater for refugee crisis over the next four years.

This unprecedented influx has created massive pressures on the environment which are likely to worsen if environment sustainability is not incorporated in the refugee management practices. In some districts such as West Nile and Moyo, the number of refugees exceeds the local inhabitants' population size thereby imposing more pressure on the natural resources and socio-cultural environment as well. Refugees need water, energy for cooking and land for building settlements. These requirements imply increased deforestation for firewood and charcoal and conversion of virgin land into settlement camps. Uganda has allocated over 1,000 square miles of land for the refugees which they cultivate to promote self-reliance.

Housing and living conditions

The 2015 National Service Delivery Surveys revealed that only 44 per cent of households have good housing conditions such as tenure, number of people in the house and construction materials used. For instance, 69 per cent of households are living in houses with either earth, sand, or dung floors. Improvements to housing conditions should be possible using materials from the environment, although this may put pressure on the natural resources leading to degradation. Rural households (81 per cent) are more likely than urban dwellers to have poor housing conditions (UBOS, 2012).

Figure 2.8: Distribution of Household housing conditions

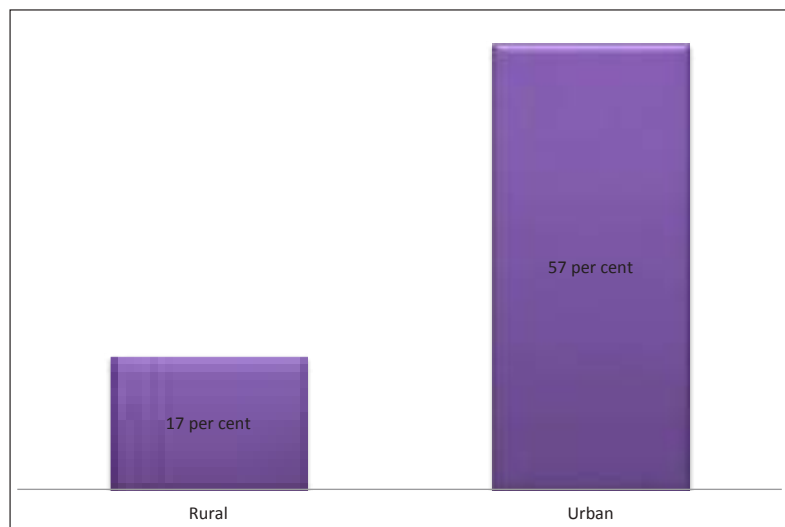


Source: Author's computation from UBOS data, 2012

Access to electricity for lighting energy

According to UBOS (2016) about 57 per cent of the household in the urban areas have access to electricity for lighting. This implies that the balance – about 3.9 million people - in the urban areas are at risk of airborne diseases from indoor pollution. Furthermore, in the rural areas 89 per cent have no access to electricity for lighting energy translating into about 4.6 million households (23.1 million people) with an unmet need for electricity for lighting.

Figure 2.9: Access to electricity and risk of indoor air pollution



Source: Author's computation from UBOS data, 2016

Access to cheap energy for cooking

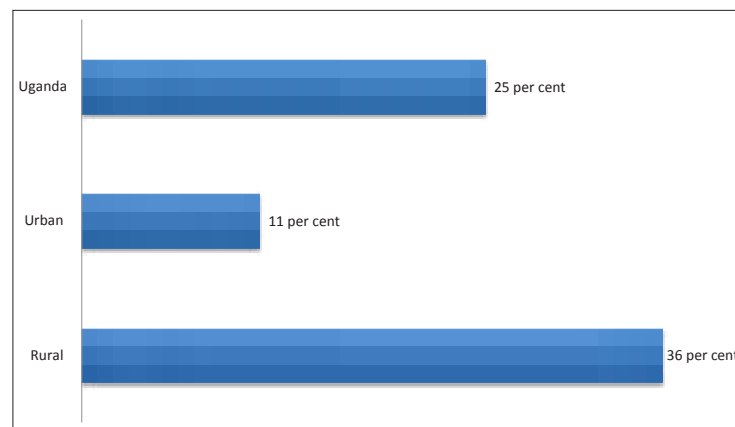
Over 96 per cent of the households in Uganda depend on biomass as source of cheap cooking and heating energy (UBOS 2016). Furthermore, this demand is expected to increase with increasing population. The current demand for biomass energy as charcoal and firewood for urban and rural respectively has led to the observed decline in the forest area across the country. There is therefore need to address the demand for cheaper cooking energy if the forest loss is to be halted. The increased demand for clean and affordable lighting and cooking energy is in line with SDG 7 that **seeks to ensure access to affordable, reliable, sustainable and modern energy for all**.

Access to safe drinking water

According to the National Service Delivery Survey 2015, about 75 per cent of Ugandans have access to safe drinking water (UBOS, 2016). With the growing population, there will still be increased demand for safe drinking water across the country mainly amongst the rural and urban poor. This increased demand for safe drinking water is likely to increase the pressure on the water resources in the country.

Lack of access to safe drinking water leaves the population vulnerable to exposure to waterborne diseases. Within urban areas, about 11 per cent of the population was at risk of suffering from waterborne diseases as compared to about 29 per cent among the population in rural areas (UBOS, 2016). In absolute numbers this translates to 9.22 million people at risk of waterborne diseases. The provision of safe drinking water is in line with SDG 6 that **seeks to ensure availability and sustainable management of water and sanitation for all**.

Figure 2.10: Proportion of population with no access to safe water



Source: Author's computation from UBOS data, 2016

Ineffective policies and laws

Another factor in promoting degradation of natural resources is weak enforcement. Results revealed that about 16 per cent of observed degradation of natural resources is attributed to weak enforcement. Setting up an effective system to monitor and protect natural resources plays an important role in the sustainable and equitable utilization of the resources. However, this finding is not surprising given the fact that management of the environment is allocated less than 1 per cent of the national budget (UBOS, 2016).

Weak compliance and enforcement

Findings revealed that about 10 per cent of environmental degradation especially in the forestry and wetlands sectors are attributed to ineffective policies and laws. This implies that our existing policies and laws might not be sufficient to handle matters of environmental degradation in Uganda. The ongoing review of the National Environment Management Policy and the National Environment Act and its regulations has highlighted major concerns over environmental compliance. The concerns seem to stem from the projects that have major impacts on the environment through both small cumulative impacts such as construction of fuel stations in wetlands, to larger projects that cause conversion of wetlands and forest areas for instance industrial parks and infrastructure projects. The concerns are that the regulators may not have adequately assessed or predicted the impact that would occur; and that mitigation actions or instruments proposed were not commensurate or many times much lower than required. Adequately addressing these compliance concerns requires technical capacity building, improved design of instruments, and a strong commitment to enhance the assessment of environmental impacts and assign the appropriate level of regulation. Uganda aims to achieve SDG 17 to **strengthen the means of implementation and revitalize the global partnership for sustainable development**. There will therefore be need to place enforcement and compliance with laws to prevent environmental degradation at the centre of environmental management in Uganda.

Lack of environmental awareness

Lack of awareness and information is a contributory cause of natural resources degradation. The literature indicates that 11 per cent of forest and wetland degradation can be attributed to ignorance amongst the population (UBOS, 2016). Awareness creation is necessary so as to provide targeted information the population.

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Agro forestry in Manafwa fragile soils
Photo credit: Elizabeth Mutayanjulwa (NEMA 2017)

PART 2: ENVIRONMENT: STATE AND TRENDS

CHAPTER 3: Wetlands, River banks and Lake shores

INTRODUCTION

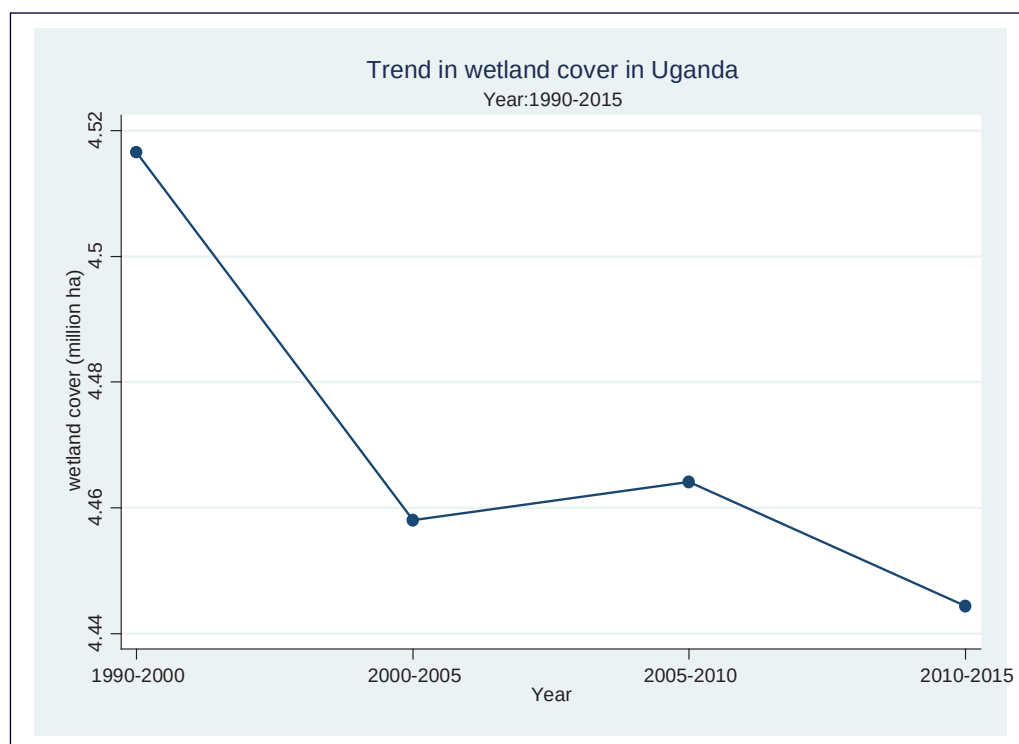
Wetlands, riverbanks and lakeshores are very important hydrological ecosystems. They are the stratum that links the water catchments and water bodies and are a key life support system and resource base for development in the country.

Wetlands play important ecological functions and provide a number of ecosystem services like flooding regulation, water purification, and reservoirs of water for domestic and industrial use, carbon sequestration, habitat for diverse species of plants and animals. The integrity of Uganda's water resources, agricultural productivity and the welfare of its people are sustained by wetlands. However, wetlands can only fulfill their ecological, social and economic functions if they are healthy.

WETLAND RESOURCES

In 1990 wetlands covered about 4.5 million hectares. Trend analysis shows that wetland cover is reducing at an average rate of about 21,000 ha per year (NFA, 2015). Furthermore, for the period 2000-2015, the wetland cover seems to have remained constant. This observed trend might be attributed to the fact that at the time of survey, most of the farmers had finished harvesting their crops hence leaving the wetlands free before the next planting period.

Figure 3.1. Trend in wetland cover



Source: Author's computation based on NFA data

PRESSURES AND IMPACTS

Wetlands are under serious pressure from the increasing population and associated livelihood activities. Some of these activities include expanding settlements, sand mining, agriculture and industrial activities. This has resulted in a decline of wetland cover from 13 per cent in 1990 to 8.6 per cent in 2015. It is estimated that Uganda loses 846 km² of its wetlands annually. At this rate, it is likely that there may be no wetlands left by 2040. Once a wetland is degraded, it becomes very costly and almost impossible to restore it to its original ecological state.

Rapid population growth and wetlands in Kampala

Informal settlements are one of the key drivers leading to a decline of water quality in wetlands and drainage courses. About 40 per cent of the population of Kampala city and recent migrants live in informal settlements that lack basic infrastructure services for the provision of water, storm drainage, sewerage treatment and solid waste collection (KCCA, 2012). The dense informal settlements tend to be located along the edges of the wetland corridors throughout the city. Wetlands in Kampala cover only 9 per cent of the city (KCCA, 2012). Kampala City has relied on the wetlands to provide numerous ecological services including:

- Physically and biologically cleansing water, filtering out sediments and nutrients that enable the raw drinking water to be cost-effectively treated for human consumption.
- Serving as the city's primary sponge for absorbing storm waters, slowly releasing and cleansing waters by discharging into Lake Victoria and/or recharging groundwater flows.
- Acting as the primary human waste processing function by receiving raw sewage and mechanically treated wastewater, processing nutrient loads, and releasing waste water downstream with a higher degree of treatment.
- Providing food, fuel, and building materials.
- Supporting the fisheries that provide livelihoods for approximately 1,200 people at Port Bell, Ggaba and Munyonyo (KCCA, 2014).

The following sections describe the Nakivubo, Kinawataka and Kyetinda wetlands as case studies for population as a driver for settlement expansion into wetlands.

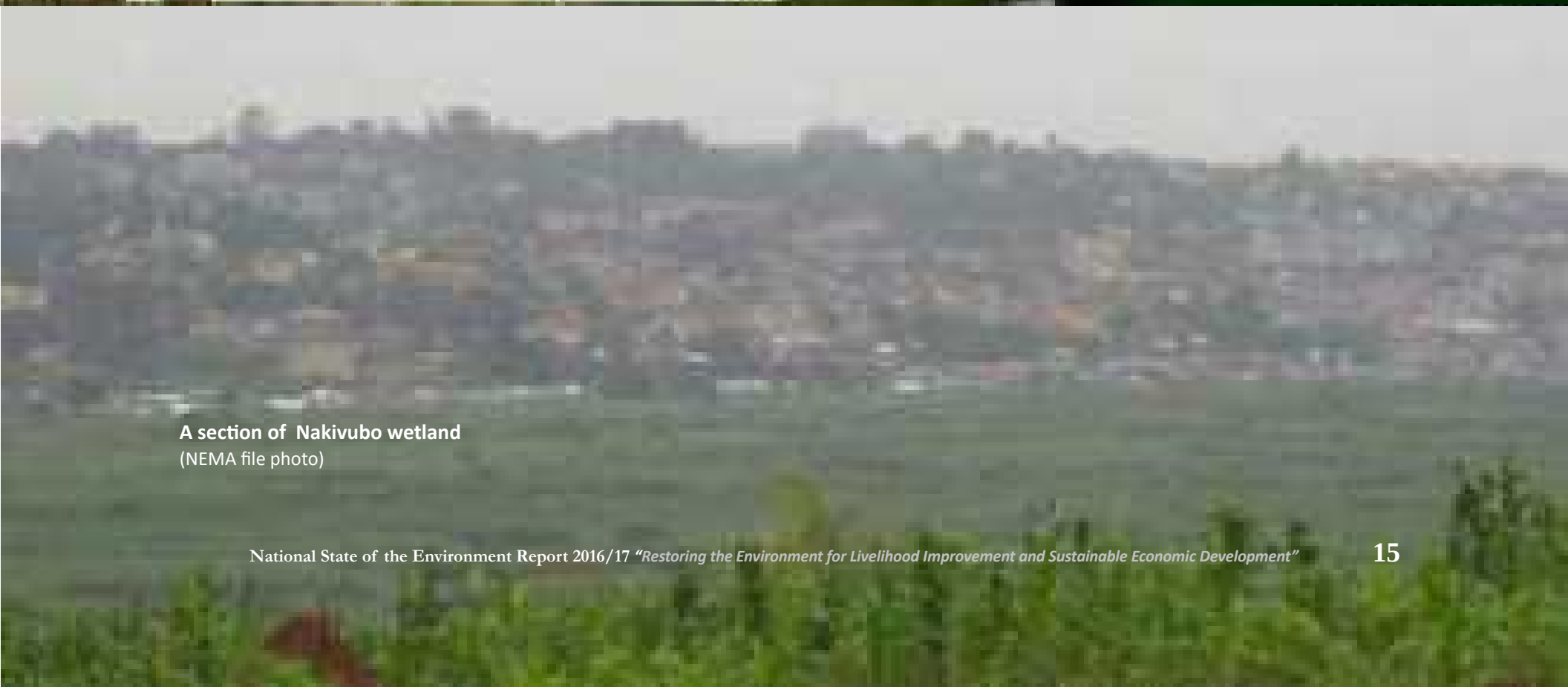


Encroachment by informal settlement in Nakivubo Wetland in 2004 and 2017 (Source: UNEP GRID)

Nakivubo Wetland

This wetland is located in Nakawa subcounty and is 5.5 km south east of Kampala City Centre, it lies between Bugolobi, Mpanga and Muyenga Hills and feeds into Lake Victoria. It is one of the largest wetlands in Kampala and is currently 5.29 km² (Gumm 2011). It is permanently water logged with Nakivubo channel as the main river flowing into it. The land use in 2000 mainly cultivation and few settlements were observed in Wakaliga valley, Namuwongo (Soweto, Kasavu zones) and

in Mpanga valley on Kitintale side. Over time the pressure increased and by 2016 informal settlements had edged up Namuwongo side onto Nakivubo Channel as shown in satellite image. The wetland serves as an integral part for tertiary waste water treatment of Bugolobi Waste water treatment Plant as well as carries storm water from central business district. The functioning of the wetland to maintain water quality is highly dependent on its natural integrity.





Encroachment by informal settlement in Kinawataka Wetland in 2004 and 2017 (Source: UNEP GRID)

Kinawataka Wetland

Kinawataka is also referred to as Kinawataka-Kawoya. It is 1.5 km² and is located in Nakawa sub-county, 6.5 km east of the city center. Kinawataka wetland drains into Lake Victoria and provides buffering

functions especially around the Inner Murchison Bay. It also controls flooding upstream. The wetland occupies a valley below Ntinda, Banda, Kyambogo, Kireka, Mbuya and Mutungo hills.



The wetland is under pressure from settlements expansion. From 2013 to date, there has been backfilling of the wetland with marram. In addition, the Kinawataka slum which in 2004 was only just a few houses, had by 2008 expanded into a major settlement. It is growing rapidly with more settlements coming from the Kasokoso side. By July 2016, as shown

in the satellite image, almost the entire wetland had been overrun with settlements. This has severely constricted the storm water storage and holding capacity of the wetlands leading to the frequent severe flooding around Kyambogo and Kireka whenever it rains. This exposing the adjacent communities to waterborne diseases such as cholera.



Encroachment by informal settlement in Kyetinda Wetland in 2004 and 2017 (Source: UNEP GRID)

Kyetinda Wetland

Kyetinda wetland covers an area of approximately 1.43km² and is located in Makindye Division about 9km south east of Kampala. This wetland

is of critical importance because it buffers the Lake Victoria shoreline at Gaba-Munyonyo where the source of water for Kampala City is.



The wetland plays a major role in purification of effluents both from the urban dwellers and Ggaba water works before being discharged into the lake. It also performs other functions such as flood control and

other hydrological roles. The wetland is under serious pressure from the growing population and encroaching informal settlements in Katoogo and Cape Town as shown in the 2004 and 2016 satellite images.

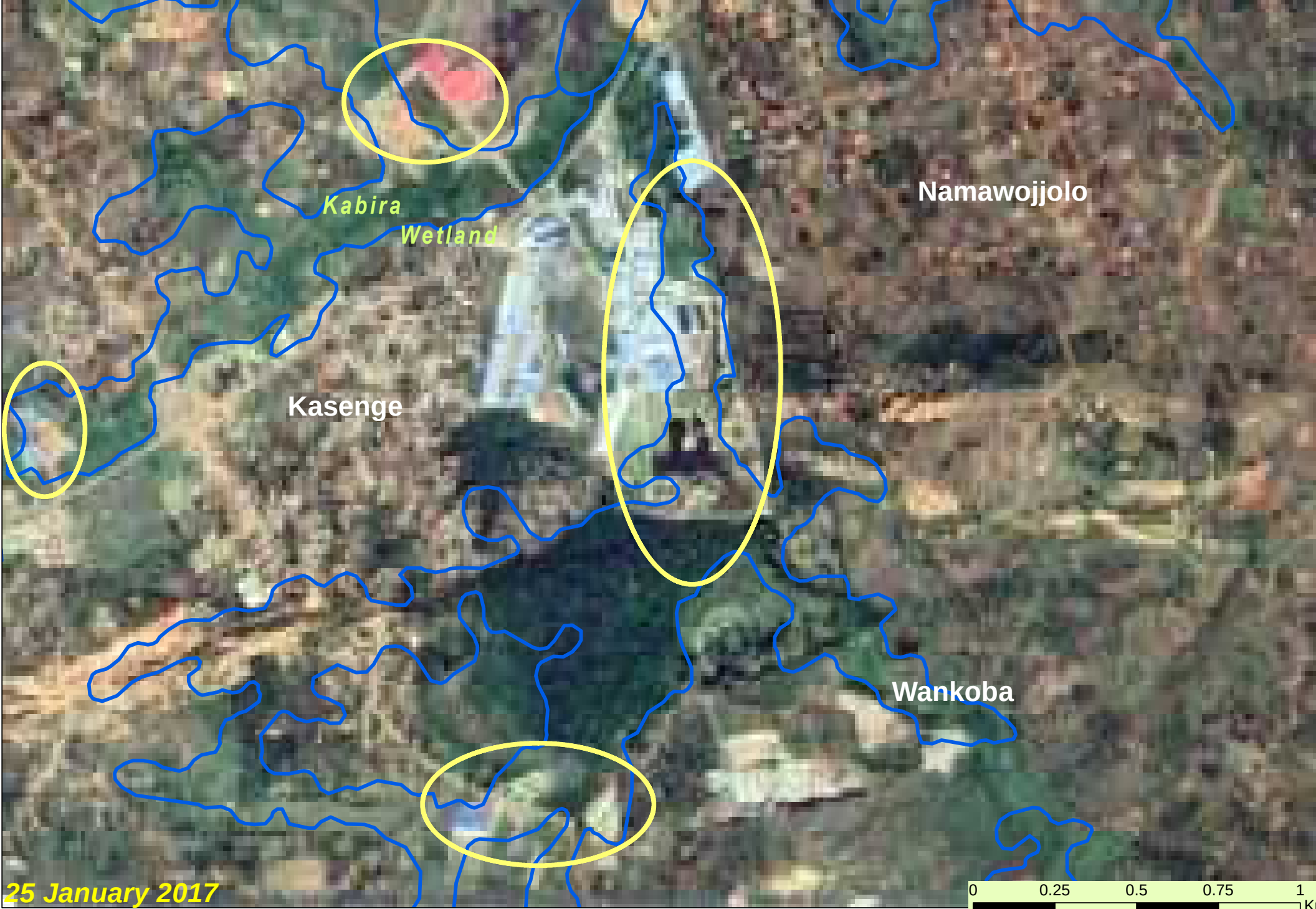


Mbalala Industrial Development in 2014 and 2017 along Mukono-Jinja Road (Source: UNEP GRID)

Industrial development - Mbalala wetland, Mukono

In urban areas, particularly Kampala, Mukono and Wakiso, wetlands are seen as the largest and cheapest land areas available for industrial development. Many wetlands have been converted for industrial development or business sites for local manufacturing artisans (*jua kali*). Many Ugandans who have recently failed to utilize titled wetlands because of the current laws and regulations have resorted to selling them to investors mainly of Chinese and Indian origin who use them primarily for industrial development.

Mbalala wetland (also known as Nakawole wetland) is a permanent wetland that drains areas of Mukono Municipality in the villages of Ngandu, Kigombya, Lwanyonyi, Mbalala, Kasenge and discharges into the River Sezibwa System. It mainly serves as flood control. The wetland was previously used by the local people for income generation through brick making, sand mining and subsistence crop production. As the Seeta-Mukono area rapidly gets urbanized, the Mbalala wetland is continuously being degraded due to pressure from infrastructural developments such as industries. The satellite images of 2005 and 2016 shows encroachment of industrial development in Mbalala wetland.



A section of Lake Victoria shoreline in Mukono District
(NEMA file photo)





Sand mining activities in Lwera wetland in 2010 and 2016 with poor environmental compliance practices.

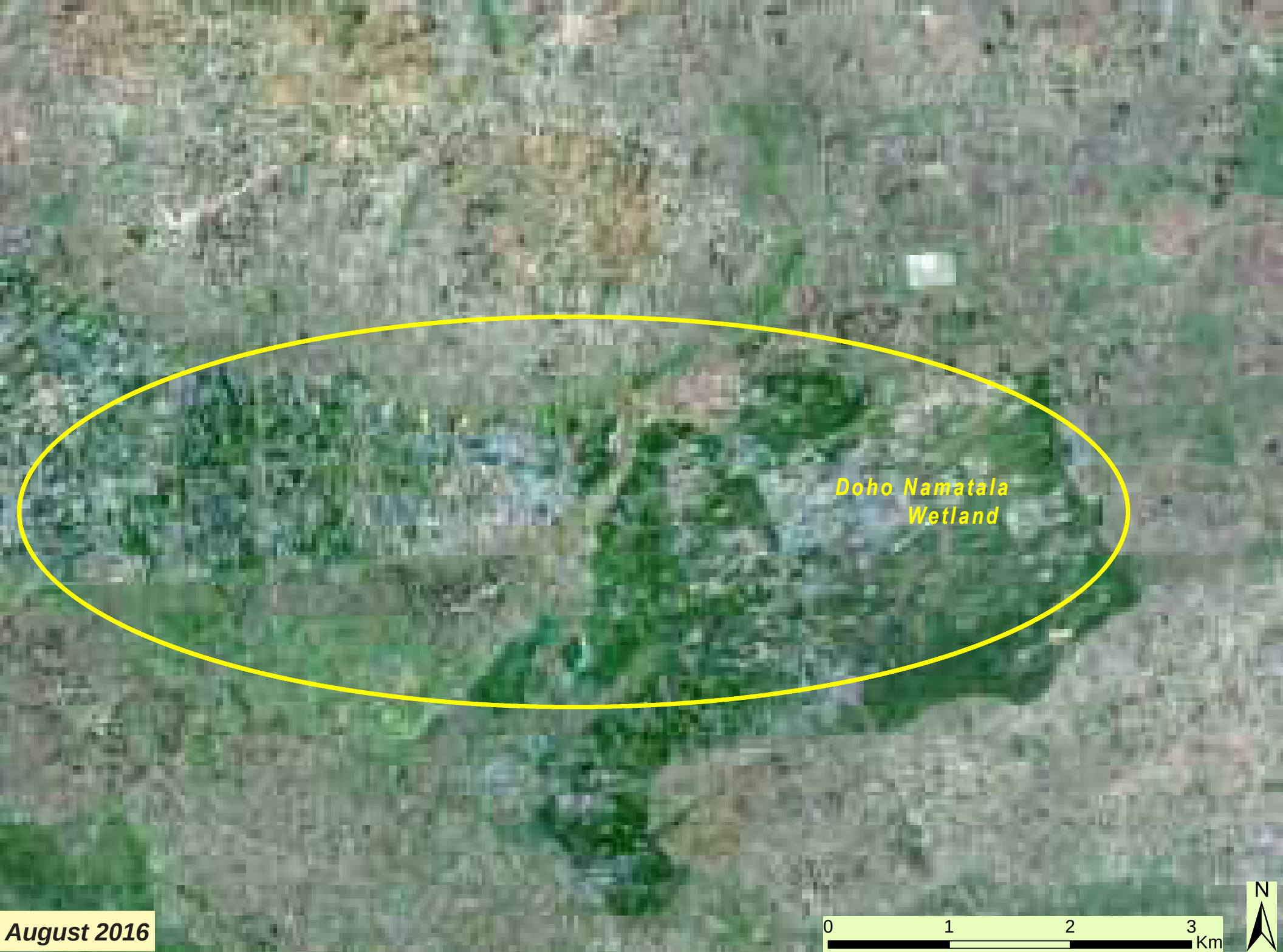
Sand mining - Bukakata wetland in Lwera, Masaka

The Lwera-Bukakata wetland along the shores of Lake Victoria and the lakes is a complex ecosystem and part of the biodiversity-rich Lake Nabugabo Ramsar site system. It is under pressure from mechanized sand mining. Sand from Lwera goes to feed the booming construction industry in the Kampala Metropolitan area. Despite regulations to guide

sand mining, these resources continue to be harvested with impunity. More research is required to ascertain the impacts, but the visible impacts include large fragmented holes that fill with water, at times altering the shoreline of Lake Victoria.



Sand mining in Lwera
Photo credit: Julius Muyizzi (NEMA 2017)



Doho Namatala Wetland section with Doho Rice Scheme with no more areas for expansion (Source: UNEP GRID)

Monocultural agriculture - Doho-Namatala Wetland, Eastern Uganda

The River Manafwa joins River Namatala in the lowlands of Mbale, Butalejja and Budaka districts to flow into the Doho-Namatala wetland. This wetland is under threat from expanding agriculture and pollution from Mbale town. Intense crop cultivation by communities has led to the replacement of the original wetland vegetation with paddy rice and other crops especially in Butalejja district. Loss of vegetation on the mountain slopes has led to a continuous flow of sediment that constantly silts up the wetland. Sewage from the municipality, the use of agro-chemicals

and discharge from the waragi distillery is also polluting the wetland. Furthermore, the Doho Rice Scheme seems to have reached its carrying capacity so now farmers are encroaching even further into the wetlands in order to expand their farms. The satellite image of 21st August 2016 shows the section of wetland where the Doho Rice Scheme has reached its carrying capacity and this has resulted in expansion of rice cultivation in other wetland areas as shown in the satellite images of 2011 and 2016.



Soil erosion in the rice fields reduces the life span of the irrigation channels (NEMA file photo)



2011

Satellite images of 2011 and 2016 show expansion of rice cultivation areas in the west of Doho Rice Scheme (Source: UNEP GRID)



RIVER BANKS

The National Environment (Wetlands, River Banks and Lake Shores Management) Regulations, 2000, Sixth schedule (Regulation 29) specifies the major rivers that shall have a protection zone of one hundred meters from the highest watermark of the river; and rivers not specified shall have a protected zone of thirty meters from highest watermark of the river. However, due to increased pressure exerted on some river banks from both natural and human driven activities such as cultivation, human settlement and overgrazing has continuously degraded the river banks. The main rivers in Uganda are indicated in Table 3.1.

Table 3.1 Length of major rivers in Uganda

Name of water body	Countries shared with	Length (miles)
Nile	Burundi, Democratic republic of Congo, Egypt, Eritrea, Ethiopia, Kenya, South Sudan, Rwanda, Tanzania, Uganda	
White Nile	Burundi, Kenya, South Sudan, Rwanda, Tanzania, Uganda	2,299
Kagera	Burundi, Rwanda, Tanzania, Uganda	249
Turkwel	Kenya, Uganda	211
Katonga		137
Kafu		112
Sezibwa		93
Semliki	Democratic Republic of the Congo, Uganda	87

Soil erosion - River Manafwa

River Manafawa originates from Mount Elgon flows down through Bududa and Manafwa Districts to lowland areas of Mbale through Butaleja district and ultimately confluences with the River Namatala draining through the Mpologoma wetland to Lake Kyoga. Clearance of vegetation and cultivation on hilly terrain has led to soils becoming loose and prone to erosion. The water quality and quantity of river is affected by the heavy siltation arising from erosion from cultivation mainly on Bukusu hills as shown below. The extent of encroachment was not known at period of assessment.

The degradation of the catchment has resulted in a continuous increase in the silt load of the river making treatment of water more expensive and requiring high expenditure on the part of National Water and Sewerage Corporation (NWSC). This is not sustainable because it continuously increased the capital input and while the quality of the raw water improves in the short run, the quantity that can be abstracted decreases as effective catchment reduces. During the dry season, reduced river flow leads to scarcity of water in Mbale town.

Cultivation along Bukusu hills, Manafwa District

Photo credit: Julius Muyizzi (NEMA 2017)



Deposited soils from Bukusu hills harvested and sold as sands. Photo credit: Julius Muyizzi (NEMA 2016)



The soils washed down and deposited in River Manafwa are exacerbated by cultivation within the bed and up to the bank of the river. Photo credit: Julius Muyizzi (NEMA 2016)



Degrading catchment - River Rwizi

River Rwizi originates from Buhweju hills with various tributaries and streams which are very important for water supply in the area. The river catchment covers an area of about 8,000 km² and stretches across 10 districts in south-western Uganda. The upper, central and lower reaches of the catchment are covered by wetlands which make up about 3.5 per cent of the total land area. The wetlands in the catchment play an important role in capturing and storing water, releasing it into the river channel over time. They attenuate high flows and also help in trapping and settling sediment.

However, due to the population pressure, the water catchments of this important local and regional drainage system have degraded and require urgent restoration and proper management. Some of the tributaries have been harnessed for gravity water schemes while downstream the river is a source of water supply for Mbarara Municipality and watering animals in areas along the river in the predominantly cattle corridor area. The severity of degradation of the catchment is reflected in the poor quality of the river water which is heavily loaded with sediment from farms and

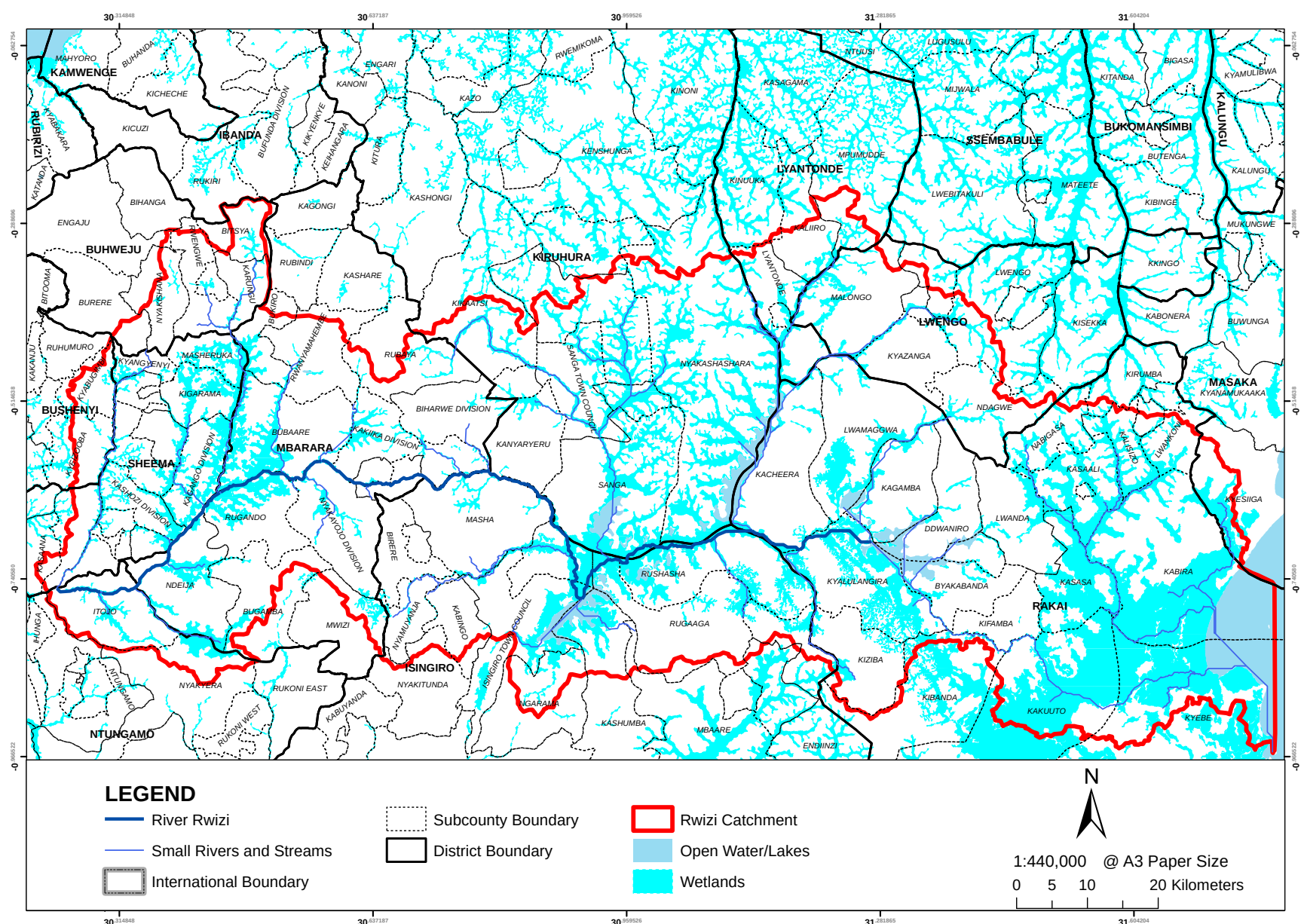
the bare surfaces within the catchment.

Today the valleys and lower valley slopes are occupied by crops and settlements which the upper more marginal slopes have been deforested and over grazed leading to almost bare surfaces. The River Rwizi catchment underpins community livelihoods and is also important for the local industries operating in the region, such as the Coca-Cola Company. The river experiences fluctuation in water flow, especially in the dry season when low flow has led to rationing for households and also for industries.

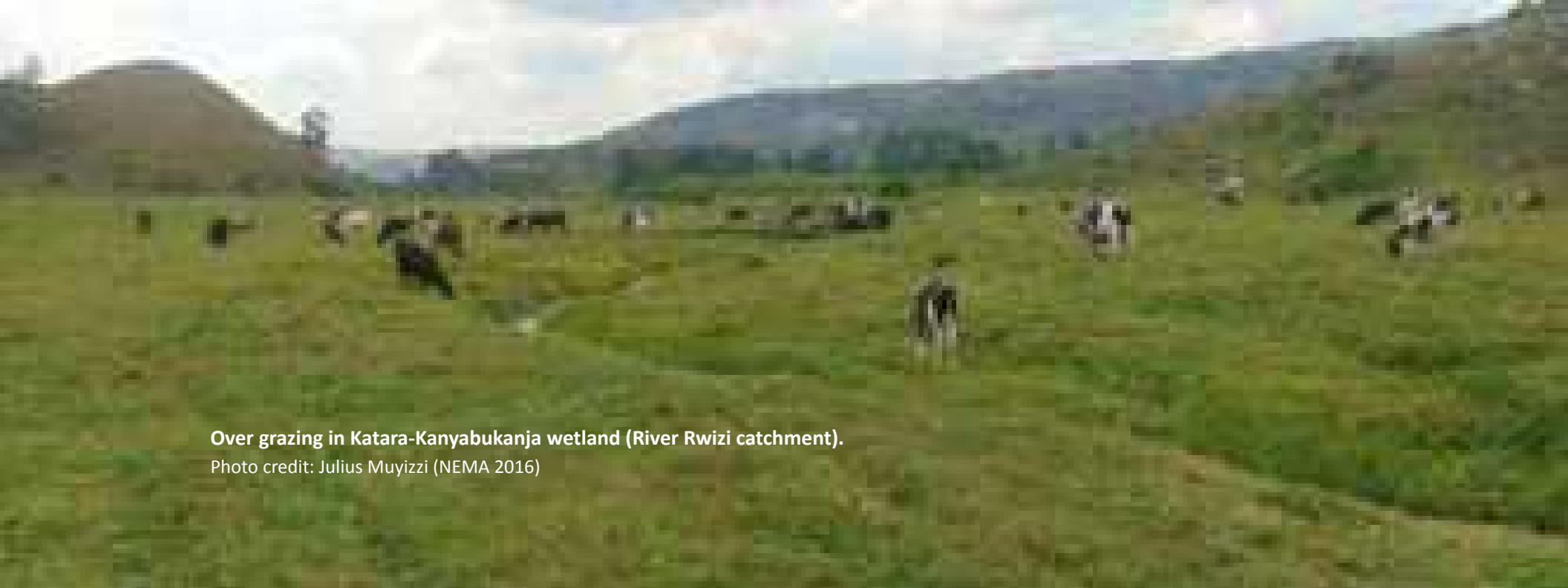
Encroachment for agriculture - The Kanyabukanja - Katara wetland

The 50 km-long Kanyabukanja-Katara wetland is a major catchment source of the upstream River Rwizi. About 50 per cent of the wetland has been degraded by encroachers, mainly dairy farmers. Over 300 ha of the wetland system was recently encroached by over 100 families who among others dug up channels to drain the wetland, established cattle farms, planted eucalyptus trees and occupied the rest with food crop gardens.

Figure 3.2. River Rwizi Catchment



Source: NEMA 2017



Over grazing in Katara-Kanyabukanja wetland (River Rwizi catchment).
Photo credit: Julius Muyizzi (NEMA 2016)



Vegetation cleared in 2016 along River Rwizi due to over grazing in Katara-Kanyabukanja wetland (Source UNEP GRID)

Conclusions

The catchment of River Rwizi is the only reliable source of water for all the surrounding community and the major investments within its wider catchment. Sustainable management and conservation of the catchment is therefore a necessity. The massive ongoing encroachment, especially from agricultural and livestock activity, within the area is illegal. However, the Local Government does not have the capacity (financial and human resources) to deal with the problem. There are several Non-Governmental Organizations and Community Based Organization in the catchment undertaking conservation efforts, but their impact is yet to be seen on the ground.

There are several opportunities for the conservation of the catchment especially from the developers such as Nile Breweries and National Water and Sewerage Corporation who are the major bulk water consumers here. This opportunity need to be exploited.

Recommendations

Government of Uganda must take deliberate effort to put in place funds for the restoration and management of the River Rwizi catchment.

All illegal land titles in the wetland should be cancelled in line with the guidance given by Cabinet on 16th April 2014.

In the meantime, NEMA should enforce the National Environmental Act and bring the encroachers to book. This should include among others issuing them with Environmental Restoration Orders and instituting criminal proceedings on them in the Courts of law.

River Semliki

River Semliki is one of the most important rivers that form Uganda's natural drainage system. The river derives its origin from Lake Edward through Mt. Rwenzori and a series of tributaries that join it along its 140 km course in the Albertine Rift (Western Rift Valley), before draining into Lake Albert. In the first 40 km, the river travels through a heavily forested Semliki National Park, while for the remaining distance it flows through grasslands that are inhabited by the Batuku pastoral community. A substantial section of the River Semliki in Bukuku- Bweramule sub-county forms the border between Uganda and DR Congo. It is regarded as a hotspot because of its meandering that continuously changes the course of the river and territory especially in the villages of Rukora 1, Rukora 2 and Bweramule.

The driving forces include the strong and heavy run-off from the mountains, over grazing along the river banks and deforestation in Rukora 1 village leading to silting of the river due to extensive erosion from the mountain, overflow and reduced river water quality, change of the river's course (meandering) and its impacts on trans-boundary resources including territory. There is concern that with the migration of River Semliki meanders on the Ugandan side, loss of land is taking place thus extension of buffers and an equivalent shrinkage of legally available land for animal grazing, cultivation and settlement. The outcome of the latter are land conflicts as the land becomes increasing limited for use by herders and cultivators.

River Semliki course meandering over time and this is associated with heavy run-off from the mountains, over grazing and this has caused loss of land on either side of Uganda and Democratic Republic of Congo.

River Semliki breaking the banks causing loss of land on the Uganda side (NEMA 2017)



Exposed the River Semliki banks to erosion caused by cattle grazing (NEMA 2017)





River Semliki course meandering (Source UNEP GRID)

Original location of telecommunication Mast before changing location due to breaking of the the banks (NEMA 2017)





River Kagera Siltation in 2011 and 2016 (Source: UNEP GRID)

Siltation in River Kagera

The Kagera River originates from Burundi and flows into Lake Victoria. The Rwanda-Tanzania, Tanzania-Uganda borders is the largest contributor of water from the catchments. The river bank has been

degraded due to poor agricultural practices and this has resulted into Siltation. Siltation is mostly associated with agricultural activities. The delta at the mouth of the river has shifted more into the lake.



Satellite images of July 2011 which is the last month of the dry season show no silting in the lake while that of December 2016 which is the end of the second rainy season shows a lot of silt pouring into Lake Victoria.

Silting of the lake is a cycle that goes with the season in the catchment in River Kagera.



2010

Satellite images showing sugarcane growing along River Nile banks in 2010 and 2016 (Source: UNEP GRID)

Plantation agriculture along the River Nile

Sugarcane growing along the banks of River Nile in Kayunga District has exposed the river to pollution and siltation due to agricultural chemicals used for fertilizers and erosion respectively. The riparian community uses

this water for domestic purposes and are thus exposed to varying levels of pollution from the chemicals used. The proliferation of invasive species such as Water hyacinth (*Eichornia crassipes*) and Kariba weed (*Salvinia molesta*) weed also hinders their access to the waters.



2016

Water supply and water purification - River Enyau Water Catchment

The River Enyau wetland system has its source in the Ezuku Forest reserve, at the border with the DRC. It starts as a very small stream, fed by tributaries along the way before it crosses into Arua Municipality, eventually draining into the River Nile. The River Enyau wetlands are important as they purify storm water that comes loaded with a lot of waste and fecal matter arising from poor waste disposal. The wetlands also hold water and release it slowly ensuring that there is water flow throughout the year. This wetland system is under pressure from a number of factors including agriculture, washing bays deforestation and encroaching settlements.

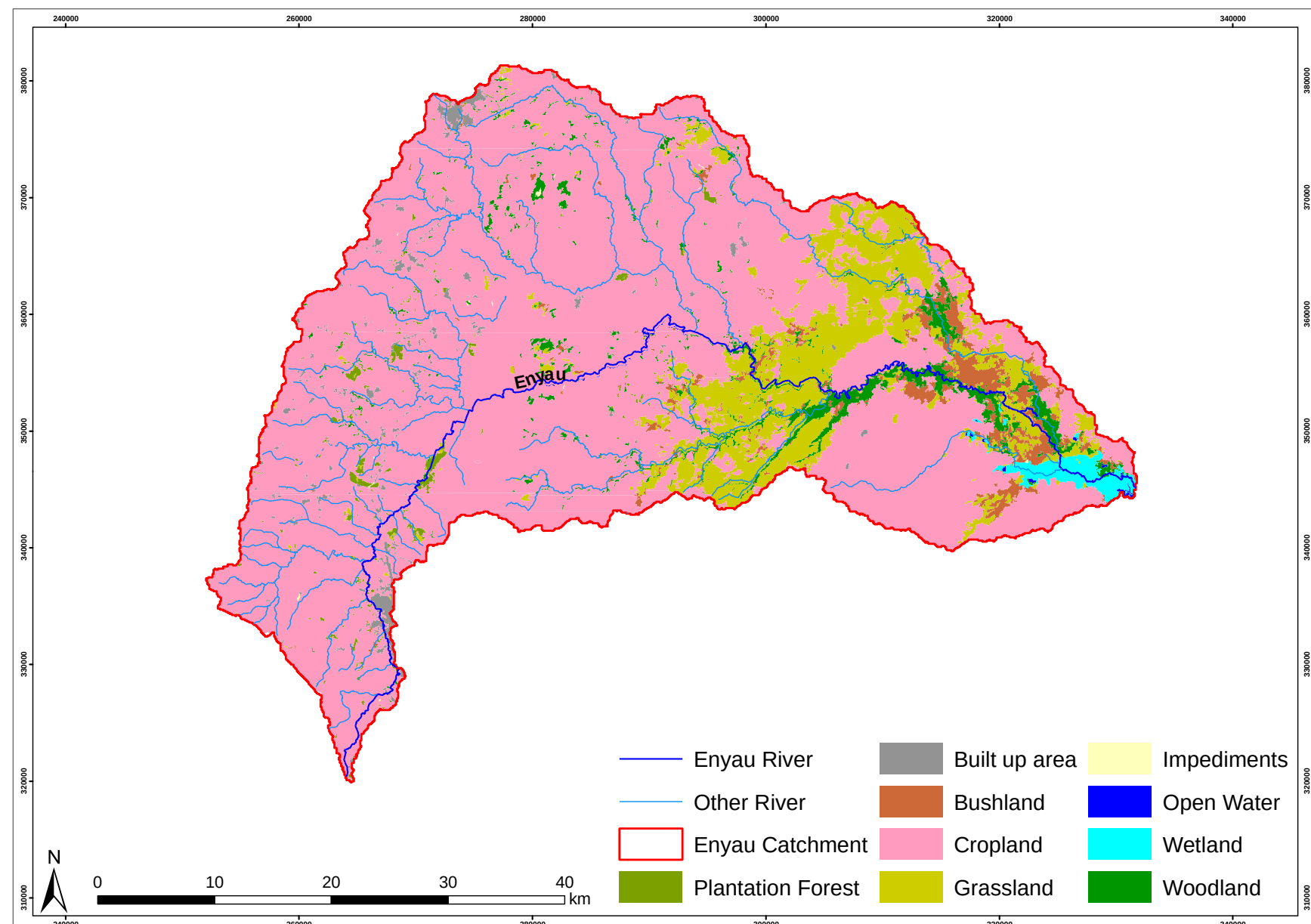
River Enyau is the main source of water for Arua Municipality. The intake for Arua Water Works are situated on River Enyau, approximately 15.8 km from the source of the river. There are three tributaries that join the

river before it reaches the intake works. The major two being River Oje and River Emuleva. River Enyau is gauged much further downstream at the Arua-Moyo Road crossing. The National Water and Sewerage Corporation pumps water from River Enyau, treats it and supplies it to areas within and outside Arua Municipality. About 72 per cent of the population of Arua Town, (about 101,000 people) are connected to the water supply system. The water supply situation is reliable during the wet season but is severely affected during the dry season when the water level reduces to a trickle. The seasonal rivers within the municipality normally dry up during the dry season exacerbating the water supply situation in the municipality.

Cultivation and water diversion within the Enyau wetland system

The wetlands along R. Enyau are highly encroached upon for cultivation of crops such as maize, sugarcane, yams, sorghum, bananas and sweet potatoes for instance in Adravu Village at Ezuku Parish and Opevu

Figure 3.3: Land Cover 2015 River Enyau Catchment



Source: NEMA, 2016

Village, Ajono Parish. Over 60 per cent of the wetland has been encroached and this has consequences on both the quality of water and quantity. The removal of deep-rooted perennial vegetation and its replacement by shallow-rooted pasture and crop species reduces evapo-

transpiration, thereby allowing ground water to rise and ground and surface water flows to increase. Wetlands are known to recharge ground and surface water however, their degradation directly impacts on water release and recharge, a case in point is the drying up of some boreholes within the catchment.

Cultivation along River Enyau banks and water diversion into agricultural lands for irrigation

Photo credit: Julius Muyizzi (NEMA 2016)





Settlement along River Enyau and River Azita 2010 and 2016 (Source: UNEP GRID)

River Enyau Water and River Azita Catchment

Encroaching settlements

Over the years, human settlements have become more complex and the environmental impacts of settlement dynamics coupled with increasing population size and pressure have become greater. Informal settlements, many of the housing units are in a dilapidated state and in poor design. Some of them are not permanent in some of the cells; they are built out of unburned bricks with grass thatch.

Deforestation and vegetation loss in the wider catchment

Land clearing, primarily for agriculture, is perhaps the single most important cause of environmental degradation, loss of species, and depletion of ecological communities along River Enyau. Trees and vegetation along the entire extent of Enyau wetland have been cleared and replaced with gardens

for instance in Ajono Parish, Vurra subcounty and a few scattered plantations of Eucalyptus at Vurra (under a private sector arrangement with the District Forest Office). The ecosystems that remain after land clearing are usually fragmented and modified. They are subject to new disturbance regimes, invasive species, disease, increased nutrient loads, and changes in physical edge effects, including changes in wind, temperature, light and humidity. In addition, the removal of perennial vegetation has contributed to soil erosion leading to declines in water quality especially during the dry season. There is need for restoration by planting indigenous trees along the banks both for stabilization and to act as wind breakers as the area is largely without trees.



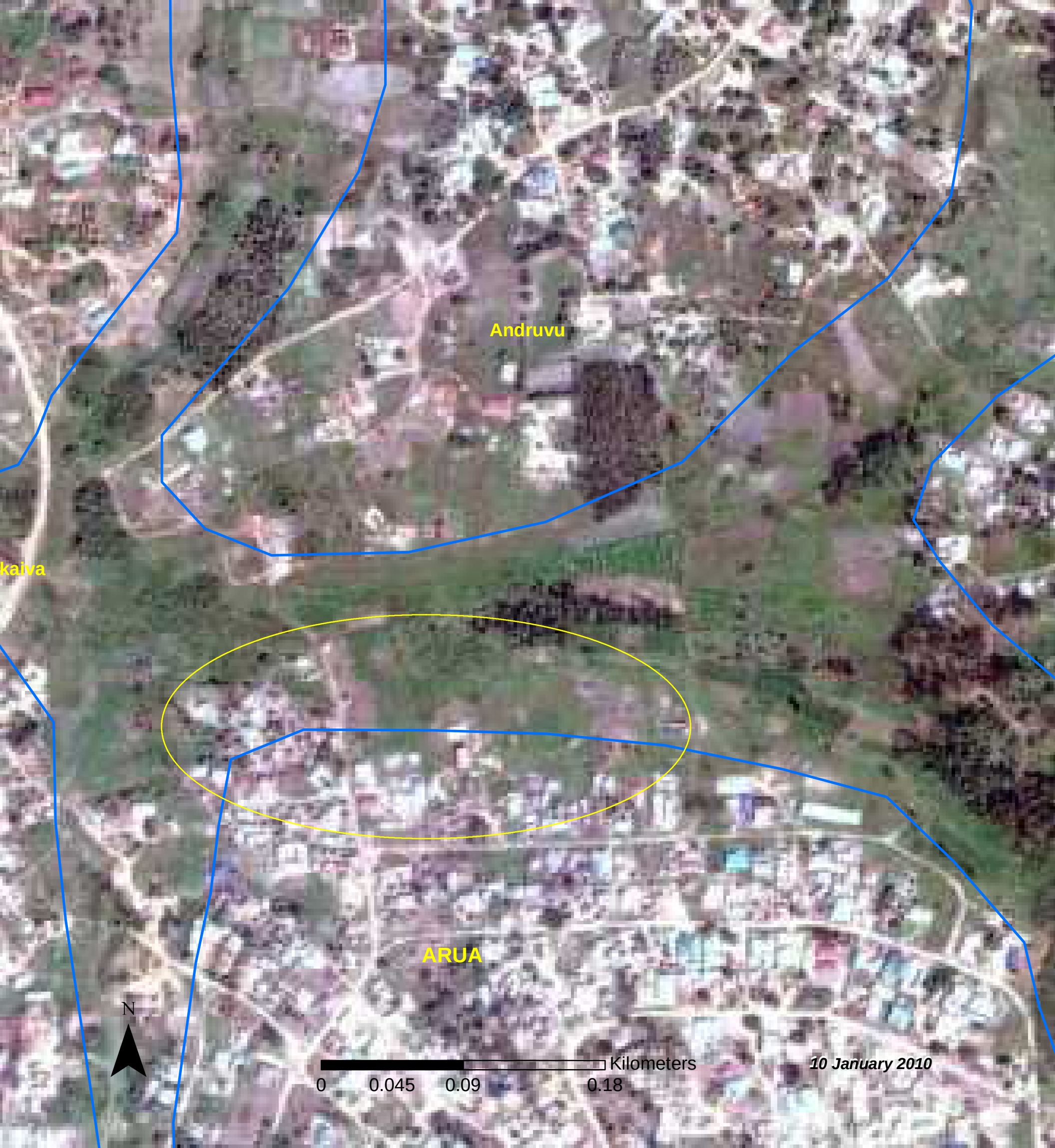
Washing Bays on the banks of River Enyau

The washing bays are located directly along the river, for instance, at Pajulu bridge in Pajulu Village. Cars are washed in the middle of the river. The water that runs off the cars contain pollutants such as detergents, residue from exhaust fumes, fuel, heavy metals from rust, and motor

oils. These flow directly into the river. Phosphates that are contained in soap can lead to eutrophication causing excess algae to grow. This affects the water quality as it smells bad and looks distasteful. As algae decays, the process uses up oxygen in the water that is needed by the aquatic biodiversity for life.



Vehicle and motorcycle washing within River Enyau upstream of the water intake point for Arua Town (Arua District file photo, 2016)



Settlement along along River Enyau in Andruvu 2010 and 2013 (Source: UNEP GRID)



LAKESHORES

The word lakeshore means the land not more than 100 metres adjacent to or bordering a lake. This land is threatened by the continuously increasing population growing alongside the lakes and from nearby towns that depend for economic growth directly or indirectly from the lake and its shores. The resulting degradation has varying impacts on the lakeshores as discussed below.

PRESSURES AND IMPACTS

Pollution of the Inner Murchison Bay, Lake Victoria

The Inner Murchison Bay covers an area of about 25 km². It is one of the pollution 'hot spots' that has been receiving municipal and industrial wastewater, urban wastes and run-off from Kampala city for over 40 years now. It is the same Bay from which raw water is drawn to supply Kampala City, Wakiso and Mukono Towns. It is also a navigation hub through Port-Bell where ferries connect Uganda to the rest of East Africa. There are many other economic activities including fisheries, hotels, tourism and recreation that are within the Inner Murchison Bay. These are all under threat from the degradation of the wetlands.



Eutrophication at Murchison bay in 2016. (Source UNEP GRID)

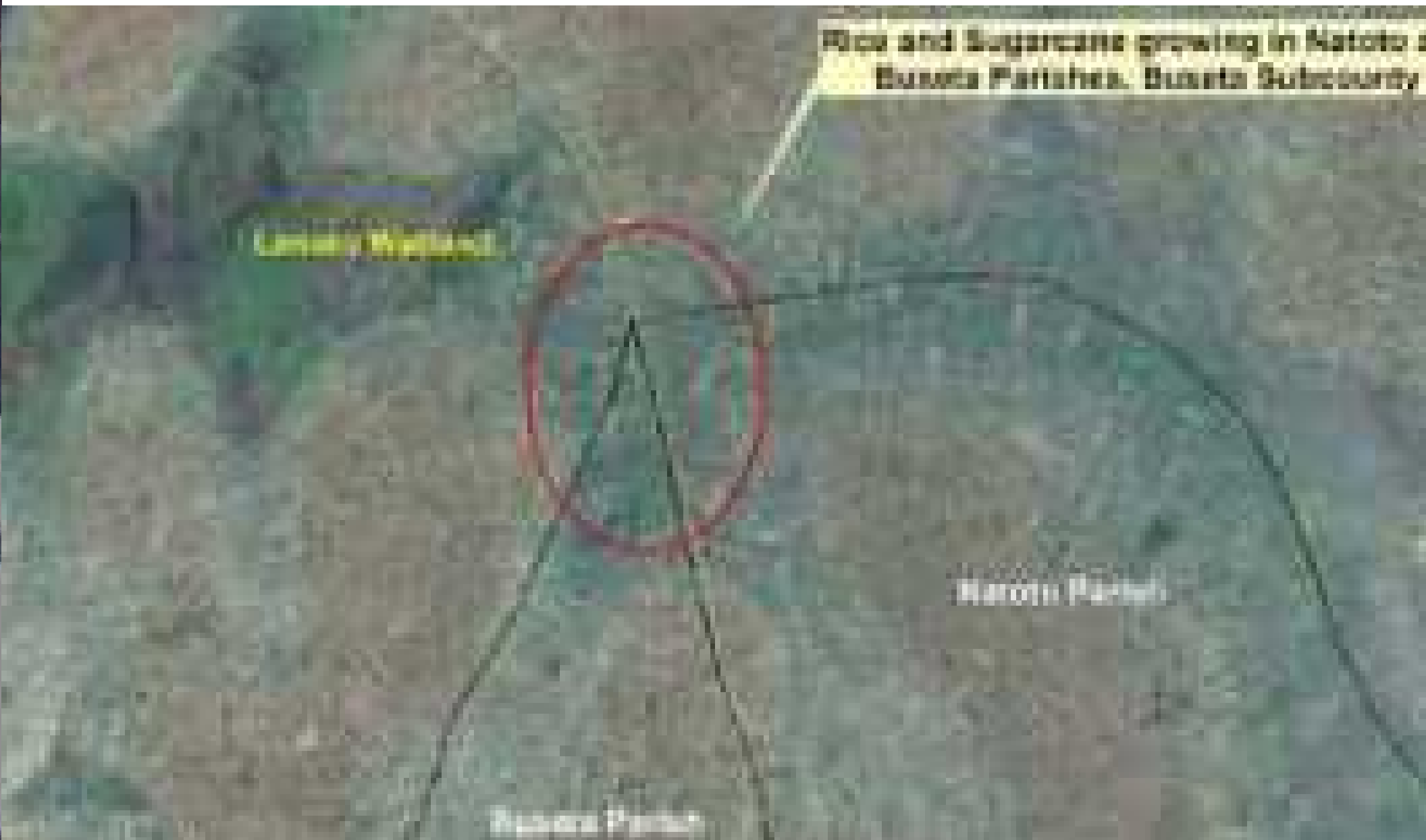
The major wetland systems buffering the Bay include Nakivubo, Kyetinda, Kansanga, Kinawataka and Bukasa-Kirinya. They function as filters or sinks for the wastes from the surrounding urban areas and also provide flood attenuation. However, these wetlands have been encroached upon and destroyed, and thus their ability to perform the described ecological hydrological and socio-economic functions has been much reduced. Population growth has been the major driver of this degradation. The associated urbanization, commercial and industrial activities, poor waste and sanitation management have led to an increase in the volume of polluted water entering the environment.

The Nakivubo Channel contributes a very significant pollution load. It carries partially treated effluent from the Bugolobi Sewerage Treatment works, and as it passes through the slums, markets and commercial areas wastewater and solid waste much of it organic in content is discharged into it (Kizito, 1986). As a result, the Inner Murchison bay is now heavily polluted and characterised by eutrophication, algal blooms, invasion by Water hyacinth and other water plants. Fish kills resulting from toxic, and anaerobic conditions, smelly and unattractive conditions are now common. The deteriorating water quality now poses a threat to public and ecosystem health and requires costly advances in water treatment to reach standards where it is suitable for human consumption.

Agricultural encroachment on Limoto wetland, Lake Lemwa

Limoto wetland has an area of about 40.6 km² along the shoreline of Lake Lemwa. It is both a seasonal and permanent wetland and lies at an elevation of 1,045m. It is the source of water for Pallisa town council. Until recently, abstraction of water at the lake has been impacted by siltation and invasive species on the lake arising from the degradation of Limoto wetland and associated forest. It is habitat to plenty of fish and water birds such as Cranes, Ducks, Egrets, Ibis and Storks.

Limoto wetland provides varying functions to the surrounding communities. The provisioning functions include water for domestic and livestock use, recharge of ground water, thatch, pasture and fish. Regulatory functions include climate amelioration, flood control and filtration of water. However, these functions are under threat from pressures from the growing population. Riparian communities engage in grazing and agricultural activities such as rice cultivation in the wetland and surrounding catchment and this has led to erosion and siltation of both the wetland and lake. In 2016, the siltation was so bad it led to water scarcity with Pallisa Town Council and forced the National Water and Sewerage Corporation to extend the water intake point further into the lake. The persistent drought in the same year worsened the situation leaving about 42,000 people in Pallisa Town Council, Nakiseneye and Hospital ward without water as nearby wells had dried up (Pallisa District Local Government).



Rice and Sugarcane growing in Limoto Wetland. Source NEMA (Source NEMA)

The water intake point is to be extended further inside the lake



Rice cultivation in Limoto wetland before restoration in 2014 (Source NEMA)



Several interventions have been proposed, some in the offing aimed at restoring the shoreline



A restored section of Limoto wetland
Photo credit: Bob Nuwagira (NEMA 2017)



RESPONSES

Cabinet Directive on cancellation land titles in wetlands

On 16th April 2014, Cabinet while discussing the Cabinet Paper No. CT(2012)172 under Minute 114 (CT 2014) on cancellation of land titles issued in wetlands as one of the measures to address the problem of wetland degradation, approved the cancellation of land titles in wetlands on public land acquired unlawfully after 1995. This resulted in development of a Wetlands Atlas which was published in 2015 to guide this directive.

Restoration of Limoto Mpologoma wetland system

In order to reverse the high rate of degradation of Limoto wetland, NEMA has undertaken several community driven interventions in partnership with the District Local Governments with the initial focus on Limoto and Mpologoma wetland ecosystems. Interventions such as sensitisation of over 6000 community members in the affected catchment, identification and documentation of actual encroachers and degraders to support necessary litigation efforts for errant degraders, over 4000 degraders were identified and documented.

Response additional

Coding of wetlands for Kyoga and Lake Victoria Basins was completed in preparation for gazetting wetlands in Uganda. The road map for the cancellation of land titles in wetlands was approved by Cabinet and the Wetlands Management Department has developed guidelines for wetlands restoration. The department is producing copies for dissemination to local governments and relevant institutions for use.

During the reporting period, MWE demarcated 167.7kms of critical wetlands in Hoima, Kisoro, Jinja, Iganga, Arua, Gulu, Alebtong, Lira and Masindi Districts, and restored a total of 476 hectares (ha) of degraded wetlands in the districts of Kiruhura (150ha), Soroti (13ha), Rakai (145ha), Isingiro (40ha), Bududa (10ha), Budaka (28ha), Bulambuli (80ha), Omoro (6ha), and Lira (10ha).

Recommendations

1. Taking into account the ongoing restoration and demarcation activities and the implementation of the Cabinet Directive to cancel titles issued on wetlands, the following recommendations are made to promote conservation and management of wetland resources in Uganda;
1. Government should intensify adherence to planning requirements in Peri-urban flood prone areas across all districts taking into

consideration resettlement plans to promote conservation.

2. Sustainable use of wetlands for livelihood improvement should be precautionary and relevant institutions should be encouraged to design strategies for improving livelihoods of the poor that are environmentally sustainable.
3. Agencies involved in the management of wetland should develop and implement integrated management plans that include input from local communities. This should include designing a common approach for wetland resources management with standardized guidelines for enforcement and implementation.
4. Wetlands that have been surveyed and mapped should be valued and classified based on their biological, hydrological and socioeconomic data. A number of zones should be established in protected wetland areas including conservation zone, buffer zone, mixed urban zone and residential zone.
5. It should be remembered that government hold wetlands in trust for the public for the common good of all people and future generations. Minimize policies that interfere with the tenure and use of wetland resources and increase financial and human resources for wetland resources management.
6. The general recommendation is to demarcate all wetlands boundaries in preparation for gazettment. This should be collaboration between the Ministry of Lands Housing and Urban development, Ministry of Water and Environment, National Environment Management Authority and Ministry of Justice.
7. Construction of formal low income housing estates for low income people to reduce illegal housing in wetlands in the urban areas. The industrial developers should be encouraged to invest in some basic housing for their employees to improve their welfare, as most of their employees end up in the slums.
8. The area of dry land is 5% of the total area, so to reduce on the pressure there should be a plan to decongest the central region by spreading developments such as industries to other regions by creating the necessary incentives such well-planned industrial and office parks, services such housing, shopping, banking etc.
9. Construction of wide and standard channels to accommodate storm water in most of the hot spots and strict enforcement of domestic waste management regulations.
10. The Land Information System should be strengthened such that areas of wetlands are not titled, and information on regulated or prohibited areas should be made available key relevant institutions, including the local authorities, Banks and the Investment Authority, among others.
11. Some of the areas of wetlands which are still intact should be secured and protected immediately.

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Fresh Uganda *Tilapia* fish (Internet photo)

CHAPTER 4: Fisheries

INTRODUCTION

Fish is one of the high value commodities that contribute to economic growth in Uganda. The fisheries sub-sector continues to be one of the important sub-sectors contributing 1.2 percent to the national GDP and 5 percent (%) to agricultural GDP of Uganda (ASSP, 2015/2016 to 2019/2020, UBOS, 2015). However, despite this contribution from the sub-sector to the GDP in the 2015-2016 Financial Year (FY), it showed a decline of 0.6% from 1.8 percent contribution in the previous year; 2014/2015. Fish and fish products accounted for 10% of agricultural export value in 2014 and this was second only to coffee. The fisheries sub-sector regulated by the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) is a priority area in the National Development Plan II (NDPII) as it supports livelihoods and the economy in general through providing employment, income generation and food security. It employs up to 1.5 million people (ASSP, 2015/2016 to 2019/2020; NEMA, 2016).

In terms of fish consumption, Uganda is still low at an average per capita fish consumption of 8.0 kg. This is over two times less than the 17 kg average per capita fish consumption recommended by the Food and Agricultural Organization of the United Nations (FAO) (DFR, 2014; FAO, 2016; NaFIRRI, 2016). Consumption of diversified and nutritious food is very healthy and; a good diet should include sufficient

proteins containing all essential amino acids, essential fats (e.g. long-chain omega-3 fatty acids), vitamins and minerals (FAO, 2016). Fish is nutritionally very important because it is a rich source of these nutrients. It is rich in various vitamins like vitamins D, A and B; as well as minerals including calcium, iodine, zinc, iron and selenium, particularly if eaten whole. It is a source of easily digested, high-quality proteins containing all essential amino acids. Additionally, fish is usually high in unsaturated fats, particularly long-chain omega-3 fatty acids. While average per capita fish consumption may be low, even small quantities of fish can have a significant positive nutritional impact on plant-based diets, and this is the case in many Low-Income Food-Deficit Countries (LIFDC), where Uganda is listed and least-developed countries (FAO, 2016).

STATUS AND TRENDS IN FISH PRODUCTION (FISH CATCH AND PRODUCTION)

Fish production

Total fish production from all Uganda's water bodies in 2016 was estimated at 467,530 MT compared to 461,730 MT in 2014, showing an increase of 12,660 MT. This increase however, did not reflect the same trend in fish exports which registered a decline of 318 metric tons, that is; from 17,597 MT registered in 2014 to 17279MT registered in 2016.

Table 4.1: Fish production by water body ('000 tonnes) 2001-2016

Year	Lake Victoria	Lake Albert	Lake Kyoga	Lakes Edward, George, Kazinga Channel	Lake Wamala	Albert Nile	Other water bodies	Total
2001	131.80	19.60	8.40	6.40			4.50	220.70
2002	136.10	9.40	5.60	5.20			5.60	221.90
2003	175.30	9.50	2.90	5.90		5.60	8.30	247.50
2004	253.30	56.40	68.50	9.60		6.40	40.60	434.80
2005	253.30	56.40	68.40	9.60		5.00	24.10	416.80
2006	215.90	56.40	60.00	8.80		5.00	21.10	367.20
2007	223.10	6.40	0.00	8.80		5.00	21.00	374.30
2008	219.50	56.50	60.00	8.80			20.00	364.80
2009	221.30	6.50	60.00	8.80			20.00	366.60
2010	162.93	55.81	1.71	4.50	5.60	5.20	10.30	396.05
2011	175.82	163.95	61.59	5.30	75.11	5.00	7.08	493.84
2012	185.00	52.56	44.05	5.21	5.71	5.04	9.55	407.12
2013	193.00	60.00	40.00	6.25	4.50	5.50	10.00	419.25
2014	245.00	152.00	38.00	6.25	4.59	5.39	10.50	461.73
2015	238.63	149.04	41.77	6.35	4.19	5.12	9.77	454.87
2016	252.80	148.16	40.71	6.64	3.96	5.38	9.88	467.53

(Source: DiFR, 2016, NaFIRRI, 2016)

Fish catch trends by water body

The fish industry in Uganda is supported by an array of water bodies that include the five large lakes of Victoria, Kyoga, Albert, Edward and George; and over 160 small lakes. Fish are also found in the many rivers that include the River Nile, R. Aswa, R. Semliki and R. Kagera among others. There are also numerous swamps and flood plains which are all key habitats, breeding and nursery grounds for fish and other biota that support fish growth. All these water bodies together can support a flourishing fish industry if well managed (MAAIF, 2011; FAO, 2004; FAO, 2016). Lake Victoria is the most important water body, both in size and contribution to the total fish production in Uganda followed by Lake Albert (Table 4.1). Until 2009, Lake Kyoga was the second most productive lake in terms of fish however several factors such as over fishing and use of illegal fishing gears have led to a decline in its productivity.

Fishing effort

Lake Victoria still remains the most important water body; both in size and contribution to total fish production in Uganda (Table 4.1), and therefore major studies on fishing effort normally target the lake. On the whole, fishing effort (indicated as major fishing inputs and facilities at landing sites) has grown over the years. For instance, the number of fishers increased

by 90.8 per cent while the number of boats has increased by 89.2 per cent between 2000 and 2016 (DiFR Frame Survey Report, 2016). Some indicators have remained the same such as the number of landing sites. The number of ‘other gear’ between 2000 and 2016 has more than tripled (DiFR Frame Survey Report, 2016). In most cases, this includes illegal gears that are usually used by fishers to target immature fish. This practice leads to depletion of fish stocks and impacts the environment negatively by altering the ecological status of the lake ecosystems. Generally, as in the previous reports, the declining fish production levels could be attributed to many factors like;

- i) Increased illegal, unreported and unregulated (IUU) fishing activities.
- ii) Increased fishing effort due to open-access nature - where no person or group of persons has exclusive rights over the fisheries resources, (i.e. where fishers would like to catch as many fish as possible before their competitors can fish) which results in overfishing,
- iii) Lack of continual catch data collection by the responsible departments
- iv) Infestation of new invasive weeds like the Kariba weed (*Salvinia molesta*) on Lakes Kyoga and Albert systems.

Table 4. 2: Trends of key fishery variables in the biennial Frame Surveys for the Ugandan side of Lake Victoria (2000-2016)

No.	Indicator	Year								
		2000	2002	2004	2006	2008	2010	2012	2014	2016
1										
2	Number of landing sites	597	552	554	481	435	503	555	567	556
3	No. of fishers	34,889	41,674	37,721	54,148	51,916	56,957	63,921	64,617	66,585
4	Total No. of fishing crafts	15,544	18,609	16,775	24,148	21,836	23,455	27,971	28,234	29,411
5	Crafts using engines	2,031	3,250	3,173	5,047	5,156	6,334	9,351	9,955	11,109
6	Gillnets by mesh size <5"	54,454	52,846	56,246	91,740	76,908	66,532	59,585	78,571	78,070
7	Gillnets by mesh size ≥5"	243,209	374,642	402,351	498,037	327,098	307,052	423,155	1,015,225	955,377
8	Total gillnets	297,663	427,488	458,597	589,777	404,006	373,584	482,740	1,093,796	1,033,447
9	Total small seines Mukene fishing	2,452	1,296	1,181	1,608	2,334	2,699	7,343	6,227	5781
10	No. of Hooks (Long & hand line hooks)	250,038	933,506	977,183	2,301,469	2,783,428	2,593,497	4,430,917	4,591,700	4,552,922
11	Other gears	13,507	7,785	7,960	2,605	21,468	25,014	24,835	33,971	43,298

(Source: DiFR, MAAIF, 2016)

Fish exports

Uganda’s fish processing industry is mainly composed of private companies most of which are situated on the shores of Lake Victoria and the Nile perch (*Lates niloticus*) is the main catch for export. Over all, fish quantities and value under fish trade continued to decline in 2015 - 2016 (i.e. 25,654 t and US\$136,548 m), compared to 2013-2014 period (28,358 t and US\$144,624 m), Figure 4.1. below. Despite this general declining trend in fish exports, there was a registered increase in both quantities and value in the year 2015 when compared with the previous year of 2014. The quantities increased from 8,271 t to 15,166 t

and US\$61, 976 m to US\$78,213 m respectively for 2014 and 2015 but declined again in 2016 (10,479 t and US\$58,338 m), the least value recorded since 2012 (US\$57,541 m) fetched from 26,722 t) (DiFR, Fish Export Report 2016). The total fish and fish products exports in 2016 amounted to 17,279 MT, compared to 17,597 MT which were exported in 2014, indicating a reduction of 318 MT (Joint Agriculture Sector Annual Review Report 2017). The main markets for Uganda’s fish are European Union (EU), Japan, Hong Kong, Singapore, Australia, Dubai, Israel and the United States.

Figure 4.1: Trends of estimated annual fish exports (tonnes) and value (US\$) from Uganda for years 1991 to 2016



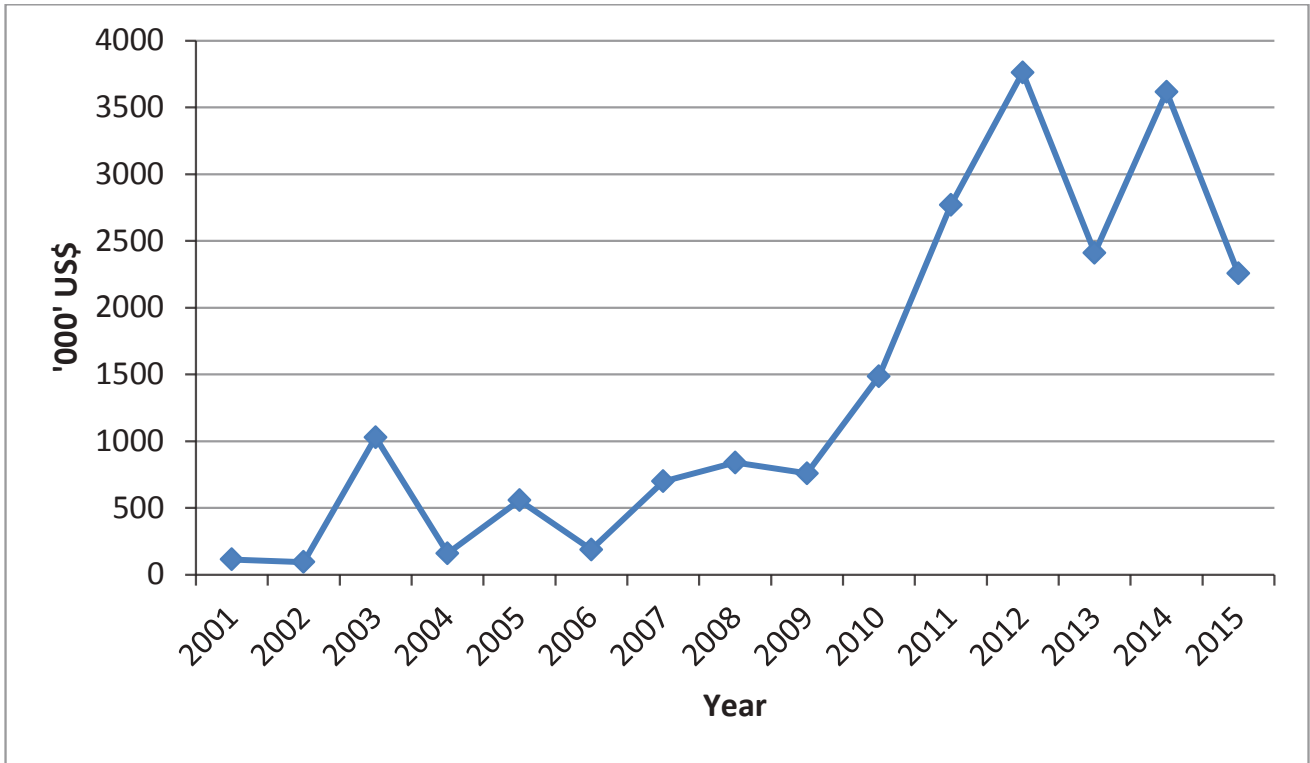
(Source: DiFR 2016; unpublished data)

Fish imports

Uganda, known for its brand product - Nile perch export to various markets in Europe, America, Asia and some countries in Africa; also to some extent imports some fish and other related aquatic organisms and products. According to the un-published data obtained from the Ministry of Trade, Industry and Cooperatives (MTIC) as well as from Uganda revenue Authority (URA), Uganda imports live ornamental fish, crustaceans, molluscs and other filleted fish for consumption.

From the available data which shows only the amount of money in thousands of US Dollars spent on importation of fish and other products since 2001, there has been a gradual increasing trend in amount of money spent which shoot-up from the year 2006 till the year 2012, and then slightly dropped in 2013 for the first time since the amount spent started going up in 2006. The amount spent shows it raised again in the year 2014, despite another sharp fall in 2015.

Figure 4. 2: Trends of estimated annual expenditure value (US\$) on fish and other aquatic products imports to Uganda for years 2001 to 2015



(Data source: Ministry of Trade, Industry and Cooperatives and Uganda Revenue Authority-URA).

Aquaculture

Aquaculture, commonly known as fish farming is a non-traditional farming technology and has been adopted by many farmers in Uganda to get more fish for their home consumption and surplus for sell. Over the previous five to eight years, the government put in more effort to improve aquaculture production in the whole country by enhancing aquaculture research and management and by encouraging farmers who are able, to venture into this industry. This has led to the fast growing rate of the sub-sector to levels which were never anticipated. The rapidly increasing human population and the export market are said to have increased the demand for fish in Uganda despite the declining production of high value wild fish stocks from capture fisheries (NaFIRRI, 2016).

Aquaculture practices like cage fish farming which has many advantages over other fish culture systems has been necessitated by increase in both local and global demand for fish which is attributed to the ever increasing human population and preference for the high quality fish protein (Tacon and Metian, 2013). Cage fish farming can achieve very high production in a small volume of water and hence its adaptability by fish farmers has shown an increasing trend (Beveridge, 1984). In an effort to boost aquaculture and probably reduce pressure on capture fisheries, the government has put in place favorable policies like the National Fisheries Policy, and the liberalization of fish seed production, and quick access to information (Kifuko, 2015). This has led to the quick adoption of cage fish farming by farmers as the farming takes place in already existing water bodies that may not recreation.

PRESSURES AND IMPACTS

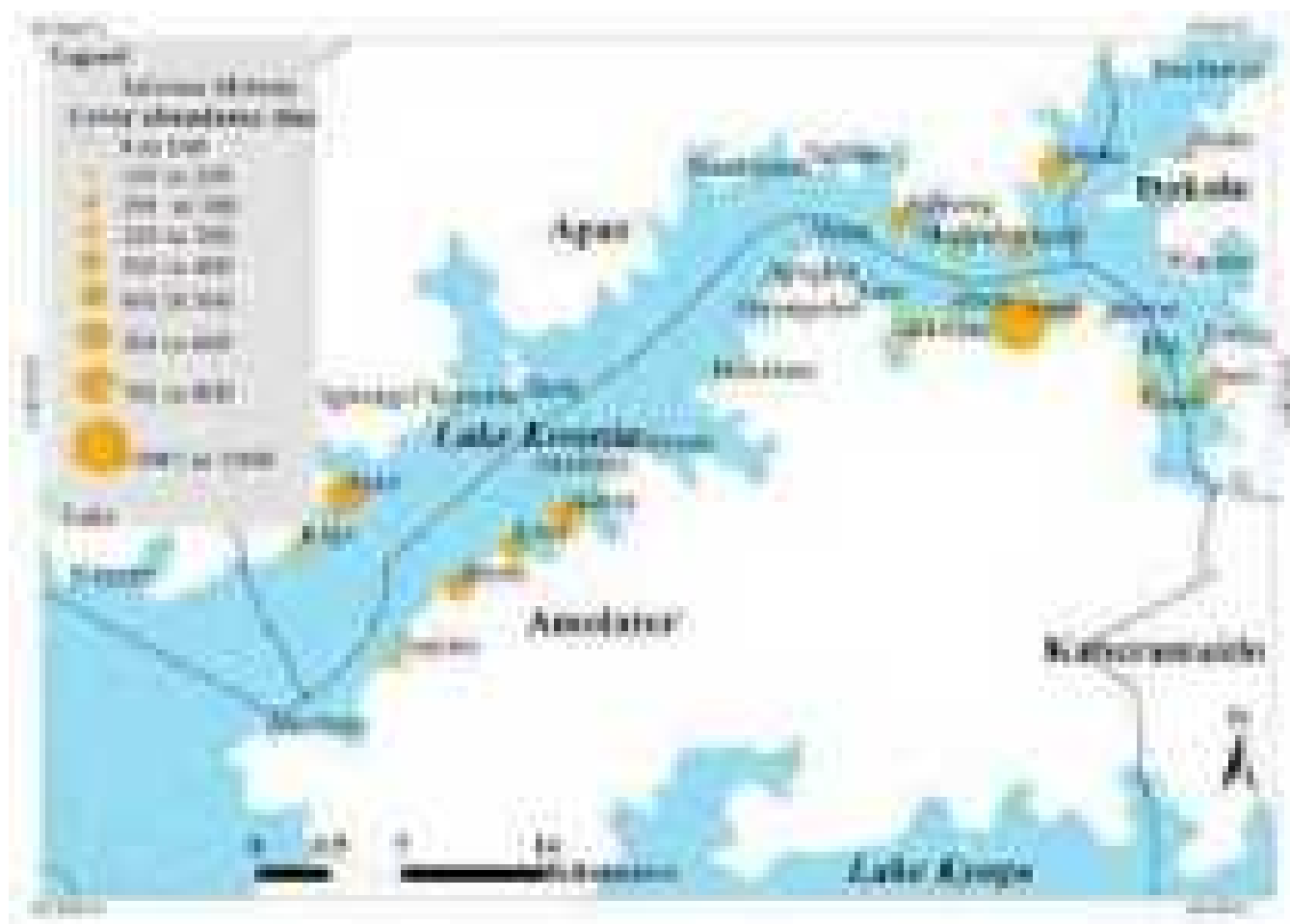
Invasive aquatic weeds

Invasive weeds are a big problem on many of the major water bodies. Although a lot of effort has been made to reduce or eliminate them, they continue to spread because of their ability to regenerate quickly (Manson & Manson, 1958). The major invasive weeds that have infested our Ugandan water bodies are *Eichhornia crassipes* (Water hyacinth) and *Salvinia molesta* (Kariba weed).

Kariba weed (*Salvinia molesta*)

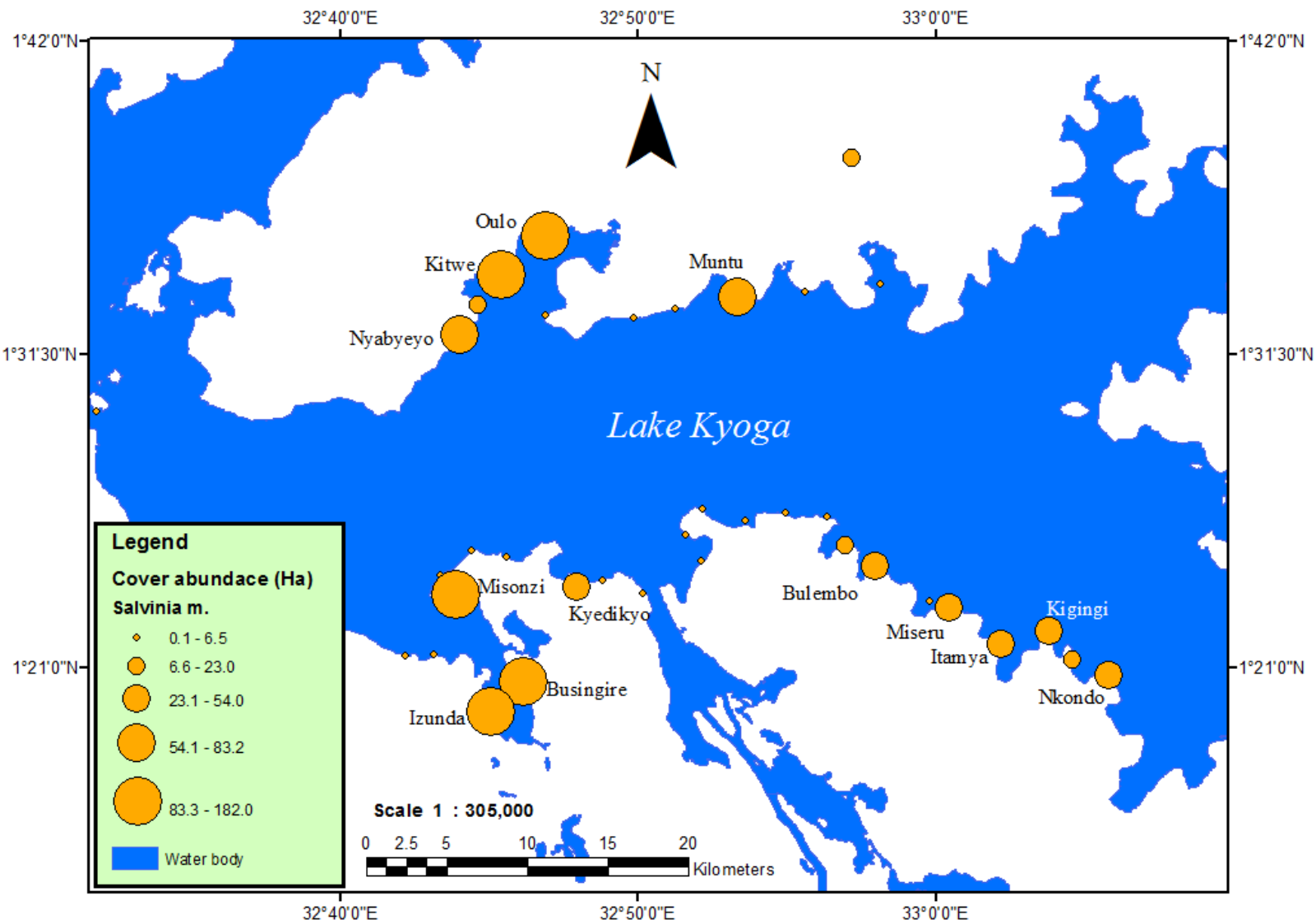
Between October-December 2016, a study was undertaken to determine the cover abundance and hotspots of the Kariba weed on Lakes Albert, Kyoga and Kwanja. It was found that the weed is most abundant in the sheltered zones. Wave and wind actions blow the weed out into the open water aiding its spread. The total area covered with the weed on Lake Kwanja by October 2016 was 9,090 ha with Amai area in Amolatar district having the highest cover abundance of 1,752 ha (NaFIRRI, 2016). From the shoreline to open waters, the waterweed varied in width between 0.002-1 km. Analysis by riparian district shows that by cover abundance, Amolatar was the worst hit with 5,850 ha, followed by Apac and then Dokolo with 2,715 ha and 525 ha respectively. As a result, the government is in the process of developing a cabinet paper to control the weed.

Figure 4.3: Abundance of *Salvinia molesta* on Lake Kwanja (October-December, 2016)



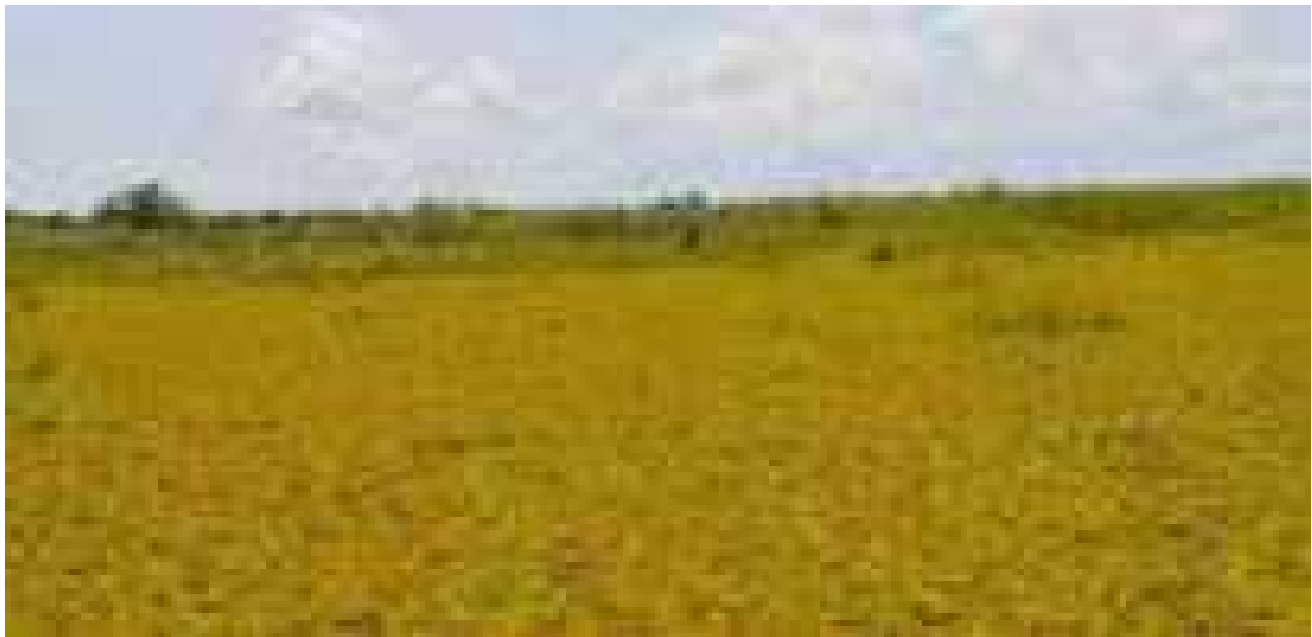
(Source: NaFIRRI, 2016)

Figure 4.4: Kariba weed cover abundance (hot spots) for Lake Kyoga



(Source: NaFIRRI November, 2016)

Kariba weed (*Salvinia molesta*) on Lake Nawampasa (Photo credit: Elias Muhumuza, 2016)



Water hyacinth covers extensive portions of Uganda's water bodies

This perennial herbaceous plant is a floating freshwater hydrophyte. It belongs to the Family Pontederiaceae and all the species in the Genus *Eichhornia* are aquatic. Water Hyacinth shows considerable variation in both leaf and flower form and colour, which also depends on the age of the plant. The flowers are bluish purple, large and self-fertile. The seeds are produced in large numbers and are contained in capsules, each capsule containing up to 300 seeds (Manson and Manson, 1958). The seeds can remain viable for 5-20 years (Matthews et al., 1977). The plant can also reproduce vegetatively through the production of horizontal stolons.

Water hyacinth (*Eichhornia crassipes*) mat on Lake Kyoga

(Photo credit: Elias Muhumuza, 2016)



Impacts of the water weeds

Infestation of the Kariba weed comes with both environmental and economic impacts. For instance the extensive coverage on the main parts of a lake especially the sheltered bays, blocking the water ways and making it difficult for fishermen to access the fishing grounds. This increases on the fuel consumption for those using outboard engines and takes a lot of energy and time for those using paddles. In addition, it prevents sunlight penetration to the deeper parts of the lake, and the underwater plants are thus unable to photosynthesize as much as they could, leading to less

dissolved oxygen in the water. Low levels of dissolved oxygen can lead to stressful conditions for fish and other aquatic biodiversity. MAAIF is undertaking research aimed at reducing or eliminating the weed using biological means as it was the case with the Water hyacinth in some of the major lakes in Uganda (NaFIRI, 2016). Water hyacinth also reduces biological diversity, impacts native submersed plants, alters immersed plant communities by pushing and crushing them away, and also alters animal communities by blocking access to the water and/or eliminating plants the fish depend on for shelter and nesting.

RESPONSES

The responses on the various environmental aspects affecting the fisheries sector include but not limited to:

1. Government's efforts to control unsustainable fishing practices continue with increased enforcement of the existing laws, more strict licensing and equipment requirements and reorganization of other industry players and community-level monitoring units to stabilize the industry. In a more concerted effort, the military has recently (2016) been deployed on all the major lakes of Uganda to carry out enforcement of the existing laws and regulations and any person who takes any wrong gear or equipment to the lake for fishing has been dubbed a "terrorist" and the military has been asked to deal with him/her as such;
2. MAAIF has facilitated and is supporting licensing of all fishing vessels on all water bodies.
3. During the same licensing exercise for gears and boats, all landing sites shall be gazetted or licensed
4. The ministry of MAAIF has put in effort and supported the study and subsequent identification of fish breeding and nursery areas and hope they will continue to support their gazettelement in future.
5. The central government together with locals governments have created an enabling environment for prospective cage fish farmers to get licenses in the shortest time possible to allow them proceed with their business plans without any hindrances.
6. Other efforts and responses include support to conduct studies on invasive weeds like *Eichhornia crassipes* and *Salvinia molesta*.

Salvinia molesta on Lake Kyoga

Photo credit: Tony Kiwanuka (NEMA 2015)



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Murchison Falls
(Internet photo)



CHAPTER 5: Water Resources

INTRODUCTION

This chapter describes the qualitative and quantitative status of Uganda's water resources which comprise of rivers, lakes and groundwater. Water resources are impacted by a wide range of anthropogenic and natural factors such as urbanization, industrialization and climate variations leading to severe impacts. These factors affect both the quality and quantity of water in rivers, lakes and groundwater bodies. As a mandate of the Ministry of Water and Environment to sustainably manage water resources, monitoring and assessment become critical to acquire data and assess the status of water resources. The Ministry through the Directorate of Water Resources Management runs various networks for monitoring water quality, quantity, as well as compliance and enforcement to laws and regulations. The purpose of monitoring is to produce information on water availability which forms the basis of the status and also early warning systems. The country's Water Resources therefore are monitored

through developed national networks of Water Quality, Surface Water, Ground Water and Law Compliance (see Figure 5.1). There are also basic monitoring networks temporary designed for research and projects to address. It is through regular collection of data from these established networks, referred to as operation of the network, that Water Resources status and trends are generated from the data thereof.

The networks have a relatively good spatial coverage of the country to yield comprehensive data for meaningful presentation of the status and trends of the water resources. However it is difficult using data from the assessment of the Water Resources to generalize the status and trends as different resources behave uniquely different depending on a number of local factors. In this chapter therefore a few individual case studies are more realistically represented to explain and emphasize major status and trends observations of the Water Resources.

Figure 5.1: Location of active monitoring stations for 2015 and 2016



Source: DWRM, 2016

STATUS AND TRENDS

The total renewable water resources for Uganda amount to 43km³/year with internal contribution of approximately 14km³/year and external contribution of 29km³/year (MWE, 2013).

There was a net gain in lake levels during 2015 and the earlier part of 2016 due to increased precipitation and regulation of the lakes. However, the intense and prolonged drought experienced from June 2016 led to a decline of observed water levels in the most of the water bodies in the country. In the case of Lake Victoria (Figure 5.2), lake levels rose by over 0.7m from the beginning of 2015 to June 2016, the water level then declined to the pre – 2015 level.

Groundwater trends

The main aquifers in Uganda are found in weathered crystalline basement rocks (Owor, et al., 2017). Three cases are presented in this section,

1. Apac groundwater monitoring station which monitors a very shallow aquifer system
2. Isingiro groundwater monitoring station which draws water from a confined aquifer
3. Soroti monitoring station which monitors motorized groundwater abstraction from a nearby source.

Figure 5.4: Mean Monthly water levels at Isingiro Groundwater Monitoring Station

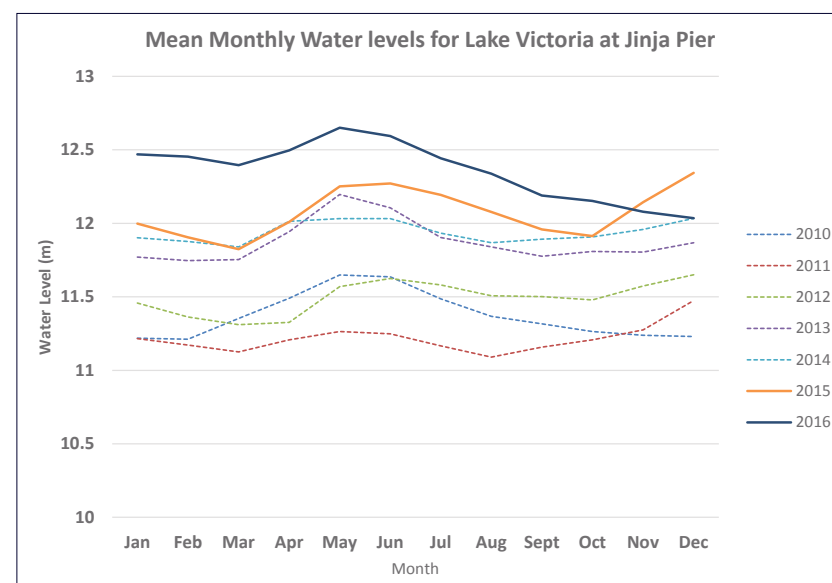


Source: DWRM, 2016

Water levels at Apac station rose by approximately 1m between January 2015 and February 2016 but declined by close to 2m from February until the end of 2016. The causes of these observations are not clear and further investigations should to be conducted to identify the cause of the decline. Above it all though it calls for regulation of water use from this aquifer to ensure sustainability.

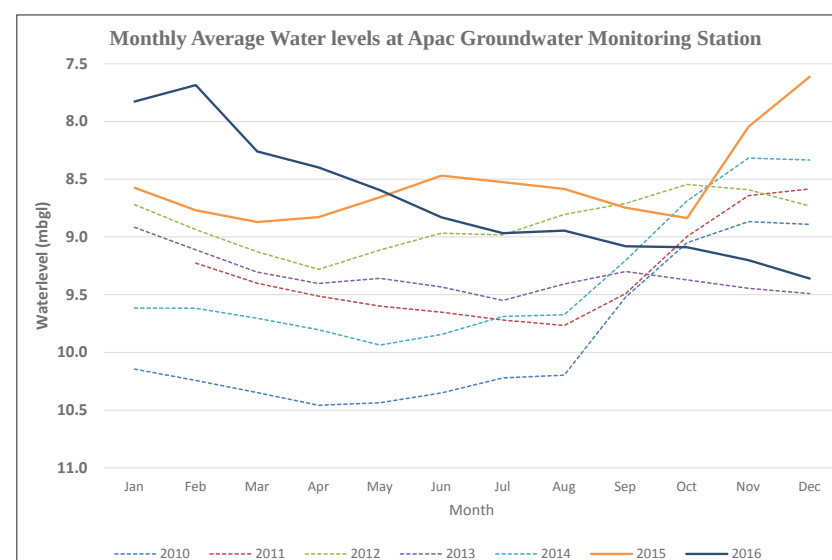
Groundwater levels at Isingiro groundwater monitoring station which draws water from a confined aquifer remained constant throughout the reporting period.

Figure 5.2: Mean Monthly Water Levels for Lake Victoria



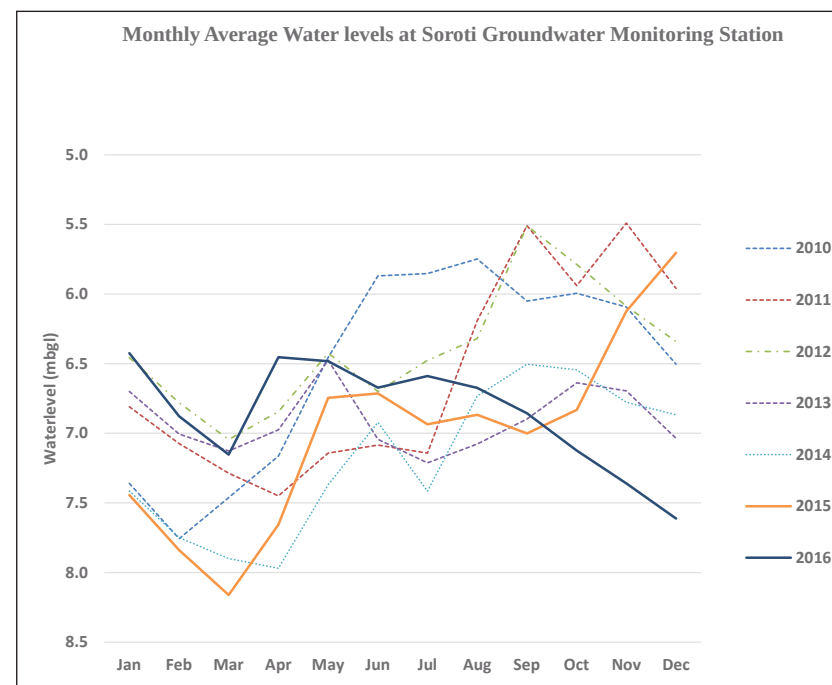
Source: DWRM, 2016

Figure 5.3: Mean Monthly Water Levels at Apac Groundwater Monitoring Station



Source: DWRM, 2016

Figure 5.5: Mean Monthly water levels at Apac, Isingiro and Soroti groundwater monitoring stations



Source: DWRM, 2016

Soroti monitoring station which monitors abstraction indicates that there is a decline in groundwater levels, this may be due to the combined effect of over exploitation of the aquifer and climatic conditions.

Most of the stations in the country showed the same kind of trend like the above three characteristic stations cases.

Water Quality Status

Water Quality Status is given depending on collected data from the networks which are defined by the water quality objectives and criteria. The networks therefore include the following, in addition to a few basics ones:

- i) Ambient monitoring- trend detection defining ecological Healthy and functionality
- ii) Effluent Monitoring – calculating loads and discharges impacts on WRs
- iii) Operational monitoring – operational use and domestic water supply

A number of parameters are commonly employed to address the above water quality objectives. One of the parameters for ambient water quality monitoring is assessment of turbidity and trend development is important for observing the rate of deterioration of a given water body especially rivers and lakes.

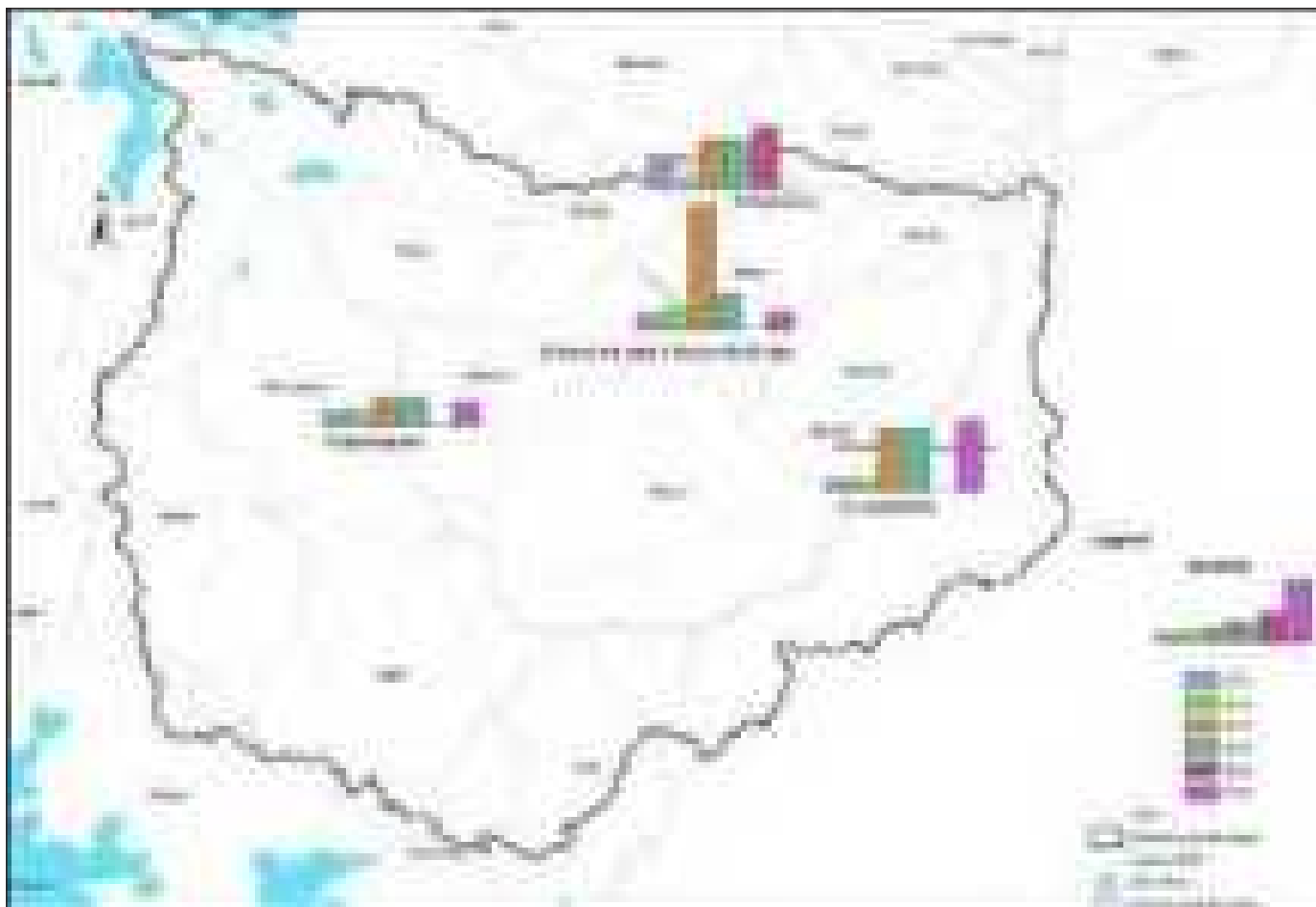
As part of case studies, water bodies were monitored for various parameters including turbidity, figures 4(a) and 4(b) show trends in turbidity of the major national water bodies and Mpologoma sub-catchment in Kyoga WMZ respectively. Water bodies in Kyoga basin exhibited higher turbidity compared to others around the country. However, integrated water resources and land management may improve the state of the water bodies whereby turbidity is an important parameter for monitoring.

Figure 5.6: Turbidity of major water bodies in Uganda



Source: DWRM, 2016

Figure 5.7: Mpologoma sub-catchment



Source: DWRM, 2016

Monitoring water quality for domestic (operational) purposes is based on Golden Indicator 5 identified as “the percentage of water samples taken at the point of water collection, or waste water discharge point that comply with National Standards for Drinking (Potable) Water (2008) and Water (Waste) Effluent Discharge Standards (1999)”. The following parameters were considered in measuring performance based on this indicator:

- i) Presence of Escherichia coli (E. coli) in drinking water from protected/improved sources in rural areas
- ii) E. coli presence in water from treated drinking water supplies in urban towns
- iii) Biological Oxygen Demand (BOD5) and Total Suspended Solids (TSS) in both municipal and industrial wastewater

Status of rural water supplies

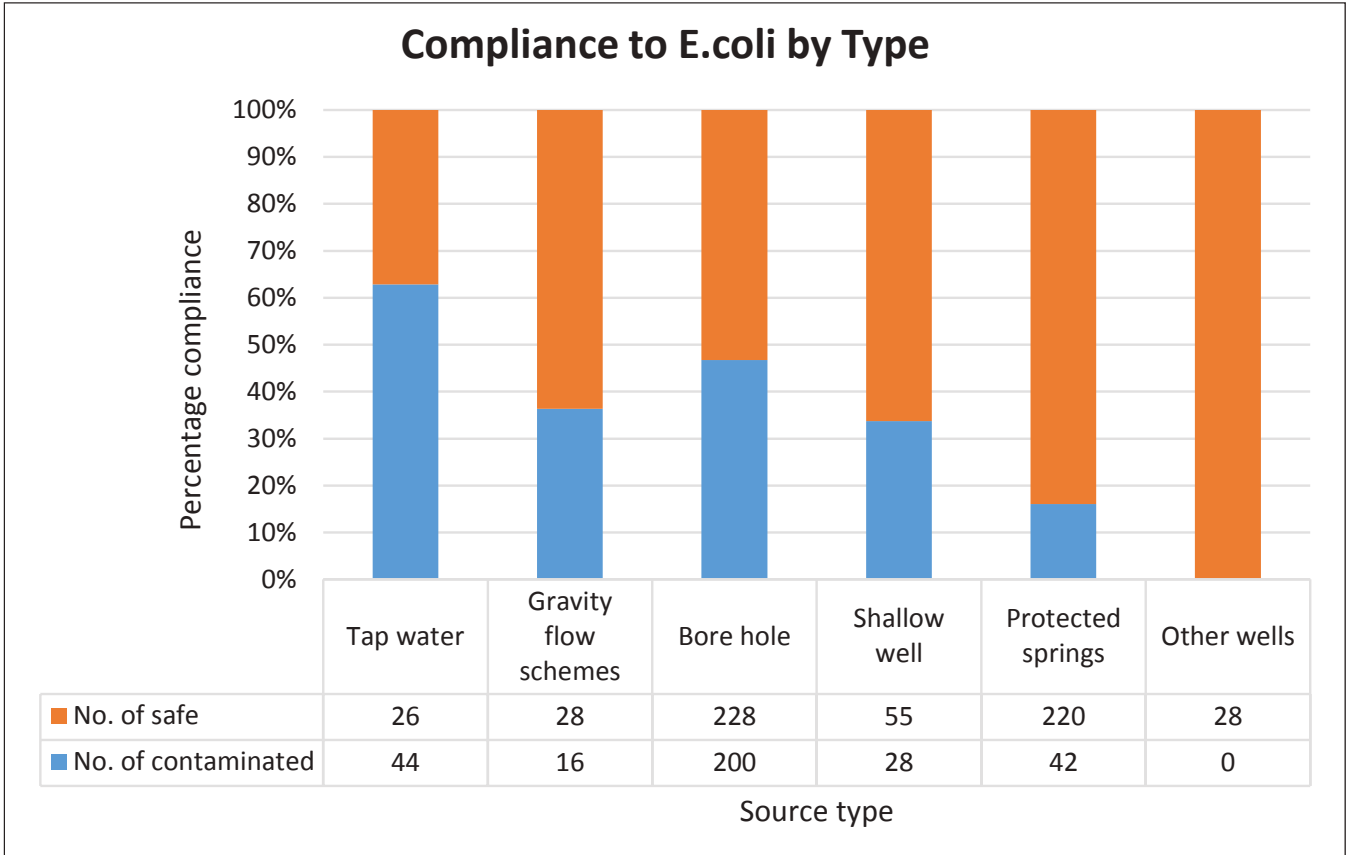
According to a rapid assessment of the quality of drinking water undertaken for rural water supplies in 45 districts in the period under review, 41 % of rural water samples comply with national standards.

Rapid assessment of the quality of drinking water of rural water supplies

was subjected to rural water supplies in 45 districts between August 2015 and February 2016 and 20 villages were sampled in each district. A total of 973 water samples were collected from water sources of different technology types, and homes from both rural areas and rural growth centres. Bacteriological quality (E.coli) was used to assess the suitability of water for drinking purposes. The national standard for potable (drinking) water recommends zero E.coli in drinking water.

- Only 41% of the sources sampled were found to be safe; 59% were contaminated with E.coli.
- Only 29% of household samples were safe; 71% were contaminated.
- Water quality disaggregated by technology type indicates that protected springs were most contaminated followed by gravity flow schemes and shallow wells. In all the three types, compliance levels were less than 30%, see figure below.
- Tap water and boreholes had comparable compliance levels of about 60%. It was noted that water in the rural growth centres is supplied mainly from production wells without any form of treatment.

Figure 5.8: Compliance to E.coli by source type

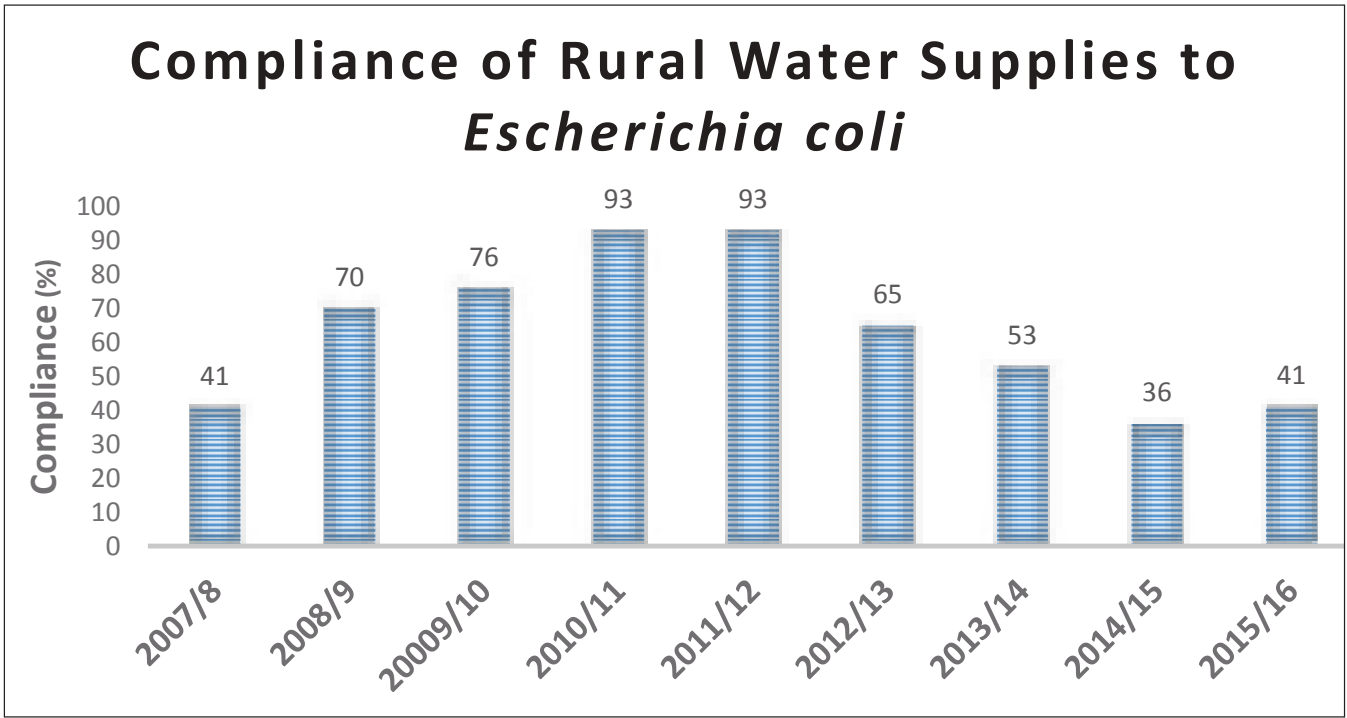


Source: DWRM, 2016

The districts where compliance levels were below 60% (e.g. Adjumani, Arua, Isingiro, Mbale, Sironko and Hoima) are among the 15 cholera endemic districts that have been listed by Ministry of Health.

However, generally there has apparent decline in water quality of rural water supplies as seen in the trend Figure 5.9 below based on the data sets available.

Figure 5.9: Compliance of rural water supplies to Escherichia coli



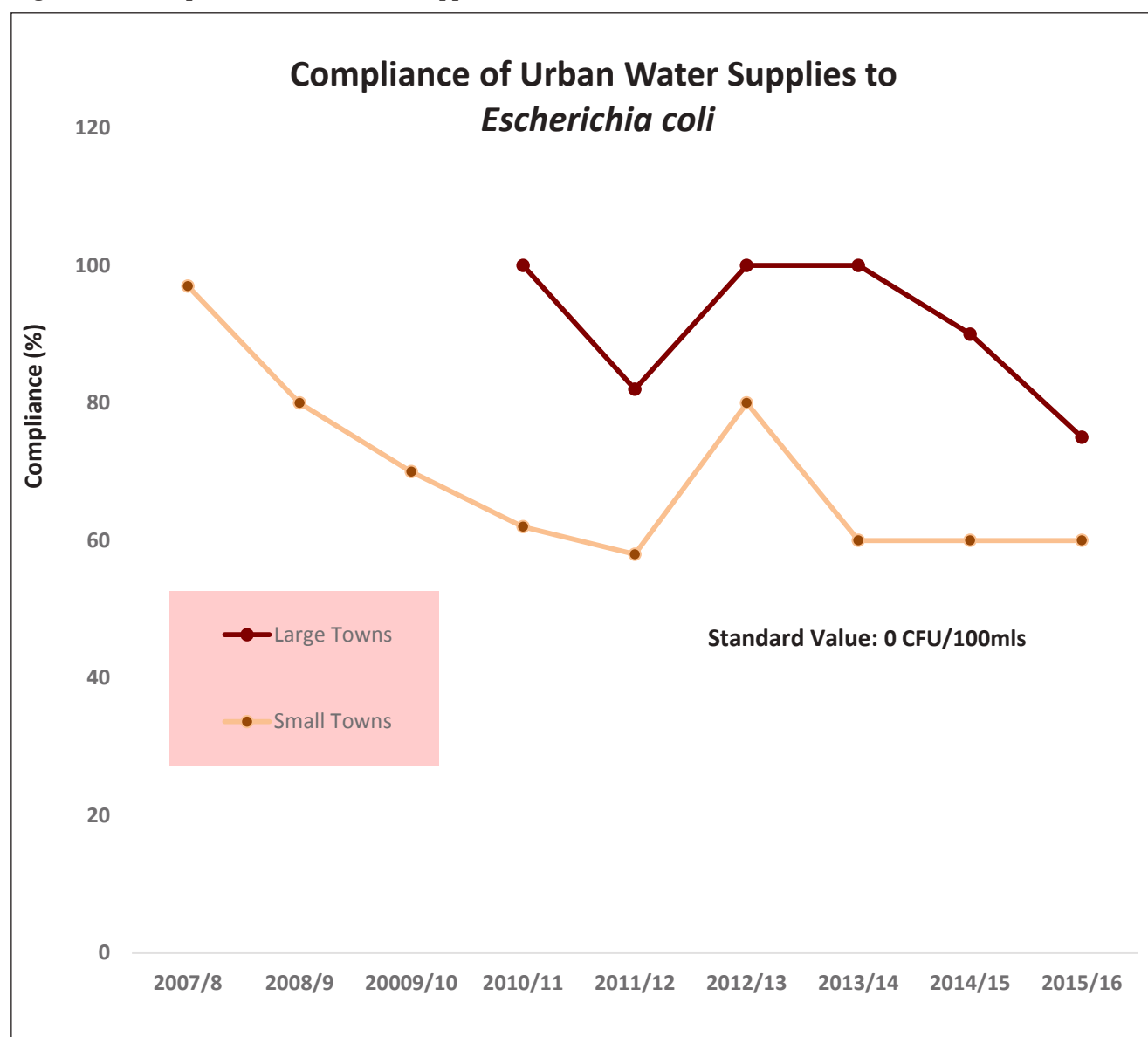
Source: DWRM, 2016

Water Quality of Urban Water Supplies

In the small towns' water supply, water quality has not reached the desired target of 100% compliance level (Figure 5.10). This is attributed to various factors, including the supply of water without any treatment from production wells, poor operation and maintenance, lack of skilled manpower for water treatment, seasonal variations in water quality,

abstraction of swamp water which is problematic to treat, lack of basic laboratory facilities to guide operations of the water works, lack of risk management and inadequate monitoring and supervision by regulators and poor water source protection. There has been low integration of management approaches more especially those from Catchment based Management to improve the water sources from risks.

Figure 5.10: Compliance of urban water supplies to *Escherichia coli*



Source: DWRM, 2016

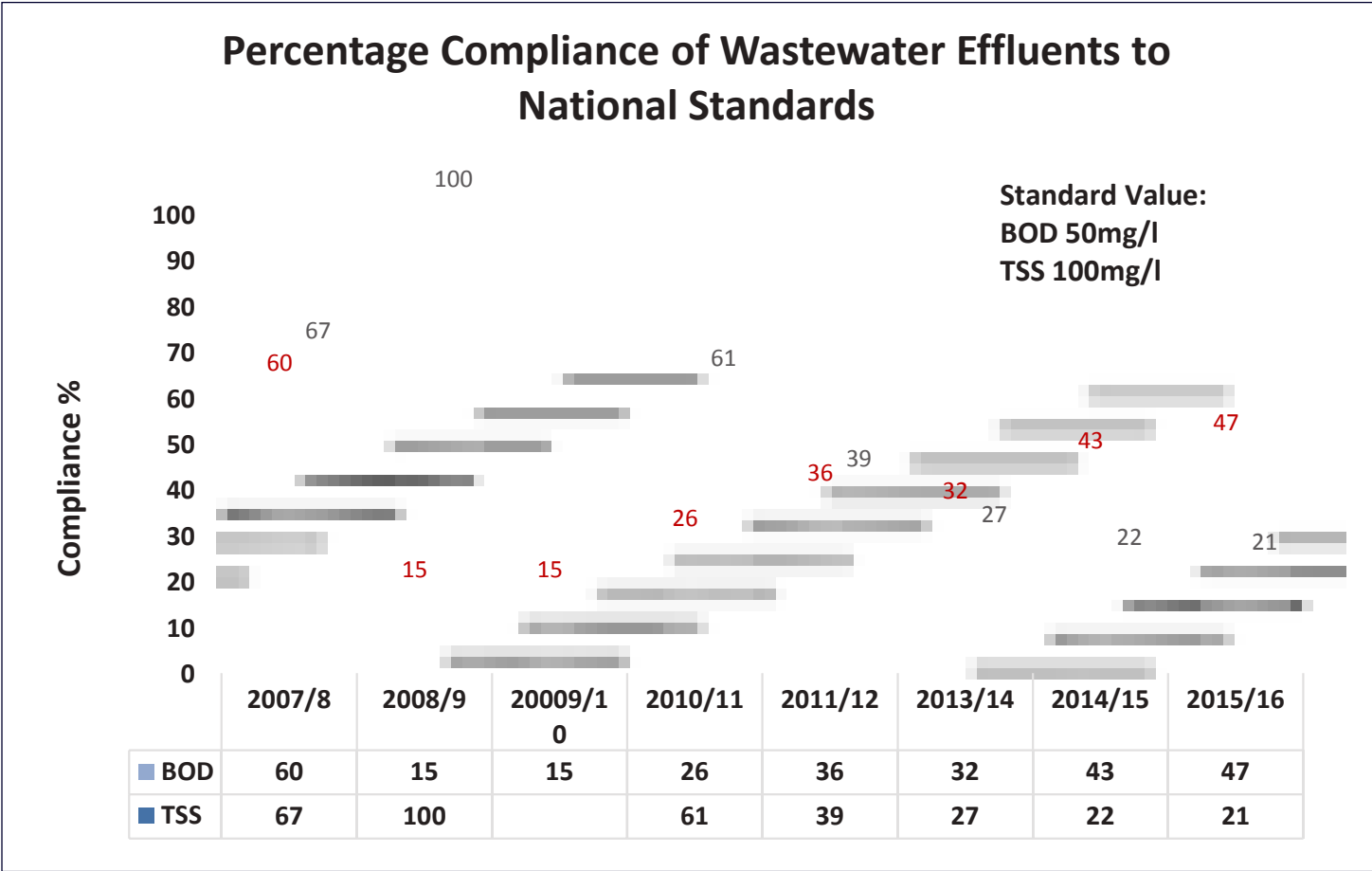
Quality of Wastewater Discharges

Wastewater discharge compliance trend has been improving over time with improved permit enforcement and increased vigilance of stakeholders. The performance of industries and municipal wastewater effluents in comparison with the National wastewater effluent discharge standards differs. Municipal wastewater effluents had a compliance level of 80% for BOD, and 0% for TSS. Industries however had a compliance level of 43% for BOD and 29% for TSS. This indicates that municipal treatment

plants remove organic matter better than the industries but discharge lots of suspended matter. Industries are still inefficient in treating both the organic matter and suspended solids.

The receiving environments of these wastes, including water bodies and wetlands, get polluted by the wastes. High organic matter as indicated by high BOD values leading to algal blooms and proliferation of water weeds such as water hyacinth and *Salvinia molesta*. Wastewater with high TSS value causes siltation of water bodies affecting navigation and docking of ships as has been experienced at Port Bell in the Inner Murchison bay.

Figure 5.11: Percentage compliance of wastewater effluents to National standards



Source: DWRM, 2016

However, low compliance to effluent standard over the years is attributed to lack of wastewater treatment facilities and inadequate enforcement of laws and regulations.

Water resources regulation

According to DWRM, water resources regulation improved during the reporting period, as evidenced by the increased number of clients applying for water use permits. The number of water use permits issued increased from 203 to 313. 20 permits for dam construction were issued along with technical advice on the type of hydraulic structures to be installed. The directorate reported that compliance to permit conditions had improved from 751 to 856. Compliance is defined as “the percentage of water abstraction and discharge permit holders complying with permit conditions i.e: validity of the drilling permits, possession of wastewater treatment facilities for waste discharge, compliance to permitted water abstraction volumes and quarterly submission of borehole completion reports. Improved water resources regulation is attributed to the de-concentration of some of the water resources management functions to the four WMZs which brought services such as compliance monitoring, compliance assistance and awareness raising closer to the permit holders. This ultimately improved performance in terms of water permits issuance and compliance monitoring and enforcement. Through the WMZs, awareness

about the need for catchment based integrated water resources planning, allocation and regulation of water resources greatly improved among the stakeholders who have responded through applying for various water permits (MWE, 2016).

PRESSURES AND IMPACTS

Pressures affecting water resources availability have not changed significantly from 2014, however some new pressures have emerged. Most notable among the new pressures is the water weed. Table 5.1 highlights the major pressures and impacts on water bodies during the reporting period.

Table 5.1: Major pressures and their impacts on Ugandan Water Resources

	Pressures	Impacts on Water Resources	Locations
1	River banks, wetlands and lakeshores degradation	- Increased flood events - Increased soil erosion and siltation, deterioration of water quality - Reduced water levels during dry seasons	R. Kagera Nile Delta
2	Low access to water supply	Inadequate access to water for productive use (subsistence and economy)	Mpologoma catchment
3	Discharge of untreated municipal wastes into water bodies	- Water pollution - Water borne diseases	
4	Insufficient sanitation coverage and inadequate treatment	Pollution of water bodies	
5	Draught	Inadequate water availability	

Source: DWRM, 2016



Satellite images of 2010 and 2017 shows invasion of L. Kyoga by the Kariba-weed (Source: UNEP GRID)





Eutrophication at Murchison Bay (Source: UNEP GRID)



Eutrophication of water bodies

*Invasion of *Salvinia molesta* on Ugandan water bodies*

The weed commonly called Kariba-weed and locally known as Nankabirwa weed, originates from Brazil and Argentina, and it grows all year round. Giant *Salvinia* grows rapidly and produces a dense floating canopy on the surface of ponds, lakes and rivers. The Kariba-weed was sighted about four years ago in Lake Kyoga (see satellite images of 2010 and 2017). Over the last two years, it has covered large parts of Lake Kyoga and has spread to Lake Edward and River Nile all the way to South Sudan. It has also been reported in valley dams constructed by MWE. It has affected ferry docking at Masindi port, Namasale and Laropi, and water abstraction, fishing and navigation on Lake Kyoga and River Nile (MWE, 2016).

RESPONSES

Containment: Floating booms may be installed before physical removal and herbicide treatments; to contain *S. Molesta* that will be stranded, and to separate bio control areas. One permanent boom prevents spread into

the main area of open water. This can be applied in rivers and streams which fed open water bodies like Victoria Nile and River Nile.

Small-scale mechanical removal: This method requires the use of mechanical scoop used in all accessible areas to remove the weed and push it into areas that dry out when water levels recede or dry areas where it is dried and burnt or composted and used as manure.

Herbicides: There are a number of herbicides that can be used in areas infested by the weed.

Biological Control: Bio-control is another method that is useful in areas inaccessible to mechanical scoop. Biocontrol prevents the weed from establishment beyond vegetated areas. Bio-control makes use of some insects, aquatic grasshopper and weevils.

Manual removal: Small amounts of *Salvinia* that occur in areas used for swimming, recreation and landing sites areas are easily removed manually. **Monitoring:** All the affected rivers and lakes in the country and their surrounding catchments should be monitored regularly.

Catchment Based Integrated Water Resources Management

Figure 5.12: Catchment management plans have been developed for various catchments



Source: DWRM, 2016

Public awareness: A Catchment Care Information Kit should be developed and is distributed to stakeholders that include fishing communities, local governments, Uganda National Roads Authority (UNRA) and others to provide information on the dangers of the weed and stop its deliberate propagation as ornamentals etc.

Water Source Protection

The Directorate of Water Resources Management developed guidelines for water source protection. Water source protection plans for Rivers of Namatala, Nabijo and Nabuyonga in Mbale, Kitagata in Bushenyi and Enyau Arua were developed in 2016.

Policy Issues

Lack of coordination, particularly between production and natural resources management (erosion issues, encroaching would need combined response of agriculture and NRM - The collapse of the extension services that used to be done by the parish chief (a civil servant), prevent the dissemination of good practices)

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Farmers in Kisoro District brave the rocky soils to carry out agricultural activities

Photo credit: Elizabeth Mutayanjulwa (NEMA 2017)

CHAPTER 6: Soil degradation

INTRODUCTION

Most Ugandan soils are old and predominantly ferralitic (Ferralsols and Acrisols) with little weatherable minerals to replace spent nutrients. Soil organic matter is the main source of crop nutrients. It is found mainly in the surface layers of the soil and is thus highly susceptible to losses through erosion especially when vegetation cover has been removed. The nutrients also are prone to leaching during times of, or in areas of heavy rainfall. When these nutrient losses are coupled

with deterioration of soil physical properties, crop yields gradually fall especially where intensive cropping is practiced. Against the backdrop of a growing population dependent on rain-fed agriculture, this is a recipe for poverty and food insecurity.

Soil degradation is a growing issue in Uganda and is leading to a decline in soil fertility. The main causes include loss of soil cover by vegetation or crop residue removal, poor soil properties that lead to inadequate water infiltration, and poor agricultural practices leading to nutrient mining.

Figure 6.1: Map of Soils in Uganda



Source: NARO, 2016

STATUS AND TRENDS

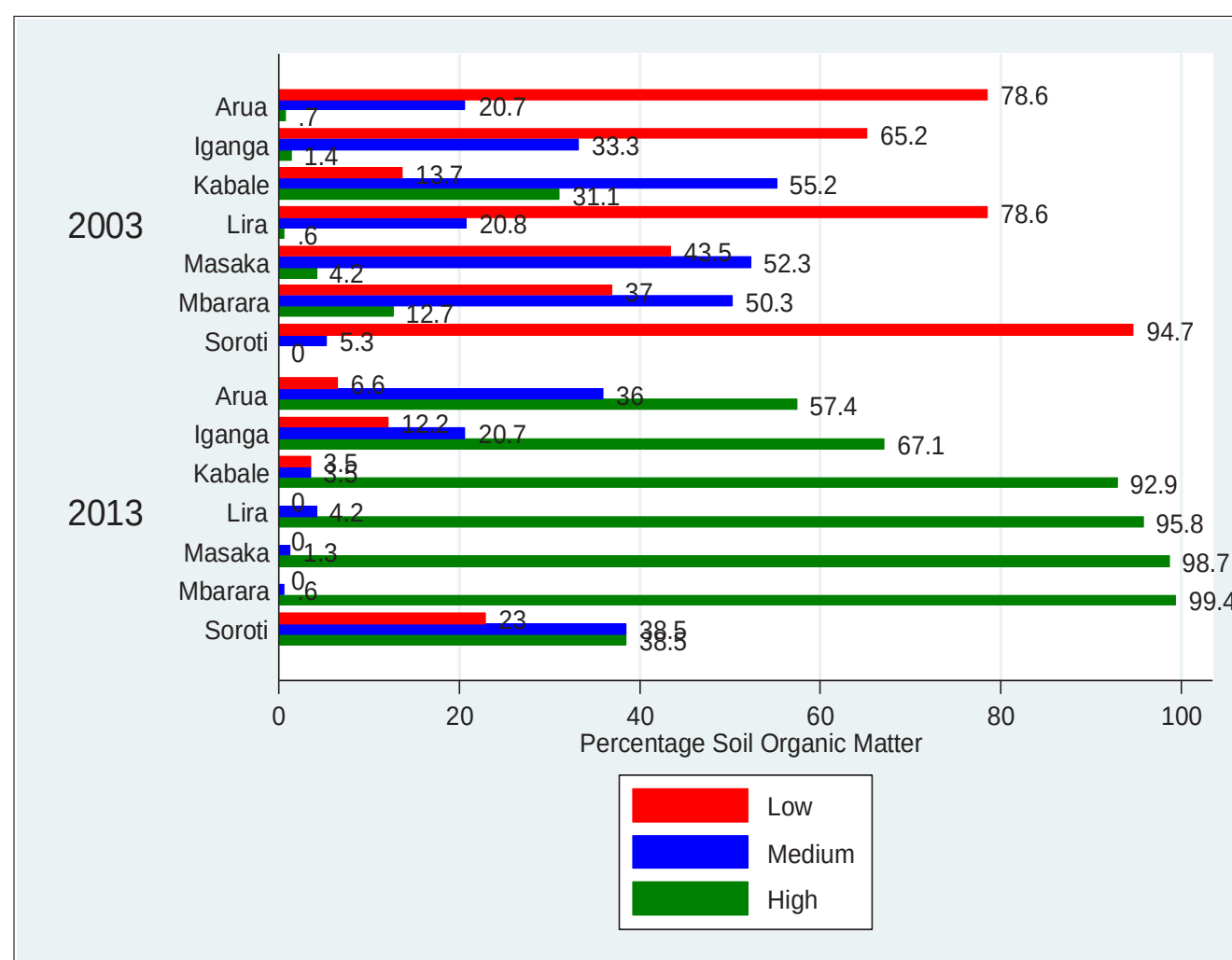
Soil Organic Matter (SOM)

Soil organic matter is a major source of plant nutrients. It contributes to soil nutrient retention and improves the physical properties of the soil that allow for adequate water infiltration and retention, proper soil aeration, plant root penetration. Soil organic matter is found in the top 20cm of soil and is vulnerable to erosion especially with the removal of foliage cover. Erosion that leads to the loss of top soil, results in the permanent loss of soil fertility and productivity. The proper management of soils is necessary for soils to remain productive.

Soil organic matter is an indicator of sustainability in a soil management system because of its central role of in maintaining soil fertility (Greenland, 1994). Organic matter content varies from district to district with some having quite high organic content. For instance, in Kabale, Lira, Masaka and Mbarara over 90 per cent of the samples had high soil organic matter. The soil organic content has also been improving over the years. For example, between 2003 and 2013, in Soroti district samples

tested there was an improvement in the soil organic matter based on samples from the districts in Figure 6.2. For example, in Soroti district in Eastern Uganda, soil organic matter was low in about 79 per cent of the samples which as reduced drastically to about 23 per cent of the samples. Furthermore, in Iganga district, about 65 per cent of the soils had low organic matter in 2003 as compared to only 12.2 per cent observed in 2013. A significant number of samples have high organic matter content; however this may not translate to high productivity because only a small fraction of soil organic C and N is associated with microbial decomposer activity and most N mineralization is from recent organic matter inputs. This small fraction of actively cycling N may contain significant quantities of recently deposited organic material including fine roots and fungal hyphae and is often referred to as particulate or light fraction SOM (Tisdall and Oades, 1982) which is important to seasonal N cycling (Legorreta-Padilla, 2005 and Bird et al., 2002). The stability, size, and N contribution or turnover within these pools is influenced by the nature of residue quantity and quality, anthropogenic inputs of N, and the physical environment. Ssali (2000) reported a decline in crop yield in central Uganda despite a non-significant change in SOM across several sites over a 25 to 30 year period.

Figure 6.2: Shows the state and trend in soil organic matter for some selected districts in Uganda



Source: Author's computation from NARO data, 2013

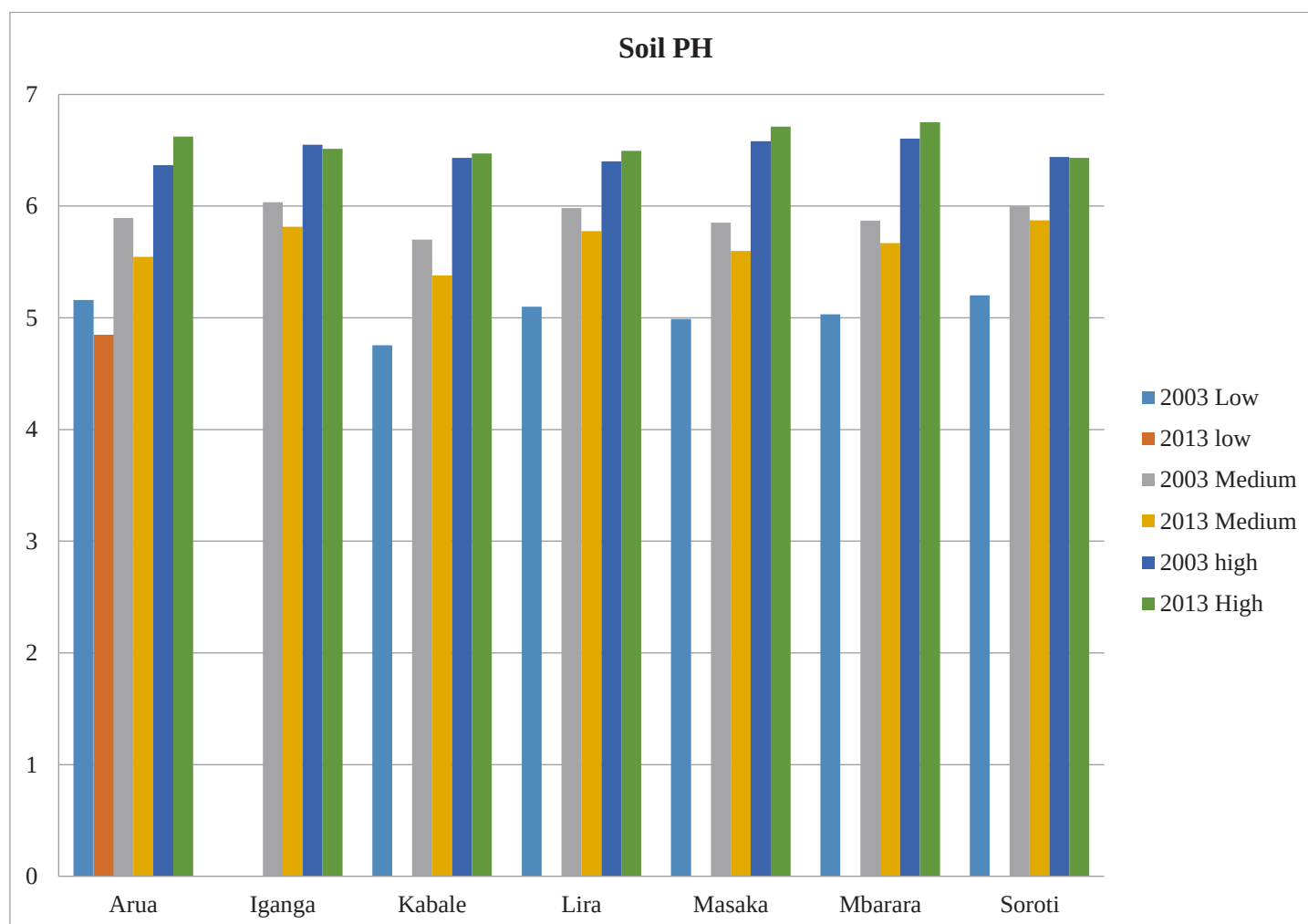
Soil pH

Soil pH is another important soil parameter because it controls several chemical reactions in the soil thus influencing the availability of plant nutrients, trace elements and levels of potential contaminants in the soil. Most soils will tie up relatively large quantities of trace elements (Zinc, Iron, Copper, Manganese), heavy metals and pollutants if the soil pH is high (> 6.5) thus becoming unavailable for plant uptake.

Findings revealed that between 2003 and 2013, the soil pH did not change significantly. Generally, the soils in the selected districts were

only slightly acid with a pH less than 7 (IFPRI 2016 Survey DATA). This could be attributed to human activities such as draining of acid sulphate soils commonly in swamps for agricultural purposes, use of soil acidifying fertilizers such as DAP, urea and leaching of bases in high rainfall areas. Changes in soil pH affect soil productivity because of increase or deficiency of micro nutrients. The current status of the soils might be attributed to the observed soil productivity and yields as discussed in the next chapter.

Figure 6.3: Status and trend in soil PH for selected districts in Uganda



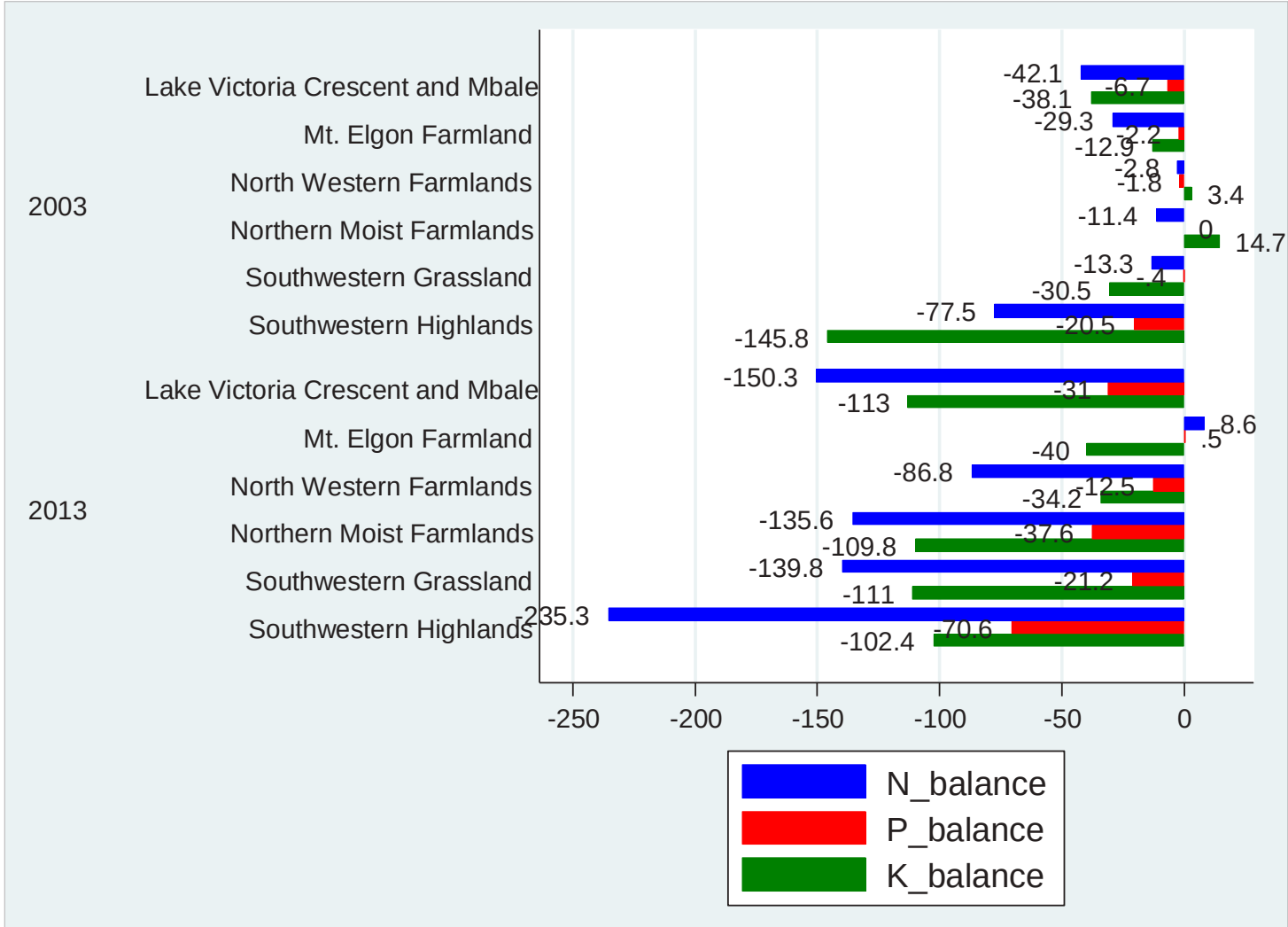
Source: IFPRI (2016) Survey DATA

Household level soil nutrient balance and productivity

Figure 6.4 shows the Nitrogen, Potassium and Phosphorus in the soils at household level. The nutrient balance is a measure of nutrient intake and loss in the soils at household level. For example, Nitrogen Balance: nitrogen balance covering the main categories of nitrogen inputs and outputs, the nitrogen balance calculation (inputs minus outputs), and the expression of the nitrogen balance in kg of nitrogen per hectare of agricultural land.

Nutrient deficiencies affect most of the soils in the different agro-ecological zones (Figure 6.4). For instance, in the south western highlands the deficiency for Nitrogen was 77.5 kg/ha in 2003 increasing to 235 kg/ha in 2013 (Kaizzi et al 2004). The declining soil nutrients is a serious indication of soil degradation and could be attributed to poor farming systems and improper application of fertilizers leading to reduced soil productivity. The reduced soil productivity increases the demand for more fertile soils and thus drives encroachment into wetlands and forests.

Figure 6.4: Soil nutrient balance



Source: Kaizzi et al (unpublished data)

Vegetation cover as an indication of land condition

The Normalized Difference Vegetation Index (NDVI) is used as proxy for vegetation cover and therefore an indication of land condition depicting areas of gains or positive change and therefore improvements in vegetation cover or areas of loss or negative changes: In short, the capacity of land units to deliver land-based ecosystem services. Low to bare areas are associated with areas ranging from no vegetation cover to scanty vegetation including grasslands with limited or no tree cover. Medium vegetation cover areas are largely agricultural characterized by annual crops with limited perennials and few trees. They are either areas of vegetation improvement from low or vegetation loss from high and very high vegetation covers.

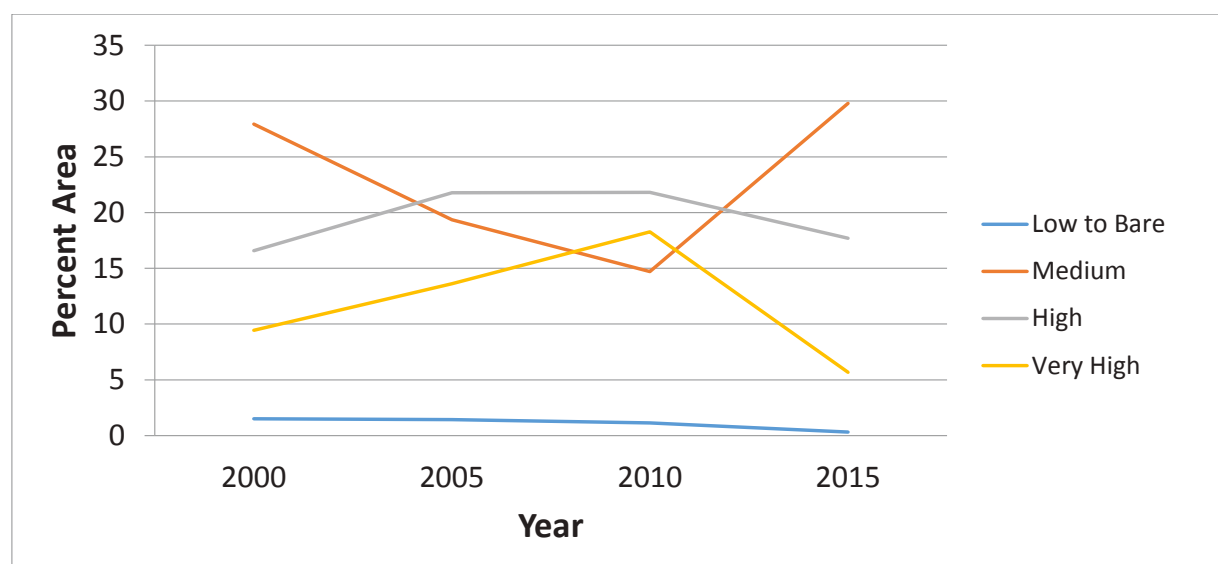
Table 6.1: Uganda vegetation cover density trends for January 2000, 2005, 2010 and 2015

	2000	2005	2010	2015
	Per cent of total area			
Low to Bare	2	1	1	0
Medium	28	19	15	30
High	17	22	22	18
Very High	9	14	18	6

Author's computation from Busitema University Data 2015

High vegetation cover areas are agroforestry characterized by perennial crops like coffee and bananas or sole cropping of sugarcane. Degraded forests also fall within this category. Both natural and planted forests are associated with very high vegetation cover category.

Figure 6.5: Uganda vegetation cover density trends for January 2000, 2005, 2010 and 2015



Author's computation from Busitema University Data 2015

Vegetation cover density trends for Karamoja region

Karamoja region is generally semi-arid with large areas of Acacia bush land and thicket and very little actual ground cover. Erosion is widespread over all the drier parts of the district. Cattle are kept in large numbers and are the mainstay to the life of the community. However, there is an ever-increasing tendency to cultivate cereal foods like Sorghum, Bulrush millet and Maize. Perennial crop cultivation can be supported on the higher mountains where rainfall is over 890 mm per year. These areas are also associated with high to very high vegetation cover with relatively higher tree cover including forests and tall grass cover. The drier eastern areas where rainfall ranges from 380 mm to 635 mm can only support subsistence agriculture. They are characterized by low vegetation cover comprised of short grass. These areas are largely bare during the extensive dry seasons (November to the end of March) when they are vulnerable to soil erosion at the onset of the rains in April. Areas of medium vegetation cover are transitional representing areas of improvement from low to bare cover and areas that have lost vegetation cover, previously of high to very high vegetation cover.

As for the national level, Karamoja region (Table 6.2 and Figure 6.6) the low to bare areas are less with overall decreasing trends of areas

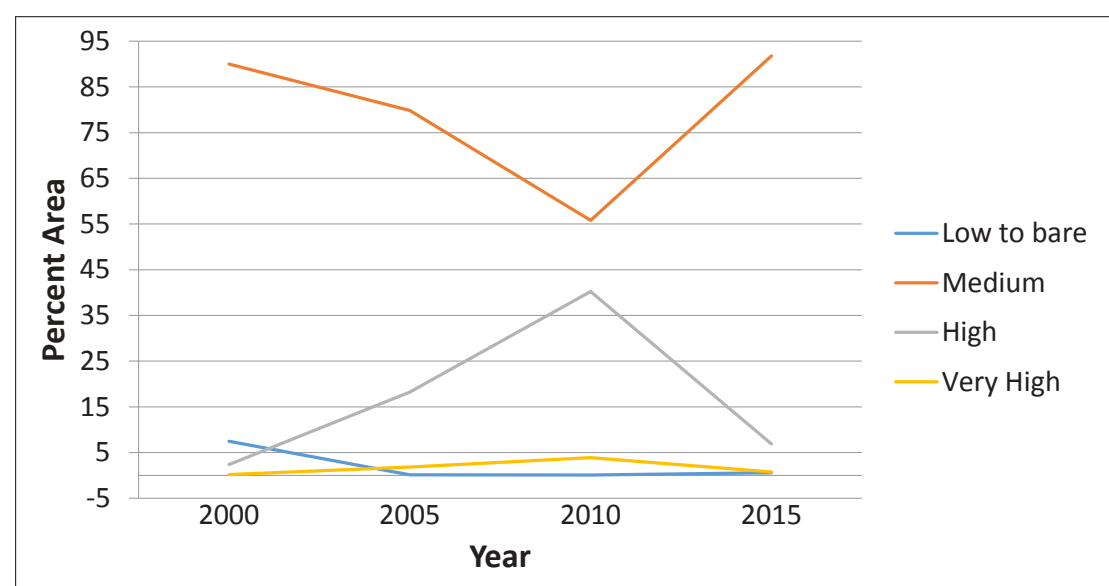
with low vegetation cover. Negative trends are significant with as high as 36 percent of the high and very high categories of vegetation cover degraded to medium vegetation cover. Excessive tree cutting is associated with negative trends in vegetation cover.

Table 6.2: Karamoja vegetation cover density trends for January 2000, 2005, 2010 and 2015

	2000	2005	2010	2015
	Area (sq. Km)			
Low to bare	7	0	0	1
Medium	90	80	56	92
High	2	18	40	7
Very High	0	2	4	1

Author's computation from Busitema University Data 2015

Figure 6.6: Karamoja vegetation cover density trends for January 2000, 2005, 2010 and 2015



Author's computation from Busitema University Data 2015

Areas of low to bare are about constant but with a decreasing trend. It means that all areas in Karamoja sample area have good soils that can support the recovery of vegetation lost during the dry seasons.

IMPACTS OF CHANGING SOIL HEALTH IN OM

Reduction of soil organic matter

Organic matter plays a key role in soil health as a source of nutrients for plants and also in physical, and biological fertility. A decrease in soil organic matter content will have negative impact on the soil health which manifests itself as reduced crop yield. The quality of soil organic matter is very important in its role as a source of nutrients, when it is dominated by recalcitrant fraction, it ceases to be a source of nutrients but mainly playing a role in physical and biological fertility plus nutrient retention. Recalcitrant soil organic matter fractions are mainly from residues that were added a long time and hence are highly stable. To play its role as a source of nutrients, it should be dominated by the particulate or active fractions which are mainly from fresh and frequent additions of organic materials including plant roots. The common practice by farmers to remove or burn crop residues, burn bushes and also graze the vegetative fallow leads to very little replenishment of the active and labile SOM pools hence deprive the soil of a major source of organic matter, with negative impact on soil health hence productivity leading to low crops food insecurity. Furthermore, the levels of soil organic matter might be high but crop yields remain low. This is common in Uganda when the soil organic matter is dominated by recalcitrant fractions. A decline in crop yield in central Uganda was reported despite a non-significant change in SOM across several sites over a 25 to 30-year period (Ssali, 2000).

Reduced productivity

Soil health is a function of the chemical, biological and physical fertility of soil. Soil erosion contributes over 75 per cent of nutrient mining or loss from agro-ecosystems in Uganda (Kaizzi et al., 2004) and this affects the overall condition of soil health. Which reduces the chemical, biological and physical fertility these together constitutes the soil health. This ultimately results in reduced productivity and crop yield. The phenomena is observed as either stagnant or declining crop yields per unit area of production and per capita food production which is common across SSA since the 1980s. Though the main contributing factor is poor inherent soil fertility particularly N and P deficiencies (Bekunda, Bationo, & Ssali, 1997), it is exacerbated by soil fertility depletion (Vlek, 1993), and other biophysical factors.

Increased poverty and dependence on food aid

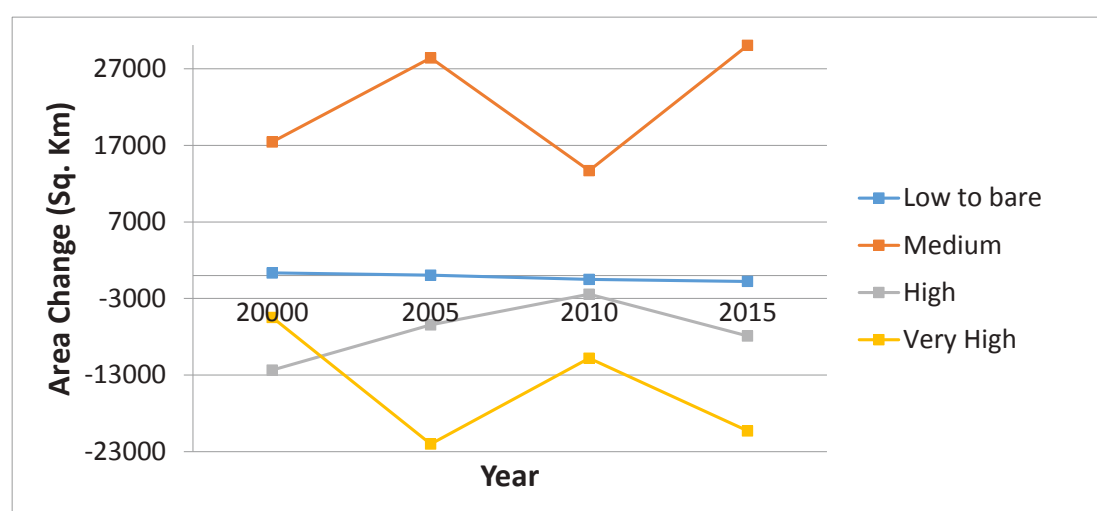
Land degradation and soil fertility or nutrient depletion are considered as the major threats to food security and natural resource conservation in Sub Saharan Africa. Uganda is among the countries with the most

Table 6.3: Karamoja vegetation cover differences between the rainy (May) and dry (February) seasons

	2000	2005	2010	2015
	Area (Sq. Km)			
Low to bare	345	46	-492	-775
Medium	17441	28403	13703	30058
High	-12347	-6451	-2434	-7883
Very High	-5458	-22002	-10808	-20287

Author's computation from Busitema University Data 2015

Figure 6.7: Karamoja vegetation cover differences between the rainy (May) and dry (February) seasons



Author's computation from Busitema University Data 2015

severe soil nutrient depletion in Africa (Stoorvogel & Smaling, 1990). The estimated average depletion rates for nitrogen (N), phosphorus (P) and potassium (K) are -21, -8 and -43 kg/ha/year (Wortmann & Kaizzi, 1998) (Nkonya, Kaizzi, & Pender, 2005) (Smaling, Nandwa, & Janssen, 1997). A decline in soil health results in a decrease in crop yield hence food insecurity and poverty affecting about 4 million households that survive on farming. Food insecurity and increased poverty levels may lead to an increased need for food aid to meet the food deficit (Sanchez, 2002).

Drop in contribution of the agriculture sector (particular directly dependent on land) to the GDP

Agriculture is the largest employer in Uganda, employing 74 per cent of the working population and accounts for 85 per cent of total export earnings and the bulk of the raw materials used by the agricultural-based industrial sector in the country (UBOS 2010). Poor soil health results in low productivity which has a direct negative impact on the GDP of the country.

Increased siltation of lakes and rivers associated with materials coming off land

Soil erosion has resulted in several environmental problems such as sedimentation, siltation of reservoirs and eutrophication of rivers and lakes. Increases in the coverage of the surfaces of water bodies by weeds

such as the recent algae boom on Lake Victoria and the water hyacinth infestation are on the increase due to enrichment of water bodies with nutrients brought in as constituents of eroded soil from poorly managed lands.

Recommendations

1. Soil degradation is affecting the land on which the majority of the people in Uganda depend for their livelihood. Soil erosion is a major cause of land degradation, farmers should invest resources and efforts to control soil erosion for sustainable use of land. Laws and bye-laws for reducing soil erosion should be enforced.
2. Negative nutrient balances should be addressed through increased use of organic and inorganic fertilizers to replenish nutrients lost from farming systems.
3. Efforts should be made to map the soil pH across the country because it is an important soil parameter that influences availability of plant nutrients and control several chemical processes in the soil.
4. Removal of vegetative cover through deforestation, bush burning and uncontrolled destruction of vegetation should be addressed through enforcing existing laws.

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Commercial maize growing in Nwoya District
Photo credit: Elizabeth Mutayanjulwa (NEMA 2016)

CHAPTER 7: Crops

INTRODUCTION

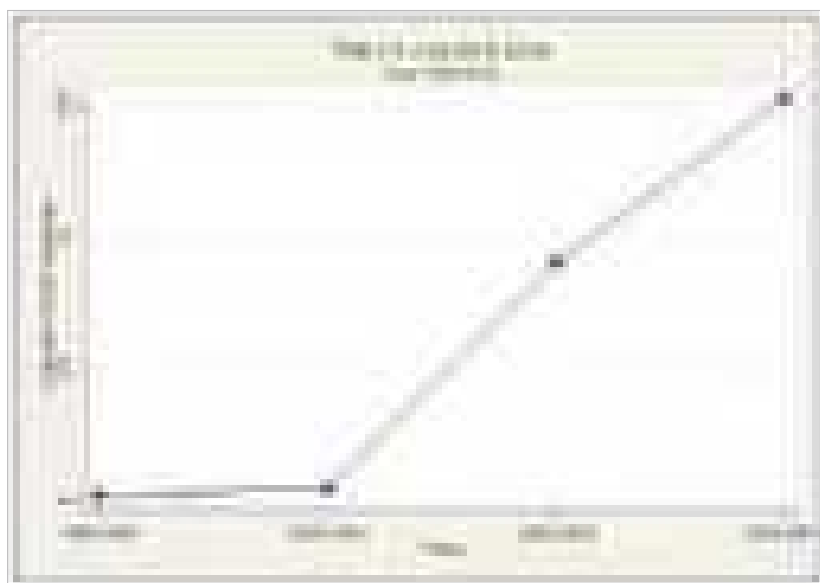
This chapter discusses the area under crops, demand for more land for agriculture and the implications for environment. The state and trends of cropland and productivity of selected crops are also highlighted. According to the 2015 land use survey, area under crops was estimated about 10.5 million hectares. Figure 7.1 shows the state and trend in cropland for the period 1990-2015.

STATUS AND TRENDS IN CROP LAND

Land use change

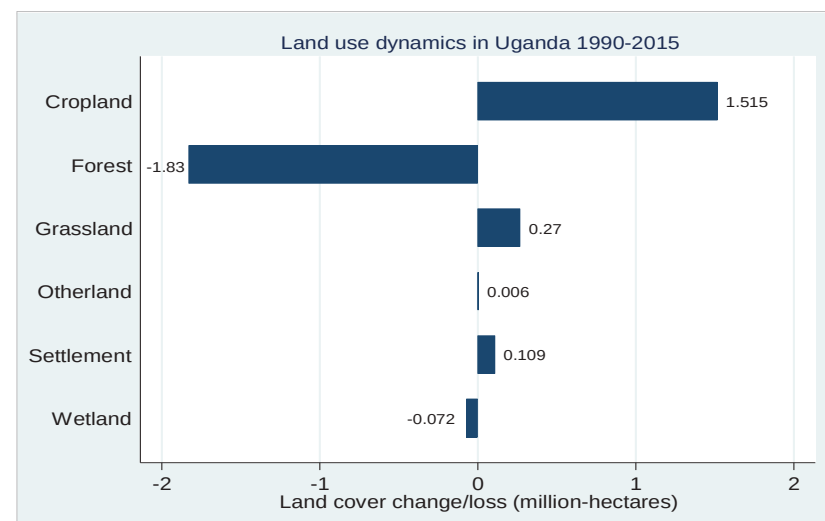
The increasing area under crops is leading to land use change with forests and wetlands being converted to agricultural land (Figure 7.2). Over the 1990-2015 period, Uganda lost about 48.3 per cent of the forest cover and about 1.6 per cent of the wetlands. The area under cropland, grassland, and settlements increased. For example, the area under cropland has expanded by about 16.8 per cent. In terms of area, 1.9 million hectares of forests and wetlands were lost and about 80 per cent of this was converted to cropland. This implies that most of the forests and wetlands lost are converted into agricultural land as cropland.

Figure 7.1: Variation in crop land for the period 1990-2015



Source: Author's computation from NFA data, 2015

Figure 7.2: Land use dynamics in Uganda

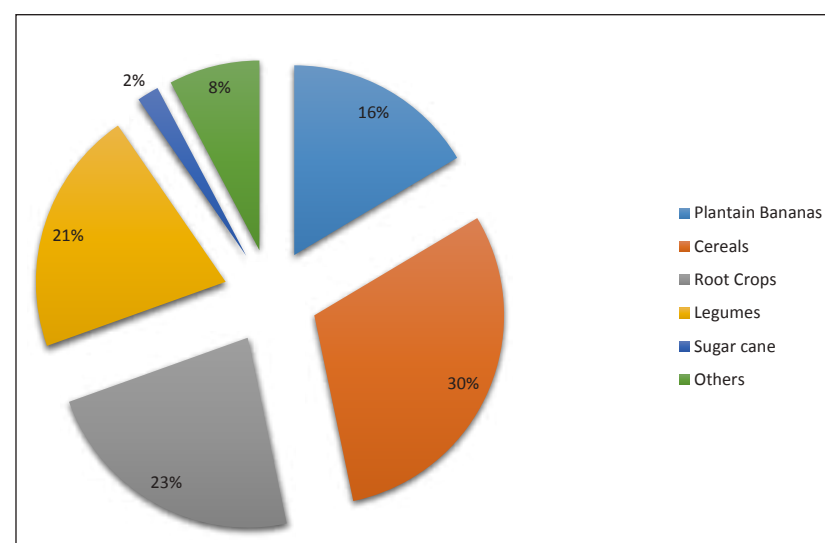


Source: Author's computation from NFA data, 2015

Area under crop production

Most of the land that is converted for agriculture is used to grow food crops such as cereals (Millet, Maize, Sorghum, Rice, Wheat), root crops (Cassava, Irish and Sweet potatoes), plantain bananas and sugar cane among others. Figure 7.3 shows the distribution of crop land under different crops. About 52 per cent of the area under crop land is growing cereals and root crops; with sugarcane growing covering about 2 per cent or 110,000 ha of cropland in the Busoga region. These crops are a major driver of land use change in the country. Cereals, particularly maize growing in mid-western, eastern and central Uganda has been the major cause of deforestation in Uganda, alongside charcoal burning. In southwestern Uganda, root crops (mainly Sweet potatoes and Irish potatoes) are the major drivers behind the reclamation of wetlands. Land use change and increasing poverty in eastern Uganda has also played an important role in degrading the environment and ecosystems.

Figure 7.3: Distribution of cropland by type of crops



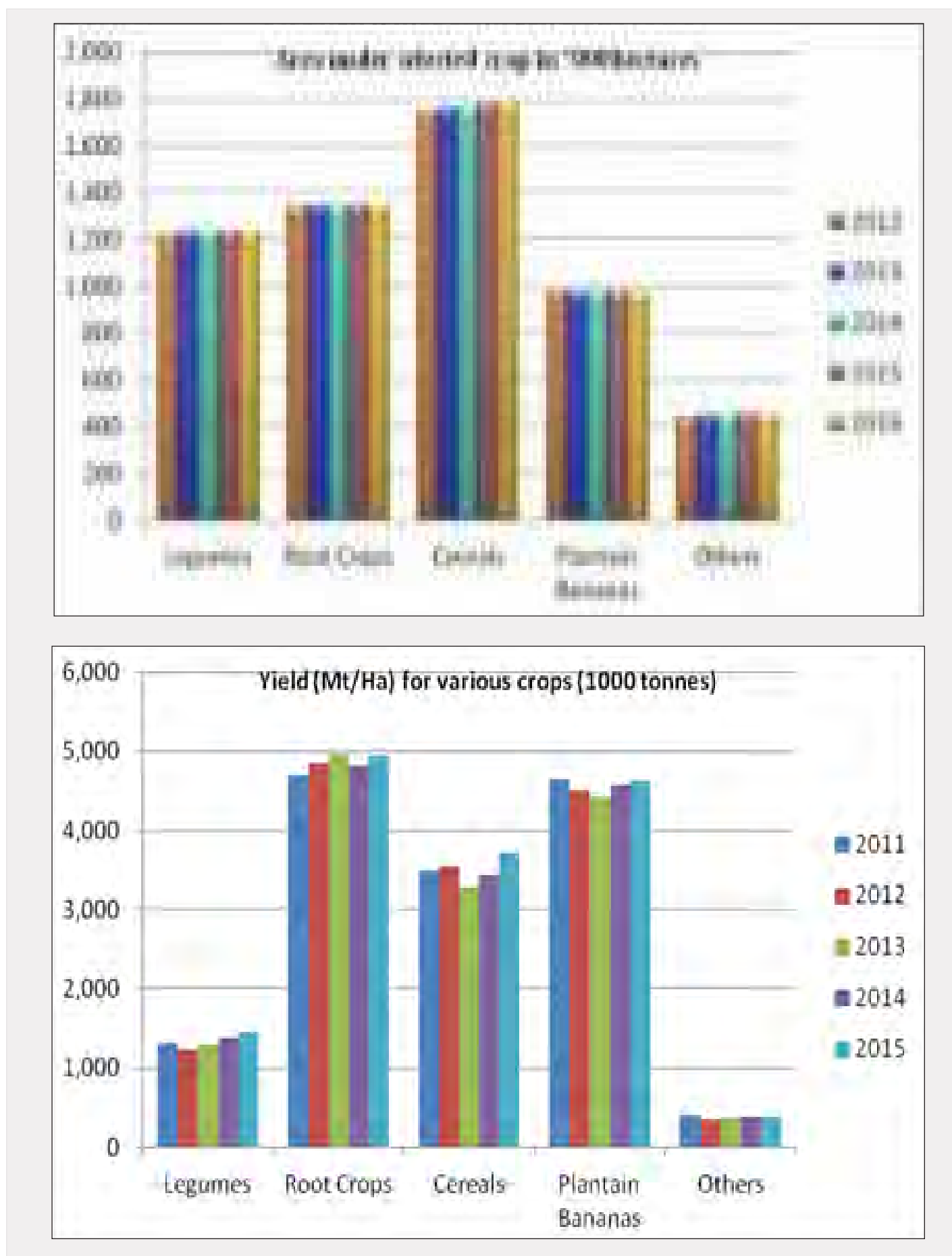
Source: Author's computation from NFA data, 2015

Productivity

The area under crop land is increasing at an average of about 108,160.2 ha per year. Despite this, the productivity or yield per hectare seems to be stagnating or evening declining for select main crops. The decline in productivity might be attributed to the suitability of the crops for

the available land in the different regions. In an attempt to maintain livelihoods and income, area under crop is expanded to maintain the same level of crop yields. In addition, farmers at times attempt to increase yields by increased application of fertilizers which also further leads to soil degradation. Figure 7.4 shows the status and trend in yield and productivity of main crops grown in Uganda.

Figure 7.4: Soil productivity and yield 2011-2015



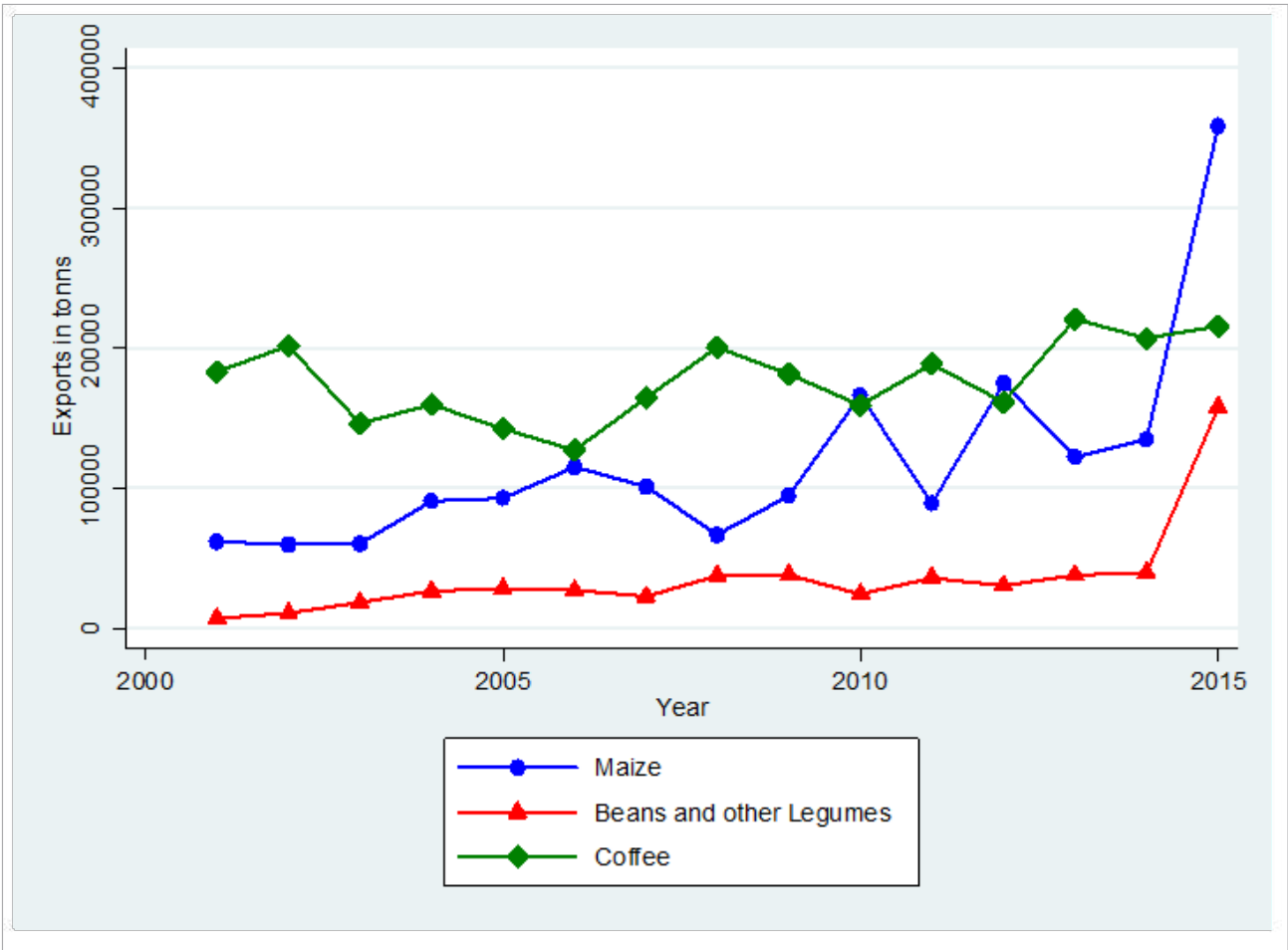
Source: Author's computation from NFA data, 2015

Demand for agricultural crops

There is increasing demand for some crops on the international market leading to an increase in exports over the 2001-2015 period. This partly explains the increasing area under cropland in an effort to satisfy the

increasing domestic and international demand for the crops. There is thus need to improve farming systems to ensure increasing yields without encroaching onto existing forests and wetlands.

Figure 7.5: Trend in export of some agricultural crops



Source: Author’s computation from NFA data, 2015

Uncontrolled cultivation in Kisoro that has affected natural land cover and water systems
Photo credit: Elizabeth Mutayanjulwa (NEMA, 2017)



Grazing cattle at the Semliki river bank
Photo credit: Julius Muyizzi (NEMA 2017)

CHAPTER 8: Livestock

INTRODUCTION

Uganda's livestock sector contributes 4.3 per cent to agricultural gross domestic product (GDP) which is estimated at 23 per cent of the national GDP (UBOS, 2015). The sector, boosted by high demand for animal protein-based products is growing fast at 3 per cent per year. This demand is likely to double in the next 20 years because of urbanization and economic growth (Mugerwa, et al., 2013a) (CIWF, 2009). In addition, it is likely to be accompanied with increased emission of greenhouse gasses, land degradation and possibly, erosion of indigenous livestock genetic resources. Therefore, adequate planning for the sector in light of expected pressures and impacts is necessary to mitigate negative impacts and enhance the socio-economic development of the country (Mugerwa, Zziwa, Kabirizi, & Ndikumana, 2013b) (MAAIF, 2016).

STATUS AND TRENDS

Livestock farming

Total land area in Uganda is 200,523.2 Km² and livestock farming is carried out on commercial fenced farm land (684.5 Km²) and open grass rangelands (53,153.3 Km²). The major farming systems include dairy, beef, poultry, swine, sheep and goat farming. Meat and milk production are the main livestock farming activities but also include animal traction, manure production, and the management and conservation of fodder, forage and pasture. Growth of livestock farming sector in 2014/2015

was at 2.9 per cent. This reduced to 2.8 per cent in 2015/16 (UBOS, 2016). The most commonly kept livestock animals include cattle, goats and poultry. The stock of goats and cattle has been growing rising from 6,620 and 6,144 in 2001 to 14,453 and 15,788 respectively in 2016.

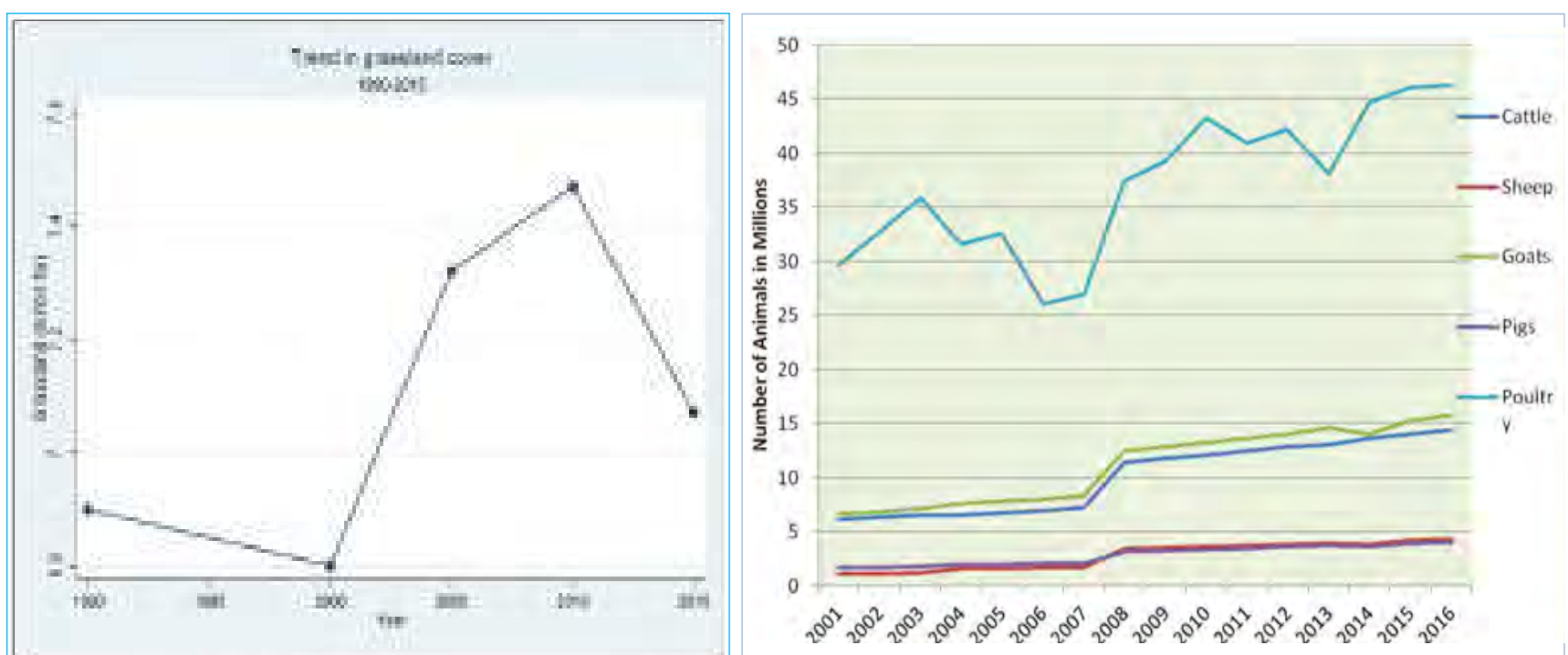
The area under grassland has been increasing - about 14 per cent of land lost from the degradation of forest and wetlands is converted to grassland for livestock. However, in 2015, there was a steep drop in the area under grassland. Livestock numbers are going up and this might result in overgrazing leading to degradation of the grassland resources. Farmers therefore need to adopt better methods of livestock farming since the space for free range grazing might not be enough.

Demand for livestock and their products

Over 1.6 million households derive food, nutrition and livelihood benefits from cattle (MAAIF 2010) (UBOS, 2015). The economic contribution of cattle (as beef) amounts to 70 per cent of livestock sector GDP (179,000 metric tons), (MAAIF 2010, 2012) (UBOS, 2015). In 2014, the national cattle herd stood at 14,453 million with 95 per cent of the breeds indigenous. The population of other livestock included: goats (15,788 m), sheep (4,327 m) and pigs (4,037 m). The number of chicken was 46,291 million.

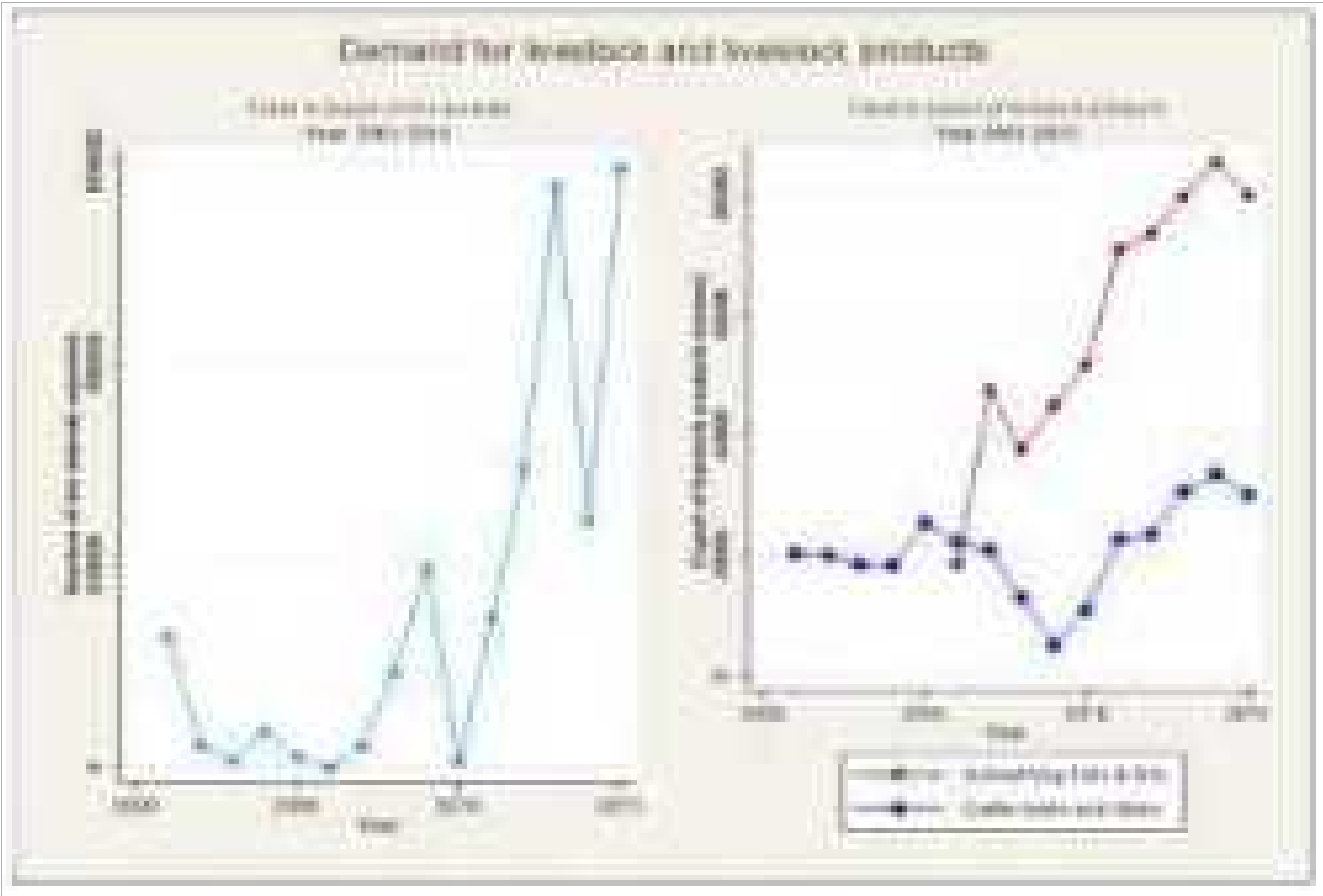
Uganda exported 245,000 live animals in 2014, doubling this number to 594,000 in 2015 (figure 8.2). Foreign exchange earnings from exports of only live animals increased from US \$2,006,000 to 2,020,000 between 2014 and 2015 (UBOS, 2015). This is expected to keep increasing with the continual improvement of farming practices and breeding programmes.

Figure 8.1: Trend in grassland and livestock for the period 1990-2015



Source: Author's computation from UBOS data, 2016

Figure 8.2: Export of livestock and livestock products

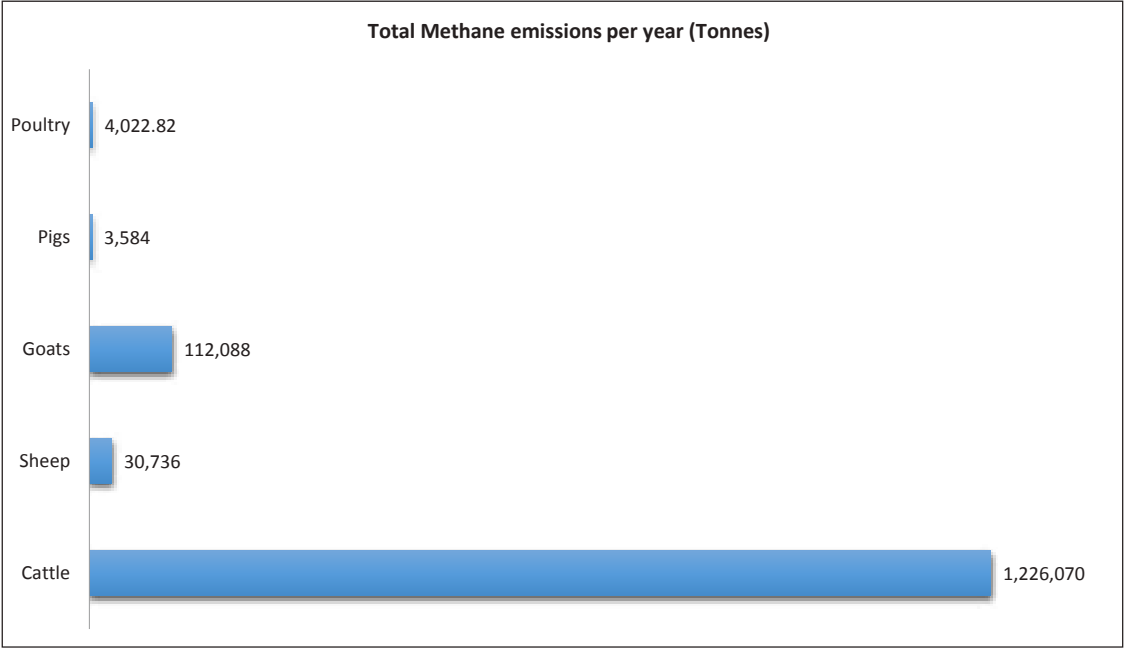


Source: Author’s computation from UBOS data, 2015

Apiculture

Apiculture is another growing subsector with about 1.5 million households in Bushenyi, Bugisu, Nakasongola and West Nile depending on bee keeping for their livelihoods (MAAIF, 2016). The country has the production potential of 500,000 metric tons of honey but currently on 5,000 metric tons are produced. Demand on the international market is also growing.

Figure 8.3: Estimated methane emissions from livestock to the environment



Source: Author’s computation from UBOS data, 2015

PRESSURES AND IMPACT

Impact of livestock farming on the environment

The emissions of livestock-related greenhouse gases (GHGs) are an emerging threat to the environment. Agriculture is well documented as the dominant source of both methane and nitrous oxide emissions (Krapivin, Savinykh, & Varotsos, 2004). The emissions of these gases

are thought to lead to climate change outcomes like reduction of annual rainfall and greater variability in weather patterns (Tubiello, et al., 2013) that are likely to threaten agricultural production through the increased frequency of extreme weather events such as droughts, heat waves and floods, disease outbreaks among others (DIICCSRTE, 2013) (Patra, 2012).

GHG emissions are increasing in tandem with the increasing number of livestock. By 2014 Uganda was emitting 34,222,350 tons of CO₂ equivalent. This is expected to continue as animal numbers increase (USAID, 2014)(CIWF, 2009) (MAAIF, 2016). Of all farmed animals, ruminants emit most methane compared to

non-ruminant animals, with cattle emitting more than a million tons of methane (Figure 8.3). In Uganda, the main sources of methane are cattle, goats, sheep (ruminants) and others (non-ruminants) are pigs and poultry (UBOS, 2015).

Emissions from Agriculture, Forestry and Land Use (AFOLU) Sector

In this sector, Carbon dioxide (CO₂) was the most emitted gas with a significant variance between the levels emitted of Carbon dioxide and Nitrous oxide (N₂O) and Methane (CH₄) that remained relatively low in the period between 2010 and 2015.

Overgrazing and grassland deterioration

Figure 8.4: Emission trends for AFOLU SECTOR between 2010 and 2015



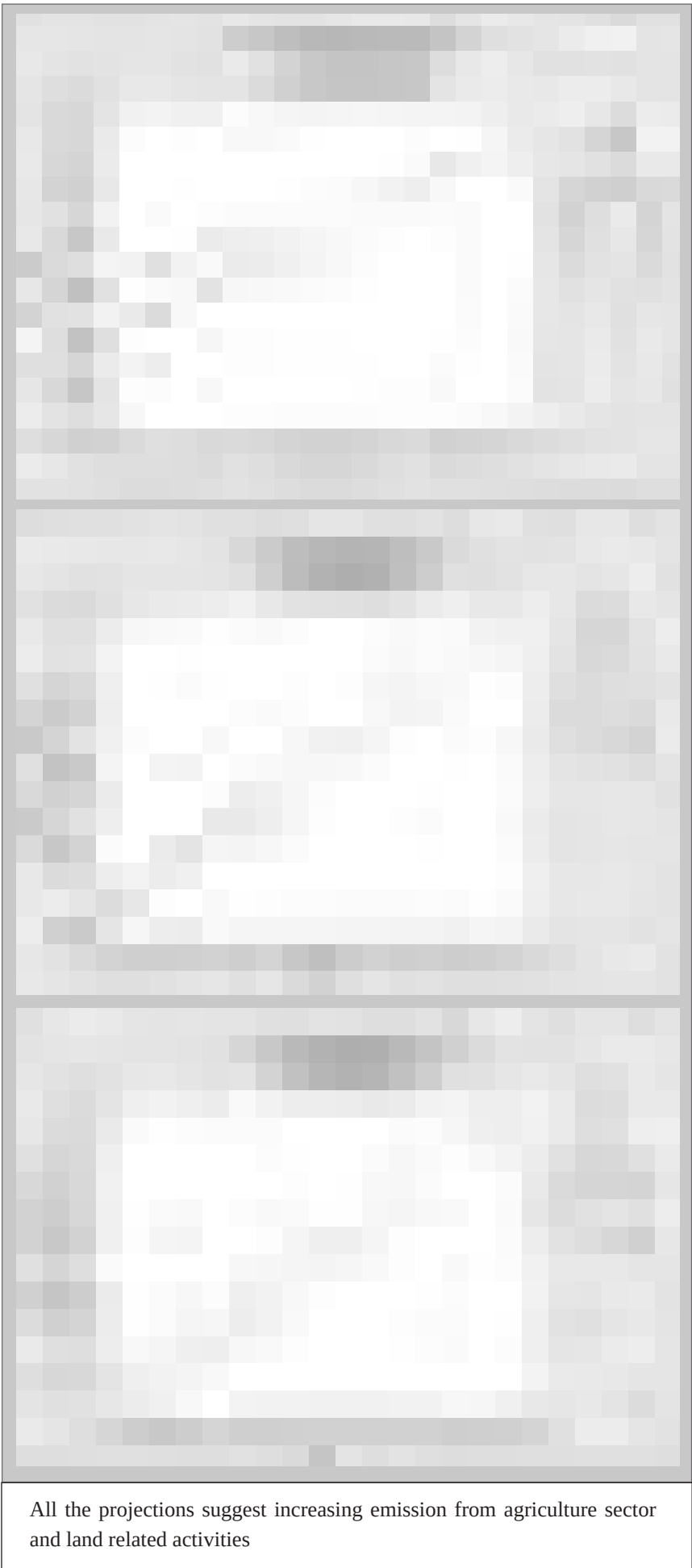
Source: Uganda National Greenhouse Gas Inventory Management System, 2016

Grasslands are a vital resource for food and nutrition security in Uganda. They occupy the so-called “cattle corridor”, an area extending from the north east (Karamoja region), through the central (Luwero and Nakasongola Districts) to the south western parts of the country (Dong, Kassam, Tourrand, & Boone, 2016) (Mugerwa & Emmanuel, 2014). However, the productivity and sustainability of grassland ecology is endangered by anthropogenic-led degradation of the ecosystem. The hot spot area for Uganda between 2014 and 2016 is Nakasongola and Karamoja region. Land in these areas has been overgrazed, with scanty vegetation and shortage of pasture which compels nomadic movements during the extended dry season of September-April, leading to competition for scarce resources and resultant social conflicts (USAID, 2014).

The increasing number of animals requires ever expanding grazing land. The area of Uganda under grasslands has increased, primarily due to degradation of other ecosystems. For instance, between 2000 and 2015, grasslands increased from 6.8 million to 7.07 million ha respectively . This increase came about as a result of a reduction in forest cover from 3.79 million to 1.96 million ha; and from 4.52 million to 4.44 million ha for wetlands over the same time period.

Farmers need to utilize the sufficient grass and fodder for the herd during the rainy season and hay during the dry seasons. Pessimistic forecasts indicate that the cultivable/fodder land will run out in most parts of the

Figure 8.5: Emission projection from Agricultural sector



Source: Uganda National Greenhouse Gas Inventory Management System, 2016

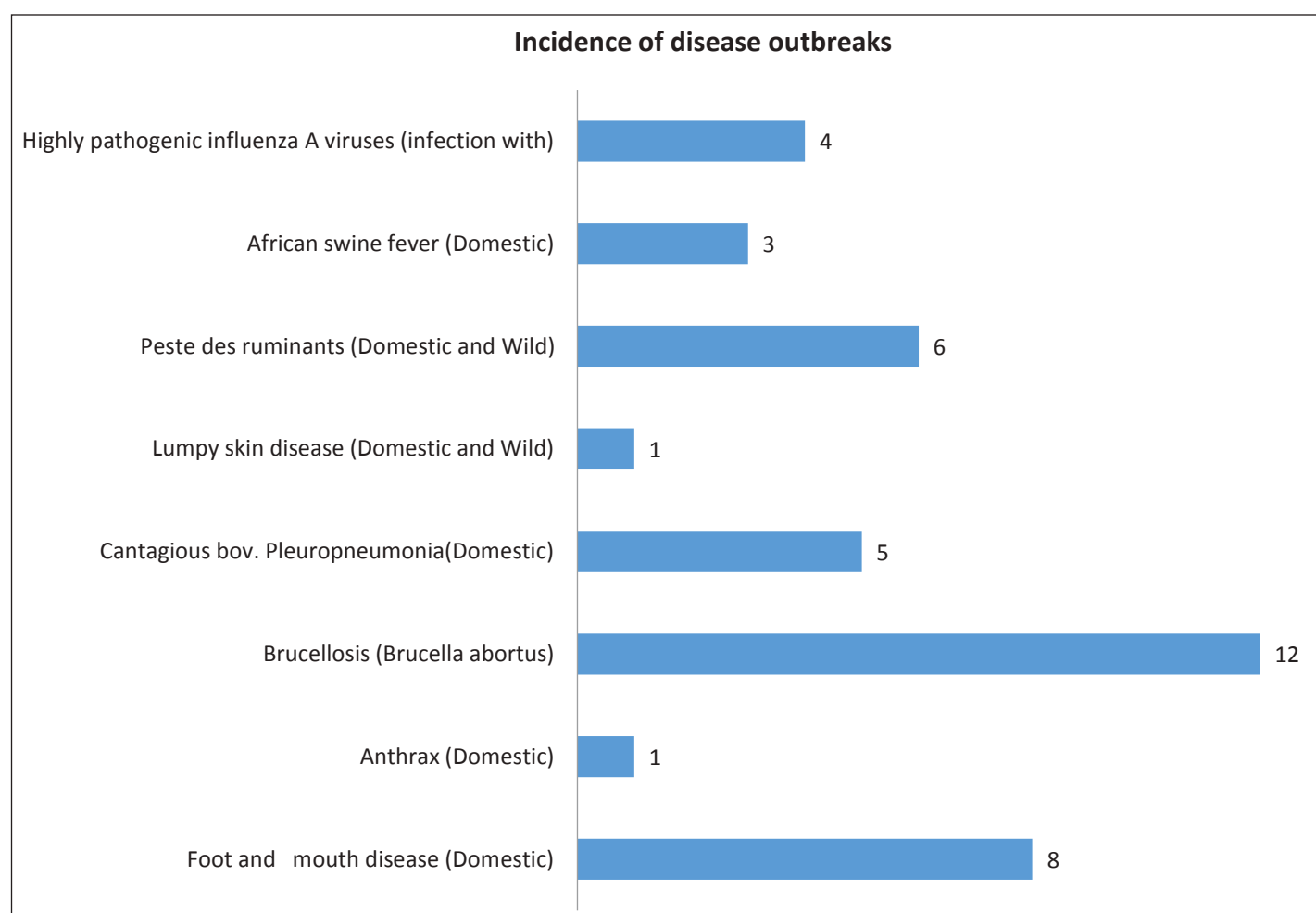
country by around 2022. Against that background, it is necessary that sustainable land management approaches be embraced to address this issue.

Animal diseases and zoonoses

Most diseases reported in animals between 2014-2016 are transboundary and zoonoses (MAAIF, 2016) Lolli et al, 2016 . The priority transboundary animal diseases are Foot and Mouth Disease, African swine fever, Brucellosis, Contagious Bovine Pleuropneumonia, New Castle Disease, Lumpy Skin Disease, Peste Petit Ruminants, Sheep and Goat Pox, Tick

Borne Diseases (such as East Coast Fever, Anaplasmosis, and Babesiosis), Trypanosomosis, Tuberculosis, Anthrax and Rabies. The incidence of disease outbreaks among the animals and number of animals affected in the year 2016 is shown in figure 8.6. In 2016, Uganda had 12 outbreaks of Brucellosis in the different parts of the country while the Highly pathogenic influenza virus infection had the most impact affected 2000 animals in several districts.

Figure 8.6: Incidence of animal disease outbreaks and number of animals affected in 2016



Source: Author's computation from MAAIF data, 2016

Pesticide misuse and environmental contamination

Insecticides, fungicides and herbicides are becoming increasingly more predominant in Uganda, even in remote locations. As pesticides continue to be released into the environment, it may have several short term or long term adverse ecological effects.

Recommendations

High level resource-demanding farming systems which have led to deforestation, degradation of wetlands with impacts on the water supply problem by undermining the water filtering and storage function of wetlands. In addition, soil degradation and high levels of GHGs are likely to have negative impacts on food security and the sustainability of agricultural production systems. Uganda needs innovative systems that enhance conservation of the natural resource base, whilst increasing productivity. Approaches such as conservation agriculture, agro-ecology and climate-smart agriculture and others that incorporate indigenous knowledge should be adopted. Innovations in water harvesting

infrastructures and provision of extension services to farmers planting sustainable forages should also be encouraged to reduce on uncontrolled animal movements in search of pasture and water. Develop and disseminate information on the grazing systems in different agro-ecological set ups. So far, information and advice regarding optimum stocking rates has been provided to farmers in various zones to reduce on overgrazing and minimize degradation. Furthermore, investing in high yielding livestock breeds will enhance financial returns.

Tracking methane emissions from ruminant livestock is an area that Uganda needs to invest in. Currently there is limited technical capacity and a lack of analytical tools for measurement in the country. In addition, there is need to invest into methodologies for capturing waste methane and using it for pasture improvement or for energy generation. The government should adopt cost effective techniques, enhance technical capacity, collect data on periodic climate emissions, adopt tools for climate monitoring and in the long run have in place better strategies for mitigating climate change and its footprint.

Promotion and transformation of degraded pastureland by planting high quality grass and legumes especially in drought prone cattle corridor by improvement of ground cover, increasing nutrient availability through supply and recycling and; establishment of plant species and varieties with high palatability and quality.

Develop feed management strategies to mitigate methane emissions from cattle through enhancing animal production and reducing the amount of methane produced per unit of milk and meat with government and donors support is necessary to mitigate climate change and related footprints from the livestock sector.

The government remains in full charge of ensuring that pests and diseases are controlled at field level. Wherever vectors and disease prevalence exceed the ability of the farmers and local leaders, the central government should declare an epidemic and assume responsibility for countering it. A strategic disease control and vaccination programme to control the spread of contagious cattle diseases such as foot and mouth disease, contagious bovine pleuropneumonia, rabies and East Coast fever should be implemented before the dry season onset. To fully support this government should ensure the delivery of veterinary drugs and vaccines. Although the sector has been liberalized, government has the responsibility for on-time supply with the local governments accountable for doing actual vaccination.

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Isimba Hydro power plant during construction (NEMA file photo, 2015)

CHAPTER 9: Energy, Oil and Gas

ENERGY RESOURCES

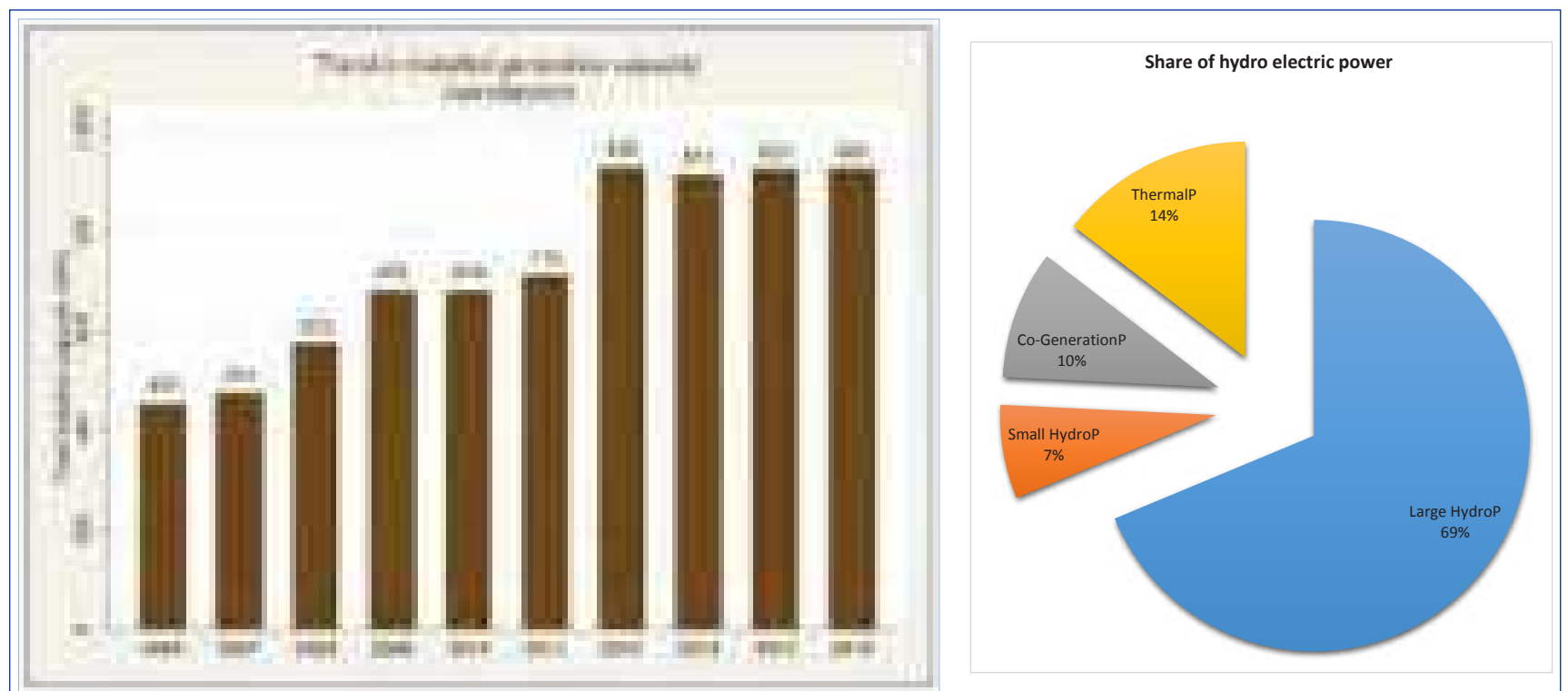
This chapter discusses the installed capacity of hydropower sources for industrial and household use. Furthermore, consumption of hydropower and other energy like petrol, diesel, Kerosene and LPG are also discussed.

STATUS AND TRENDS

Electrical power

The installed capacity by end of 2015 totaled to 924.9 MW out of which 759.4 MW were licensed across all energy sources. Large hydro accounted for 69% of installed capacity while thermal, co-generation and small hydro accounted for 15%, 9% and 7%, respectively. Over the past ten years, the country has registered a steady increase in the installed capacity as shown in Figure 9.1.

Figure 9.1: Installed hydro power generation capacity and sources



Source: Author's computation from UBOS data, 2016

The increase installed capacity for hydro power is attributed to Government policy to increase electricity generation capacity and transmission network and to increase access to modern energy services through rural electrification in order to steer economic growth and industrialization.

Demand for electricity for lighting energy

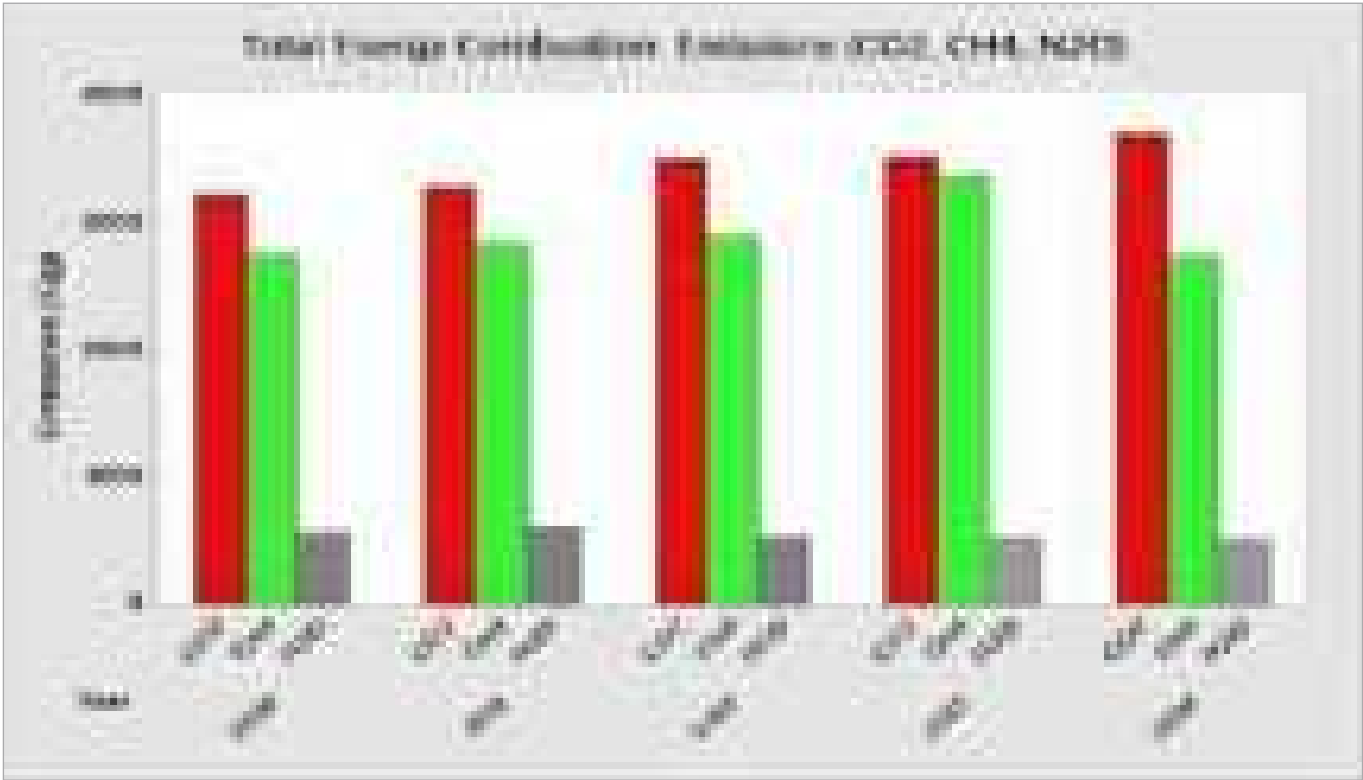
According to UBOS, 2016, about 57% of the household in the urban areas have access to electricity for lighting. This implies that 43% of the household about 0.774 million household with unmet demand for electricity for lighting. Furthermore, in the rural areas, 89% have no access to electricity for lighting energy translating into about 4.6 million households with increased demand for electricity. This implies that about

23.1 million Ugandans still need electricity for lighting which increases the pressure on government to construct more hydropower dams. However, the construction of new hydropower dams increases the demand for water for power generation and other industrial and domestic use.

Impact of the energy sector on the environment

Generation of electricity, transmission and distribution of power to both household and industrial use significantly affect the environment in terms of emission of Green House Gases. For example Carbon Dioxide (CO₂) contributed 49.9%, Methane (CH₄) contributed 42.2% while Nitrous Oxide (N₂O) contributed 7.8% of emissions in this sector.

Figure 9.2: Total Energy Combustion Emissions Carbon Dioxide (CO₂), Nitrous Oxide (N₂O) and Methane (CH₄)

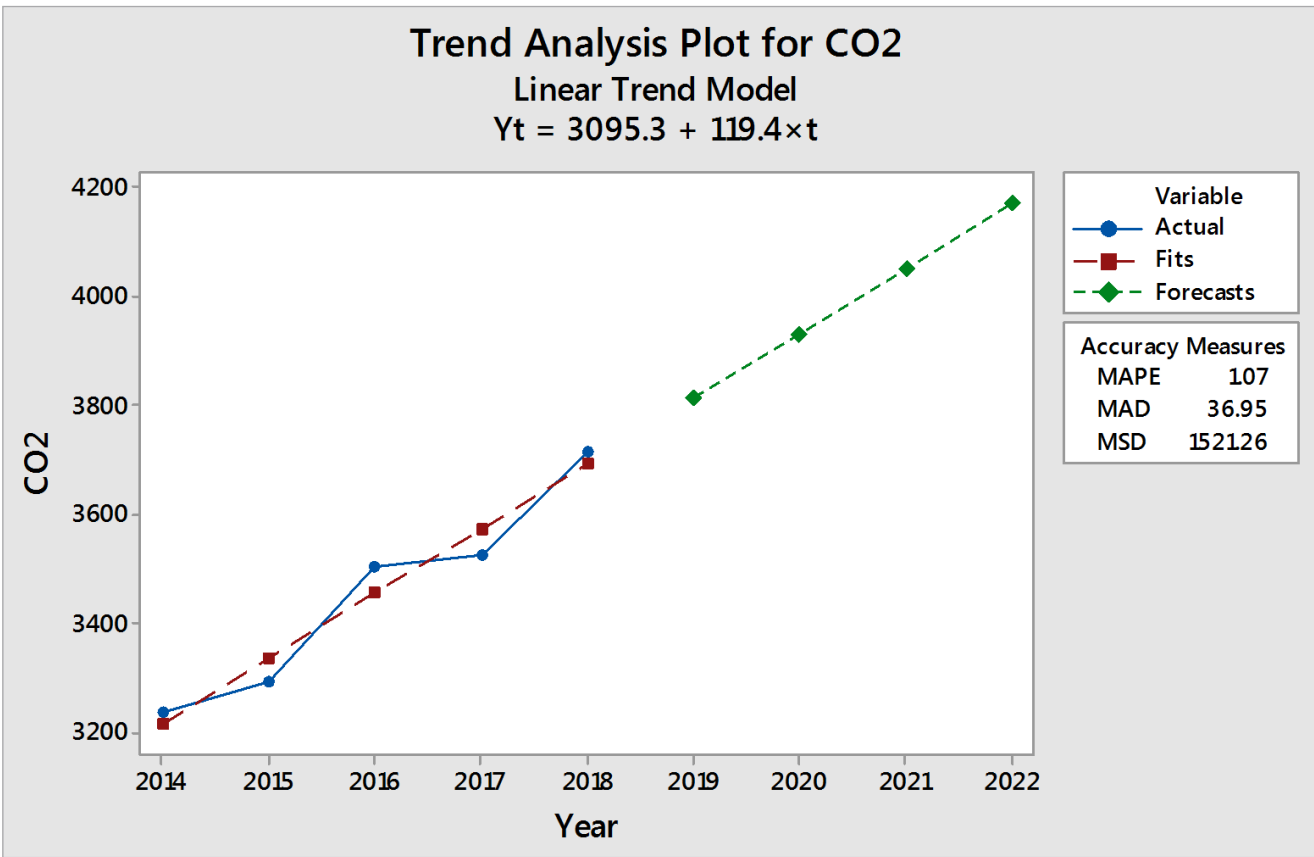


Source: Uganda National Greenhouse Gas Inventory Management System, 2016

The energy sector showed a generally steady rise in levels of Carbon Dioxide (CO₂) emissions. Emissions of Methane gas steadily rose only showing a small decline in 2013. This decline in methane emissions

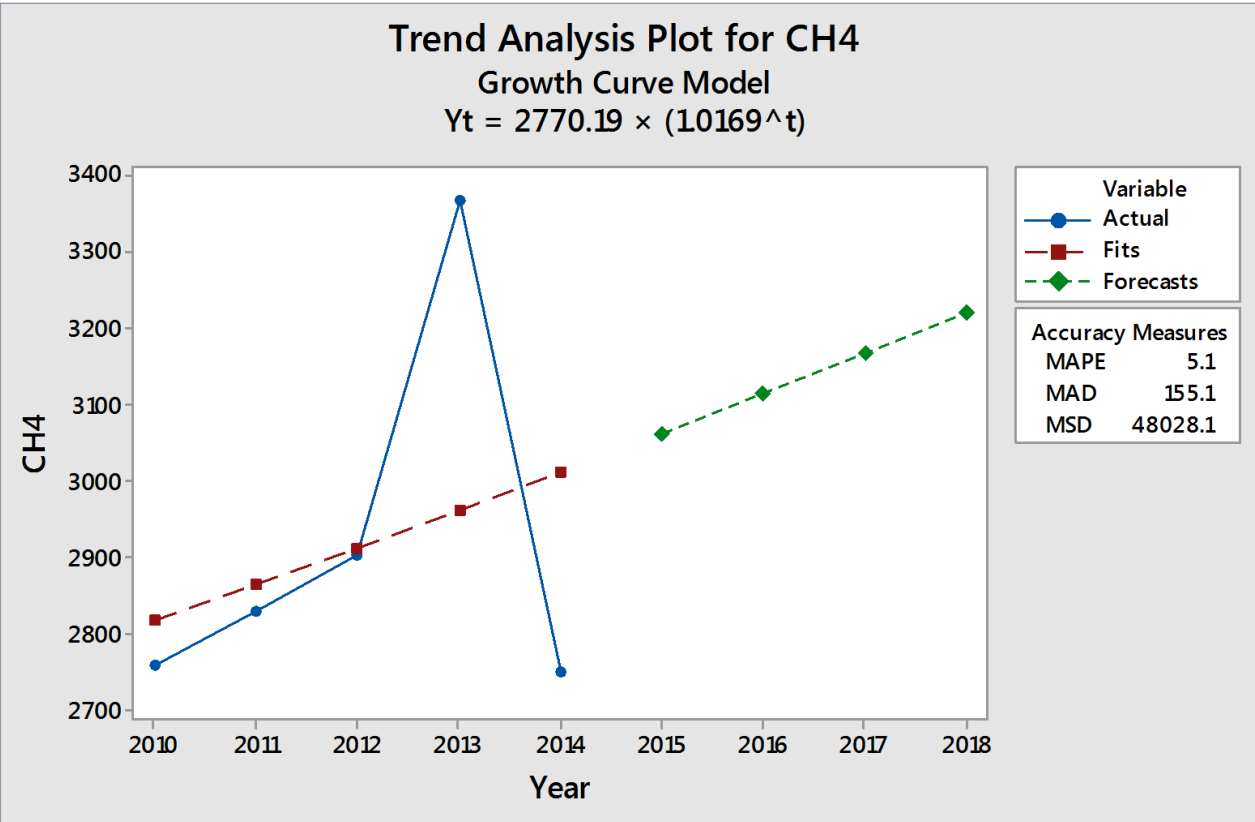
from 2013 onwards is attributable to improvements in municipal waste management and promotion of renewable energy and energy efficiency.

Figure 9.3: Trend analysis of carbon dioxide gas



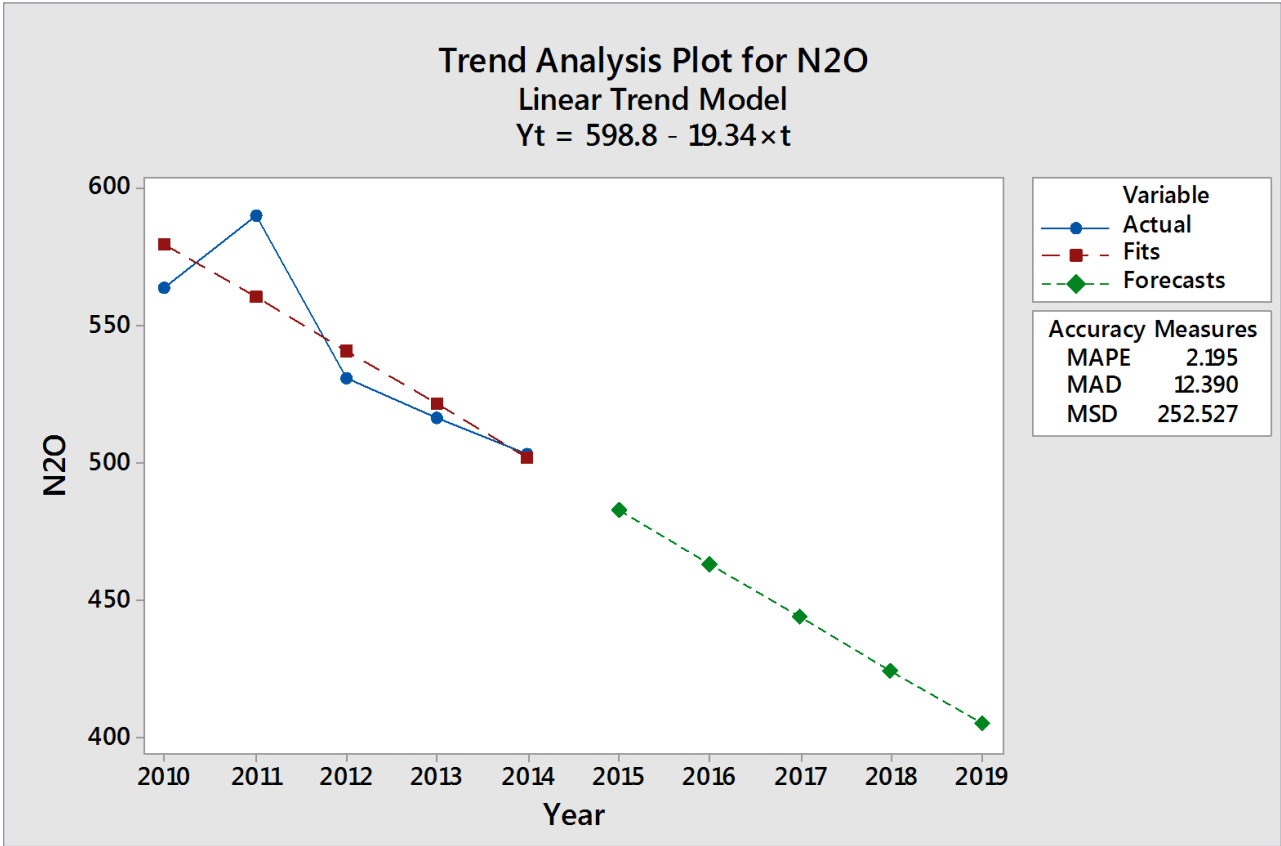
Source: Uganda National Greenhouse Gas Inventory Management System, 2016

Figure 9.4: Trend analysis of Methane gas



Source: Uganda National Greenhouse Gas Inventory Management System, 2016

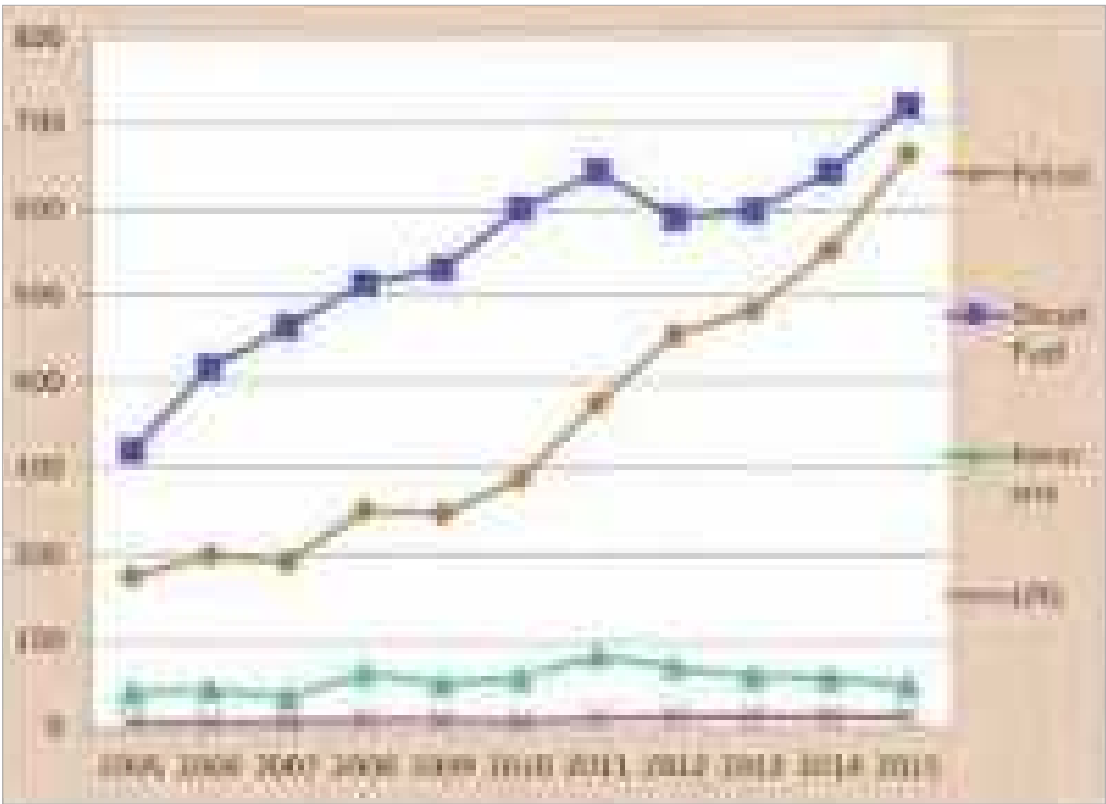
Figure 9.5: Trend analysis of Nitrous Oxide gas



Source: Uganda National Greenhouse Gas Inventory Management System, 2016

Other energy sources

Figure 9.6: Consumption of fuel energy 2005-2015 showing the status and trend in the consumption of petrol, diesel, kerosene and LPG among the Ugandan population

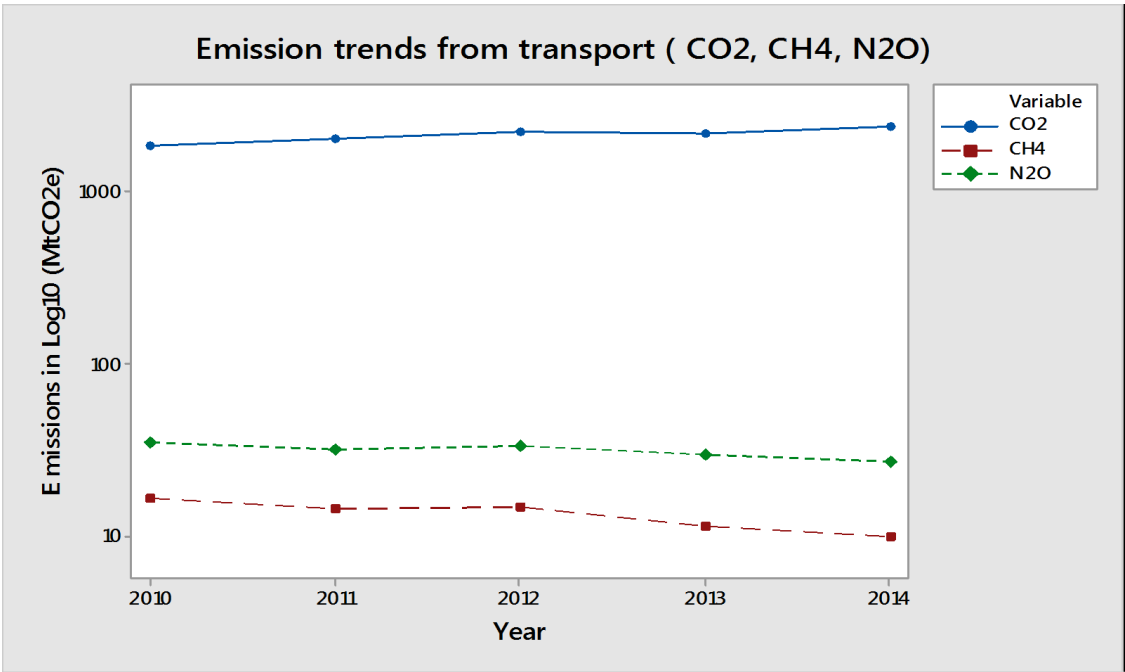


Source: Author’s computation from NEA data, 2015

The consumption of both diesel and petrol has been increasing since 2005 at average rate of 9% and 15% respectively. This is directly related to the rates of importation of cars that use the two petroleum products. Kerosene and Liquefied Petroleum Gas (LPG) have on the other stagnated to an average of 55,000. Generally the generation and consumption of hydropower electricity are on the increase. Similarly, the importation and consumption of fuel products like diesels, gas, and petrol are also on the increase Figure 9.6. The increased importation of petrol and diesel fuel might be an indicator of increased air pollution from combustion of the fuels by the vehicles.

Emissions from the Transport Sector

Figure 9.7: Emission Trends from the Transport Sector (Carbon Dioxide (CO₂), Nitrous Oxide (N₂O) and Methane (CH₄))



Source: Uganda National Greenhouse Gas Inventory Management System, 2016

The graph shows a steady rise in annual Carbon Dioxide (CO₂) emissions between 2010 and 2014. Nitrous Oxide (N₂O) and Methane (CH₄) emissions remained stable between 2010 and 2012 with a slight decline in the emissions of both gases between 2012 and 2014.

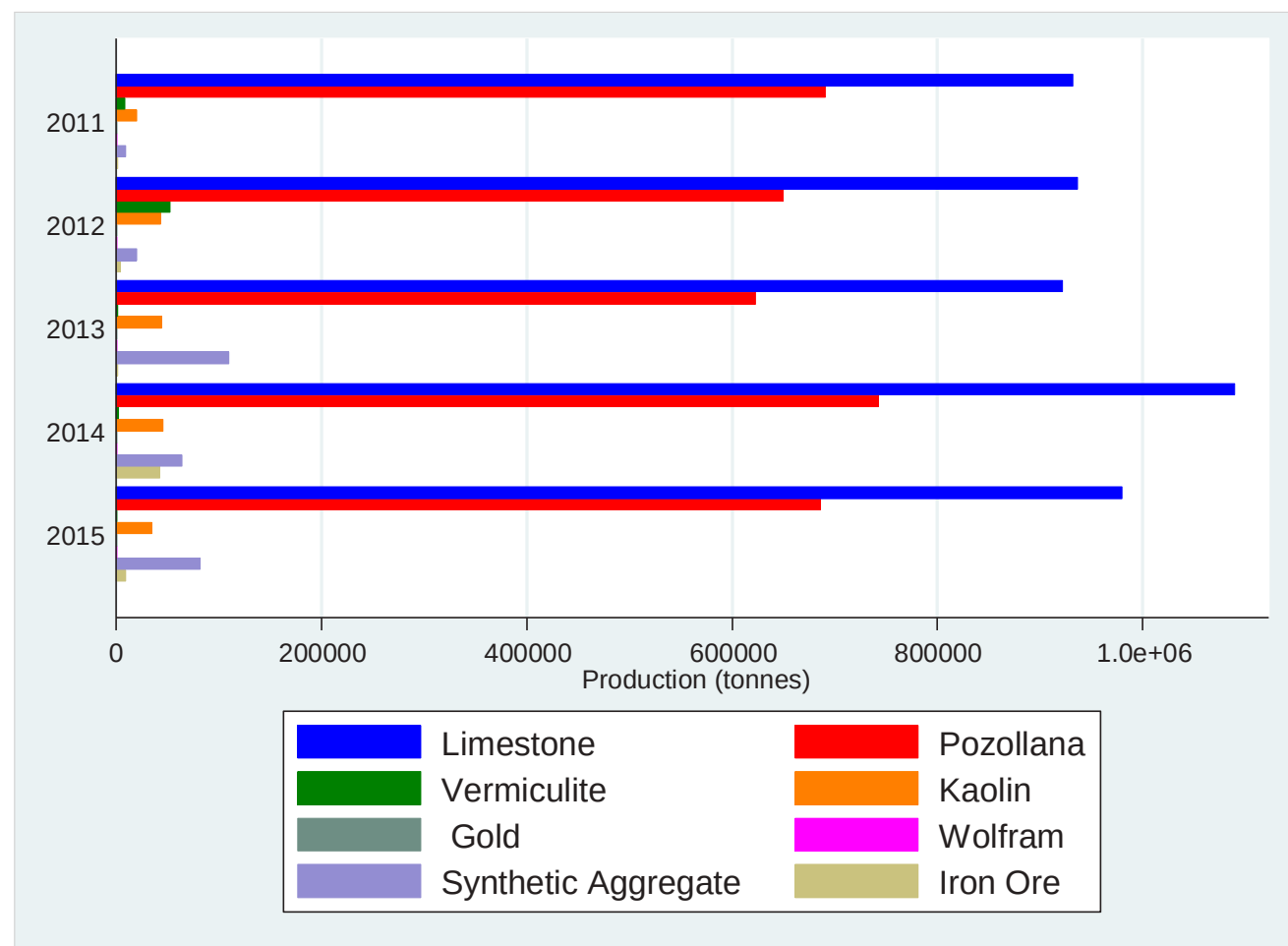
CHAPTER 10: Mineral and Extractives

INTRODUCTION

There is an abundance of minerals in Uganda, though not all are being exploited. Currently, the minerals being commercially mined include gold, iron ore, limestone, vermiculite, wolfram, kaolin and sand amongst others. The most highly extracted mineral is limestone which is used in

the production of cement. Between 2014 and 2015, quantities mined fell from 1,090,240 to 979,660 MT respectively (MEMD, 2014). This followed by Pozollana which stood at 686,564 in 2015 having fallen from 742,423 the previous year. Generally mineral extraction fell between 2014 and 2015 (mainly due to a fall in international prices) except for synthetic aggregate which increased from 64,603 to 82,715 (MEMD,2014). Figure 10.1 shows production status of selected minerals from 2011 to 2015.

Figure 10.1: Production of some selected minerals 2011-2015



Source: MEMD, 2014

STATUS AND TRENDS

Demand for mineral and mineral products

There is increasing demand for both export and domestic use of cement, iron and steel, sand dimension stones and limestone. This increased demand will lead to increased mining activities for the raw materials used in the manufacturing of the products. The increased mining activities

have high effect on the environment if not well handled. For example, borrow pits that are not restored while mining sand have resulted into loss of life, increased malaria out breaks, loss of ecosystems and others. Limestone is growing in importance as the construction industry is increasingly growing. This has been especially so over the last five years as there have been some major projects including: power dams, roads, residential and non-residential buildings.

Figure 10.2: Trend in mineral imports and exports 2001-2015



Source: MEMD, 2014



Plate 1: Gold mining in Buhweju District encroaching on a forest.



Plate 2: Open pits and undulated landscape are common consequences of gold mining like here in Alurong Sub County, Moroto District.



Plate 3: Gold washing in informal pits and using mercury are a threat to life and the environment.



Plate 4: Gold mining activities are diverse, including manual crushing, buying and selling.



Children get involved in gold mining activities in Mubende, even during school time
Photo credit: Elizabeth Mutayanjulwa (NEMA 2016)



2013

Gold Mining in Mubende in 2013

PRESSURES AND IMPACTS

Gold mining and use of mercury

Gold occurs in small quantities in various parts of the country including the districts of Mayuge, Namayingo, Mubende, Bushenyi, Buhweju and parts of region for example Moroto, Amudat, Abim, Nakapirit, Napak and Kadam districts. Much of its extraction is currently not well monitored, unlicensed/ unregulated and uses traditional methods. This has led to landscape changes due to big open pits and the use of mercury in the extraction process (see also Fig. 10.2 and Plates 1-4).

RESPONSES

Most environmental degradation have been due to unlicensed and therefore unregulation illegal small scale miners, especially in gold

mining, MEMD. With the reviewed Minerals and Mining Policy (2017), a new category of licence named “small scale mining lease” has been introduced to encourage small miners to form associations and thereafter formalize their activities. This will not only enable the Government to collect revenue from such miners, but also regulate their activities including environmental conservation. Additionally, the Mining Protection Unit has been created under the Uganda Police which amongst others will work hand in hand with MEMD Mining Inspectors to enforce miners adherence to mining best practices including environmental conservation.

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2017

Gold Mining in Mubende in 2017



A view of a gold mining area in Mubende
Photo credit: Elizabeth Mutayanjulwa (NEMA 2016)



Following the drying up of Akadot wetland in 2014, most of the ecosystem was affected greatly. Photo credit: Bob Nuwagira (NEMA 2014)

CHAPTER 11: Atmospheric Resources

OVERVIEW OF CLIMATE RESOURCES

Overview of Climate Resources

Climate is a natural resource that influences the global geographical distribution of fauna and flora. Climate is not merely a natural resource, but a key determinant of the state of other natural resources such as soils, water resources, forests, agriculture and the wildlife and plants that make up the ecotourism product. Climate influences development in all sectors of the economy, and is thus a key factor for socio-economic development. The climate resources are in the form of the elements of weather namely: temperature (max and min), precipitation (rainfall, snow, hail), wind (speed and direction), sunshine, humidity, cloudiness (type, amount and height), pressure and visibility. Uganda is endowed with diverse and abundant atmospheric resources and they provide life-supporting goods and services.

STATUS AND TRENDS

Rainfall

The climate in Uganda is largely influenced by rainfall which is the most sensitive climate variable. On average, observed annual rainfall totals for Uganda vary from 500 to 2,800 mm, with an average of 1,180 mm. Observed seasonal rainfall totals for Uganda are characterized by a bimodal cycle (two rainy seasons) in the south with higher rainfall during

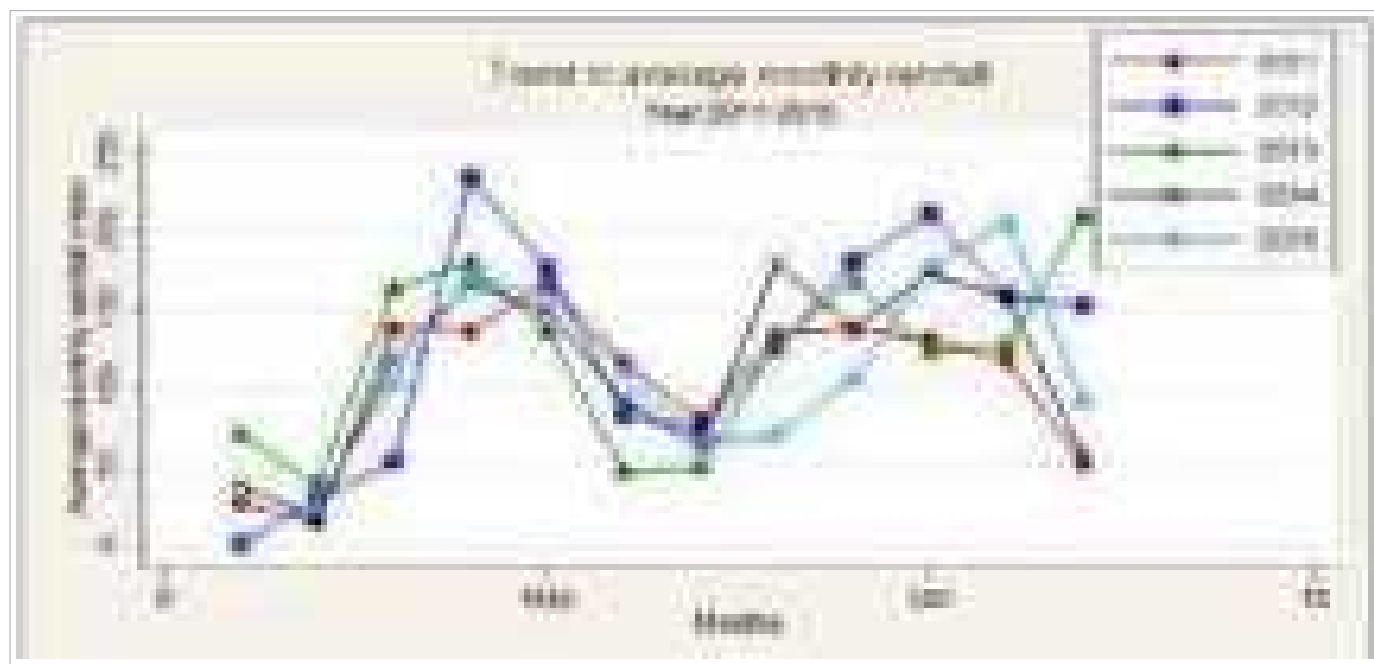
the rainy seasons MAM (March-April-May) and SON (September-October-November). In the north, a unimodal cycle (one rainy season) becomes more obvious with a longer single rainy season that extends across the seasons MAM, JJA (June-July-August) and SON, while the DJF (December-January-February) season is drier. The far north-east of Uganda receives little rain during all months of the year. The seasonality of rainfall is linked to the seasonal migration of primary humid air masses and convergence zones over Africa that shifts towards a northerly location in August and into the south during January.

Between 2011 and 2015, the average maximum rainfall registered in April and October was 177.9mm and 163.6mm respectively while the average minimum rainfall registered in February and January was 25.4mm and 27.9mm respectively (Figure 11.1).

The trend shows that there is a seasonal variation in the monthly rainfall received across the various years. Furthermore, the amount of monthly rainfall received over time is decreasing. For example, Uganda received more rains in 2012 as compared to 2015 (Figure 11.1).

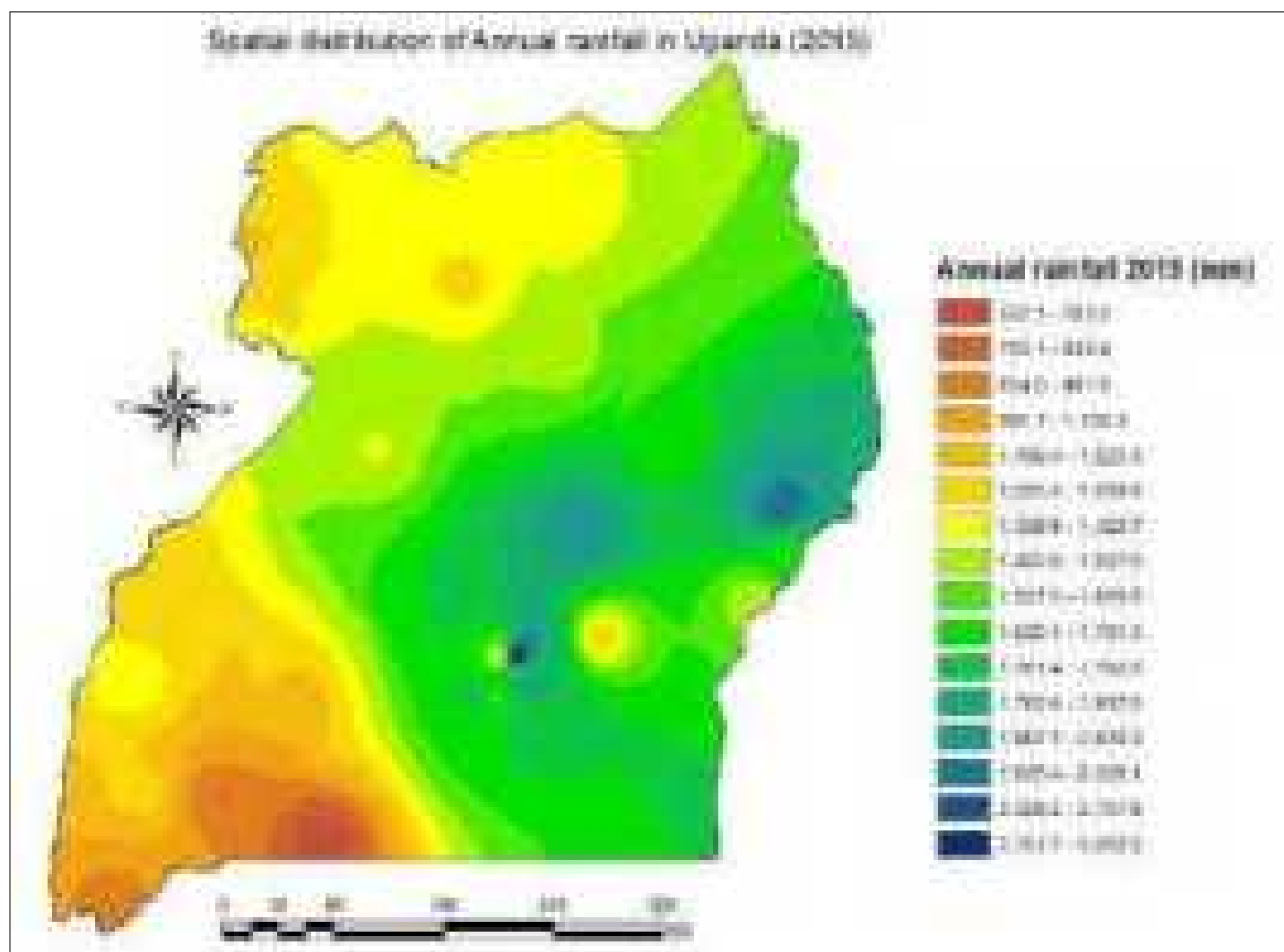
Uganda's rainfall and climatic patterns are influenced by variations in altitude, the Inter-Tropical Convergence Zone (ITCZ) and the air currents such as the South-East and North-East monsoons. In general, most parts of the country experience fairly well marked rainy and dry seasons. Furthermore, in areas adjacent to large water bodies such as Lake Victoria, maritime conditions tend to modify climate while in mountainous and highlands, climate is modified orographically.

Figure 11.1: Variation in monthly amount of rainfall received for the period 2011-2015



Source: Author's computation based on data from UNMA, 2015

Figure 11.2: Spatial distribution of annual rainfall in Uganda, 2015 and 2016



Source UNMA

Temperature

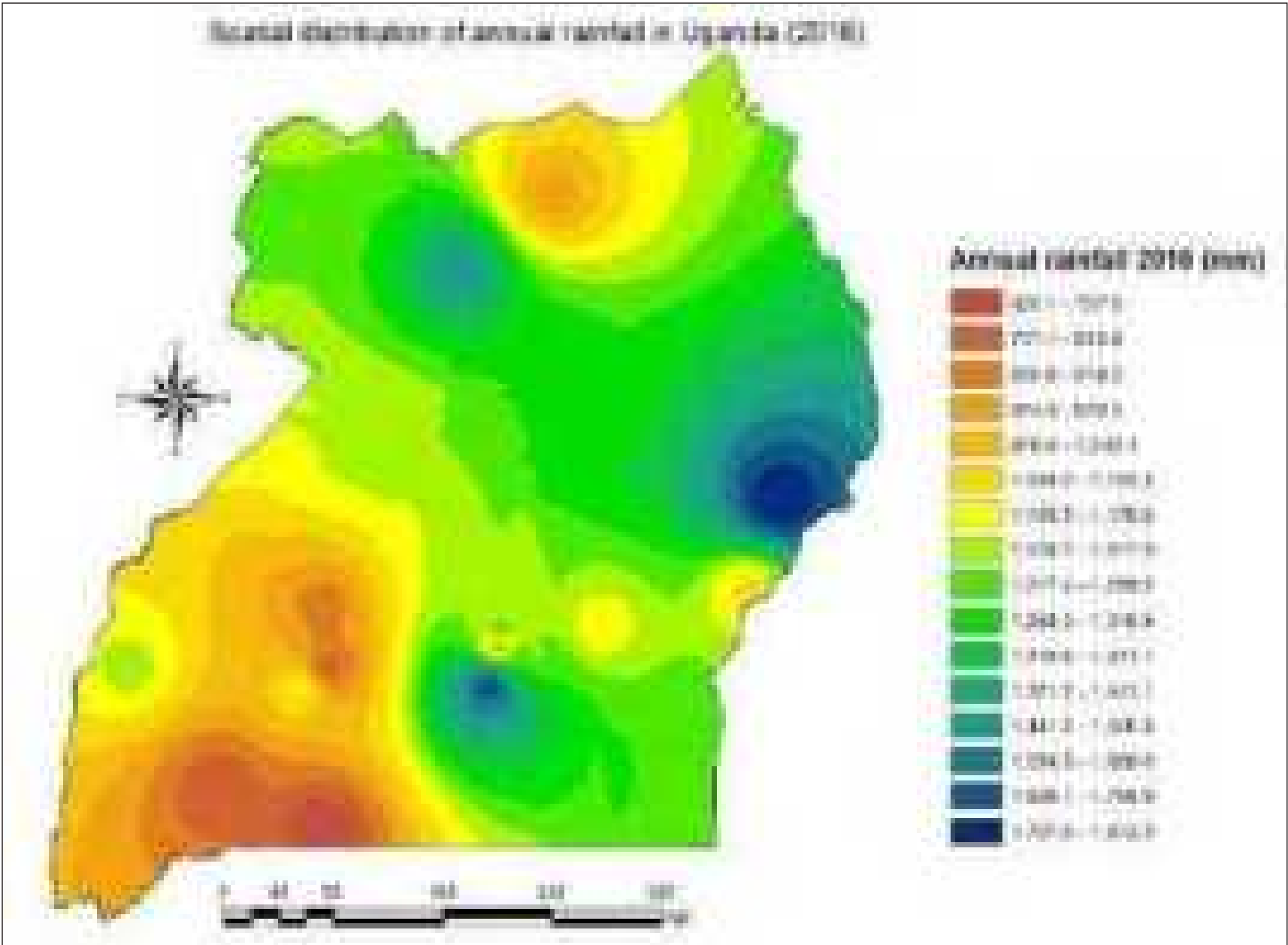
Uganda's location along the equator means that it experiences moderate temperatures throughout the year. Observed averages in annual near-surface temperatures for Uganda are around 21°C. Monthly temperatures range from a minimum of 15°C in July, to a maximum of 30°C in February. The highest temperatures are observed in the north, especially in the north-east, while lower temperatures occur in the south. The JJA season is the coolest, while DJF and MAM are the warmest.

The average maximum monthly temperature has been decreasing over the years. On average, between 2011 and 2015, the maximum temperature between January and July dropped from 30.4 to 27.1°C and thereafter increased between August and December from 27.5 to 28.9°C

respectively. The average monthly maximum temperature over this time period was 28.5°C, the observed lowest maximum temperature was about 26.4°C and the highest maximum temperature was about 31°C .

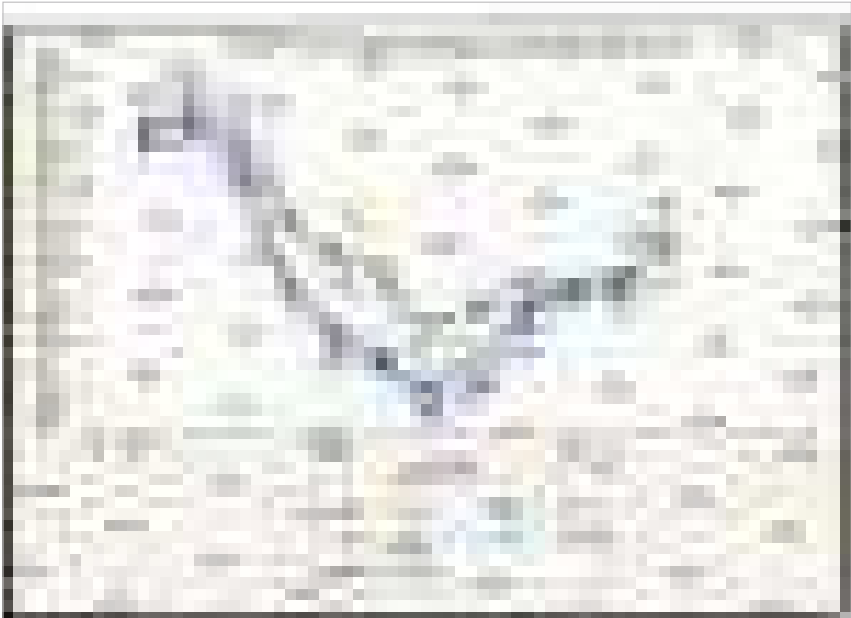
On average the minimum temperature increased between January and April from 17.1°C to 17.8°C and thereafter it declined and remained constant between May and December from 17.6°C to 16.9°C. The average monthly minimum temperature was about 16.9°C in the period 2011-2015, the lowest observed minimum monthly average temperature was 15.2°C while the highest minimum average temperature was about 18.3°C.

Figure 11.3: Spatial distribution of Uganda temperature in 2016



Source UNMA

Figure 11.4: Trend in maximum monthly temperature



Source: Author's computation based on data from UNMA, 2015

Figure 11.5: Trend minimum monthly temperature



Source: Author's computation based on data from UNMA, 2015

Sunshine

Uganda enjoys a fair amount of sunshine throughout the year. The utilization of this environmental good to support generation of electricity is growing progressively, especially in rural communities due to the high cost of hydro power. Solar energy has also been found to be an ideal alternative powering vaccine refrigeration and reducing post-harvest losses through drying of produce. It is for example used for powering health centres, schools and village water pumps among others.

Wind

Compared to other parts of the world, the wind speeds in eastern Africa in general and Uganda in particular, are low. Nonetheless, there are some localized sites with good wind speeds that could be tapped for water pumping and electricity generation. However, in Uganda currently there is no installed wind turbines used for electricity generation due to the costs involved. There is need to re-assess its wind energy potential for the generation of electricity especially micro-size units. The use of wind energy for pumping water for irrigation is ideally suited for dry land areas such as in the ‘Cattle Corridor’.

PRESSURES AND IMPACTS

Climate variability and climate change

Climate variability is defined as any deviation in the long-term statistics of climate elements over a short period of time. This can take the form of diurnal, seasonal, year-to-year or decade-to-decade differences in climate. Climate change on the other hand is defined as any change in climate over a period of time of thirty years or more, whether due to natural variability or as a result of human activity (IPCC, 2013) .

Causes of climate variability and climate change

There are a number of possible mechanisms that can cause the changes in the climate. These include: natural changes caused by the internal dynamics of the earth-atmosphere system; human activities that emit greenhouse gases into the atmosphere such as deforestation and use of fossil fuels; increases in temperature caused by the greenhouse effect; and intense sun solar activity such as solar winds and sunspots. According to the Intergovernmental Panel on Climate Change Fifth Assessment Report, economic and population growth continue to be the most important drivers leading to increases in CO₂ emissions from fossil fuel combustion.

Greenhouse Gas Emissions

Uganda’s National Greenhouse Gas Inventory Management system is based on the Tier 1 of the Intergovernmental Panel on Climate Change GhG Inventory management system. In this report emissions GhG emissions estimates from four key sectors are considered.

They include: the Energy sector, Agriculture, Forestry and Land Use (AFOLU) sector, Industrial Processes and Products Use (IPPU) sector and the Waste Sector.

Evidence of climate change (Frequency of extreme events)

Table 11.1 shows the distribution and summary of occurrence of extreme events based on Uganda National Panel Surveys (UNPS) that are conducted in Uganda on an annual basis. Droughts or irregular rains are the most prevalent natural disasters among the communities in Uganda. For example, in 2009/10 drought or irregular rains were prevalent in about 46 per cent of the communities in Uganda. The prevalence of droughts or irregular rains slightly decreased in 2010/11 to about 26.9 per cent but again increased in 2013/14 to about 29.5 per cent. The duration of the droughts or irregular rains for the period under study has been estimated at about 3 months. Other natural disasters include floods, high level of crop pests and diseases.

Table 11.1: Frequency and duration of extreme events

Prevalence of disasters (%)	2009/10	2010/11	2011/12	2013/14
Drought/irregular rains	45.8	26.9	20	29.5
Floods	2.11	3.84	5.23	3.15
High level of crop pests & disease	4.66	1.51	2.17	0.55
High level of livestock disease	2.79	1.43	1.1	1.54
Landslides/erosion	0.75	0.26	0.61	0.54
Duration of disaster (months)				
Drought/irregular rains	4.3	3.4	3.1	3.1
Floods	1.3	2.5	2.7	2.1
High level of crop pests & disease	4.9	3.9	6	4.2
High level of livestock disease	1.9	2.1	3.3	2.2
Landslides/erosion	1.6	1.6	1.9	1.7

Source: Author’s computation based on data from UBOS, 2014

Impacts of natural disasters

Natural disasters have a multitude of impacts. These can be felt on household income, assets, crop production, and number of people affected among others. For the considered extreme events the number of affected household and people are on the increase (Table 11.2).

Climate change projections

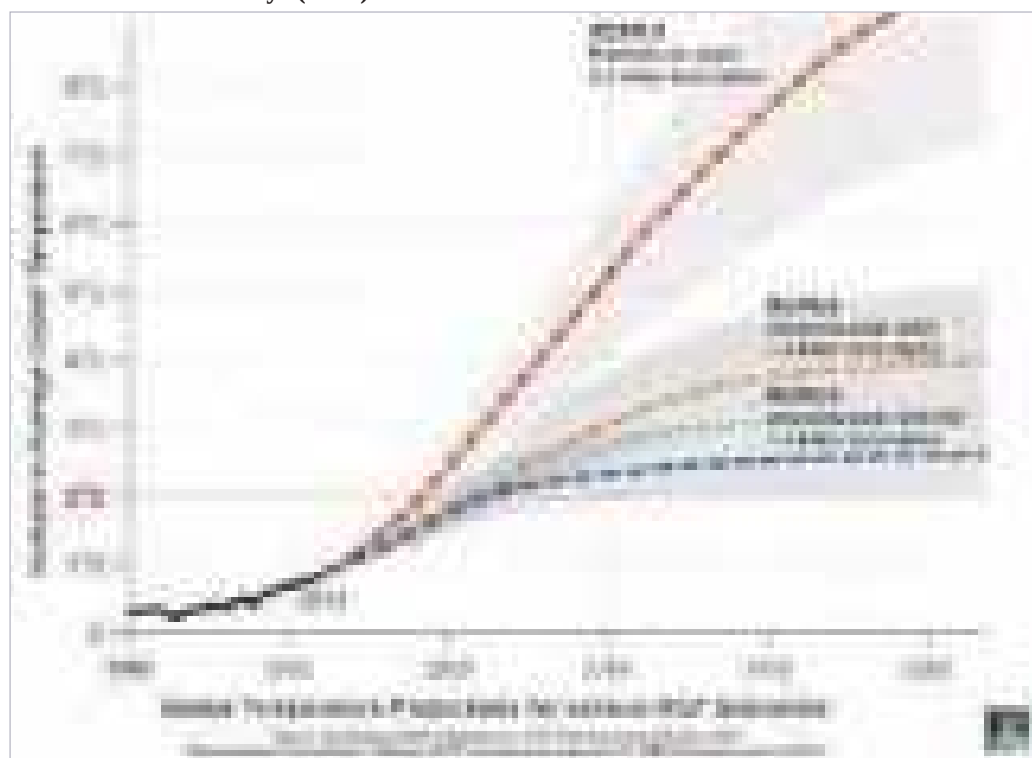
At the global level, the IPCC in its AR5 projected that continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems.

Table 11.2: Impact of extreme events on households and population

Natural disaster	Impact	2009/10	2010/11	2011/12	2013/14
Drought/irregular rains	Households affected	2095592	1095748	855897	2162647
	Population affected	11944874	5807467	4450662	11245763
	Household income lost	1694831	889766	619745	1725386
	Number of household assets lost	474465	183384	103891	561140
	Number of household food production lost	1972599	1020188	766281	1981294
Floods	Households affected	83187	142788	217720	211798
	Population affected	474164	756777	1132145	1101347
	Household income lost	36793	99109	111620	137069
	Number of household assets lost	11595	31663	24604	39710
	Number of household food production lost	66777	132543	195690	194046
High level of crop pests and disease	Households affected	228163	70212	100080	135107
	Population affected	1300530	372124	520417	702555
	Household income lost	165819	59427	73497	106757
	Number of household assets lost	61054	8246	16426	27012
	Number of household food production lost	194335	68394	96042	129966
High level of livestock disease	Households affected	147972	62013	46462	46024
	Population affected	843440	328671	241602	239325
	Household income lost	94419	42601	17267	39160
	Number of household assets lost	58266	28733	16595	25656
	Number of household food production lost	26213	10615	5478	26131
Landslides/erosion	Households affected	44256	9178	33141	31031
	Population affected	252259	48645	172333	161359
	Household income lost	18884	4691	12786	13109
	Number of household assets lost	3384	2179	775	5777
	Number of household food production lost	35601	2512	29411	27714

Source: Author's computation based on data from UBOS, 2014

Figure 11.6: Global temperature projections according to various Representative Concentration Pathways (RCP)



According to the Fourth Intergovernmental Panel on Climate Change Assessment Report, the global climate change models predict an increase in average temperatures in Uganda by up to 1.5°C in the next 20 years and by up to 4.3°C by the 2080's. Changes in rainfall patterns and total annual rainfall amounts are also expected. Based on the models, predictions indicate an increase in rainfall of 10-20 per cent over most of the country with a decrease expected over the semiarid cattle corridor. From the precipitation predictions, it is estimated that there will be 10 to 20% increase in runoff under future climate change scenarios for most of Uganda. Recent recorded rainfall data indicate some significant variations and changes in various parts of the country.

Table 11.3: Summary of Climate Projections for Uganda under RCP 4.5 and RCP 8.5

Parameter	Representative Concentration Pathway RCP (4.5)	Representative Concentration Pathway (RCP 8.5)
Annual temperature changes from the median	In +50 years to present: +1.5°C to +2°C in most continental parts of Uganda In +80 years from present: +2°C to +2.5°C in most of Uganda	In +50 years to present: +2°C to +3°C in most continental parts of Uganda In +80 years from present: +4°C to +5°C in most of Uganda
Annual rainfall changes from the median	In both +50 and +80 years: -5 mm (mostly in the northern half) to -10mm per month (mostly in the southern half). Up to -70mm per month over Lake Victoria	In both +50 and +80 years: -10mm to -20mm (mostly in the northern half) to -30mm per month (mostly in the south). Over -100mm per month over Lake Victoria

Source: (Markandya, Cabot-Venton, & Beucher, 2015)

The decrease in rainfall over most of the country, combined with a significantly wetter DJF season, will result in significantly drier conditions for the rest of the year (longer wet season that extends from SON towards DJF). There will also be increases in temperatures especially during the MAM and JJA seasons. Adaptation strategies will be required in the key sectors of energy agriculture, water and infrastructure to reduce the vulnerability of communities. A significant drop of total rainfall of about 20 per cent from the present over Lake Victoria, along with an increase of about 1°C in temperature will impact the lake water level. Specificities of some of the regions where case-studies have been conducted such as in the Mount Elgon area and the western districts of the country, where more rainfall is expected), have also been duly considered.

Government of Uganda in a study to determine the economic impacts of climate change in Uganda (Markandya, Cabot-Venton, & Beucher, 2015) concluded that:

- Development prospects will only be reached if the impacts of climate change on Uganda are mitigated.
- The impacts of climate change are expected to be felt across all the sectors and local areas studied, to varying degrees.
- The cost of adaptation is high: estimated at around US\$406 m over the next five years (2015–2020). On an annual basis, this amounts to about 5 per cent of net official development assistance received and 3.2 per cent of total government revenues (excluding grants).
- The cost of inaction is 20 times greater than the cost of adaptation: inaction is estimated at between US\$3.1 billion and 5.9 billion per year by 2025, which is more than 20 times the proposed adaptation budget.

RESPONSES

Responses to Climate Change

The overarching frameworks for responding to climate change in the country are hinged on the international climate change action frameworks and measures. The overall goal of this frameworks is to provide a platform in which nations are able to build resilience and adapt to the impacts of climate change while at the same time be able to reduce the emissions of Greenhouse gases as a result of their socio–economics development initiatives. The United Nations Framework Convention on Climate Change (UNFCCC) is the global framework at the forefront of galvanizing nations to tackle the challenge of

climate change. Under the auspices of this convention, member states and institutions signed the Paris Agreement on climate Change in 2015. Uganda is a signatory to the Paris agreement and is already taking a number of steps to domesticate her commitments under the Paris Agreement namely;

- In 2015 Uganda approved the National climate change policy and costed implementation strategy.

This is a basis for all policy options for tackling climate change including adaptation, mitigation, monitoring reporting and verification, mainstreaming of climate change into development plans, work plans and budgets, creation of general awareness and consciousness about climate change and its impacts

- In 2015, the National Climate Change Focal institution was elevated from a unit to a full department in the Ministry of Water and Environment
- In 2016, Uganda developed and commissioned a National Greenhouse Gas Inventory Management System for measuring levels and trends of emissions of GhGs, This system has enabled the country to identify the key category sources, levels and trends in emissions. This is important in designing climate change actions to reduce emissions of GhGs.
- A number of climate change related projects are currently being implemented in the country in various sectors by government ministries, departments and agencies, civil society organizations and the private sector.
- Government and the development partners have continued to raise mass awareness on climate change and its impacts to all stakeholders including the general public of Uganda
- Climate change is mainstreamed into the country's major development planning frameworks including the National Development Plan 2015/2016 – 2019/2020, the Vision, 2040, the ruling party manifesto, annual work plans and budgets.
- Uganda continues to be part of the global efforts to combat climate change and its impacts through participation in international and regional negotiations conferences on climate change.

- National Adaptation Programmes of Actions (NAPAs)
- In 2016 Uganda commenced the process to enact a climate change law to domesticate the Paris Agreement. National Climate Change coordination institutional frameworks

Recommendations

The government should fast track the enactment of a climate change law to clarify roles and responsibilities of the various stakeholders involved in climate change action and more resources need to be raised within government, civil society organizations and the private sector to meet the additional costs of climate proofing of investments and estimated in the costed implementation strategy of the National Climate Change Policy.

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Uganda Bureau of Statistics datasets

Uganda National Meteorological Authority datasets

Migratory birds at Lutembe Bay
(Internet photo)



CHAPTER 12: Wildlife and Tourism

INTRODUCTION

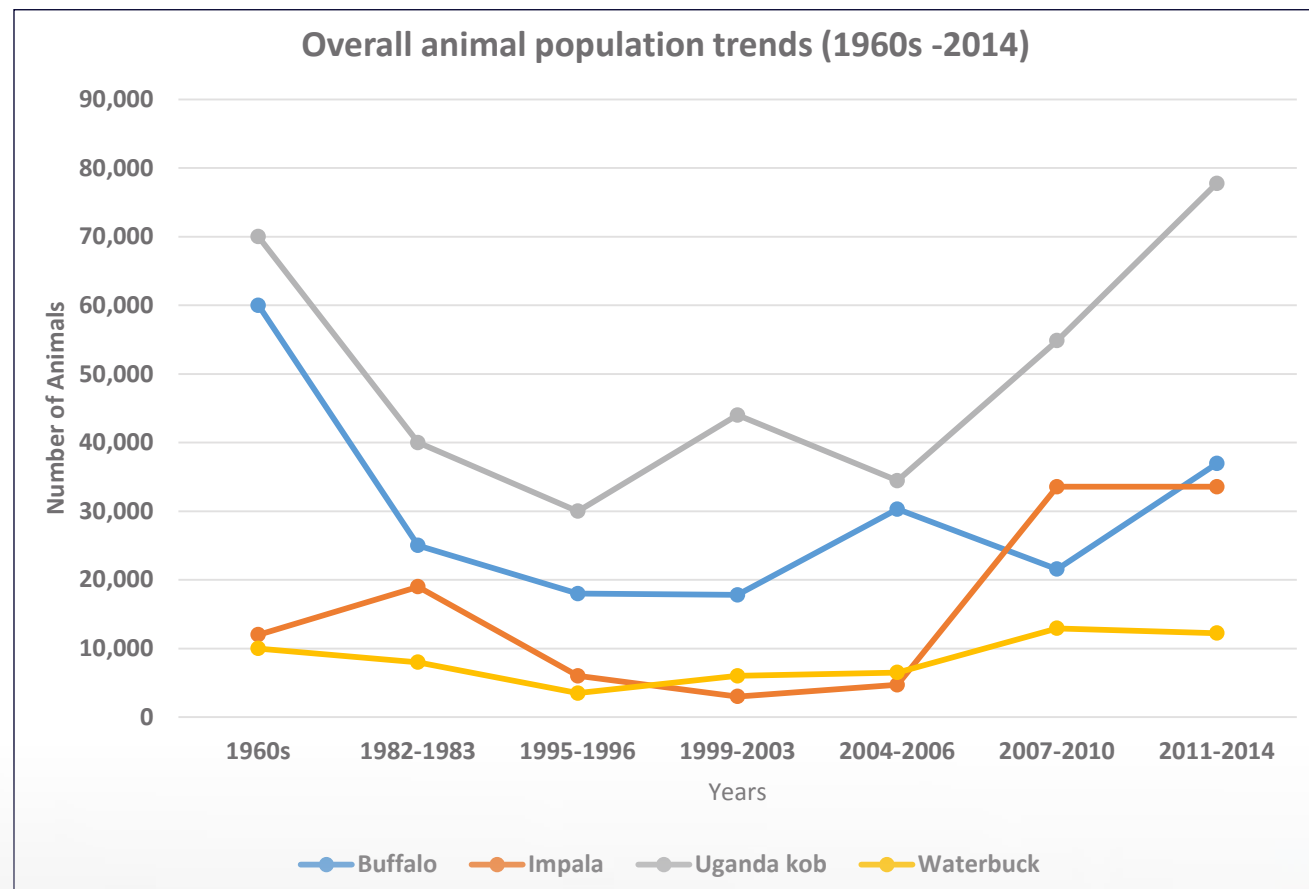
Wildlife includes all species of plants and animals in the wild both within and outside protected areas. Uganda Wildlife Authority (UWA) is a government institution mandated to manage all wildlife in Uganda. Wildlife management is important given the role it plays in tourism and the welfare of the communities around the protected areas. However, the sector is facing challenges due to pressure exerted by the increasing population which is restricting wildlife to ever smaller areas.

STATUS AND TRENDS

Wildlife populations

Wildlife populations are steadily increasing in National Parks and Wildlife Reserves throughout the country. UWA has been carrying out routine animal censuses in wildlife protected areas to monitor animal population trends and distribution pattern across the country as shown in table 12.1. Although animal numbers significantly dropped in the 1995-1996 period, the population of most species recovered in subsequent years. Some species such as the Hartebeest, Buffalo and Uganda Kob show a more rapid increase than others. Figures 12.1 and 12.2 show samples the general trend of population recovery within protected areas.

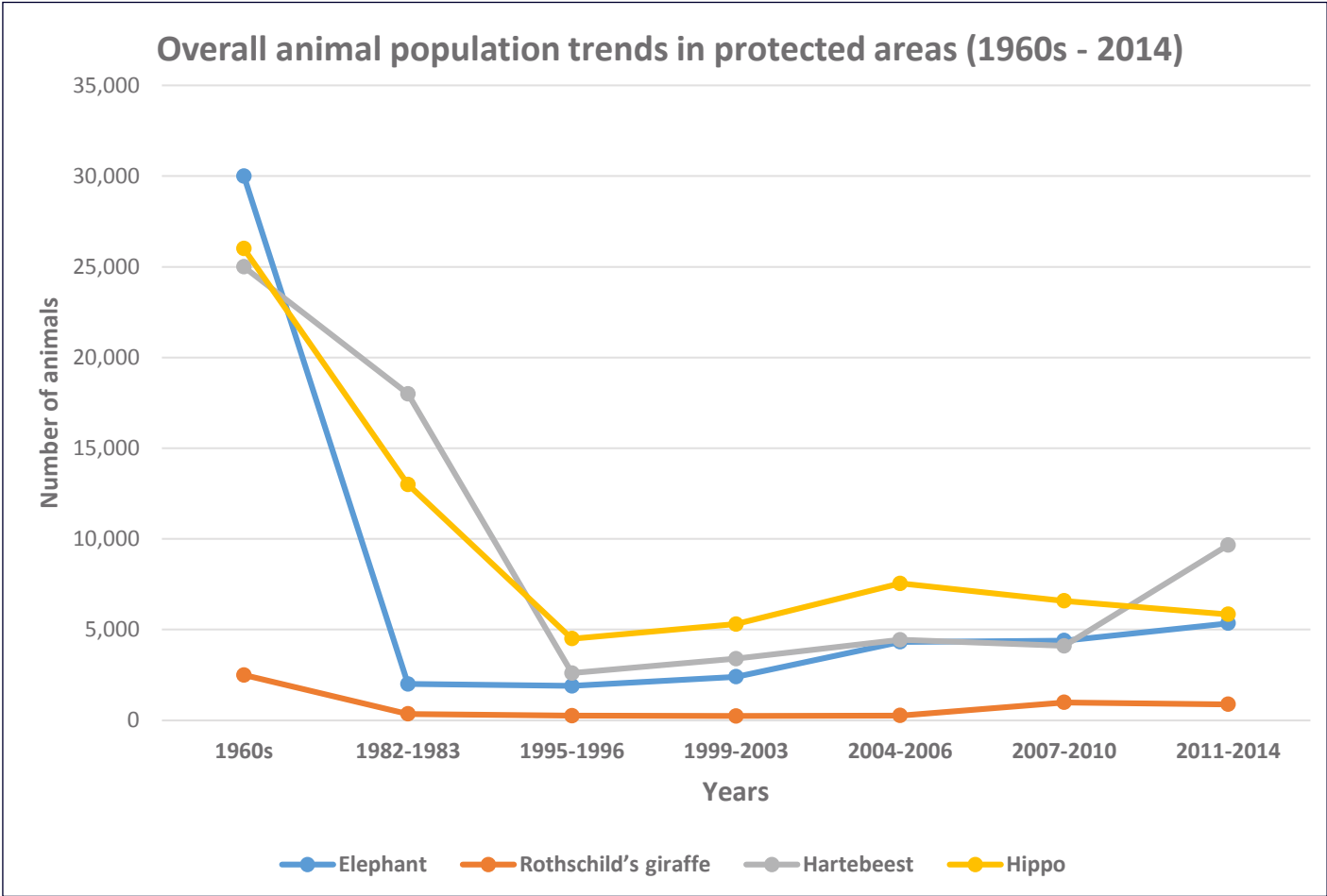
Figure 12.1: Population trend of the Buffalo, Impala, Uganda Kob and Waterbuck from the 1960s to 2014



Data source: UWA 2015

Buffaloes in Kidepo National Park
(Photo credit: Bob Nuwagira (NEMA 2016))

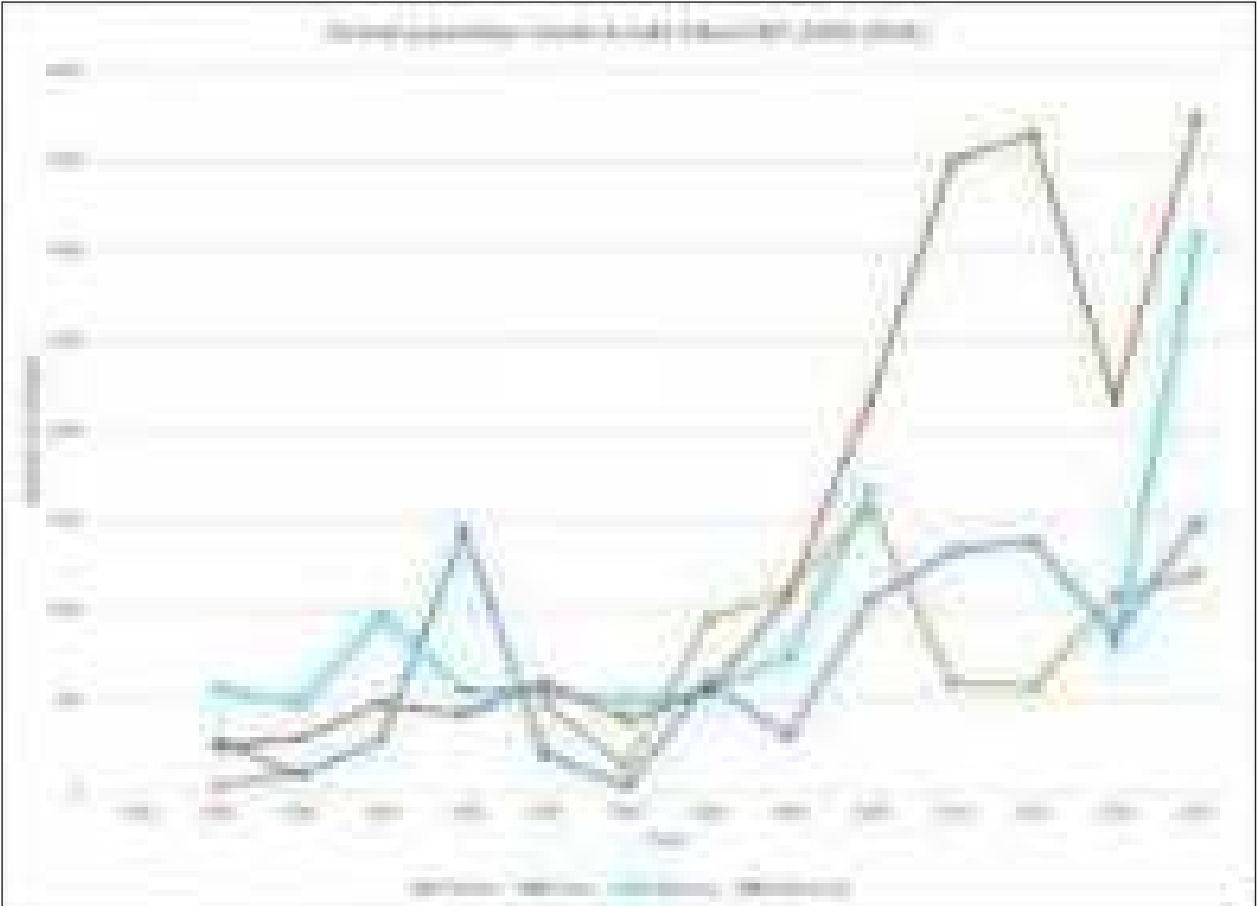
Figure 12.2: Population trend of the Elephant, Hartebeest, Giraffe and Hippopotamus from the 1960s to 2014



Data source: UWA 2015

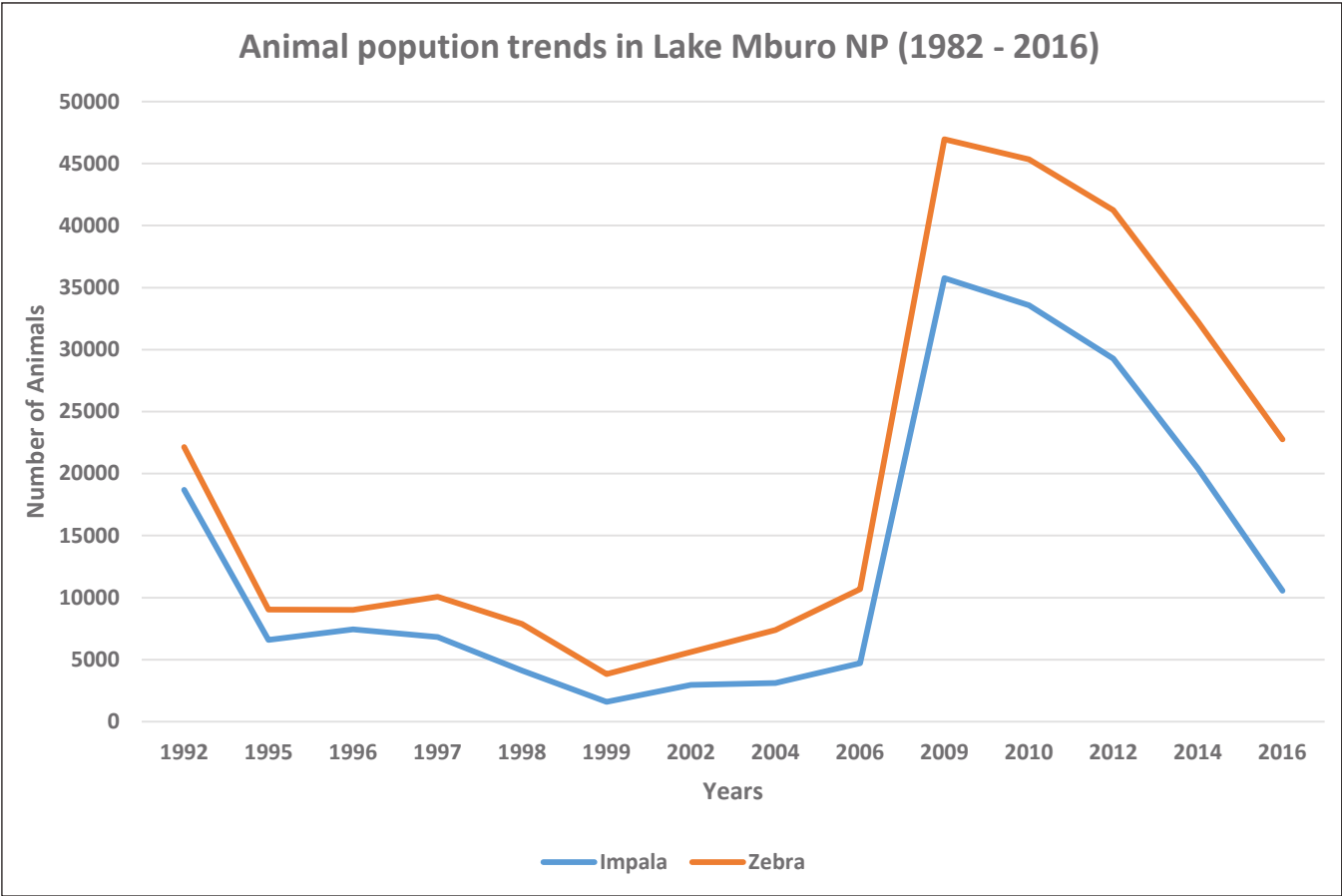
Even within individual protected areas, there has been an overall improving trend in the wildlife species population. For instance, most animal numbers in Lake Mburo National park have generally increased (Figure 12.3) and is thought to be due to the improved management coupled with the various initiatives including working with communities to establish ecotourism opportunities on private land. These have improved the park-community relationship. Populations of Zebra and Impala, have dropped in recent years (Figure 12.4).

Figure 12.3: Population trends of the Buffalo, Eland, Warthog and Water buck in Lake Mburo National Park



Source: Kisame E. F, 2017

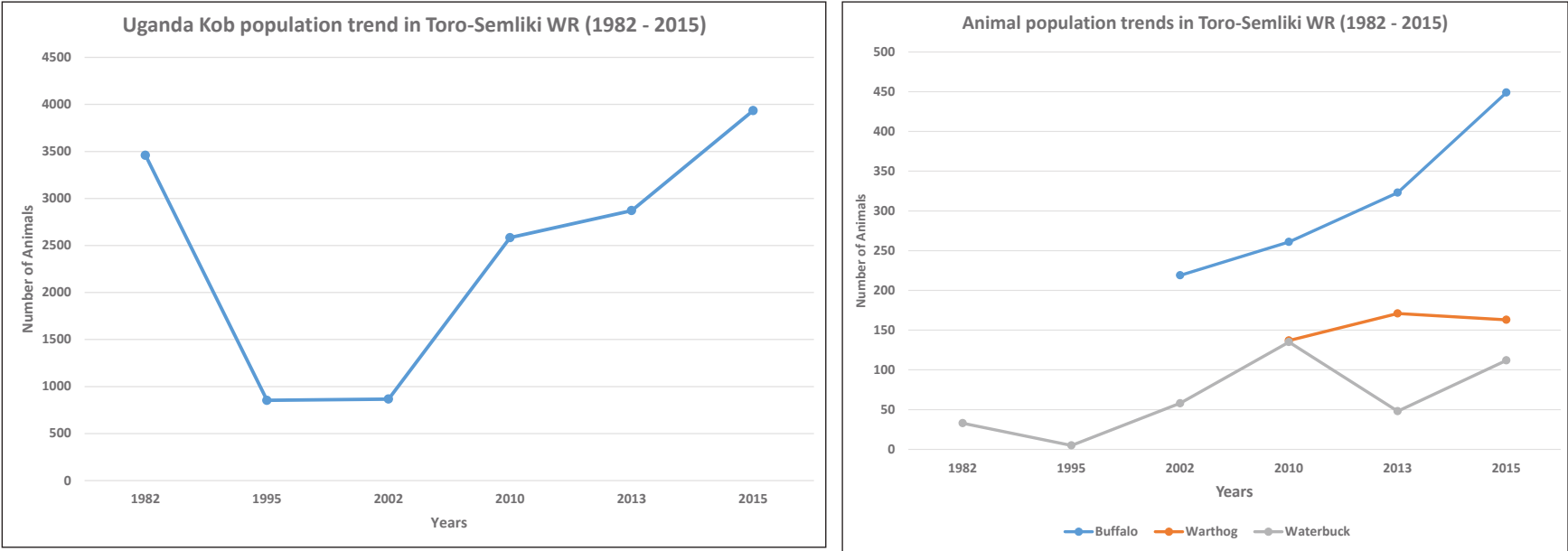
Figure 12.4: Population trends of the Impala and Zebra in Lake Mburo National Park



Source: Kisame E. F, et al, 2017

The animal numbers in Toro-Semliki show a positive trend for the recent years. For the Uganda Kob, the population significantly reduced until 1995 then started showing a positive trend after 2002, The Water buck, on the other hand, shows fluctuations throughout the period of recording.

Figure 12.5: Uganda Kob and Animal population trends in Toro-Semliki Wildlife Reserve between 1982-2015

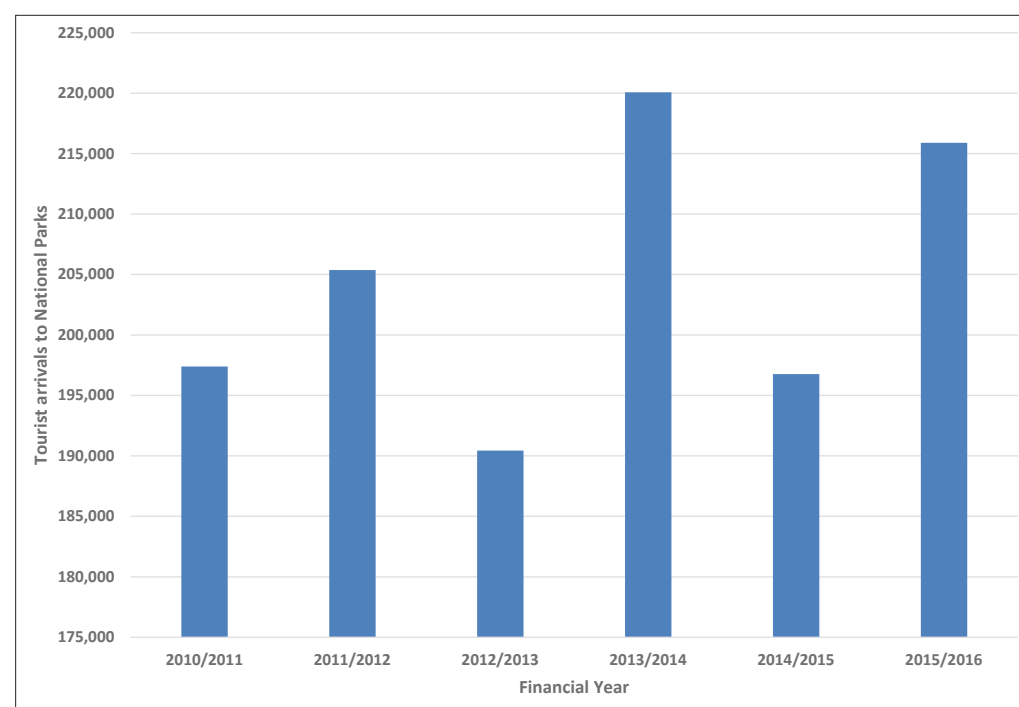


Source: Toro-Semliki Wildlife Reserve aerial survey data (from UWA Research and Monitoring Department)

Translocation

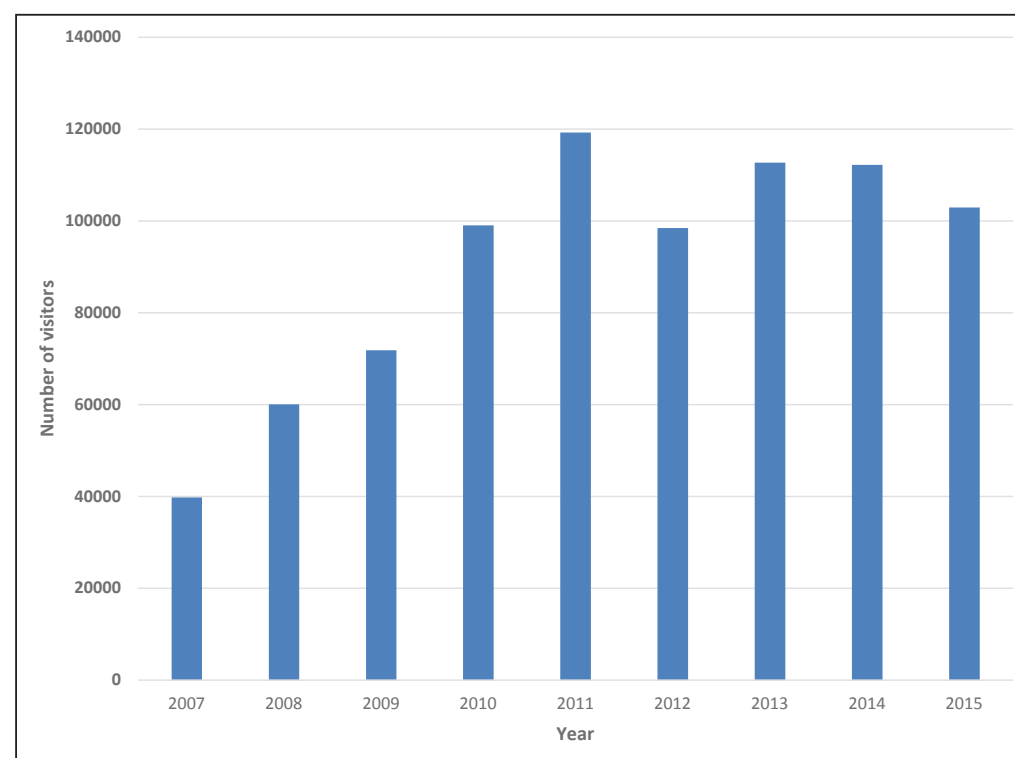
UWA has continued to enhance the populations in the protected areas through translocation of different species. In 2014, 17 giraffes were translocated to Lake Mburo National Park boosting the park's tourism numbers. Previously giraffes only occurred only in Murchison Falls National Park and Kidepo Valley National Park. Impalas and Zebras were also translocated from Lake Mburo National Park to Katonga Wildlife Reserve. Plans are underway to translocate additional animals (Giraffes and Uganda Kobs) from Murchison Falls National Park to other protected areas.

Figure 12.6: Number of Visitors to the National Parks, FY2010/2011 to FY2015/2016)



Source: UWA, 2016

Figure 12.7: Number of visitors to the Uganda museum, 2007-2015



Source: Uganda Museum 2016

Tourism and tourists

Uganda is endowed with various tourism attractions, most of it natural resource based with wildlife constituting the biggest tourist attraction. Government has set aside protected areas in order to conserve the wildlife as much land is under pressure for agriculture and settlements. Any threat to the wildlife poses a threat to the tourism industry. The World Wildlife Fund for Nature (WWF) highlights the following principles as priorities to define responsible tourism:

- Tourism should be part of a sustainable development strategy and plan.
- Natural and cultural resources should be used in a sustainable way.
 - Pollution and consumption should be kept as low as possible.
 - Tourism should respect the cultural values of the local population and enable them to participate in economic prosperity.
 - Tourism should be informative and promote respect for local culture and environment.

The main tourism products are gorilla tracking, bird watching, eco-tourism, faith-based tourism, water sport, mountain climbing, chimpanzee watching, nature guided walks, community walks, butterfly viewing, viewing Golden patas monkeys, cultural and heritage sites viewing, visual arts and white-water rafting. It is estimated that the country has more than 50 per cent of the world's Mountain gorillas, 7 per cent of the world's mammal species including the unique tree climbing lions and White rhinos, 11 per cent of the world's bird's species (1,061 bird species), and a wide variety of butterflies (Plumptre et al., 2003). Other unique attractions include Chimpanzees and Golden monkeys. The country has beautiful mountain ranges including the snow-capped Rwenzori Mountain ranges, the world's second largest fresh water lake, the third deepest lake and a source of the world's longest river with beautiful waterfalls and unique water scenery.

Tourists arrivals have been increasing steadily since 2014 (Figure 12.7). According to UWA, visitation to the National Parks grew by 14 per cent in 2016 to reach 245,725 (MTWA statistical bulletin 2017). This increase was largely attributed to the aggressive marketing by government and the private sector which continues to supplement government efforts to market the destination. The category of Foreign Non-residents contributed most to this performance having grown from 77,206 in 2015 to 95,949 visitors in 2016 (MTWA, 2017).

Queen Elizabeth National Park (QENP) is the most popular park with visitors and also had the highest number of student visitors (Table 12.1). However, most foreign non-residents, foreign residents and East African residents preferred Murchison Falls National Park (MFNP). The MFNP

was also the only national park that registered visitors in transit. Each of the protected areas offers a unique experience to tourists because of the variation in species diversity that occurs in these parks.

Table 12.1: General performance of NPs between 2015 and 2016

PARK	FNR	FR	EAR	STUDENTS	TRANSIT	VIPs/UWA	TOTAL
Bwindi Impenetrable National Park	15,719	380	633	128	-	12	16,872
Kidepo Valley National Park	1,563	587	3,621	128	-	27	5,926
Murchison Falls National Park	27,964	6,631	23,264	6,926	3,088	-	67,873
Queen Elizabeth National Park	19,005	3,252	17,645	31,906	-	-	71,808
K National Park	9,416	245	442	537	-	8	10,648
Mount Elgon National Park	423	280	1,534	418	-	-	2,655
Ruwenzori Mountains National Park	994	227	312	801	-	-	2,334
S National Park	336	255	1,597	6,740	-	53	8,981
Lake Mburo National Park	8,500	2,150	7,002	7,622	-	-	25,274
Mgahinga National Park	1,778	95	431	527	-	43	2,874
Toro-Semliki Wildlife Reserve	168	79	99	220	-	79	645
Total	85,866	14,181	56,580	55,953	3,088	222	215,890

FNR=Foreign non-residents, FR=Foreign residents, EAR=East African Residents and VIPs/UWA = Official visitors from Government or to Government hosted by UWA.

Tangible Cultural heritage in Uganda

The Department of Museums and Monuments has so far documented 850 cultural heritage sites (Historic sites, Museums and Monuments) with outstanding heritage values across the country. Between 2014 and 2016 over 10 sites were surveyed and titled under Uganda Land Commission (ULC). Other Land titles for sites that are not on private land are being first tracked by the Museums and Monuments Department. Currently, Uganda has 5 public museums (Uganda Museum in Kampala, Kabale Museum, Soroti Museum, Karamoja Museum and Fort Lugard Museums), about 16 private Museums and numerous community museums.

Out of the 850 sites, one is on the World Heritage List (Kasubi Royal Tombs) while nine sites (Nyero and other geometric sites of eastern Uganda, Kibiro salt village, Bigo Bya Mugenyi and Ntuusi mounds) are

on UNESCO's tentative list. In 2015, the Ministry of Tourism, Wildlife and Antiquities submitted Nyero and other geometric rock art sites of eastern Uganda (Mukongoro, Kakoro, Kapir, Komuge and Dolwe) to UNESCO World Heritage Centre for World Heritage Listing but were deferred due to research, management and conservation issues. Nyero nomination dossier will be submitted in 2018 to the World Heritage Center for World Heritage listing.

As far as infrastructure is concerned, most of the cultural heritage sites lack or have inadequate visitor facilities to boost the visitor experience. Uganda is still lagging behind in terms of cultural heritage development. There is no single site that is fully developed (MTWA, 2015). Only 10 sites were demarcated between 2014 and 2016. In 2016 only one museum in Soroti was completed and will be open to tourists soon. Other sites

surveyed and titled for development are Fort-Portal land, Dolwe, Kakoro, Bigo Byamugenyi and Ntuusi. A few of the government cultural heritage sites such as Partiko, Nyero, Mukongoro, Komuge, Dolwe, Wadelai, and Bigo Bya Mugenyi have installed signage. This has attracted additional tourists to the sites. Despite the challenging status of cultural heritage sites across the country, the sites still attract visitors for spiritual reasons, research and tourism.

Most visitors to the cultural heritage sites across the country are domestic. The Kasubi Royal Tombs by virtue of being a World Heritage Site attracts more international than local visitors. Crafts are on sale at all the active cultural heritage sites; and entertainment is on display. For instance, at Nyero, a women’s group has local food and drinks on sale and performs music and dance for guests. The move by government to develop and promote cultural heritage sites will attract visitors and improve employment and livelihood opportunities for the community.

Private museums such as the Great Lakes and Igongo that lie in the tourism circuit also attract transit visitors, which is good news for the tourism industry. Creative goods and services contribute significantly to the tax revenue of the country. Overall, about 386,000 people are employed in the cultural sector.

PRESSURES AND IMPACTS

Illegal wildlife trade and poaching

Wildlife trade is pushing some species to extinction. The illegal wildlife trade includes all forms of trade in wildlife and wildlife products without a license. This also includes transit of wildlife or wildlife products from neighboring countries through Uganda, especially ivory. The international trade in wildlife is regulated by CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora). Uganda became a party to CITES in 1993. Legal wildlife trade was incorporated in the Wildlife Act under Class D Wildlife Use right (Section 29). Illegal trade in wildlife was not a big issue until around 2010 when cases of elephant poaching and illegal ivory trade started to increase. Today, Uganda is faced with a challenge of illegal ivory trade with the country mainly being used as a transit for ivory from other countries. The trade in prohibited products is a multibillion shilling industry and is growing over the years. For instance, Table 12.2 shows the amount of pangolin scales seized over the years. The drivers behind this increase need to be explored.

Ivory confiscated as it was being smuggled out of the country. Photo credit: UWA

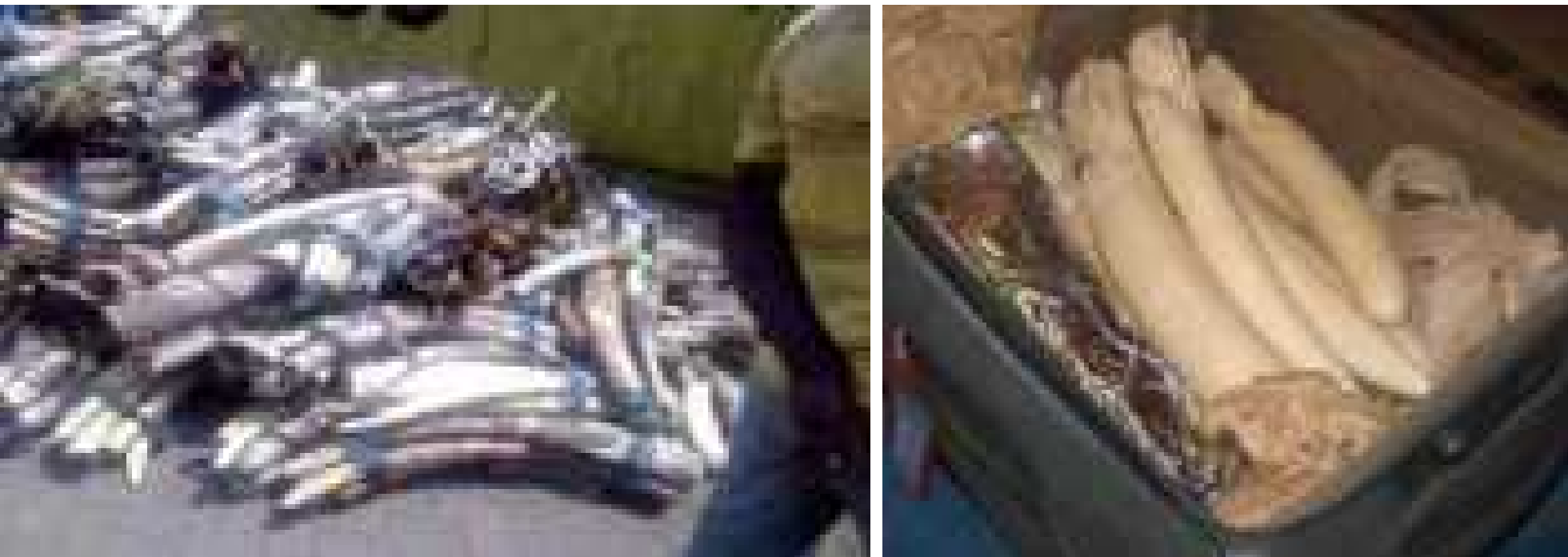


Table 12.2: Kilograms of pangolin scales seized at Entebbe and other places in Uganda, 2012-2015

Year	Entebbe	Other places	Total
2012		125	125
2013		181	181
2014	20	52	72
2015	2,049	129	2,178

Source: (GVTC, 2015)

Human wildlife conflict

The increasing population has continued to exert pressure on protected areas in pursuit of extraction of resources, and land for agriculture and settlement. As the population continues to grow much pressure is exerted on the national parks that border settlements. There is increasing demand for land for settlement, agriculture and other development needs and this leads to encroachment into the protected areas. For instance, Bokora Matheniko and Pian Upe Reserves in Karamoja have continued to experience a lot of encroachment. The Office of the Prime Minister together with UWA and surrounding districts have come up with containment areas within these reserves to address this challenge and to try and halt the expansion of the settlements into the protected areas.

Human-wildlife conflict continues to be one of the biggest management challenges facing protected areas. The conversion of wildlife habitat outside protected area boundaries to agriculture, urban settlements and

industrialization has increased cases of human-wildlife conflicts. Human-wildlife conflicts are characterized by crop raiding, attacks on humans, loss of property and cross transmission of diseases (Wallace & Hill, 2012). The number of human-wildlife conflicts recorded between 2006 and 2016 are shown in Table 12.3 below. The general trend is an increase in incidents of conflict around all the protected areas. This may partly be due to the increased sensitization that is taking place in areas adjacent to protected areas where communities are encouraged and are also able to report these cases to the authorities unlike previously. The key wildlife species frequently involved include elephants, hippos, buffaloes, crocodiles, leopards, baboons and monkeys.

Overharvesting of certain natural resources also contributes to the problem animal phenomenon. For instance, the extreme reduction of the fish resource in Lake Victoria and in other lakes, has partially led to increased cases of problem crocodiles (UWA, 2016).

Table 12.3: Human-wildlife conflict cases for selected protected areas, 2011-2016

Year	LMCA	BMCA	QECA	KCA	MFCA	KVCA	Total
2006	36	-	-	-		-	36
2007	38	35	-	-		-	73
2008	50	979	5	69		-	1,103
2009	54	1,230	24	89	238	-	1,635
2010	61	1,153	16	128	216	-	1,574
2011	67	80	45	148	231	5	576
2012	103	127	65	182	236	35	748
2013	75	114	16	210	864	25	1,304
2014	50	260	71	166	1,192	33	1,772
2015	86	190	131	206	1,082	2	1,697
2016	99	104	212	161	1,108	149	2,021

Source: (UWA, 2016)

To further highlight the extent of human-wildlife conflicts, details of human-wildlife conflicts recorded in Murchison Falls Protected Area (MFPA) are indicated in Table 12.4 below.

Murchison Falls Protected Area (MFPA): A case study of human-wildlife conflict

MFPA (Figure 12.6) is composed of Murchison Falls National Park, Karuma and Bugungu Wildlife Reserves. While most of the area north of River Nile and the central part of MFNP is composed of grassland vegetation, the area south of the river is dominated by woodland

vegetation. Bugungu Wildlife Reserve also has a large area of grassland vegetation. The grassland area hosts most of the animal species of tourist attraction while the woodland and forest contain a number of woody plant species of conservation importance. Some of these animals e.g. the elephant, Jackson's or Lelwel Hartebeest and the Rothschild Giraffe are also of conservation concern such as the IUCN redlisted or endemic (restricted range) species to the Albertine rift. Some of these animals are, unfortunately, hunted for either meat or other body parts like the elephant tusks. The wildlife also often gets out of the protected areas to community land adjacent to the protected area.

Figure 12.8: Land cover/land use of Murchison Falls Protected Area in 2015



Source: UWA, 2016

The key problem animals recorded in MFPA were elephants, hippopotamus, buffaloes, crocodiles and baboons. The number of reported cases has increased over time. Table 12.4 below shows the human-wildlife cases recorded in MFPA over a 6-year period. An average

of 20 cases were reported per week. Crop damage constituted 75 per cent of the reported cases and the remaining 25 per cent constituted the rest of the cases i.e. human death and injury, killing of livestock and destruction of property (UWA, 2016).

Table 12.4: Human-wildlife conflicts cases recorded in the Murchison Falls Protected Area (2011-2016)

Year	No. Incidences responded to	No damage	Crop raiding	Property damage	Human injury	Human Death cases	Injured treated	Animals killed	Remarks
2011	231	90	141	0	7	2	0	0	7 injured by buffaloes, 3 killed by hippos
2012	236	90	146	1	5	1	5		Injury caused by 2 hippos, 2 buffaloes and 1elephant. 1 person died -by buffalo. 5 animals were killed by hippos and baboons
2013	864	231	633	2	4	0	2	3	Livestock killed by baboons
2014	1192	354	838	4	4	5	4	5	2 people killed by buffaloes, 2 by crocodiles and hippos, 1 by elephants
2015	1082	283	799	4	7	5	5	6	3 people killed by crocodiles and hippos, 2 by elephants
2016	1108	242	866	5	9	3	4	12	6 cows killed by crocodiles, 2 goats and 4 calves killed by hippos, 9 people injured by buffaloes, 3 people killed by elephants

Source: UWA, 2016

Pressure from developments

Government is currently implementing a number of projects and programs aimed at achieving the Vision 2040 goal of becoming a middle-income country by 2040. Major developments being carried out include upgrading of the transport infrastructure in many areas, oil and gas exploration and the planned production, Hydropower development and development of tourism infrastructure among others. Some of these are being implemented inside or at the fringes of protected areas and have potential to cause negative environmental impacts. In 2013, the government commissioned the construction of the Karuma Hydropower

project that is within Karuma Wildlife Reserve. Although the developer has minimized impacts, there are some residual impacts that may remain way beyond the completion of the project. The Sipi Hydropower plant that is partly located within the Mount Elgon National Park is another hydropower development which may have impacts on a protected area.

The Oil and Gas that has been discovered in some wildlife protected areas in the Albertine Graben also poses some challenges to the management of these protected areas. As the country now enters the development phase, care should be taken to minimize impacts of the different infrastructure in these protected areas.

Table 12.5: Some of the developments in wildlife PAs

Category	Protected Area	Some Proposed and implemented Projects
Oil and Gas	Murchison Falls National Park	Seismic and exploratory drilling
	Kabwoya Wildlife Reserve	Seismic and exploratory drilling
	Bugungu Wildlife Reserve	Seismic and exploratory drilling
	Toro Semuliki Wildlife Reserve	Seismic and exploratory drilling
	Queen Elizabeth National Park	Seismic and exploratory drilling
Hydropower	Karuma Wildlife Reserve	Karuma Hydro power
	Rwenzori Mountains National Park	Kakaka Hydro power
	Mount Elgon National Park	Sipi Hydro power
	Murchison Falls National Park	Oriang Hydro power
		Ayago Hydro power
		Kiba Hydropower
Gravity water scheme	Rwenzori Mountains National Park	Mugusu Gravity flow scheme
	Mount Elgon National Park	Bukwo Gravity Water scheme
Roads	Kibale National Park	Kamwenge-Fort Portal
		Kyenjojo-Fort Portal
	Queen Elizabeth National Park	Kasese-Bushenyi road
Mining	Queen Elizabeth National Park	Dura limestone mining
Transmission lines	Murchison Falls National Park	Lira-Arua-Gulu
		Karuma-Olwiyo
	Queen Elizabeth National Park	Mbarara Nkenda Line

Source: UWA, 2016

Invasive species

Invasive species are a problem that is continuing to spread inside protected areas. These species are colonizing the parks leading to a reduction of the grazing areas for wildlife. With increasing spread of these species, animal numbers are expected to reduce. The *Acacia hockii* in Lake Mburo National Park, *Dichrostachys cinerea* in Toro-Semliki, and *Imperata cylindrica* and *Opuntia sp* in QENP are some of the species that have aggressively colonized the protected areas.

These invasive species have spread and grown into thickets changing wildlife habitats from open grasslands to closed woodlands. This has resulted in declining feeding area availability for animals, direct animal and human health problems, undesired mass migration of animals, disruption of animal breeding cycles, tremendous decline in animal populations and large-scale ecosystem destabilization. As a result, the

recreational and community values of the protected area systems consequently impacting economic and social values. Left unmanaged, invasive species will increase in distribution and density, causing greater impact on wildlife survival in the protected areas.

Threats to cultural sites: Stone quarrying and agriculture

Demand for building materials, land for agriculture and road construction, destruction of cultural material such as fossils and lack of land use plans are some of the major threats facing the cultural sites. For instance, many of the cultural sites have large stones which are popular with the construction industry. With the growing population and demand for improved infrastructure, especially housing, community members often resort to crushing and selling stones from the cultural sites. One example is Kapir rock art site that is under threat from stone quarrying.

Kapir rock art site where stone quarrying is a major activity in 2016



A number of cultural sites have been cleared for agriculture. In rocky areas, such activities have exposed the land to soil erosion. In converting land to other uses, the wildlife that existed at these sites is also displaced.

Such wildlife has to access food resulting in human-wildlife encounters some of which end up as human-wildlife conflicts.

Changes in Nkondo Paleontological site between 1986 and 2014 as a result of clearing the land for agriculture



On-going efforts by the government to improve road infrastructure has led to the exposure and sometimes destruction of cultural heritage materials. Whereas most known cultural heritage materials such as fossils are on the surface and sites where they occur are known, others remain unknown until a construction activity takes place in an area. The greatest damage has been due to road construction. Often by the time such materials are noticed, excavation has already taken place. Effort made would then be to recover as much as can be got from the excavated soil or debris.

The lack of approved land use plans has led to emergence of activities around protected areas which are not compatible with wildlife management. Some of the community activities deliberately attract wildlife outside the protected area confines and thus negates the success of government interventions to protect the animals in the first place.

RESPONSES

Illegal wildlife trade and poaching

Uganda wildlife Authority has put in place measures to curb illegal wildlife trade. An intelligence Unit has been created both at Headquarters and all over their protected areas. Joint intelligence and investigation operations with Police, Army, INTERPOL and NRCN are conducted which have resulted in several arrests, confiscations and impounding of wildlife and wildlife products and various poaching tools. Suspects have been taken to Courts of Law and prosecuted accordingly (Rossi, A. 2018). UWA is constructing a Bio safety level II laboratory in QENP which will be instrumental in supporting successful prosecution of wildlife crime. A fully fledged Canine Unit has been established and staff have been trained and positioned at Entebbe International Airport and other border posts to work with other agencies to curtail the illegal trafficking of Ivory, Rhino Horns and other related wildlife products. The increased presence and vigilance at the Airport has resulted in a decrease in wildlife trafficking cases.

Human-wildlife conflict

UWA has invested in a number of interventions to address the human-wildlife conflict, which include trench excavation, scare shooting, use of red chili, bee hives, growing of unpalatable crops e.g. the tea growing as a buffer in Bwindi Impenetrable National Park and recruiting wildlife scouts e.g. in MFNP and Kidepo Valley National Park. Although these have to some extent reduced the incidences, more innovations are required to further reduce the problem.

UWA has created Wildlife centers in areas with viable wildlife populations outside gazetted areas to deal with wildlife issues some of these are located in Kyankwanzi, Rakai and Nakaseke. In addition, UWA is closely collaborating with Local Governments at all levels to manage vermin and lobby for recruitment of vermin guards. UWA is planning to construct 50 crocodile cages in the Crocodile prone areas to reduce incidences of crocodile attacks. Communities are also sensitized on how to live with wildlife and managing the problem animals. This has improved the communities' relationship with park management.

Photo of a trench at the northern part of Murchison Falls National Park dug to deter elephants from crossing from the park to community land
(Source: UWA 2016)



Revenue sharing for communities

UWA has continued to support communities around the protected areas by availing a variety of benefits to them. UWA shares 20% of all gate collections with the communities neighboring the protected area from which the money would have been collected. The amount shared has been increasing over the years. Between 2014-2016, over 7 billion Uganda shillings was disbursed compared to 6 billion Uganda shillings that was disbursed between 2011-2014, which is a 15% increase. The funds are meant to improve the livelihoods of the people who are disadvantaged because of living close to the protected areas and also help the communities develop income generating projects. Apart from the 20% of the gate proceeds that communities receive, communities also benefited from sport hunting in different parts of the country. This activity generated over 3 billion shillings between 2014-2016 (UWA

Table 12.6: Summary of major interventions carried out in the protected areas to combat human-wildlife conflicts

Type of intervention	Unit of measure	MFPA	QEPA	BMCA	Kibaale NP	Katonga	KVCA	LM CA	Target problem
Elephant trenches	km	51	74		59				Elephant
Bee hives	pieces	1,030	248		993				Elephants
Partnership with community scouts or volunteers	persons	400		108			294		Elephants
Deployed rangers to scare shoot	rangers	Done	Done	Done	Done	Done	Done	Done	Elephants and buffaloes or as reported
Use of chilli	groups	25		7	25		64		Elephants
Planting of Mauritius thorns	km	1.7		83	2.03				buffaloes, elephants
Promotion of high value unpalatable crops	ha			579.6	8	to start			All problem animals in the area
Sensitization and Awareness	All PAs	Done	Done	Done	Done	Done	Done	Done	All problem animal species
Translocation	numbers		20					No. not specified	crocodiles, Pythons and other small animals
Construction of live traps	numbers			21					elephants
Partnership with vermin control groups	Groups					3			Bush pigs, Vervets
Scare shooting by PAC rangers	Persons						18		Elephants and buffalos
Crocodile Cages (Fencing) Demo.	meters							18	Crocodiles
Hippo (Short Fence) Demo.	Hotspot areas								Hippos

records) that has also been shared among the Land owners, the Spot Hunting Association, Local Governments and UWA.

UWA has engaged landowners through Private-Public Partnership (PPP) to conserve wildlife in several areas including Nakaseke, Kalangala, Nakasongora and Kyankwanzi. In addition, in order to empower landowners to benefit from wildlife on private land, management is now piloting the concept of conservancy around Kidepo, Murchison Falls and Lake Mburo National Parks. The land owners are empowered to effectively collaborate with private investors to manage eco-tourism facilities on private land through formal agreements. This has increased the interest of landowners in wildlife conservation and protection since they are realizing a benefit. This has changed the attitudes of the people towards conservation.

Developments

In order to minimize the impacts of developments in and around protected areas, UWA always ensures that all developments in Protected Areas are subjected to Environment and Social Impact Assessments (ESIAs) and developers are required to adhere to the mitigation hierarchy (avoid, minimize, and restore) as approved by NEMA. Developers are required to restore the areas opened up during project implementation. This has been done for most of the areas where oil and gas developments have taken place. In addition, a number of tools to minimize negative impacts of developments on protected areas have been developed including the Environmental sensitivity atlases, operational guidelines for oil and gas and monitoring checklists. Despite all these efforts, sometimes there are residual impacts that cannot be adequately addressed through the existing framework. More interventions are needed such as implementation of

biodiversity offset so as to manage the residual impacts. UWA is in the process of developing the biodiversity offset guidelines to guide implementation of development activities within the Protected Areas

Invasive species

Management of invasive species has been taking place in the protected areas though still at pilot stage. Some research has been conducted to understand their propagation behavior and, therefore, identify the best approach towards controlling them. UWA has contracted the National Invasive Species Coordination Unit under NARO to pilot an integrated IAS management project for selected IAS i.e. *Acacia hockii* in LMNP and *D. cinerea*, *C. odorata* and *P. hysterophorus* in QENP.

Recommendations

For species that are showing a negative population trend e.g. zebra and impala in Lake Mburo NP, species specific conservation approaches should be developed to reverse the trend.

Human-wildlife conflict: UWA has invested in a number of interventions to address the human-wildlife conflict. Although these have to some extent reduced the incidences, more innovations are required to further reduce the problem.

Revenue sharing for communities: Communities need to be guided better on how to invest the provided money in self-sustaining projects.

Developments: UWA has put in place guidelines for implementing developments in protected areas and ensures that all projects are well monitored. Despite all these efforts, sometimes there are residual impacts that cannot be adequately addressed through the existing framework. More interventions are needed such as implementation of biodiversity offset so as to manage the residual impacts.

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CHAPTER 13: Forestry

INTRODUCTION

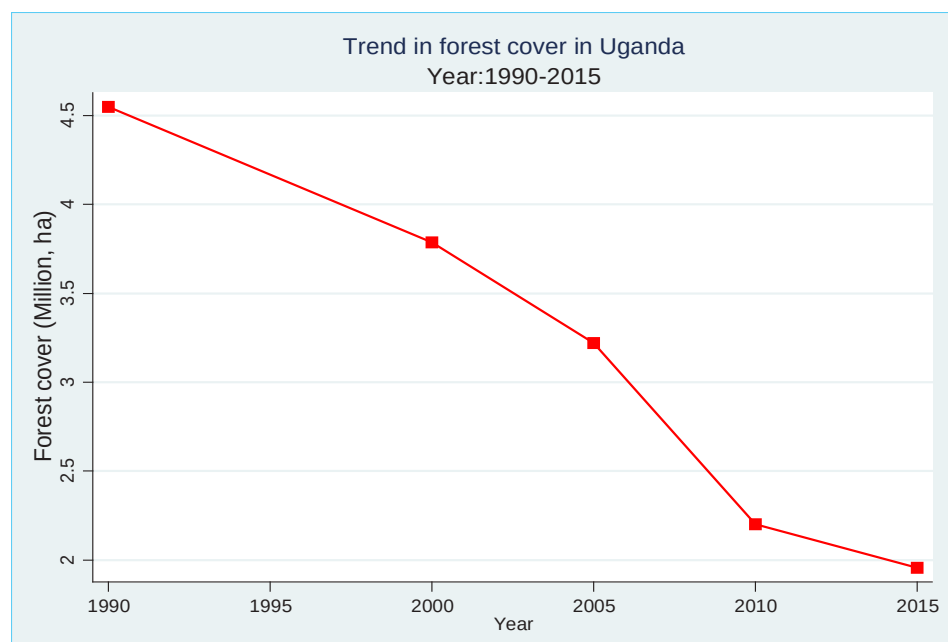
Forests provide ecosystem services that are critical for socio-economic development, agriculture, energy supply, livelihood improvement and adaptation to adverse impacts of climate change. Although the natural

forest cover was stable in the 1960’s, it has been declining. There was noticeable decline has been from 1990 to 2015 (Figure 13.1).
Status and trends

Bwindi Impenetrable Forest along Kisoro-Kabale highway
(Photo credit: Elizabeth Mutayanjulwa, NEMA 2017)

STATUS AND TRENDS

Figure 13.1: Trend in Forest Cover in Uganda between 1990 -2015



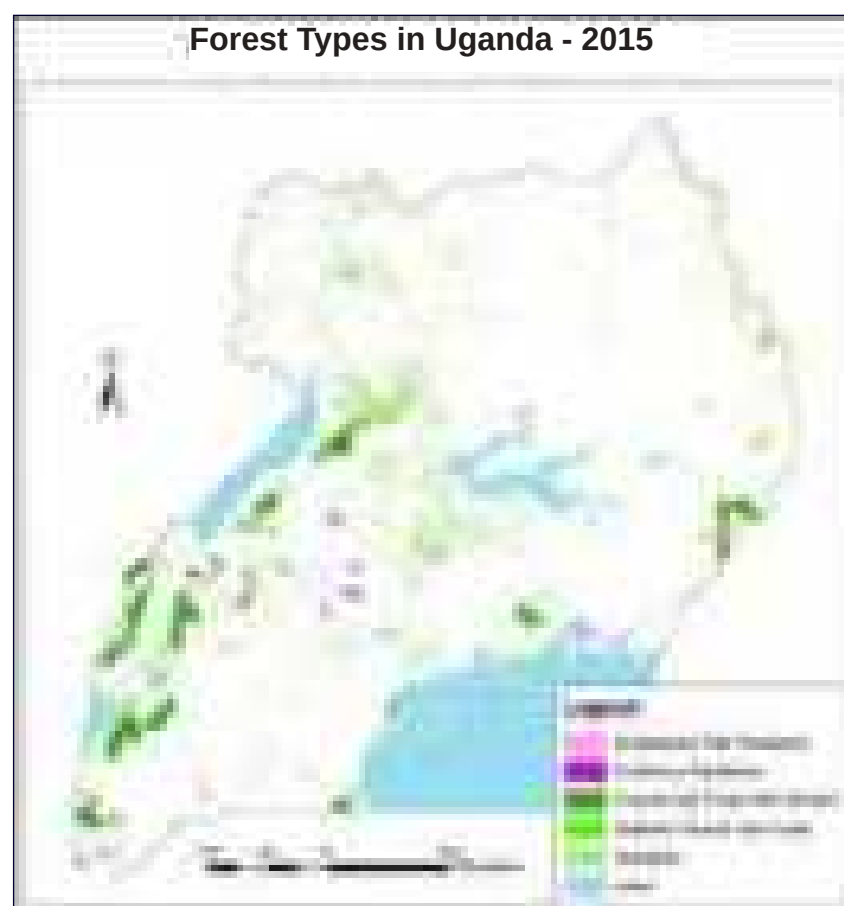
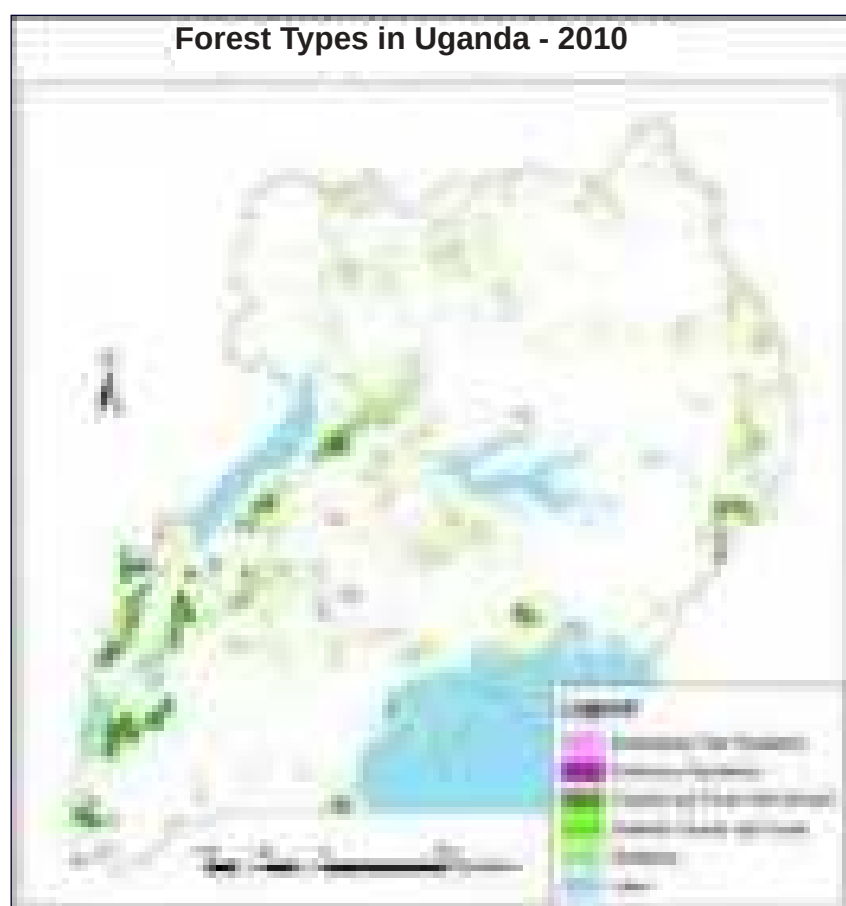
Source: Author's computation from UBOS data, 2015

Examining the two maps in Figure 13.2, it was revealed that whereas the coverage of the big forests has remained relatively stable, the smaller forests have significantly reduced in size. Others have actually been completely cleared. On a positive note, there has been an increase in planted forest.

Forestry products extracted from the forests

On average, about 37.5 million tons of different types of forestry products are extracted from the different forests around the country in the period 2002-2015. The minimum volume of forestry products extracted was about 28 million tons per annum while the maximum volume of forestry products was about 48.7 million tons per annum. The products extracted included charcoal, fuel for household, commercial and industrial use, poles and sawn timber. Figure 13.3 shows the distribution of the different forestry resources extracted leading to the forest cover loss.

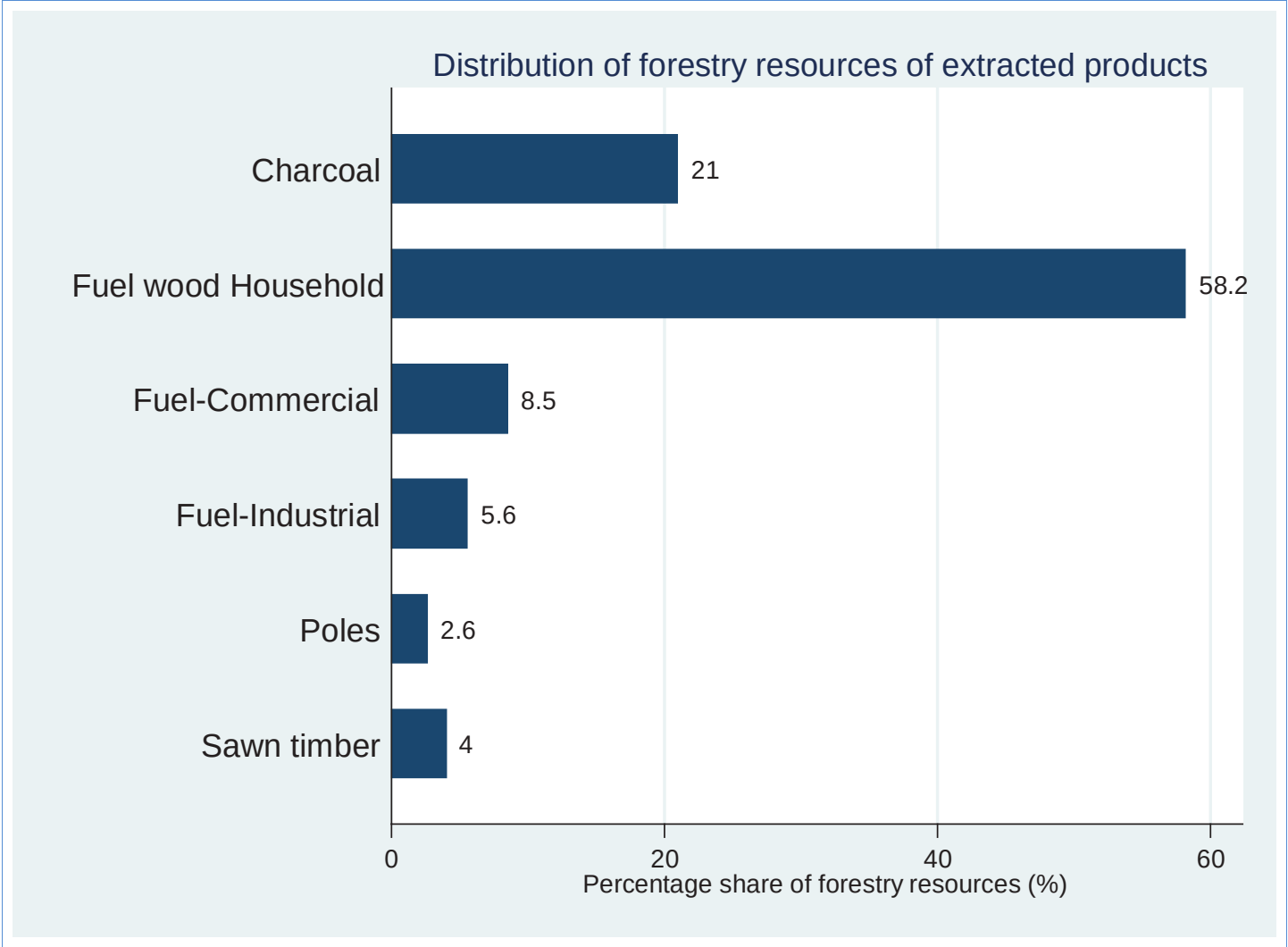
Figure 13.2: Forest cover of Uganda for 2010 and 2015



Several drivers have over time been associated with the clearing of these forests. These include clearing of land for agriculture, increased charcoal and firewood demand, infrastructure development, including expansion of urban centers, road infrastructure development and industrial

development of industrial centers, and excessive harvesting of non-timber forest products e.g. from targeted tree species. Below, we provide examples of areas that have drastically lost forest cover.

Figure 13.3: Comparison of quantities of the different forestry resources extracted in 2015



Source: Author’s computation from UBOS data, 2015

PRESSURES AND IMPACTS

Forest cover has been lost over time for various reasons. In addition to loss of surface cover for the soils, which may expose soils to erosion, several ecosystem services are lost whenever a forest is cleared. Some of these, especially provisioning services, will continue to be demanded despite the size of forest left. Loss of forest cover, therefore, has huge environmental, social and economic impacts.

Over 90% of Ugandan households use firewood or charcoal for cooking. This has exerted very high pressure on the wood resource, especially in the dry lands. Demand for agricultural land to feed the ever growing population and for export purposes. These activities have led to indiscriminate clearing of forested areas.

Demand for water for various services

Forests constitute the watersheds for Uganda. The long-term sustainable generation of energy from hydropower is dependent on how well the watersheds are protected. Loss of forest cover will undermine

this watershed function yet several hydropower facilities are under development. Loss of forest cover has also contributed to the long dry spells now being experienced in Uganda. The dry spells have negatively impacted on agriculture with most parts of the country registering crop failure and death of livestock (especially cattle, goats and sheep). The prolonged draught has over time resulted into migration and conflicts in north-eastern Uganda as the Karamojong sought water and grass for their livestock in the adjacent districts.

Wood fuel

Here, we use Yumbe district as an example of sites with high demand for wood fuel for both cooking and tobacco curing. Over 95% of the population use firewood for cooking and tobacco curing. All the tobacco farmers in the district grow flu-cured tobacco and most of the wood fuel obtained is from the natural trees (picture below). In addition, expansion of agricultural land into forested areas, unsustainable timber harvesting, charcoal burning, brick laying and the presence of refugees have greatly increased the pressure on the tree resource. The increased influx of refugees presents additional demand on the wood fuel resource.

Tree cutting for charcoal burning in Yumbe District



Targeted harvesting of some tree species

Several tree species were excessively harvested for fuelwood, especially because they make good charcoal, and for their medicinal values. Here we present a case of two species; *Prunus Africana* and *Afzelia Africana*.

Prunus Africana species threatened to extinction

Prunus africana species occurs in Kalinzu Forest Reserve, Mt. Elgon, Kibaale and Rwenzori National Park. In 2016, illegal harvesting of the species was recorded in Kibaale National Park. There is a high demand for the species by a high number of European pharmacies due to its very high concentration of the active ingredients needed for treating prostate cancer and other related health problems. *Prunus africana*, also known

by common names Red stinkwood, African cherry or Iron wood is an endangered plant species listed under the Convention on International Trade in Endangered Species of Fauna and Flora (CITES)- (MTWA, 2017). Below is a man cutting the bark of the tree for drying before exporting it abroad.

Afzelia Africana

The *Afzelia Africana* tree species is predominant in Arua, Moyo and Yumbe Districts in West Nile. The trees are scattered in community owned landscapes which are not protected. There has been massive cutting of this tree species. The harvest is transported in form of tree logs (picture below). The business is transacted between Buyers from Kampala and land owners within these communities.

Logs of *Afzelia* African tree species in Yumbe piled awaiting a truck for transportation



Here four hotspot sites were selected to show the impact of land conversion to both subsistence and commercial agriculture on forest landscapes.

Ruzaire and Kanaga are two Central forest Reserves found in Kibale district located about 3 km apart in western Uganda. In the 1990s and before, this region was covered by a mosaic of tropical high forests, farmland and rangelands. As the population of the area started increasing, the land cover started changing. Forests started decreasing while farmland increased. The housing and population census of 2014 indicated that Kibale had the highest population growth outside the Kampala metropolitan zone.

Figure 1 displays six maps of the Klamath River watershed, arranged in a 2x3 grid. The top row shows the 1986 and 2014 maps, and the bottom row shows the 1986 and 2014 maps. The maps use a color-coded legend to represent different land cover types.

Legend

- Water
- Forest
- Barren
- Grassland
- Shrubland
- Wetland
- Urban
- Barren
- Forest
- Grassland
- Shrubland
- Wetland
- Urban
- Barren
- Forest
- Grassland
- Shrubland
- Wetland
- Urban

once occurred in the landscape. Subsistence agriculture and bush were the dominant land cover/use types. In most cases, trees were just cut down and the areas planted with crop (See pictures below). The wood was not converted to other useful resources.

Forest cleared in Kinaga and planted with potatoes and pumpkin. Many large trees were killed by cutting them down or by debarking

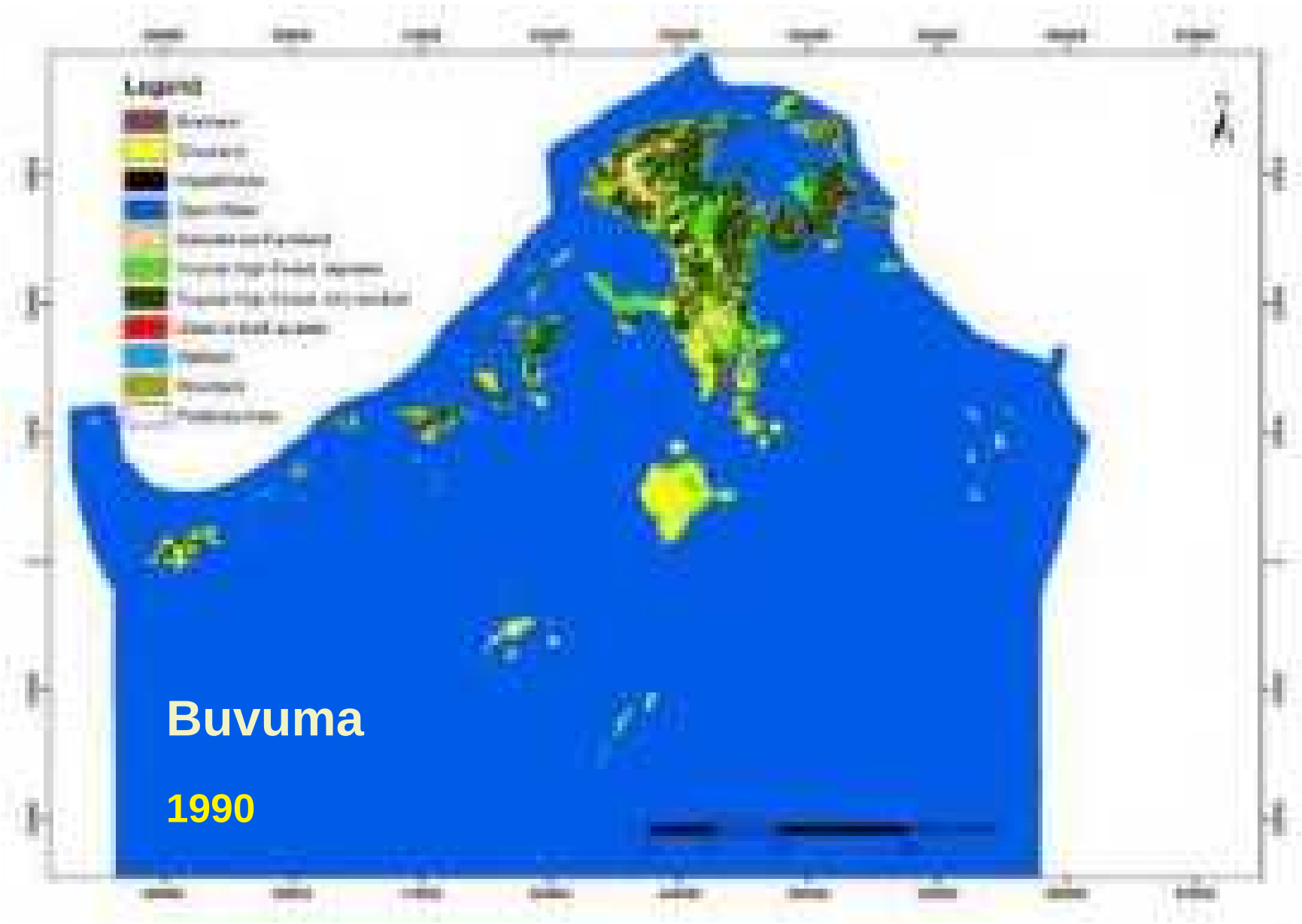


Buvuma Islands – deforestation including the protected areas for Agriculture

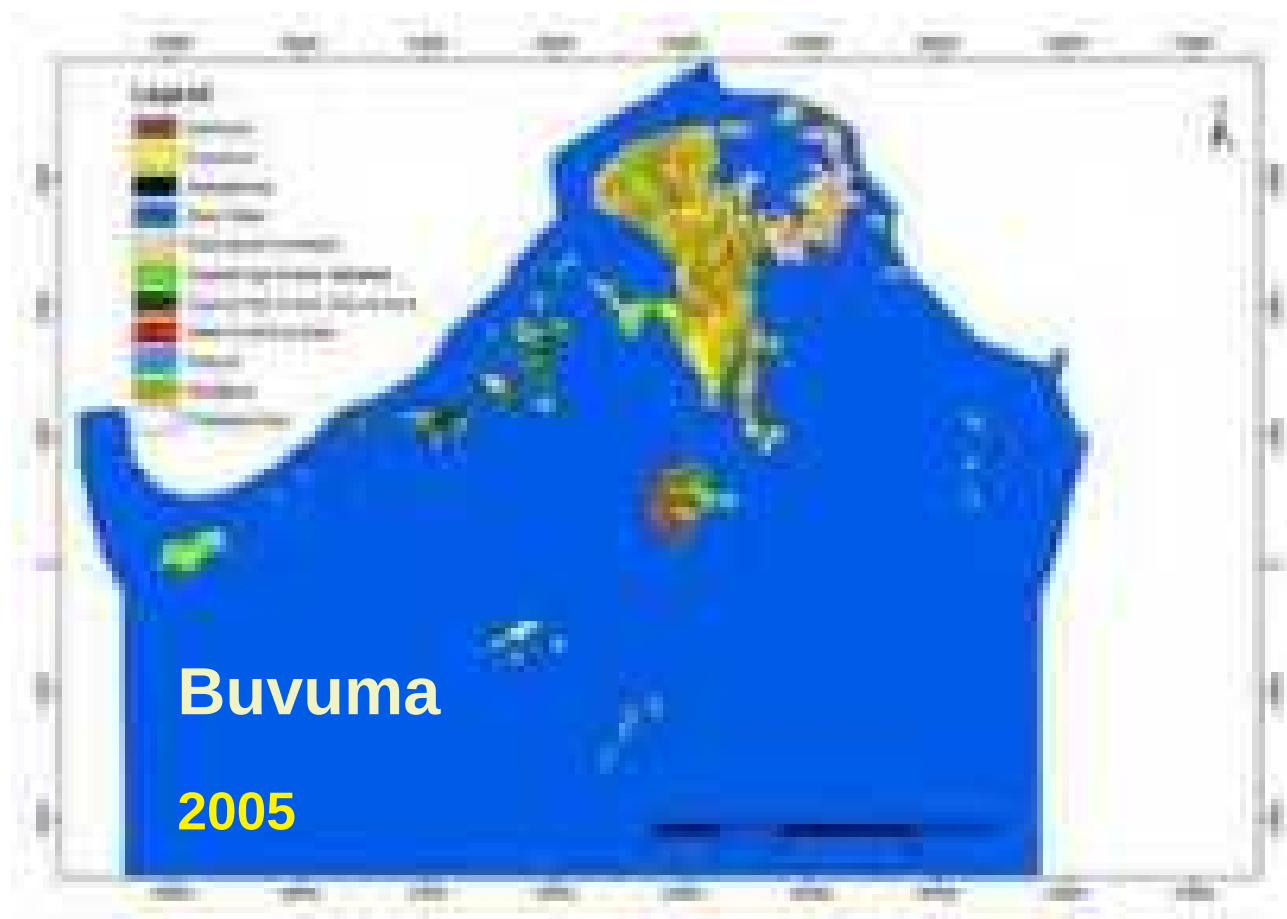
The Buvuma Island used to be covered by forest in 1990. As severe deforestation was taking place in other parts of the county, the forests in Buvuma were majorly protected by poor accessibility and the numerous forest reserves on the island.

Deforestation started increasing after the 2000 year as accessibility to the island increased. Topical high forest gave way to woodlands which persisted to the year 2010. There was also enhanced encroachment on forest reserves driven by speculation that the forest will be cut down anyway in order to grow palm trees for vegetable oil. Speculators anticipated lucrative compensation if palm oil investors found them occupying the land.

Figure 13.5: Land cover variation of forest cover on in Buvuma District between 1990 and 2015



Source: WCS, 2015



Source: WCS, 2015

Figure 13.5 shows that whereas most of Buvuma District was covered by forest cover in 1990, by 2015, it was mainly covered by subsistence agriculture. By 2005, most of the closed forest had been disturbed, probably through selective logging that it no longer qualified to be referred to as a tropical high forest but a woodland. This clearing was

indiscriminate of the protected areas. By 2005 the smaller islands still had their tropical high forest undisturbed. By 2015, most of the land on the main Buvuma Island had been converted to subsistence farmland, irrespective of its protection status, and the forests on the smaller island had been degraded.



Source: WCS, 2015



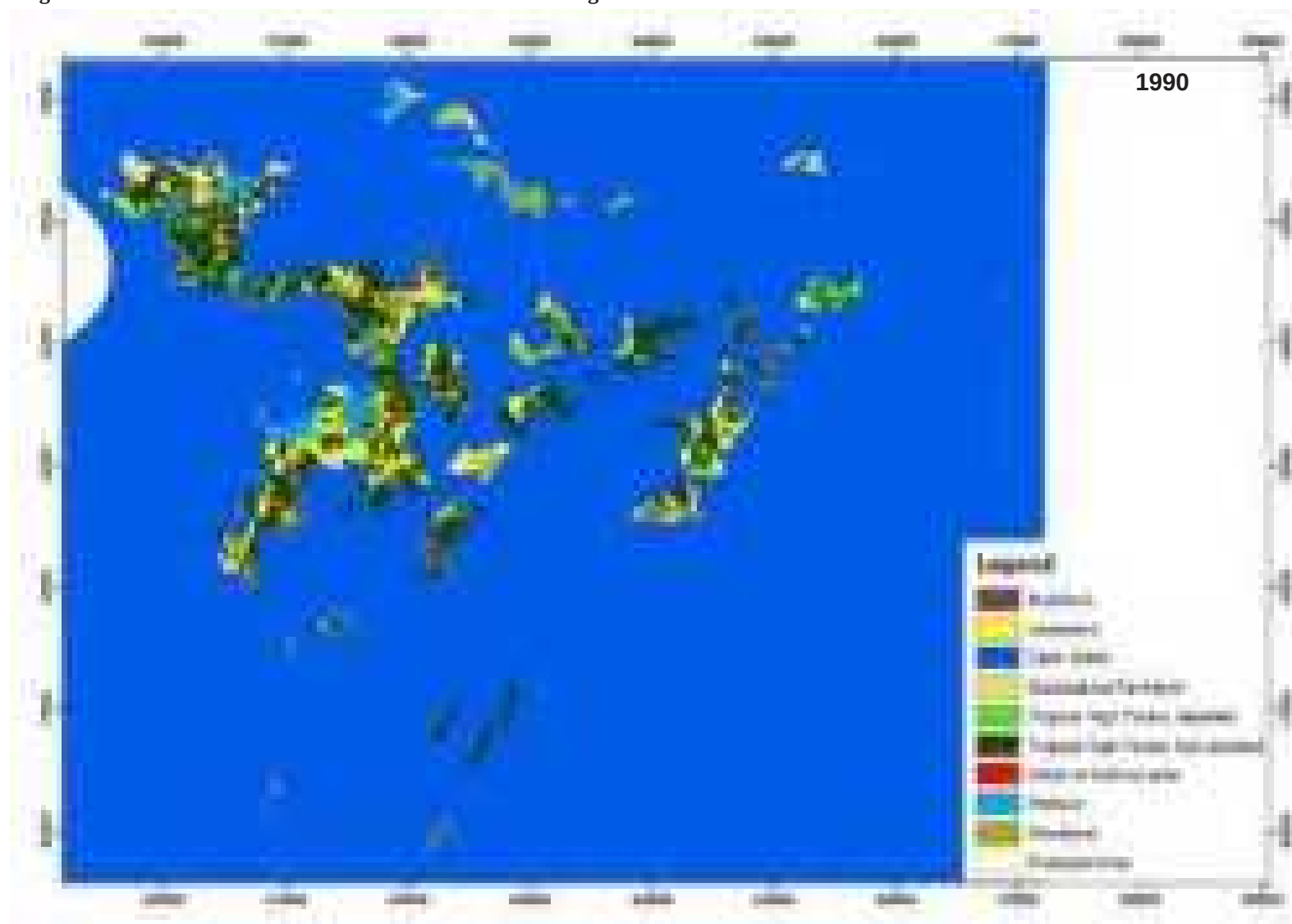
Lake Victoria shoreline surrounded by forests in Buvuma District.
Photo credit: Elizabeth Mutayanjulewa (NEMA 2015)

Kalangala Islands - Palm Farmlands along the Lake shores

Kalangala Islands are located in Lake Victoria and are a district on its own. Palm oil tree plantations are grown on the biggest Island of Bugala. Palm trees were grown in grassland areas of the Land but some of it was

grown in areas that were forested and had to be cleared first. Initially palm growing seemed to enhance protection of remaining forests especially in forest reserves. However, these forests started deteriorating and currently the hitherto luxuriant forests are heavily degraded.

Figure 13.6: Land cover variation of forest cover on in Kalangala District between 1990 and 2015

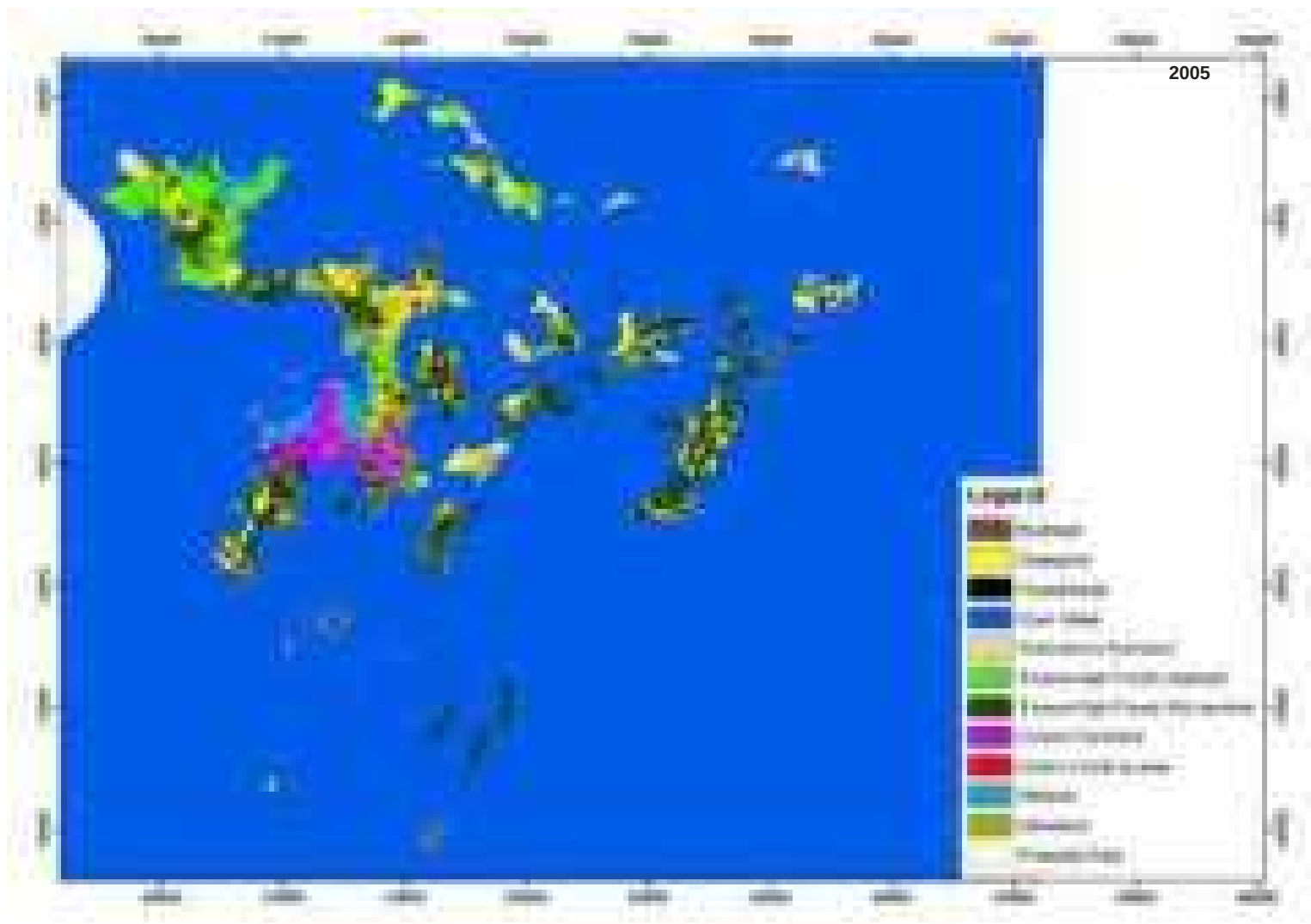


Source: WCS, 2015

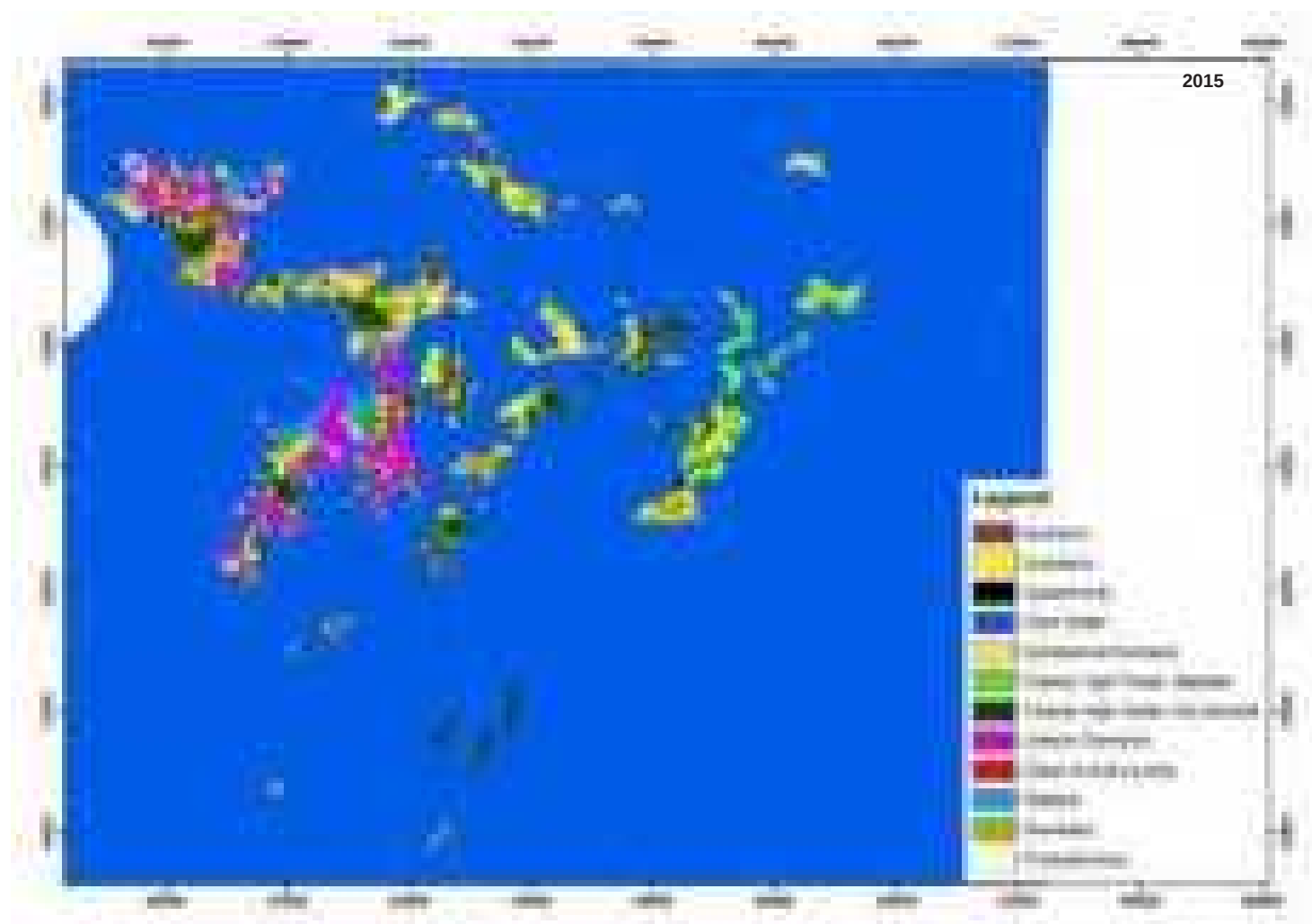
Figure 13.6 shows that whereas most of Kalangala District was covered by forest cover in 1990, by 2015, areas outside protected areas had been converted to either commercial or subsistence agriculture. By 2005, most of the southern part of the main island (Bugala Island) had been converted to commercial farmland (oil palm plantations) and forests that occurred in the northern part of the island had been depleted. Wetlands, which were once covered by grass and referred to as grassland, had also been exposed and could be clearly mapped. The forests on the smaller islands were, however, still relatively intact. By 2015, both the north and southern part of Bugala Island had been converted to oil palm plantations. In the southern part it had expanded past the areas it covered in 2005. The central part of the island had been converted to subsistence farmland. Most of the forests on the smaller island had been either depleted or converted to subsistence farmland. The main difference between Buvuma and Kalangala district mode of forest depletion is that whereas in Buvuma district all forests have been cleared irrespective of protection status, most of the protected forests in Kalangala district have been spared/conserved.



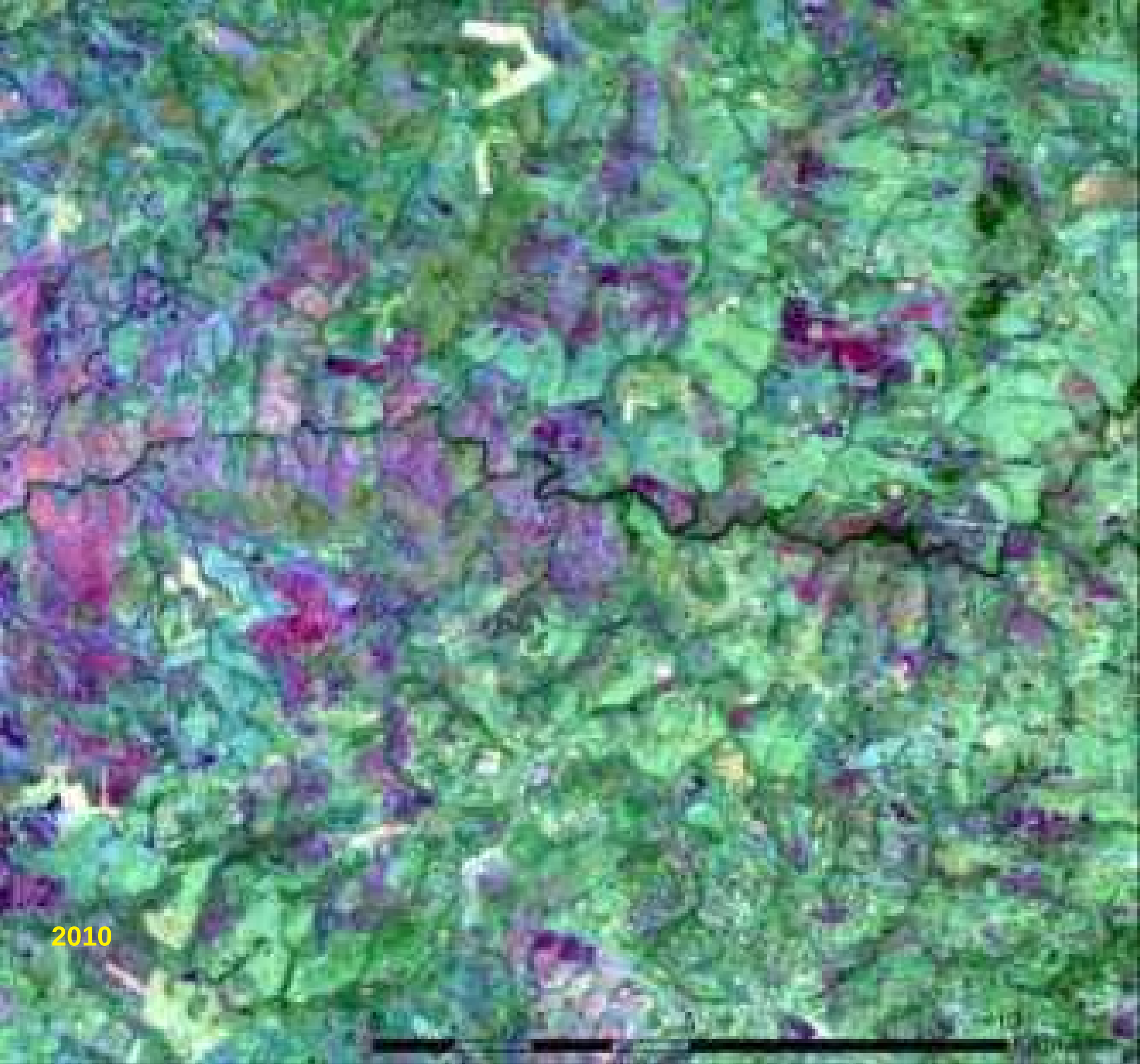
Palm plantation in Kalangala District (Internet photo)



Source: WCS, 2015



Source: WCS, 2015



Areas in Amuru District that have been cleared of forest in 2010 and 2017 (Source: UNEP GRID)

Amuru Commercial Farmlands

The western part of Amuru District was once a hunting ground known as Kilak hunting area until it was degazetted. Due to its protection status before degazettement and insecurity caused by Kony rebels after degazettement, this area remained uninhabited for a long time. When peace returned to this region, there arose high opportunities for commercial agriculture because there were large continuous fertile chunks of land where mechanization could be carried out.

Clips of Landsat satellite images of 2010 and 2017 of a portion of Amuru District showing the extent of clearing of the forested areas. Deep green = forested areas, light green = partially cleared forest or areas planted with crops, purple = cleared areas where vegetation is starting to regrow, and brown = bare areas



Areas in Amuru district that have been cleared of forest. The areas have increased in coverage between 2010 and 2017. The 2017 image shows most of the areas already disturbed i.e. lack of deep green color which depicts forest.



2010

Satellite images of Katuugo and Kasagala Central Forest Reserves in 2010 and 2016 (Source: NFA)

Katuugo and Kasagala Central Forest Reserves

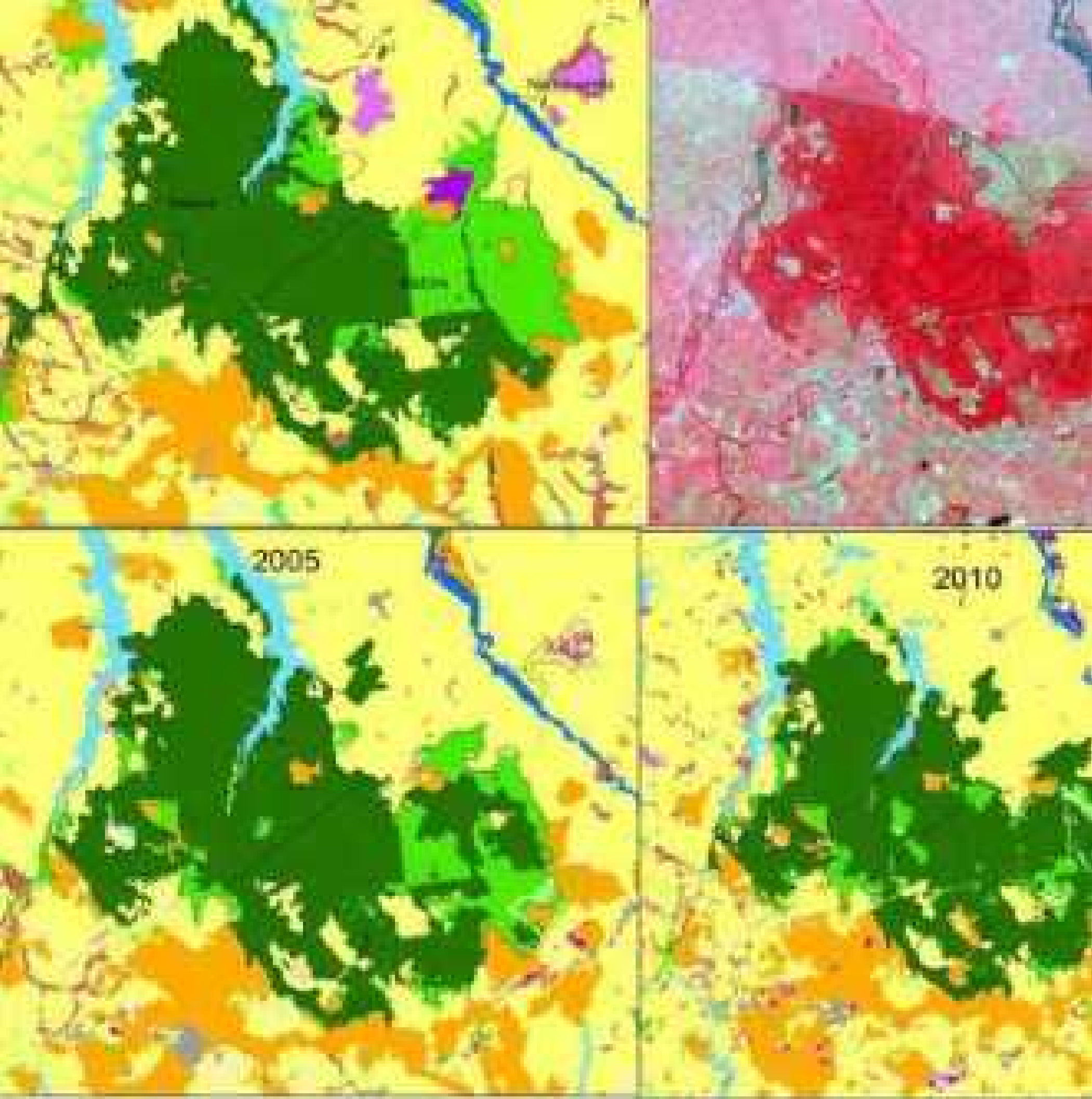
Nakasongola has been a rangeland famous for cattle rearing and charcoal production. In recent past, large scale agriculture has started emerging in Katuugo and Kasagala Central Forest Reserves.





Vegetation conversion for Agriculture in Karamoja (Kaabong) (Source: NFA 2016)



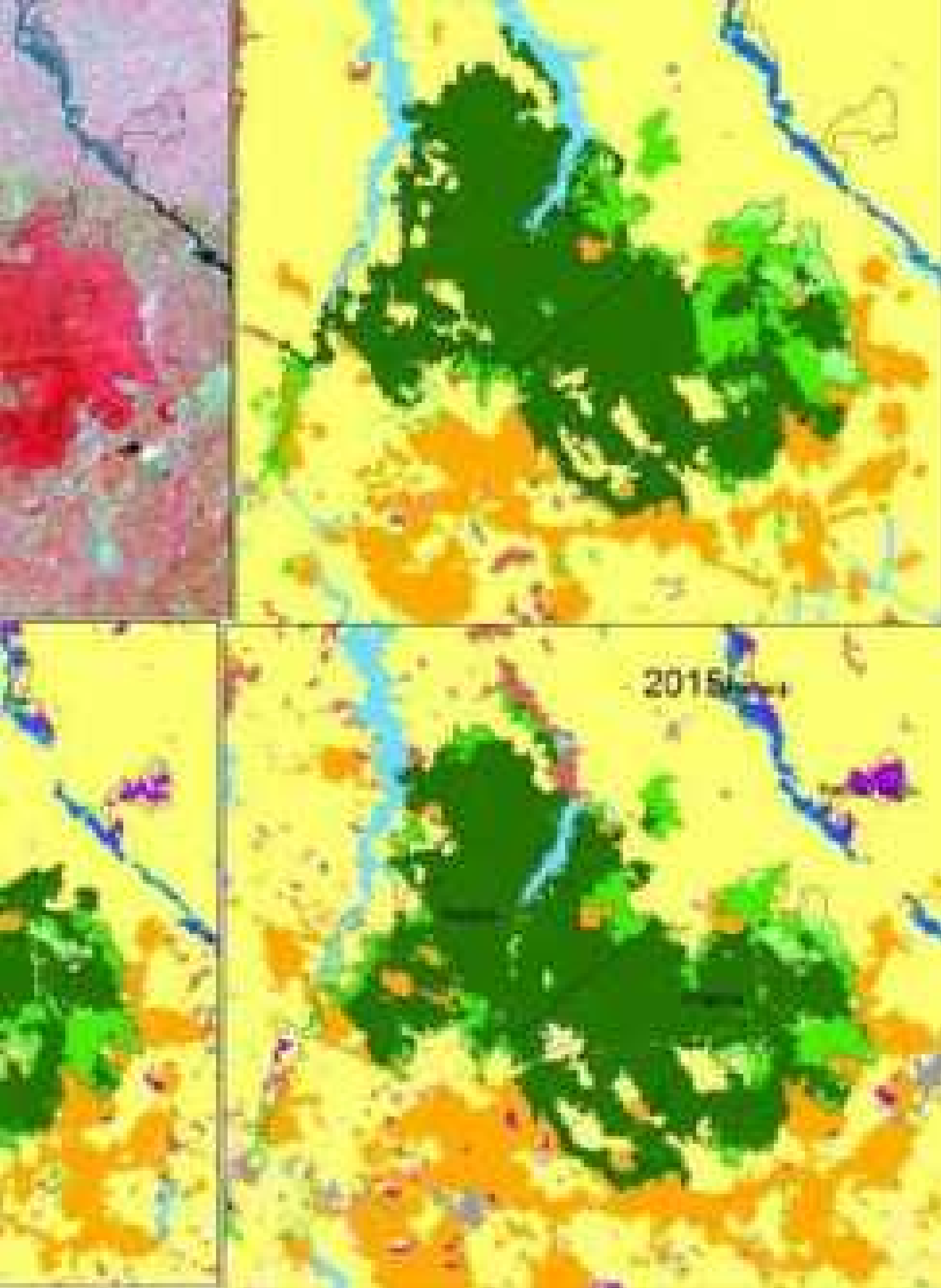


Land cover/use change of Mabira Forest Reserve between 1990 and 2015

Mabira - A success story of forest restoration and conservation

The Mabira Forest is a rainforest area covering about 300 square kilometres in Uganda, located in Buikwe District. The forest was heavily encroached in the 1970s and early 1980s. The Eastern side of Mabira

Forest Reserve and some pockets on its western side had been degraded in the 1980s. The large area on the eastern side was replanted and has been recovering over time. In 1990, it was all covered by a young forest but by 2015, most of the forest had matured to reflect true tropical high forest characterizes. Also pockets of degraded area that existed within the forest and on its western side have recovered.





Cattle grazing in Karamoja rangelands
Photo credit: Bob Nuwagira (NEMA 2016)

CHAPTER 14: Rangelands

INTRODUCTION

Almost 50 per cent of the Earth, two-thirds of Africa and 44 per cent of Uganda is covered by rangelands (Nalule, 2010). The area running from Karamoja region to Mbarara in a northeast to southwesterly direction is anecdotally referred to as the cattle corridor and the main livelihood there is livestock rearing. Rangelands support 90% of the cattle population in Uganda and about 85% of the total marketed milk and beef is produced from indigenous cattle, which feed on rangeland pasture ([tp://www.fao.org/fileadmin/user_upload](http://www.fao.org/fileadmin/user_upload)). Rangeland ecosystems and their biological resources play a critical role in overall socio-economic development and livelihoods of residents.

Uganda has a dearth of data on vegetation cover down to plant community level with (Langdale-Brown, Osmaston, & Wilson, 1964), giving the most comprehensive analysis of the vegetation cover (including rangelands) down to plant community level. A more recent account, (Robertson, Mendelsohn, & Jarvis, 2014) generally corroborates the findings of (Langdale-Brown, Osmaston, & Wilson, 1964), but does not describe plant communities in the area. Anderson and Robinson (2009) noted that the pastoralist systems are undergoing radical changes that are negatively affecting the pastoral livestock production.

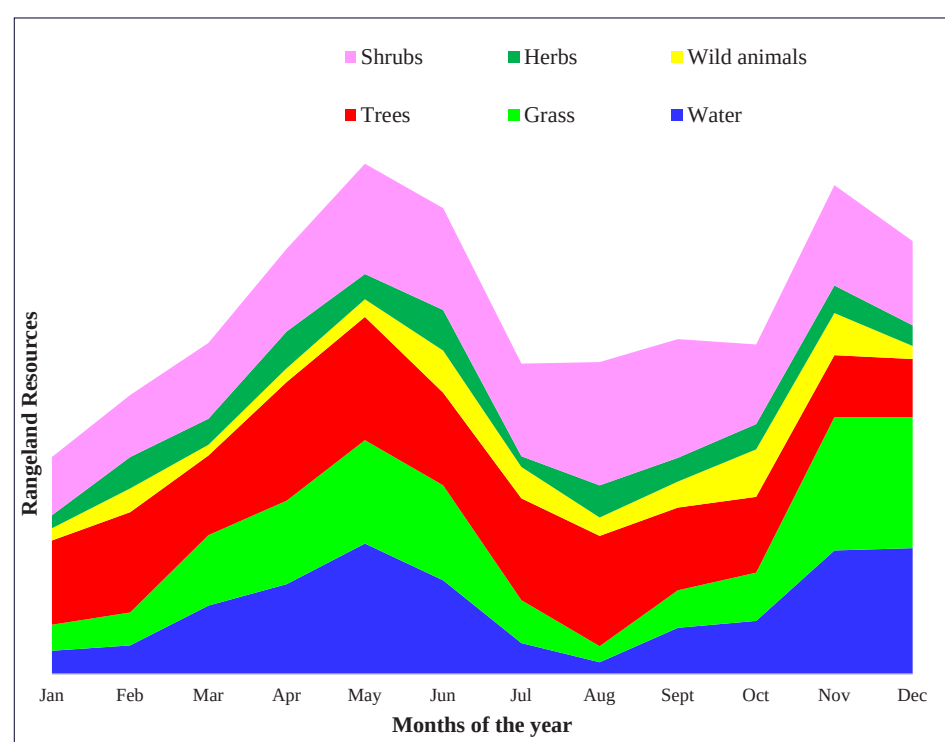
Rangelands are rich in resources

Rangeland ecosystems and their biological resources play a critical role in the country's overall socio-economic development and livelihoods. They host a rich genetic diversity of flora and fauna with the potential for improving livestock, improving crop genotypes, providing alternative food sources, curing diseases and providing numerous other benefits, including water for human and livestock consumption. Karamoja rangelands, for instance, provide habitat for a variety of wildlife including ungulates and other large grazing mammals from which the Ik people (mountain dwellers) get their animal protein. This diversity contributes significantly to the household food basket and income both in the dry and wet seasons. A typical household food basket in Nakasongola district is made up of milk, meat from cattle and goats, maize flour, cassava, beans, vegetables, fruits, honey, sugar and oil (Mbolanyi, Egeru, & Mfitumukiza, 2016). Seasonal availability of resources affects household expenditure. The dry season is characterized by declines in the availability of key resources (Figure 14.1) and this translates into an increase in expenditure at this time as compared to during the wet season.

Apart from differences caused by the seasons, rangeland areas under communal tenure have been shown to deliver a wider range of ecosystem services than land under private ownership in which cattle production is prioritized (Favretto, et al., 2016) (Favretto, Stringer, & Dougill, A case study of Botswana's Kalahari. Assessing the socio-economic and environmental dimensions of land degradation, 2014).



Figure 14.1: Monthly variations in resource availability across a year



Source: Mbolanyi B. et al, 2016

Status and trends

Subsistence farmland is the predominant land cover in the rangelands at 40.7 per cent followed by grassland and woodland at 34.5 and 11.5 per cent respectively.

The highest coverage of natural vegetation is found in the northeast (Karamoja region) and in the southern most parts of the country (NFA, 2015).

Figure 14.2: Land cover in Uganda's rangelands, 2015



Source: NFA, 2016

Productivity of rangelands

Herbage Dry Matter Yield

Herbage dry matter yield is an important factor in livestock production and is a reflection of the range condition. In Karamoja, the estimated

dry matter production at three sites, Nadunget in Moroto District, Lorengedwat in Nakapiripirit district and Nakicumet in Napak District, ranged from 619 to 1,764 kg/acre (Aleper et al, 2017).

Table 14.1: Average values for primary production, bare ground cover, dry matter estimate, estimate carrying capacity and height of herb layer for three study sites in Karamoja

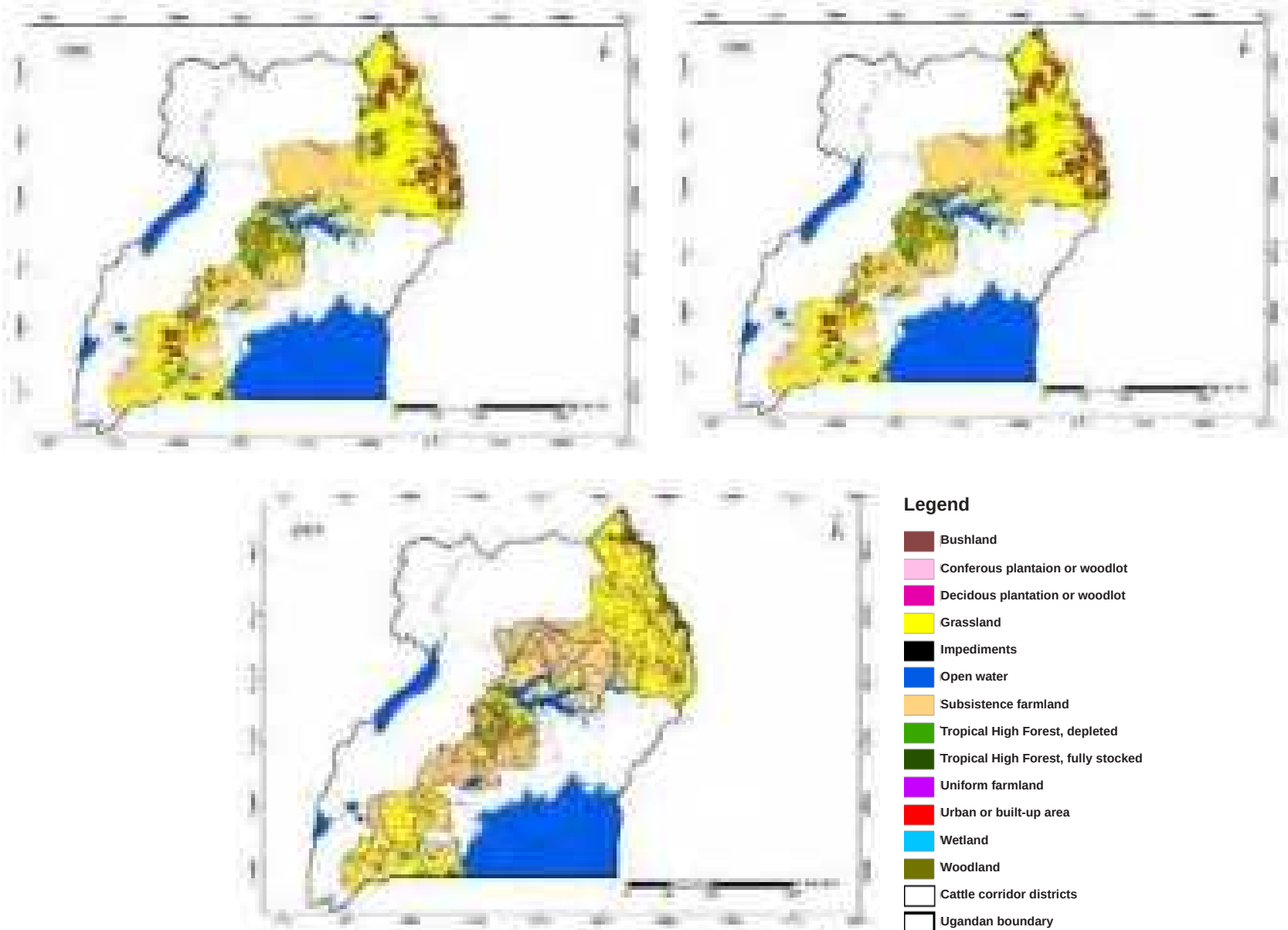
	Lorengedwat	Nadunget	Nakicumet
Primary Production (g/m ²)	417.5	242.2	694
Bare ground cover (%)	38	35	17
Height of herb layer (m)	0.9	0.4	1
Dry matter per sq. m (0.27% moisture content Aleper 2013)	304.76 gm	176.81 gm	506.62gm
25% harvest efficiency gm/ m ²	76.19	44.26	126.6
Dry matter production tons sq.km	14,435.53	1,912.5	58,437.12
Estimated foraging area sq. km	189.52	43.27	461.37
Estimated number of cattle	8,500	16,000	28,644
Estimated dry matter consumption kg per cow per month	273	273	273
Estimated cattle numbers	8,500	16,000	26,684
Estimated carrying capacity	52,877.4	7,005.5	214,055.4
Current status	Under stocked	>2Under stocked	Under stocked

Land cover change

The land cover/use mapping (Figure 14.3) shows that the area of land under subsistence farming has been increasing since 1995. Woodland, and to a smaller extent grassland, showed an overall decreasing trend

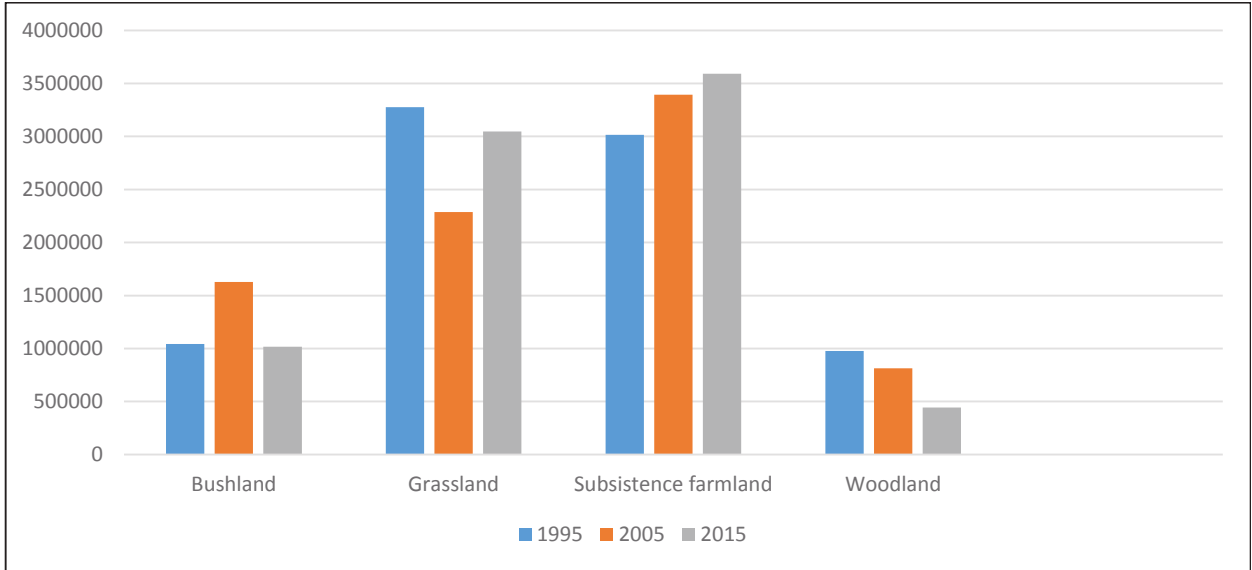
between the same years. The area of the largest classes was calculated for each mapped year and has been presented graphically in Figure 14.4.

Figure 14.3: Land cover changes in the cattle corridor between 1995 and 2015



Source: NFA, 2016

Figure 14.4: Change in area (hectares) of key land cover/use classes in the cattle corridor



Source: NFA, 2016

Land Tenure

In the cattle corridor, specifically in Karamoja, land is owned and grazed communally. The pastoral way of life has predominated but is under threat from market forces. Privatization of the communal rangelands has led to the over-grazing, soil erosion and degradation of the rangelands. Fencing off of private lands has led to overgrazing and overstocking of the remaining areas as communities that once used these lands for livestock grazing with less grazing area are left with smaller and smaller pieces of land. Overstocking occurs when the stock levels exceed the rangelands' carrying capacity, implying reduction of forage below the biological minimum when considered in terms of some unit of time (NEMA, 2007). The pastoralists in this area are yet to adopt modern land management methods.

Overstocking and overgrazing exposes bare ground which is a recipe for accelerated soil erosion and nutrient depletion resulting in reduced chances or failure of pasture establishment and growth. This situation has been observed in Nakasongola. An added challenge is the depletion of the soil pasture seed banks as was observed for palatable forage species *Panicum* and *Brachiaria* (Mugerwa & Zziwa, 2014).

PRESSURES AND IMPACTS

Population pressure

The main drivers of voluntary settlement are a combination of persistent drought and crop failure, famine, insecurity, loss of livestock, and poverty.

Within the rangelands, the population has grown by more than 50 per cent increasing the pressure on the available land. In addition, between 2000 and 2011, there was a three-fold increase in farmland in Karamoja caused mainly by government policy to modernize agriculture (Nakalembe, Dempewolf, & Christopher, 2017). This put much importance on crop and modern dairy farming while undercutting the pastoral livestock system despite its central role in the entire livestock sector. Consequently, many wetlands within the rangelands in Teso and Karamoja, which used to serve as grazing areas have been planted up with crops such as rice. The only area now available for grazing is the rangelands within the protected areas. The situation has further been made worse by the unpredictable weather conditions in the rangelands. As a result, communities that depended on livestock as their main livelihood have had to develop adaptation strategies including alternative livelihood options.

Cultivation is becoming more entrenched in the pastoral economy in western Uganda for a number of reasons. Many farmers have turned to agriculture to ensure food security. The use of milk as a source of food has drastically reduced since the establishment of commercial milk collection centres. As a result, farmers have turned to agriculture to supplement their food.

Climate change

Climate is a major determinant of the status of the natural resources and has already manifested itself through intense and frequent extreme weather events (Mubiru, 2010). The over exploitation of rangeland

resources such as water and wood species, especially on mountainous areas in Karamoja is thought to have affected the hydrological cycle with impacts on diversity of species and habitats. This is posing a serious threat to social and economic development. Persistent droughts, insecurity, poverty, restriction of livestock movement and loss of traditional institutions are the main causes of the degradation in Karamoja rangelands (Nalule, 2010). Migration both within and outside of Karamoja used to be a long-standing and important means of coping with stress and shock. However, this is no longer practice and instead new voluntary settlements are being set up in the rangelands formerly used for dry season grazing.

Overexploitation of resources

The use of the rangelands for sustainable livestock production is being undermined by a number of changes including conversion of grazing land to both small scale and commercial farming, overgrazing, and privatization of the communal rangelands. There has been an increase in bush cover in some areas, while in other areas there is clearance of trees for charcoal production. Shrub encroachment, has reduced available grazing area and contributed to overgrazing in Kazo in Mbarara district (Sabiiti & Wein, 1991) (Mugasi, Sabiiti, & Tayebwa, 2004). A recent study in Karamoja also revealed a reduction in woody cover and a change in species composition to dominance by fire resistant species like *Comiphora* and *Lanea species* (Aleper, Nyeko, & Namaganda, 2016). This is likely to be the case along most of the cattle corridor as the trend is facilitated by herbivore pressure, climate change and over exploitation of rangeland resources. Invasion by undesirable species, caused by various human activities, is an additional stressor to the rangelands.

Invasive species

Overgrazing and over exploitation of resources such as forests for firewood and charcoal is seen as one of the causes leading to the colonization of the rangelands by invasive and unpalatable species such as *Lantana camara* and *Senna tora*. These are common in overgrazed areas of Nakasongola and Nakaseke grasslands. Other invasive species that have invaded rangelands in the cattle corridor include *Amaranthus*, *Prosopis* (particularly in Karamoja), *Leucina*, *Leucaena leucocephala*, *Sena spectabilis*, *Sena siemea*, *Thevetia peruviana*, *Xanthium spinosum*, *Broussonetia papyrifera*, *Echinops giganteolls* and *Xanthium strumarium*. Invasive species have been reported to reduce crop and livestock production, encroach on native biodiversity, and increase production costs (USAID, 2014).

Recommendations

Rangeland resources contribute significantly to household food basket and income of communities through water, grass, trees and shrubs provision. The dry season is, however, characterized by low income and high levels of expenditure as compared to the wet season. Based on these observations, there is need to invest in improved management of rangeland resources to boost productivity and income.

Data should be regularly collected to document extent of fires, rangeland productivity, invasive species spread and impact of charcoal burning in the rangelands. Whereas some information is available for some areas such as the districts of Nakasongola and Nakaseke and the Karamoja region,

information about other parts of the cattle corridor is not available.

There is need to sensitize the herdsmen on beneficial approaches of using fire to improve availability of forage and reverse degradation. Investments on vector control by for instance, use of cattle dips and devising other ways of disposing off moribund vegetative material, by making briquettes, for example, need to be explored to reduce the need for bush burning.

Grazing management involves balancing the number of animals with the forage supply, selecting the appropriate species and classes of animals to be grazed, controlling the timing of grazing and distributing grazing evenly across the landscape (Briske and Heitschmidt 1991). Due to the combination of the communal ownership of most of the rangelands and the nomadic way of life of the cattle keeping communities, it is hard to have full control of these factors. Rangeland planning in communal

grazing lands should consider aspects like distribution of watering points to minimize effect of over concentration of livestock in certain parts of a landscape. Rangeland planning should be promoted in districts located within the rangeland areas.

Effort should be made to finalize and implement the rangeland policy so as to regulate the use of communal grazing areas, minimize their degradation and secure the rights of pastoralists over rangeland resources thus ensuring security of tenure and protection of property.

Farmer managed regeneration and enclosure management at private level could be promoted to reduce rangeland degradation, increase vegetation cover and increase availability of forage. At such enclosures naturally, growing pasture can be harvested or cultivated. Fodder production in enclosures enables enclosure owners to stock fodder for use during the dry season (Gaani et al., 2002; WOCAT 2003).

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Domestic waste in an urban area

CHAPTER 15: Waste and Environmental Health

INTRODUCTION

Waste generation and the need for effective waste management are inextricably related if sustainable development is to be realized. Poor waste management impacts community wellbeing and environmental health. As the population increases, consumption and production activities increase and so does the amount of waste that is generated. Cleaning up the waste places a great financial strain on the economy. For instance, by 2014, an estimated \$10,654,811 per year was spent on solid waste collection in Kampala alone (Nabukeera, Boerhannoeddin, & Ariffin, 2014).

Most of the waste is generated in urban areas with Kampala City accounting for the greatest volumes. Waste collection is primarily carried out by the respective local government authorities, however private sector involvement is on the increase throughout the country. Most of the waste collected is organic but there are new and emerging waste streams including electronic, medical and chemical wastes. These have the potential to pose serious health and environmental risks if not properly managed.

This chapter focuses on the state and trends of the waste management sector with particular reference to urban areas and the related risks and impacts.

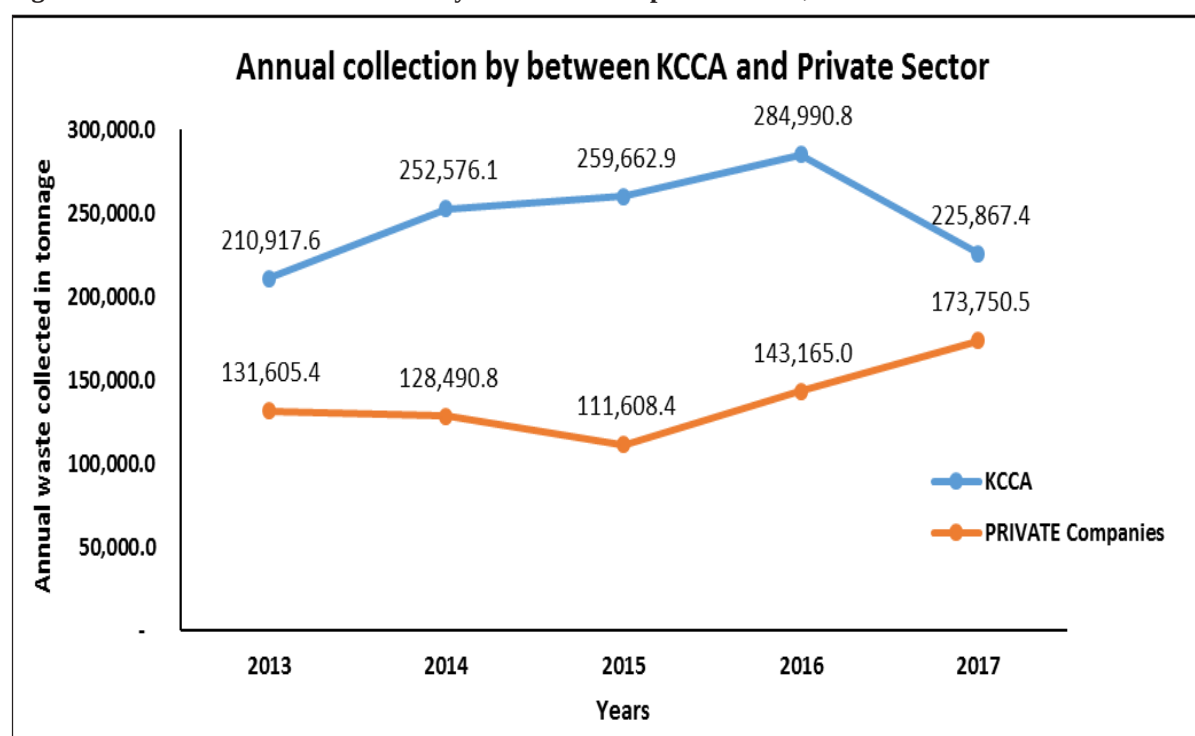
SOLID WASTE GENERATION IN KAMPALA CITY

Kampala's population is estimated at 1.5 million inhabitants while the Greater Kampala Metropolitan area population is estimated at 3.2 million. It is estimated that 70 per cent of the national GDP is generated within this metropolitan area (KCCA, 2014). The population in Kampala metropolitan area also generates the bulk of the waste (both commercial and domestic) in the country. Each person in Kampala is estimated to generate about 1 kg of waste per day which translates to 45,000 tons of waste per day and this was projected to increase by 43 per cent to 60,000 tons in 2017 (KCCA, 2014). Currently, most waste collection in Kampala is done by both Kampala Capital City Authority (KCCA) and the private collectors through a public private partnership (PPP).

Amount of waste and players in the waste management sector

There are improvements in the efficiency of garbage collection. In 2010, 16,000 tons of waste was collected, compared to 33,500 tons in 2014 – an increase of over 100 per cent (KCCA, 2014). Monthly collections in the city range between 28,500 and 35,500 tonnes, an efficiency rate of between 63-79 per cent (Figure 15.1). In the past when most collections were carried out by KCCA the efficiency rate was between 60-69 per cent. To improve on this, KCCA has encouraged PPPs to increase the efficiency and service coverage of waste collection. As a result, waste collection increased from 111,608 to 173,750 tonnes in 2015 and 2017 respectively (KCCA, 2014).

Figure 15.1: Domestic waste collected by KCCA and the private sector, 2013-2017



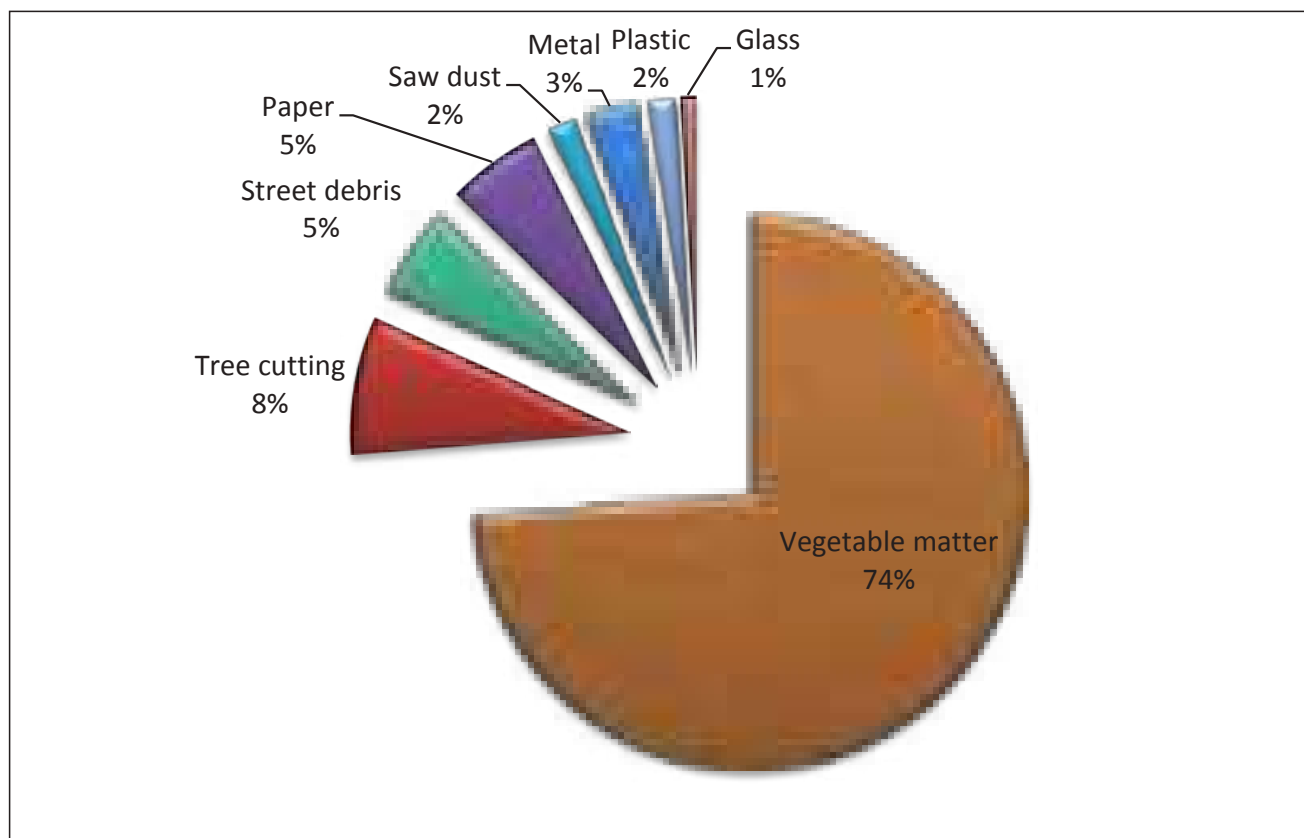
Source: Author's computation based on data from KCCA, 2017

Composition of waste

Most (74 per cent) of solid waste collected in Kampala city is organic consisting of vegetable matter (Figure 15.2). Other contents include glass, metal, plastics, saw dust, street debris and tree cuttings. This waste mix is likely to remain relatively stable in the short run, although the

proportion of plastic waste is expected to increase. Plastic waste, particularly polythene bags commonly known as *kaveera*, continue to be produced and used widely across the country. This is mainly because of poor enforcement of the 2009 ban on plastics of 100 microns and below. Figure 15.3 shows the composition of solid waste collected in Kampala City.

Figure 15.2: Composition of solid waste in Kampala City, 2017



Source: Author's computation based on data from KCCA, 2017

TREATMENT OF MUNICIPAL WASTE

Solid waste

Out of the 13 municipalities in Uganda, only 8 have solid waste treatment plants each with a daily average capacity of about 70 tonnes amounting to a total of 560 tonnes per day. The municipalities, in total, generate about 370 tonnes of solid waste per day, so for now the available waste handling capacity is adequate (NEMA, 2016). However, there is a need to scale up the construction of additional waste management facilities in the remaining municipalities and town councils.

Waste water

The National Water and Sewerage Corporation (NWSC) is responsible for the treatment and management of waste water. There are about 13 wastewater treatment plants established by NWSC across the country. On average the effluent plants receive about 3,700 cubic meters of wastewater per day with an outflow of about 1,370 cubic meters per day (NEMA, 2016). However, this does not account for all the wastewater generated in municipalities as there are cases of limited connectivity to the sewerage system. Some of the effluents have a lot of nitrogen and phosphorus that makes it suitable for the manufacture of fertilizers.

Table 15.1: Wastewater and solid waste management

Wastewater	Quantity
Number of treatment plants	13
Inflow rates m ³ /day	3,736
Outflow rate m ³ /day	1,369
Contents of waste water in mg/l	
Effluent BOD	81
Effluent COD	199
Effluent TSS	121
Effluent Total N	10
Effluent Total P	35

Source: NEMA, 2016

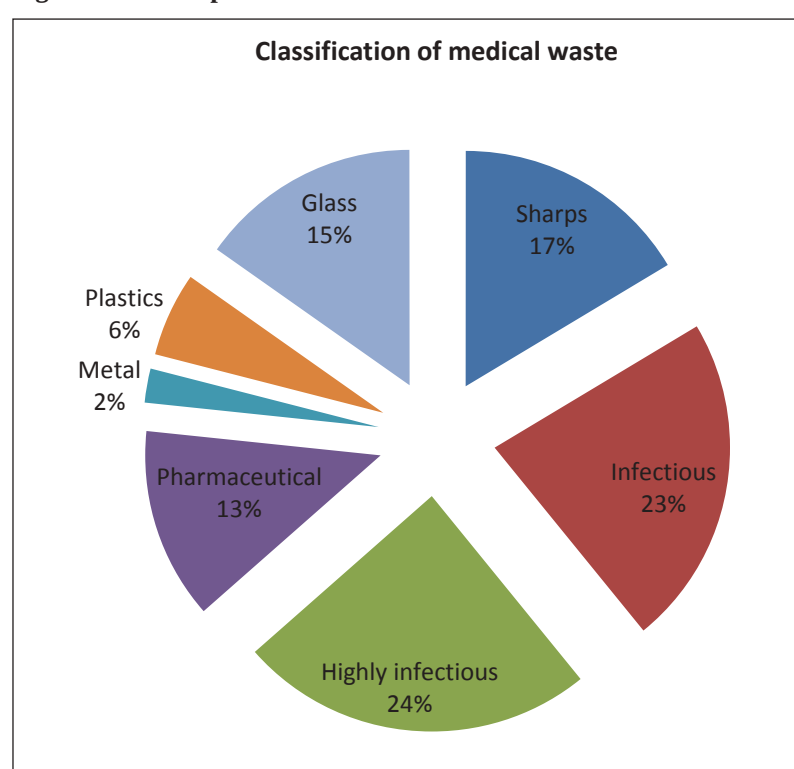
Medical Waste

The Ministry of Health under a PPP engaged Green Label Services Limited to collect Health Care Waste from a number of facilities in the country. These health facilities include hospitals, Health Centre (HC) IVs and HC IIIs that are involved in Voluntary Safe Male Circumcision. A total of 69,106 tonnes of medical waste was collected in the financial year 2015/16 across the districts in Uganda (GLSL, 2015/16). The largest proportion of medical waste is made up of highly infectious waste (16,844 tonnes) while metals made up the lowest proportion at 1,617 tonnes. However, not all the highly infectious waste is collected and data is lacking from some districts like Kampala which has the largest number of health facilities. Disaggregation by region shows that Central region leads in medical waste collection while the Northern region has the lowest percentage of collections (Figure 15.4). Most of the infectious

medical waste was collected from the Central region while most highly infectious waste came from the Western region. The Northern region had more pharmaceutical waste compared to other regions while Eastern region topped its counterparts in glass medical waste collections (*Green Label Services Limited (GLSL 2015/16 FY)*).

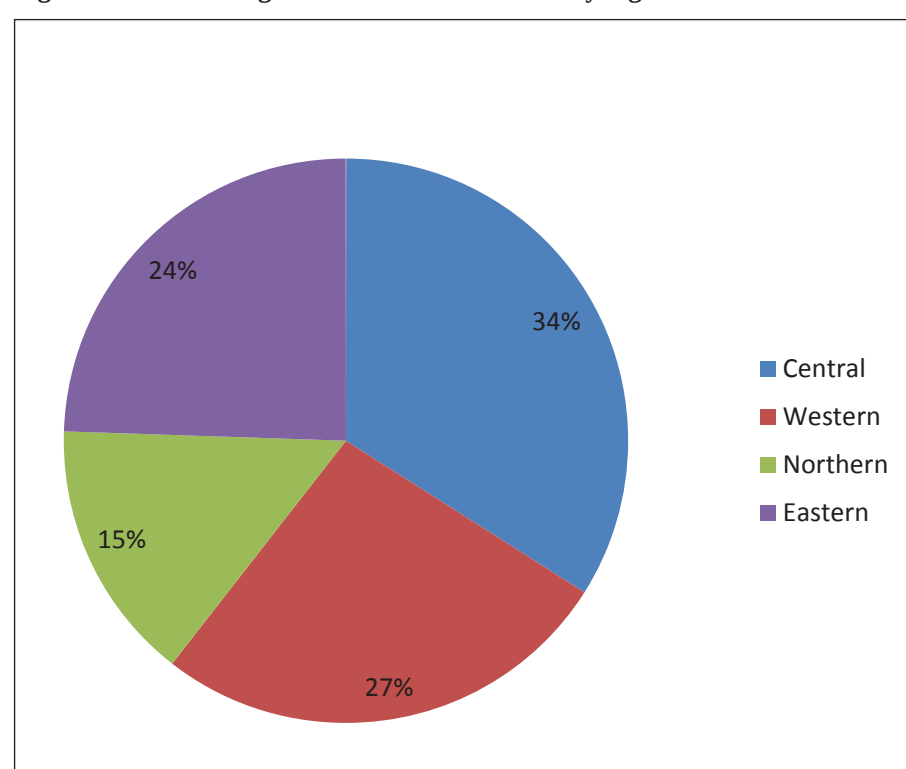
Challenges reported during collection of medical waste data included lack of reliable funding to conduct health care waste collection, transportation, treatment and final disposal. There is also low prioritization during budgeting cycles, poor waste segregation practices, lack of regional facilities to handle waste, ever increasing volumes of waste as programs scale up services, lack of infrastructure at lower levels for managing health care waste, high turnover of waste handlers at all levels and the private sector not willing to pay for health care waste management among others.

Figure 15.3: Composition of medical waste 2015/2016



Source: Green Label Services Limited (GLSL 2015/16 FY).

Figure 15.4: Percentage medical waste collection by region



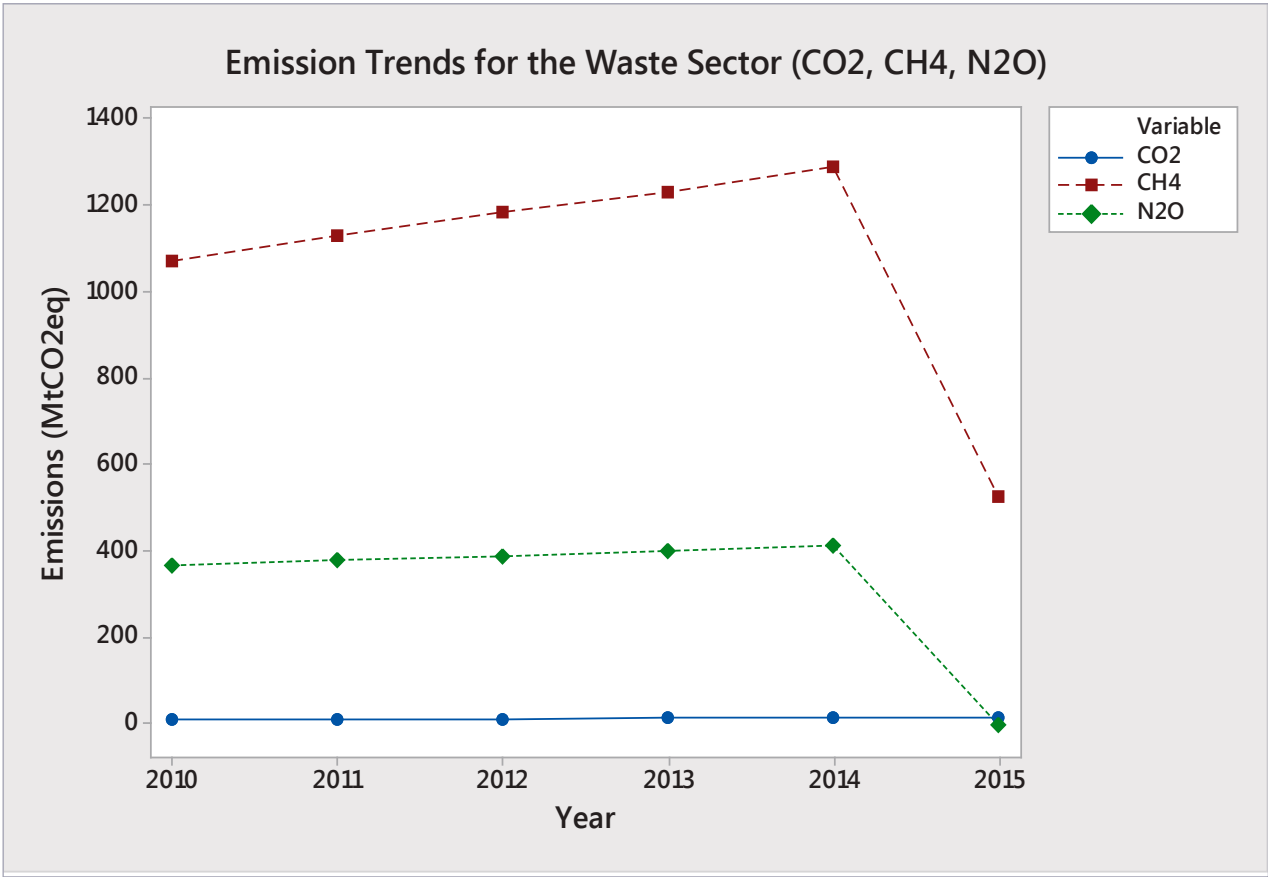
E-waste

Electrical and electronic wastes include discarded televisions, radios, refrigerators, air conditioners, cell phones, computers, and all other electrical and electronic materials. As the economy and socio-economic status of Ugandans improves more E-waste is expected to be generated. On average it is estimated that each household in Uganda has two mobile phones and each government office has two to three computers or laptops (MICT, 2013). Safe disposal of these gadgets remains a serious public health concern as it is common to see piles of old and used phones being sold at giveaway prices on the streets of Kampala City. It is necessary to develop a policy to ensure the safe management and disposal of electronic equipment.

Emissions from the Waste Sector

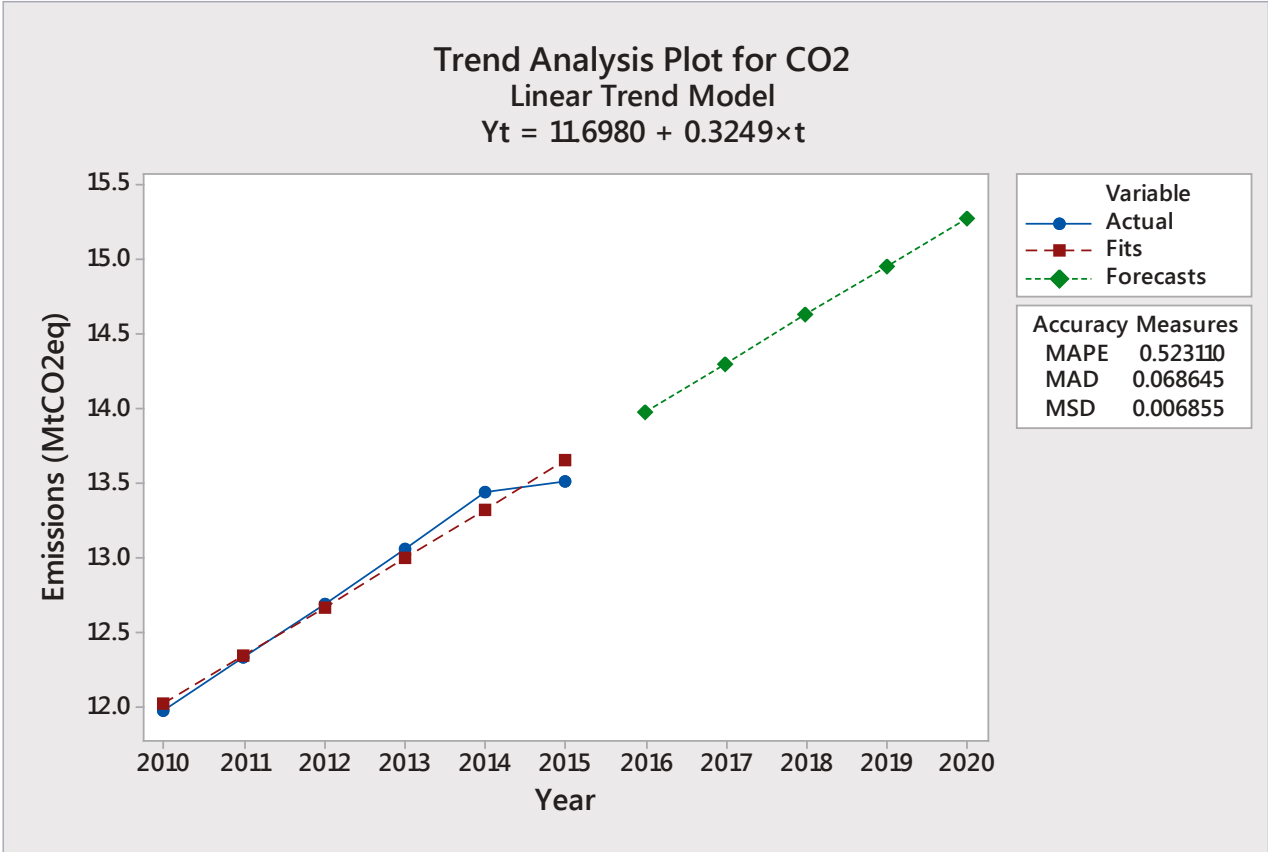
Emissions from the waste sector occur as a result of human activities and the natural biological breakdown of organic material. In Uganda, the most common gas emissions are Methane (CH₄), Nitrous oxide (NO₂) and Carbon dioxide (CO₂). Methane gas, the highest emitted gas, is a major product of the decomposition of organic matter. Overall, there was a remarkable decline in emissions of both Methane and Nitrous oxide after 2014 while Carbon dioxide remained stable for the period between 2010 and 2015. It was only in the waste sector where Carbon dioxide (CO₂) was least emitted greenhouse gas.

Figure 15.5: Emission Trends for the Waste Sector, 2010-2015



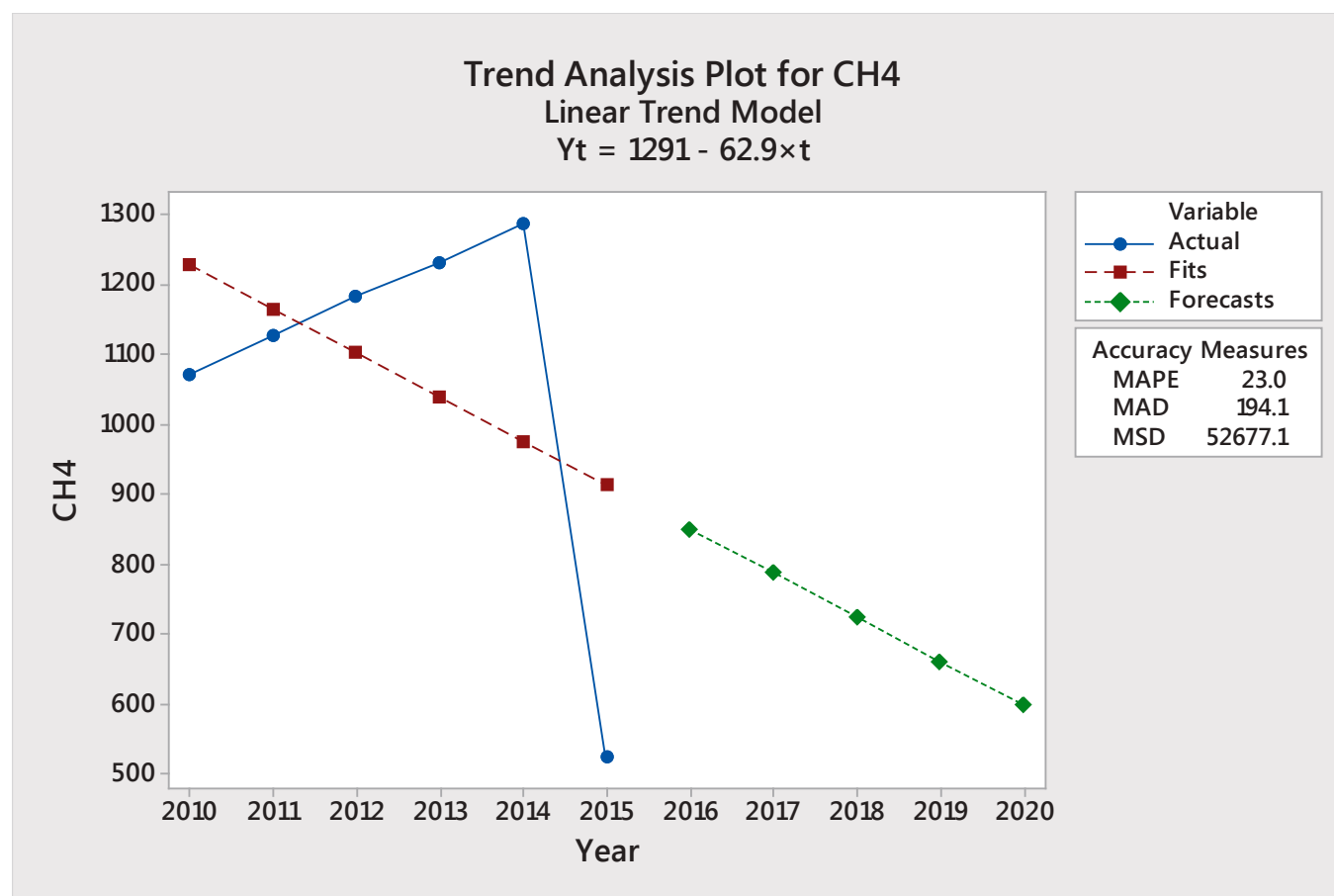
Source: Uganda National Greenhouse Gas Inventory Management System, 2016

Figure 15.6: Trend analysis and projections for CO₂



Source: Uganda National Greenhouse Gas Inventory Management System, 2016

Figure 15.7: Trend analysis and projections for CH₄



Source: Uganda National Greenhouse Gas Inventory Management System, 2016

PRESSURES AND IMPACTS

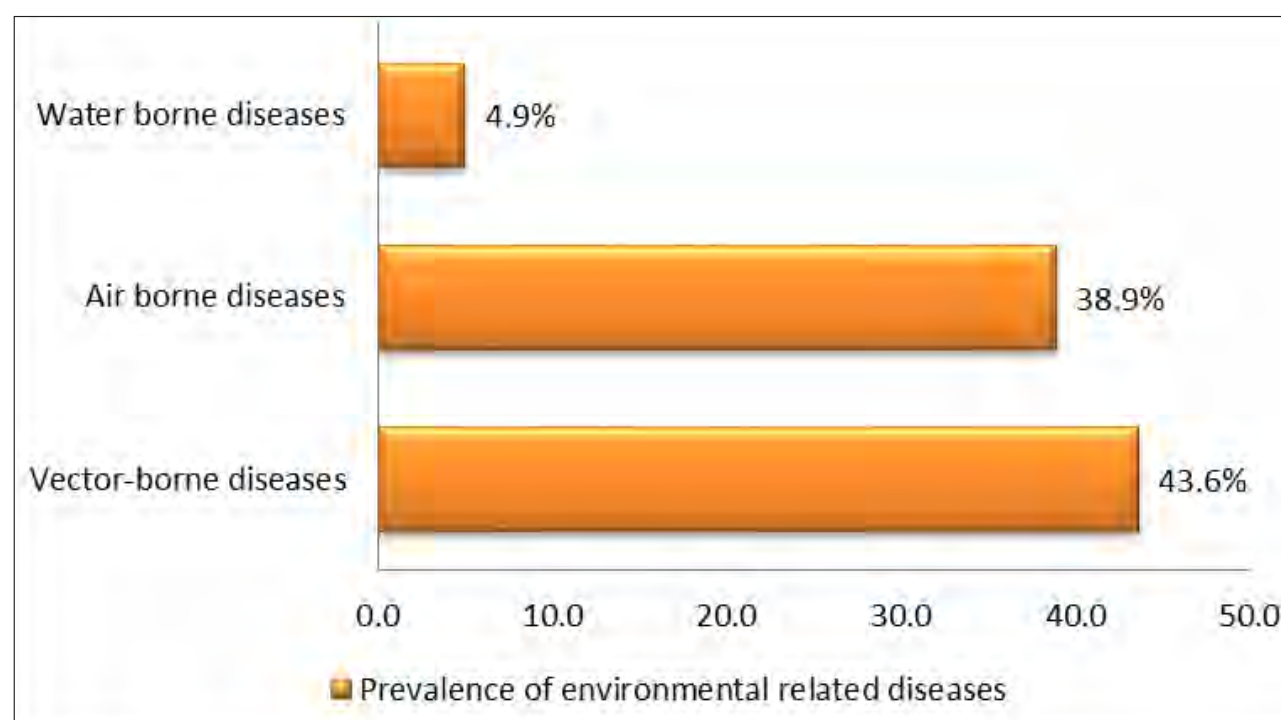
Rapid urbanization and increasing population are drivers of waste generation. The huge amounts of waste are in turn putting pressure on the existing waste management system. The urban population (both as a result of natural growth and rural-urban migration) is growing exponentially and urban authorities have to step up and expand the waste management amenities in tandem. As more people migrate from the rural areas, poverty forces them into housing in informal settlements found in the hinterlands of urban areas. Waste generation in these informal settlements is high and lack of access to these areas hinders the local authority's efforts to collect and remove the waste. As a result, there is much open and illegal dumping leading to noxious odours, unsightly and unsanitary environments and risks of disease exposure. Exposure to environmental health diseases pose a huge financial burden on the urban poor.

In Uganda, landfilling is the most common waste management practice and with increasing waste more land is demanded for expansion. KCCA's land fill at Kiteezi, for instance, is already full to capacity and many municipalities are struggling with locating new land fill sites. Expanding into new sites poses new risks to the health of communities and an environment that was initially clean and healthy. This is addition to related risks including release of methane from the anaerobic decomposition of organic materials.

Solid waste also continues to increase in volume and records show that less than a half of the waste generated remains uncollected. By 2017, only 43 per cent of the faecal waste generated daily in Kampala is currently emptied from the pit latrines and safely managed (MWE, 2017). Uncollected waste normally is dumped in open areas, streams, wetlands, open drainage channels, and other areas inaccessible to waste collection vehicles, thus creating environmental and public health hazards for local residents. The risk of contamination of water sources, air and land-based activities remains high. Illegal dumping has lowered the level of sanitation and hygiene in some neighborhoods exacerbating high risk of diseases like cholera, dysentery, malaria among others. In 2016 for instance results from biological water testing in selected districts showed that water borne diseases were on the increase as a result of *E. coli* contamination of water at the point of consumption. Findings revealed that about 1.5 million people presented with typhoid fever at various health facilities in Uganda (MWE, 2017). In addition, to poor health outcomes, inadequate waste disposal results into unpleasant smells and inconveniences from birds, flies and animals.

The requirement to replace television transmission technologies as specified under the Digital Migration Policy for Terrestrial Television Broadcasting in Uganda (2011) is going to lead to an increase in e-waste generation such as TV screens, set top boxes and antennas (MICT, 2013)

Figure 15.8: Prevalence of environmental related diseases among the population



Source: Author's computation from MWE data, 2017

About 44 per cent of the diseases among the population are vector borne. These include diseases like malaria, Yellow fever, Schistosomiasis and Leishmaniasis. Among the vector borne diseases, malaria is still the leading cause of morbidity among the population. About 17 million Ugandans are at risk of getting a malaria episode in a year. The prevalence of airborne diseases in 2016 was estimated at about 39 per cent while that of waterborne diseases was at about 5 per cent (UBOS, 2016). Airborne diseases like respiratory infections appear to be the leading cause of morbidity with estimated cases of about 11 million people per year. They are compounded by indoor air pollution mainly caused by poor ventilation in houses.

Privatization of garbage collection services has meant that the low-income segment of the population is out-priced from using this service. On average a household in an urban area pays U.Sh 30,000 per month for waste disposal which is out of reach of many urban poor. The inability to pay and lack of awareness results into poor waste management methods at household level. These include illegal dumping or burning of dangerous and hazardous waste including plastics and highly flammable containers among others. There are risks of pollution which can predispose the household to asthma, breathing complications and cancer depending on the waste being disposed. Also waste decomposition results into other emissions. While some of these gases are relatively nontoxic, release of big volumes into the atmosphere is harmful and undesirable contributing to global warming. Houses with poor ventilation are at a bigger risk from these gases as they displace oxygen for breathing resulting into respiratory related complications.

While the risks from e-waste have not been well documented in Uganda, it is well known that most e-waste contains potentially harmful material including lead and mercury. Health risks associated with e-waste may result from direct contact with harmful materials such as lead, cadmium,

chromium, brominated flame retardants or polychlorinated biphenyls (PCBs), from inhalation of toxic fumes, as well as from accumulation of the chemicals in soil, water and food (WHO, 2018). Where recycling is involved activities such as dismantling of electrical equipment may also pose an increased risk of exposure.

Responses

KCCA has put in place a number of policies to improve the management of solid waste in the city. There are also policy and operational responses by different stakeholders with respect to other types of waste in the country. The Kampala Integrated Solid Waste Management (ISWM) plan aims to improve the solid waste management services in the city through engagement of the private sector and the possible commercial utilization of refuse products and landfill gas through a Public Private Partnership (PPP) project. The ISWM project is being implemented in two phases. Phase 1 which will streamline collection and transportation of municipal solid waste and Phase 2 which will ensure treatment and final disposal of the municipal solid waste. Within Kampala, PPPs are operational with six of the seven zones being managed by private waste collectors.

The Bill and Melinda Gates Foundation is working with KCCA to improve faecal sludge management within the urban poor areas of the city through the Kampala Faecal Sludge Management (KFSM) Project. It is using a private sector led service delivery model. Currently, a mobile sludge transfer tank is being piloted in 5 parishes of Kampala: Bwaise II, Kanyanya, Kibuye I, Mutungo and Nateete.

Kiteezi landfill is currently full to capacity and plans are underway by KCCA to open up an alternative landfill site at Ddundu in Mukono district under a PPP model and proposed for operationalization in 2019 (KCCA, Undated).

A National E-Waste Policy was developed in 2012 as required by the National ICT policy and the various environmental laws and regulations. An e-waste strategy to implement the policy has also been proposed. The E-waste Policy also calls for the development of regulations, standards and guidelines to ensure the complete lifecycle management of electronic waste right from when it enters the country through to final disposal (MICT, 2013).

Green Label Services has been engaged by Ministry of Health to collect Health Care Waste from a number of facilities in the country. This is further hoped to improve health waste management in the country.

In 2014 Parliamentary committee on budgeting had asked Government to uphold the ban on the importation of used computers to stop the country from being used as a dumping ground (MICT, (2013). Maintaining the burn reduces on E-waste volumes particularly from computers

Municipal Solid Waste Composting (MSWC) project under the CDM was initiated in Uganda in 2005 as a project under the National Environment Management Authority (NEMA) with financial and technical support from the World Bank under the “Environment Management and Capacity Building Project.

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River Rwizi the main source of water in Mbarara
Photo credit: Julius Muyizzi (NEMA 2017)

PART 3

PROGRESSION OF ENVIRONMENTAL POLICIES IN UGANDA

INTRODUCTION

This part looks at policy responses, describes the different types of policy response that are being used to address environmental issues identified under each chapter; and, where possible, assesses their success or failure. Some of the policy responses include reforms and amendments, that have informed development of laws and institutions; economic instruments; decentralized arrangements for environmental management; financing of environmental actions; public participation; environmental information and education; and social policies.

The environment management policy formulation and implementation process in Uganda is a century old. The history of environmental policy has evolved over years and can be traced from 1929 when the then British colonial government formulated and implemented the first Forestry Policy in 1929.

Environmental challenges as in most other parts of the world have grown with severity over the years. The environmental problems include: climate change; biodiversity loss; deforestation; soil and land degradation; atmospheric and water pollution; among others.

In response to these challenges, various strategies derived from international conventions, protocols and declarations have been incorporated into the policy framework. The integration of environmental issues into the respective national policies has been particularly rapid in the last two decades resulting in substantial number of policy and legal instruments and a radical restructuring of the institutional frameworks. The emergence of “environmental policy proper” that addressed the mainstream environmental sector concerns was in the early 1990s following the ratification of the Ramsar Convention in 1988 and announcement of a ban on massive reclamation of wetlands. To date, the country has developed a wide range of environment-related policy instruments that are specific to and also cut across fisheries, land, water, forestry, wetlands, energy, agriculture, climate change, wildlife and tourism development, among others.

This was partly driven by the 1992 Rio Declarations and a number of international conventions to which Uganda is a signatory, which formed a strong foundation and reference points for policy formulation.

Thus many international conventions and treaties are well integrated and reflected in national policies. These include: the 1995 Constitution; the National Development Plan II and Uganda Vision 2040; the

National Environmental Management Policy (NEMP) 1994, currently under review); the climate change policy; the wildlife policy, wetlands management policy, public health and occupational safety policy, mining policy, investment policy, and sectoral policies providing for strategic actions in energy sector, water, agriculture, energy, minerals and Oil and Gas, atmospheric resources, Hilly and Mountainous Areas, waste and forestry, among others.

The policy framework was therefore: largely influenced by **the National Environment Action Plan (NEAP) 1991**; informed by ratified international conventions and declarations, the most important being the Multilateral Environmental Agreements (MEA) that include but are not limited to: the Ramsar Convention 1971; The Stockholm Convention 1972, UN Conference on Environment and Development (UNCED) 1992 (Rio conference), Convention on Biological Diversity (CBD) 1992, United Nations Framework Convention on Climate Change (UNFCCC) 1992, the United Nations Convention to Combat Desertification and Drought (UNCCD) 1994, the Convention on International Trade in Endangered Species of Wild *Fauna* and *Flora* (CITES) 1973, the convention on conservation of migratory species; and continues to evolve for sustainable development.

At the African level, Uganda is a member of the New Partnership for Africa's Development (NEPAD), a partnership that was supported by the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg. Under this arrangement, the country is obliged to submit itself to a peer review process that measures the extent of environmental sustainability attainment. The country is also a member of the Nile Basin Initiative (NBI) an institution facilitating development initiatives along the Nile in the 10 countries of the Nile Basin. The policies and programmes of the NBI have had a strong influence on environmental management in Uganda including transboundary water resources management.

International organizations for environmental governance have continued to support policy development and notable among these are: UN Environment (previously the United Nations Environmental Programme (UNEP); United Nations Development Programme (UNDP); and the World Bank that provides policy support and financing of environmental projects through the Global Environmental Facility (GEF). At the regional level Uganda is a member of the East African Community (EAC) and a signatory to its protocols.

Despite the comprehensive policy, legal and institutional frameworks in place, environmental degradation and natural resources depletion continues to occur.

THE POLICY RESPONSES

There are several environment-related policy instruments in Uganda that have been designed to help the country address environmental challenges and emerging trends. These are anchored to the 1995 Constitution enshrined in the National Objectives and Directive Principles of State Policy, and the 1994 National Environment Management Policy which set broad policy frameworks for environment management in Uganda enhanced by the National Environment Act Cap 153 enacted in 1995 (currently under review) and the National Development Plan.

The 1995 Constitution of the Republic of Uganda

Under the 1995 Constitution of the Republic of Uganda, several National Objectives and Directive Principles of State Policy set out policy measures that support environment management directly and some by implication. These include:

1. National State policy IX on the right to development;
2. National State policy X on the role of the people in development;
3. National State policy XI on the role of the state in development;
4. National State policy XII on balanced and equitable development;
5. National State policy XIII on Protection of natural resources, and,
6. National State policy XXVII on the environment.

The Constitution further imposes a duty on all citizens to protect and build the environment under Article 17(j) and accords them a right to a clean and healthy environment. Under Article 245 the Constitution provides for measures intended to protect and preserve the environment from abuse, pollution and degradation, manage the environment for sustainable development and to promote environmental awareness. These state policy objectives and directive principles together with the above-mentioned articles among others form the bedrock for the environment management policy framework in Uganda.

The National Development Plan (NDP)

The National Development Plan is a broad document that lays down strategies for the sustainable development of the country. The National Development Plan (NDP II) defines the country's development priorities and strategic direction in the medium term (2015/16-2019/20). Uganda's National Sustainable Development Strategy is contained in the National Development Plan II 2016/7 – 2020/21 that evolved into the Uganda Vision 2040. The environment and natural resource sub-sector focus areas is to restore and maintain the integrity and functionality of degraded fragile ecosystems to attain a green, clean healthy environment, eliminate water and air pollution, conserve animals and plants, restoration of ecosystem services and functions. The NDP recognizes the importance of the environment and natural resources in the country's development and makes room for its proper management.

The National Environment Management Policy (NEMP)

The NEMP 1994 is a policy strategy for integrating environmental concerns into national social-economic development planning process

and is the cornerstone of the country's commitment to social and economic development that is environmentally sustainable to the benefit of all. It was designed to respond to serious environmental degradation and wanton depletion of resources which was eroding the natural resource base by establishing a more comprehensive and integrated approach to environmental management.

The NEMP (1994) recognised that Uganda faces a number of environmental issues including: soil degradation, deforestation, loss of biodiversity, energy inadequacy, increasing pollution, and environmentally related diseases. These problems were compounded by poverty, limited environmental awareness and information, inadequate planning and management capabilities, inappropriate technologies and shortage of financial and human resources.

The emergence of new issues at both the international and national levels has necessitated the revision of the 1994 policy that transformed into NEMP 2017. The review aims to harmonize and align the environmental policy with the sustainable development strategy of the National Development Plan and Uganda Vision 2040. Since 2014 (NEMP) has been under review. The new draft policy is comprehensive and articulate in terms of the objectives, key principles and strategies that are to be used in addressing environmental problems. Best practice was applied in its formulation that used combinations of bottom-up and top-down approaches as a wide range of stakeholders were consulted and involved from the grassroots to international level. The policy recognizes the importance and contribution of environment and natural resources to economic and social development of Uganda and is designed to incorporate all aspects and principles of the Rio Declaration on environment and development, Agenda 21, plan of implementation of the World Summit on Sustainable Development (Johannesburg Declaration). NEMP is a flexible, broad and cross cutting policy framework. The revised draft was developed using an innovative approach engaged in the identification and foresight analysis through scenario building of current and emerging environmental threats and the inclusion of human element. The new and emerging issues identified and addressed in the NEMP include; climate change, oil and gas discovery, disaster reduction and risk management; strategic environmental assessment (SEA); Payment for Ecosystem Services (PES), e-waste management, managing unclear international boundaries, green economy and sustainable development among others. Another key aspect worth noting is the mainstreaming of gender issues into the policy.

Wetlands, River banks and Lakeshores Resources

The trends analysis on wetland resources predicts that Uganda may not have wetlands by 2040 if the levels of wetland degradation continue. This prediction could be true considering that the policy strategies have not been fully applied and implemented. The National Policy for the Conservation and Management of Wetland resources 1995 was designed to curtail the rampant loss of wetland resources and to ensure that benefits from wetlands are sustainable and equitably distributed. The policy is aimed at promoting the conservation of wetlands to sustain their ecological and socio-economic functions for all.

There are three principles established to achieve the goals and they include:

1. Wetland resources form an integral part of the environment and their conservation must be pursued in the overall development strategies and activities (precautionary measures for conservation);
2. Wetland conservation should be done in a coordinated and co-operative approach involving all concerned people and organisations including local communities (sustainable utilization/development); and,
3. Attitude change through public awareness and participation in wetland conservation and management (Public Participation)

The Wetland policy recognises wetlands as a public resource controlled by government on behalf of the public and prohibits leasing of any wetland to any person or organisation in Uganda at any given moment and for whatever reason. This addressed the issue of tenure and use and confirms the requirement that all land tenure documents must indicate the area containing a wetland and accordingly exclude the wetlands from such tenure.

The Wetland Resources policy strategies include; restoration and rehabilitation of degraded wetlands; prohibition of drainage of wetland resources unless environmental requirements supersede; promoting sustainable and non-destructive use of wetlands such as water access, fisheries, grazing and hunting; establishment of fully protected wetland areas to protect indigenous species of plants and animals areas, preserve ecologically important wetlands, protect internationally important wetlands, protect wetlands serving as a source of water supply and effluent treatment and to do research.

Water, Fisheries and Other Aquatic Resources

The overall objective of the National Water Policy 1999 is to manage and develop the water resources of Uganda in an integrated and sustainable manner, so as to secure and provide water of adequate quantity and quality for all social and economic needs of the present and future generations with the full participation of all stakeholders. The guiding principles include:

- (i) freshwater as a finite and vulnerable resource, essential to sustain life, development and the environment;
- (ii) management of water resources at the lowest appropriate levels;
- (iii) the role of Government as an enabler in a participatory, demand-driven approach to development;
- (iv) the recognition of water as a social and economic good;
- (v) the integration of water and land use management;
- (vi) the essential role of women in the provision, management and safeguarding of water; and,
- (vii) the important role of the private sector in water management.

The guidelines and strategies for the protection and development of Uganda's water resources thrive on structured management systems established at national, district and local levels and they include, enabling environment, institutional development, planning and prioritization, data collection and dissemination.

Over the years several policies recognise water as a major factor in the socio-economic development of the country hence resourcing has been prioritized. The guiding principles have been applied in interventions of the sector to establish water catchment regions for protection and conservation of water courses across the country, plans for water source protection, institutional restructuring and reforms, technology advancement and development of tools and guidelines for the different management systems of water resources across the country.

Catchment Based Water Resources Management

Catchment based water resources management is being implemented through the Water management zones. Under this framework, Water resources planning, development and management is being undertaken following a catchment as opposed to administrative boundaries. Each catchment is planned to be managed by a Catchment Management Organisation (CMO) consisting of a Stakeholder Forum, Catchment Management Committee (CMC), Catchment Management Technical Committee, and Catchment Management Organisation Secretariat. The CMO is a level where stakeholder-driven integrated water resources management and development is being implemented. The role of the CMOs is to promote coordination and collaboration among stakeholders and guide the process of development and implementation of catchment management plans (CMPs) in their respective catchments. Nine catchments were formed.

Catchment management planning is a process of developing streamlined water related investments in a catchment in order to ensure integrated sustainable management of the water resources. Fifteen catchment management plans (CMPs) were developed by end of 2016 as shown in figure 10 that follows. Awareness for Water Resources Management has greatly improved among stakeholders as a result of the implementation of Catchment Based Water Resources Management (CBWRM).

The DWRM guidelines for water source protection (2013)

According to the Water Source Protection Guidelines (2013), each water infrastructure project is expected to prepare a Water Source Protection Plan. Piloting of these guidelines has been undertaken in three Large Towns under National Water and Sewerage Corporation, namely Mbale, Arua and Bushenyi. For each of the towns, Water Source Protection Plans have been prepared and costed. In addition, piloting of these guidelines in eight Small Towns is ongoing. The finalisation of the piloting exercise will provide information needed to update the Water Source Protection Guidelines and issue them as legally binding documents, as well as finalising the strategy for operationalisation of the 3% contribution for water source protection through verification of the kind of activities to be undertaken and the costs for preparing and implementing Water Source Protection Plans. Improved water resources regulation through:

1. Provision of compliance assistance to permit holders in setting up and operating waste water treatment facilities including monitoring effluent quality.
2. Strengthening enforcement by taking stringent actions on non-complaint permit holders such as heavy penalties and legal action.

3. Training staff of DWRM, permit holders and other stakeholders in waste water management.
4. Reviewing the charging system for pollution to ensure that the funds are high enough to deter permit holders from discharging as well as being able to be used to restore the polluted water bodies.

The amendment of the National Water Act and Water Policy as well as the reservoir regulation and dam safety guidelines in order to enhance water resources management was initiated and new monitoring stations were established as well as Water information System designed in order to strengthen water resources monitoring.

Lake Victoria Environmental Management Project (LVEMP)

Under the Lake Victoria Environmental Management Project (LVEMP) a wastewater treatment facility is being constructed at Kirinya. A range of excavators and trucks were also provided to Kampala City Council Authority (KCCA) to collect garbage and de-silt drainage channels. Between March 2015 and March 2016, a total of 260,874 metric tonnes of silt were collected from Nakivubo Channel (MWE, 2016). As the sector extends its branches across the country, the trend analysis reveals that there is ever mounting pressure and demand for the resource. The amount of water required for domestic supply, irrigation, industrial process and infrastructure development including the Oil and Gas developments, surpasses the projected demand (NEMA Annual Performance Report FY 2015/16). If the unsustainable demand is met, it will mean the amount of water supplied will be above the minimum required and this will in turn affect the water balance in the water courses, soil conditions, control of health hazards due to quality, and a change in the ecosystems structures and functions. It is anticipated that future revisions of EIA regulations have incorporated a requirement for Water Source Protection Planning as part of EIA process.

Recommendations

1. The Agencies involved in water resources management should work with NEMA and DWRM to ensure that the tools, guidelines and regulatory measures in place are effectively adhered to.
2. Enforcement against illegal abstractions should be prioritized.
3. The EIA process on major water conservation and management process should include an economic analysis of the costs and benefits of protecting watershed forests, wetlands and other key ecosystems.
4. Strengthen the capacity to measure the quantity and quality of water.

Fisheries and Other Aquatic Resources

The trend analysis reveals that fisheries and other aquatic resources are threatened by introduction of exotic species, pollution of water bodies, evasive weeds and over exploitation. It is partly attributed to unsustainable production of fisheries resources due to poor breeding, poor fish farming and poor stocking which is haphazardly done without guidance from scientific research and information.

There has also been a Sustainable Fisheries User Levy as a measure of safe guarding the resource. This levy is collected from the fish landing site through Beach Management Units, by District Fisheries

Staff to the Directorate of Fisheries Resources (DFR) and Uganda Revenue Authority (URA). The levies include fishing vessel license, fishing permits, fish monger license, specific fish license, artisanal fish processing license, fish movement permits, fish health certificates, industrial fish processing license.

Recently, the Ministry of Agriculture completed the demarcation of fish breeding zones along lake Victoria, disbanded the Beach Management Units to harmonize the enforcement and extension roles **and prioritized Mechanical Aquatic Weed Control at Kamuwunga Landing Site in Kalungu District**. In addition, the National Fisheries Policy 2014 has been comprehensively reviewed and relaunched as the National Fisheries and Aquaculture policy 2017. The overall policy goal is *“To increase fisheries and aquaculture production to 1.7 million tonnes annually so as to contribute to food security, nutrition and economic growth.* The policy objectives include:

1. Promotion of commercial aquaculture through increased investment in Aquaculture enterprises fish cage farming and aquaculture parks.
2. Increased enforcement to crack down harvesting and trading of immature fish and issuance of fishing licensing to reduce fishing effort on lakes improved catches of big size Nile perch as a result of increased enforcement.
3. Protection of fish breeding grounds to allow recovery of fish stock through natural biological recruitment.
4. Controlling aquatic weeds to improve aquatic environment for fish growth.

Much as the illegal fishing gear has received attention, the environmental threats to fisheries and other aquatics remain outstanding. Fisheries and aquatics habitats like wetlands, lakeshores, riverbanks and swamps are highly degraded and continuous strategic measures are needed to conserve and protect the fisheries and other aquatic resources.

Recommendations

1. Zoning of fish breeding grounds should be comprehensively done, gazetted and inventories of the species distribution in all waters compiled.
2. Fish farming and breeding of aquatic biodiversity should be based on established standards to safeguard aquatic systems.
3. Fisheries and other aquatic resources habitat destruction should be controlled and measures to promote scientifically proven innovations strengthened including the mechanisms for regulation of disposal of water and waste from fish processing areas, plants and industries.
4. Build capacity for effective monitoring and harmonize management and enforcement efforts with neighbouring countries.

Land: Soils, Crops, Rangelands and Livestock

Land

Land cover includes open water, swamps and mountains. The land tenure system was designed to improve stewardship by urban and rural land users. Property rights to land is clearly defined by the form of tenure but the common regime of rights over natural resources such as forests, water, fisheries, minerals, rangelands and wildlife calls for a

comprehensive review. Regulation and monitoring of these resources is vested in the state to hold in trust for the common good of all but the fact that these mandates are scattered across sectors poses a great challenge. For instance, the National Forestry Authority (NFA) manages central forest reserves, the Uganda Wild-life Authority (UWA) manages forests in national parks and wildlife reserves, while local forest reserves fall under the mandate of local governments (District Forestry Services).

Land degradation is widespread and on the increase in the country through nutrient mining due to soil erosion, runoff and limited or non-use of external inputs by farmers. Massive land use changes without requisite land management planning pose significant socio-economic and environmental threats. Land degradation is highlighted as the greatest contributor to the annual cost of environmental degradation, largely manifested in soil nutrient loss through soil erosion. This is coupled with several factors affecting land resources including; population pressure, inappropriate land use activities in rural, urban and peri-urban areas and absence of land use plans at all levels.

For instance, agriculture is said to be one of the key drivers of biodiversity loss, land degradation, deforestation and wetland reclamation this is partly due to the tenure systems. The Agricultural Zoning Policy, the Irrigation Policy, the Uganda Development Corporation and NAADS are a result of policy measures to address land resources use challenges in the agriculture sector hence the improvement of organic matter of soils, soil PH improvement and increase in vegetation cover in selected districts surveyed.

Soils

The current status of land degradation and its impacts on land productivity if left to continue unabated, is unsustainable, considering the increasing population (implying higher food and income requirements), and therefore calls for urgent remedial measures to save the situation. There is need for promotion of better land management practices, agricultural intensification and diversification so as to make agriculture in Uganda, a sustainable economic activity.

In addition, there is urgent need to formulate and enforce policies and by-laws in favor of better land management practices at all levels.

Policy formulation and implementation: The Government took steps to address the challenges of land degradation by enacting favorable Policies e.g. the Land Use Policy, the Fertilizer Policy etc., what remains to be done is to put in place and support strategies for their implementation. For instance, to address the problem of low and declining soil fertility, there is a need to increase fertilizer use as a component of Integrated Soil Fertility Management (ISFM) (Vanlauwe, et al., 2010), without this nutrient mining with its negative effects will increase. Greater use of inorganic fertilizer, supplemented with soil and water conservation and organic nutrient supplementation, is central to realizing the productivity and yield increases required to override the current situation. Indeed, excellent agronomic responses to fertilizer application verifying that fertilizer N and P use is effective for increasing crop yield in Uganda (Kaizzi, et al., 2012) (Kaizzi, et al., 2012) (Kaizzi, et al., 2012) (Kaizzi,

Ssali, Nansamba, & Vlek, 2007) (Kaizzi, Ssali, Nansamba, & Vlek, 2007). This has positive implications for food security and farm profitability. This justifies the need to implement the Fertilizer strategy.

Investment in land and water resources management: The Government is funding the Sustainable Land Management Project implemented by MAAIF across the country. To improve the water management the country was zoned into Water Management Zones. Investments in these sectors should be increased and sustained.

Funding research: Research should emphasize development, adaptation and promotion of farmer-friendly technologies that will promote better natural resource management and improve agricultural productivity. Needless to say, this should be backed by enabling government policy and budgetary support. (Kaizzi, Ssali, Nansamba, & Vlek, 2007)

Increased awareness of Fertilizer use within the ISFM framework by farmers and extension agents: Most farmers use little if any fertilizer and are not well informed on proper fertilizer use, time of application and suitability of different products. Generally there is lack of awareness of the potential of fertilizers by smallholder farmers, unavailability of fertilizers and limited knowledge of fertilizers use and types by farmers and extension staff. Effective fertilizer use requires a well-managed crop, but also proper use of the fertilizer. Farmers and their advisors need to be aware of 4R Nutrient Stewardship including: applying the **Right Source** of nutrients, at the **Right Rate**, at the **Right Time**, and with the **Right Method**.

Recommendations

1. Government should reverse the current situation through increased use of inorganic fertilizers and manure within the Integrated Soil Fertility Management (ISFM) Framework to address challenges associated with limited or non- adoption of technologies and scale up technologies for wider adoption using of different approaches.
2. Government should promote Soil and Water Management technologies including the participatory evaluation and the benefit –to- cost ratio of the alternative technologies.
3. There is a need to increase fertilizer use by farmers through awareness creation, proper use, increasing the range of different products on the market, stimulating adequate demand for fertilizers to attract private sector investment in the fertilizer importation, distribution, and introduction and promotion of new fertilizer products manufactured in the region and country.
4. Government should invest resources in the implementation of the strategies for different policies related to reversing land degradation, otherwise the process will continue with negative impact on the poor who solely depend on natural resources for their survival.
5. Charcoal burning and fuel wood extraction are key drivers for the current reduction in the vegetation cover, this should be addressed by encouraging farmers to plant more trees, use efficient or energy saving cooking devices and use of solar power. This will definitely require increase in government investments.

Livestock resources

Overstocking is responsible for the current land degradation in the cattle corridor, this will be addressed by creating awareness of right stocking rates, improving the herd and the pastures.

High level resource-demanding farming systems, which have caused immense deforestation, water insufficiencies, soil depletion and high levels of greenhouse gas emissions, dampen sustainable food and agricultural production.

Tracking methane emissions from ruminant livestock- In Uganda, there is limited technical capacity, lack of tools for measurement and monitoring methane emissions and sluggish development in inventions which can convert methane into energy or pastures with low methanogenic capacity.

Promotion and transformation of degraded pastureland by planting high quality grass and legumes especially in drought prone cattle corridor by improvement of ground cover, increasing nutrient availability through supply and recycling and; establishment of plant species and varieties with high palatability and quality.

Contagious diseases of cattle like foot and mouth disease, contagious bovine pleuropneumonia (Domestic), rabies and East Coast fever spread, animals are controlled by vaccination before the onset of droughts and implementation of strategic disease control programs brought in by government.

Whereas the delivery of veterinary drugs and vaccines has liberalized, the government still remains with a responsibility of on time supply of the vaccines with the local governments accountable for doing actual vaccination.

The government remains in full charge of ensuring that pests and diseases are controlled at field level. Wherever vectors and disease prevalence exceed the ability of the farmers and local leaders, the central government has to declare an epidemic and assumes responsibility for countering it.

Farmers have been advised to abandon the high cost low return breeds of livestock, and to engage in rearing high yield breeds (goats, cattle, sheep and pigs).

Innovations in water harvesting infrastructures and provision of extension services to farmers planting sustainable forages are being promoted reduce on the nomads' tendency of un controlled movements with their cattle in search for pasture and water.

Recommendations

1. Innovative systems are needed to enhance conservation of the natural resource base, whilst increasing productivity and adopting 'holistic' nature safe approaches to include; agro-ecology, conservation agriculture, climate-smart agriculture yet building upon indigenous knowledge available.
2. The government of Uganda should adopt cost effective techniques, enhance technical capacity, collect data on periodic climate emissions, adopt tools for climate monitoring and in the long run have in place better strategies for mitigating climate change and its foot prints.

3. Research organizations need to develop feed management strategies to mitigate methane emissions from cattle through enhancing animal production and reducing the amount of methane produced per unit of milk and meat with government and donors support. In so doing Uganda will have joined the world wide quest for mitigating climate change and its foot prints from the livestock sector.
4. Governments should develop packages with information about varying grazing systems in different agro-ecological set ups. So far, information and advice regarding optimum stocking rates has been provided to farmers in various zones to reduce on overgrazing and minimize degradation.

Energy, Oil and Gas and Minerals Resources

Energy Resources

The energy resources including wood fuel, petroleum products, electricity, new and renewable sources have been affected by deforestation, land degradation and other environmentally unsound practices. The government of Uganda is committed to ensuring access to affordable, reliable and modern energy services. To this end, the government is constructing 2 large hydro power generation projects at karuma and Isimba to generate 600MW and 183MW respectively. Plans are also in advanced stages to develop medium size hydropower projects and Mini-hydros including; Nyagak III, Muzizi, Agago-Achwa among others. Other policy directions include developing alternative energy sources to diversify away from its hydropower plants, which are currently beset by unstable water levels blamed on dry spells and changing weather patterns. The NDPII targets to raise power generation capacity to 1,500MW by 2020, from the current 850MW.

According to the renewable energy policy, the country has a solar electricity potential of about 200MW, 1650MW from biomass, 800MW from peat, 2200MW from hydropower stations and 400MW from geothermal energy.

Oil and Gas Resources

The Uganda government has resolved to increase the oil and gas resource potential in the country through several strategies including formulation of legal, regulatory and institutional frameworks. The development of the oil infrastructure in a phase manner to maximize benefit from the resource is under way. In line with the NDPII and the National Oil and Gas Policy, the Oil and Gas sector has proposed large infrastructure development including: a refinery, oil Pipelines, roads and airfield, among other related development infrastructure by private initiatives.

The National Oil and Gas Policy, 2008 has Transparency and Accountability as one of the principles and one of the actions in the policy is to participate in the processes of the Extractive Industries and Transparency Initiative (EITI).

On 26th May, 2017, the Governments of Uganda and of Tanzania signed the Inter-Governmental Agreement (IGA) for the East African Crude Oil Pipeline (EACOP) Project. The east Africa Crude Oil Export Pipeline (EACOP) is a 1,445km crude oil pipeline that will

transport Uganda's crude oil from Kabaale in Uganda through Tanzania to the Chongoleani Peninsula near Tanga Port in Tanzania. This will be the longest electrically heated pipeline in the world and it draws environmental and social impacts including: traversing fragile ecosystems, biodiversity disturbance and loss, water abstractions, land acquisition and Resettlements, and opening up developments in remote areas.

The successful implementation of these projects will thrive on the robust national legislation on the sector and environment as well as the established international and harmonized environmental standards.

Mineral Resources

Other related policy responses in the sector target minerals. The development of Minerals has sparked off reforms to the Mining Sector in Uganda. The reforms include proposals to make sand a mineral given its commercial viability and to regularise Artisanal mining to protect human health and the environment.

Atmospheric Resources

The Uganda National Climate Change Policy, 2015

The goal of the policy is to ensure a harmonized and coordinated approach towards a climate resilient and low-carbon development path for sustainable development in Uganda. Some of the more important guiding principles of this policy are mainstreaming and coordinated response to climate change, promoting community-based approaches to adaptation and devoting adequate attention to capacity development and institutional set-ups. It outlines emissions trading mechanisms and has a link to forestry through Reducing Emissions from Deforestation and Forest Degradation (REDD) Programme.

Wildlife and tourism

Illegal wildlife trade and poaching

Uganda wildlife Authority has put in place measures to curb illegal wildlife trade. An intelligence Unit has been created both at Headquarters and all over their protected areas. Joint intelligence and investigation operations with Police, Army, INTERPOL and NRCN are conducted which have resulted in several arrests, confiscations and impounding of wildlife and wildlife products and various poaching tools. Suspects have been taken to Courts of Law and prosecuted accordingly. UWA is constructing a Bio safety level II laboratory in QENP which will be instrumental in supporting successful prosecution of wildlife crime. A fully fledged Canine Unit has been established and staff have been trained and positioned at Entebbe International Airport and other border posts to work with other agencies to curtail the illegal trafficking of Ivory, Rhino Horns and other related wildlife products. The increased presence and vigilance at the Airport has resulted in a decrease in wildlife trafficking cases.

Human-wildlife conflict

The Government of Uganda perceives human wildlife conflict as a serious issue and has thus put in place policies and laws minimizing it (see Uganda Wildlife Policy, 2014). The policy highlights mitigating human

wildlife conflicts and enhancing positive attitude towards conservation of wildlife resources as one of the critical issues in wildlife management. Strategic objective 4 of the wildlife policy 2014 outlines the strategies to be undertaken to minimize human wildlife conflict. Among them are;

1. Establish and maintain barriers along wildlife protected area boundaries for all areas susceptible to stray wild animals;
2. Human-wildlife-livestock disease interface; strengthen sector institutional capacity to manage human wildlife conflicts;
3. Promote conservation education and awareness across the nation; and,
4. Establish and implement a scheme to compensate for the loss of human life and injuries occasioned by wild animals escaping from wildlife protected areas.

UWA has invested in a number of interventions to address the human-wildlife conflict, which include trench excavation, scare shooting, use of red chili, bee hives, growing of unpalatable crops e.g. the tea growing as a buffer in Bwindi Impenetrable National Park and recruiting wildlife scouts e.g. in MFNP and Kidepo Valley National Park. Although these have to some extent reduced the incidences, more innovations are required to further reduce the problem.

UWA has created Wildlife centers in areas with viable wildlife populations outside gazetted areas to deal with wildlife issues some of these are located in Kyankwanzi, Rakai and Nakaseke. In addition, UWA is closely collaborating with Local Governments at all levels to manage vermin and lobby for recruitment of vermin guards. UWA is planning to construct 50 crocodile cages in the Crocodile prone areas to reduce incidences of crocodile attacks. Communities are also sensitized on how to live with wildlife and managing the problem animals. This has improved the communities' relationship with park management.

The different interventions Uganda Wildlife Authority has been implementing in selected protected areas are implemented in collaboration with communities. UWA has also established and formalized partnerships with both Non-Governmental Organizations such as Wildlife Conservation Society and Africa Wildlife Foundation, and private sector to enhance strategies for management of human-wildlife conflicts. In some cases of problem animals such as crocodiles have been translocated and taken to other areas.

Revenue sharing for communities

UWA has continued to support communities around the protected areas by availing a variety of benefits to them. UWA shares 20% of all gate collections with the communities neighboring the protected area from which the money would have been collected. The amount shared has been increasing over the years. Between 2014-2016, over 7 billion Uganda shillings was disbursed compared to 6 billion Uganda shillings that was disbursed between 2011-2014, which is a 15% increase. The funds are meant to improve the livelihoods of the people who are disadvantaged because of living close to the protected areas and also help the communities develop income generating projects. Apart from the 20% of the gate proceeds that communities receive, communities also benefited from sport hunting in different parts of the country.

This activity generated over 3 billion shillings between 2014-2016 (UWA records) that has also been shared among the Land owners, Local Governments and UWA.

UWA has engaged landowners through Private-Public Partnership (PPP) to conserve wildlife in several areas including Nakaseke, Kalangala, Nakasongora and Kyankwanzi. In addition, in order to empower landowners to benefit from wildlife on private land, management is now piloting the concept of conservancy around Kidepo, Murchison Falls and Lake Mburo National Parks. The land owners are empowered to effectively collaborate with private investors to manage eco-tourism facilities on private land through formal agreements. This has increased the interest of landowners in wildlife conservation and protection since they are realizing a benefit. This has changed the attitudes of the people towards conservation.

Developments

In order to minimize the impacts of developments in and around protected areas, UWA always ensures that all developments in Protected Areas are subjected to Environment and Social Impact Assessments (ESIAs) and developers are required to adhere to the mitigation hierarchy (avoid, minimize, and restore) as approved by NEMA. Developers are required to restore the areas opened up during project implementation. This has been done for most of the areas where oil and gas developments have taken place. In addition, a number of tools to minimize negative impacts of developments on protected areas have been developed including the Environmental sensitivity atlases, operational guidelines for oil and gas and monitoring checklists. Despite all these efforts, sometimes there are residual impacts that cannot be adequately addressed through the existing framework. More interventions are needed such as implementation of biodiversity offset so as to manage the residual impacts. UWA is in the process of developing the biodiversity offset guidelines to guide implementation of development activities within the Protected Areas.

Invasive species

Management of invasive species has been taking place in the protected areas though still at pilot stage. Some research has been conducted to understand their propagation behavior and, therefore, identify the best approach towards controlling them. UWA has contracted the National Invasive Species Coordination Unit under NARO to pilot an integrated IAS management project for selected IAS in LMNP (*Acacia hockii*) and QENP (*D. cinerea*, *C. odorata* and *P. hysterophorus*).

Forestry Resources

Several interventions have been made to implement the policy measures in this sector. These include:

Afforestation outside Protected Areas

There was heavy deforestation in Uganda in the late 1990s and early 2000s sometimes to the rate of 90,000ha per year. The government of Uganda intends to stop this deforestation and increase forest cover to the levels of 1990 when it was 24% of land area (Vision 2040). This will be done by both government and the private sector. Government has been issuing land permits to private tree planters to grow trees in forest

reserves. This seems to be the easiest way to increase forest cover but the land is not enough to meet the set target of 24%. Consequently, some tree farmers have acquired land outside forest reserves and raised forests. A good example is New Forest Company which has planted about 3000ha of Forest in Bugiri and Namayingo districts in Eastern Uganda.

Restoration of forest cover

Restoration of forests is done by national Forestry Authority and the private sector by restoring degraded forests or planting forests where they have never been. This is line with the Vision 2040 and NDPII which aim at restoring forest cover to that of 1990. The National Tree Seed Centre has capacity to produce ten million seedlings and 12 regional nurseries have a capacity to produce 15 million seedlings. The NTSC nursery produces indigenous and exotic seedlings for timber trees, fruits and ornamentals while regional nurseries mainly produce pine and Eucalyptus. NFA gives licenses to tree farmers to plant and raise trees in forest reserves that are degraded or are grasslands.

Payment for Ecosystem Services

Payment for Ecosystem services is a strategy that would encourage forest owner to keep them. It has been tested in Hoima and Kibaale by Eco-trust and Jane Goodall Foundation in conjunction with Wildlife Conservation Society (WCS) but it has not been up scaled. Protection of endangered species: Endangered species that are found in national parks are very well protected as these areas have the highest level of conservation. Those in natural forests in forest reserves are also well protected but are vulnerable to encroachment through illegal activities. Endangered species on private land are completely vulnerable as most land owners do not see monetary value in these species. There are efforts however to protect endangered species on private land. This is exemplified by the intervention by NEMA on Shea butter tree in Northern Uganda, the new forest regulations released in 2016 and the presidential directive on Shea butter tree. The key interventions include the development of a National strategy for the conservation and sustainable use of the shea butter tree in Uganda. Several interventions implemented under this strategy include: a) Strategic joint environmental inspections in conjunction with Environment Protection Police, District Local Governments and Resident District Commissioners in the districts of Lira, Otuke, Kitgum, Agago, Pader and Amuria; b) Functional partnership with Resident District Commissioners in northern and north-eastern Uganda and religious institutions such as Soroti Church of Uganda Diocese; c) Value addition interventions to shea products through support to CBOs including, Gwokke Kheni and Agago District Farmers Association, Fountain of Life and Facilitation for Peace and Development/FAPAD in Otuke District, and Ochamo Anyim Farmers Association in Kitgum District; and d) Support to NFA towards restoration through enrichment planting of shea butter tree in Kitgum District.

Recommendations

Uganda being a signatory to UNFCCC 2010 agreed upon actions to ensure: Reducing emissions from deforestation; Reducing emissions from forest degradation; Conservation of forest carbon stocks; Sustainable

management of forests and Enhancement of forest carbon stocks. Some of the policy strategies designed to achieve these obligations include:

Reducing Emissions from Deforestation and Forest Degradation (REDD+)

This is one of the emerging global forestry-related instruments and markets. It is an international initiative which was formally agreed during the Bali Climate Conference in 2007. Uganda is preparing plans to take advantage of REDD+ to benefit from restoration of natural forests and other conservation and SFM activities

Forest restoration

The country has been stratified into seven ecological zones namely: Afro-montane; Karamoja; Lake Victoria Crescent; Northern moist; Southeast L. Kyoga floodplains; Southwest rangelands; and Western mid-altitude. Restoration options that have been engaged include; agroforestry, afforestation, reforestation, natural regeneration, and riparian vegetation restoration in riverine buffer zones.

Uganda made a pledge in Bonn to restore 2.5 million hectares of land to forests using the Forest Landscape Restoration (FLR) approach. To-date an estimate of 70,000 hectares have been restored. Compared to the commitment, this effort should be intensified through integrated efforts.

Improving charcoal production technologies and sustainable land management practices through an integrated approach

This is to involve technology transfer, enhancement of national policy Framework through enforcement, promotion of sustainable land management, awareness raising and sustainable forest management practices.

Supporting community and private forestry

This will require reforms in the policy/legal framework to provide adequate protection to their rights. These may include compensation for not logging as well as taking out easements that would guarantee value for the forest. Where such approach is adopted, the requirement for private forest owners to secure permits before logging as well as establishing mechanisms for planned logging to minimize impacts when the forests mature for logging is a viable consideration.

COORDINATION OF MULTILATERAL ENVIRONMENTAL AGREEMENTS (MEAS)

Uganda being signatory to various conventions, protocols and agreements is required to undertake implementation of these Multilateral Environmental Agreements (MEAs) at national level. NEMA was delegated by the Ministry of Water and Environment to coordinate implementation of some of the MEAs on behalf of Government. The implementation of MEAs is critical because Government is able to meet its obligations and this has enabled mobilization of financial resources provided by the Global Environment Facility (GEF) and other development partners for implementation of activities at the national level, as well as contribute to the fulfilment of NEMA's mandate and

functions as provided for in the National Environment Act Cap 153. The following interventions have been made to implement the MEAs mentioned below.

Convention of Biological Diversity(CBD)

The Convention of Biological Diversity (CBD) focal point in the Uganda is NEMA, which has continued to implement the Strategic Plan 2011-2020 and the Aichi Targets. To achieve Goal E, and the Aichi target 20 that focuses on promoting innovative sustainable funding mechanisms to increase resource mobilization to biodiversity conservation, NEMA in collaboration with Ministry of Finance, Planning and Economic Development (MFPED), Ministry Water and Environment (MWE) and United Nations Development Programme (UNDP) are implementing a **global initiative on biodiversity finance (BIOFIN)**. The ongoing review of the policy and institutions indicates that, the contribution of climate financing in biodiversity conservation should be strengthened as well as having strong biodiversity conservation finance strategy with considerable multi-stakeholder consultation, participation, participation and commitment is required.

In addition, the biodiversity expenditure review further indicates that, the historical expenditure on biodiversity is slightly increasing over time from 2014/15 on upward trend. In order for NEMA and GOU to address the issue of increasing financing to biodiversity conservation, the BIOFIN in Uganda will identify financing solutions that will contribute to reducing the funding gaps.

In order to achieve strategic Goal A, B, C, and D for the Aichi Targets 3 to 19, in line with the vision 2040, the NDPII and the SGDs, NEMA has ongoing activities under the Kidepo Critical Landscape project, where by a total of 20 women enterprise groups under the **Kidepo Critical Landscape project (KCL)** were supported with a number of interventions on sustainable use options for shea butter trees and wildlife. On sustainable use of shea butter trees, the project has promoted production and processing of shea oil from shea butter tree nuts. In that regard, six women groups with 30 members each in Otuke district were supported with four cold and hot press machines for processing shea oil from shea butter tree nuts.

Similarly, fourteen (14) women groups in Agago district were supported with four (4) cold and hot press machines. The cold and hot press machines can produce two litres of oil from 8kgs of shea nuts in less than one hour and has a capacity to produce 80 litres of shea oil in a day. This has resulted into production of more shea oil and therefore more income for the women groups. In addition, understanding of the importance of shea butter trees has been gained by the women groups who now act as ambassadors of shea butter tree conservation in their areas hence improving decision making in conservation matters, among the men and women of Karamoja region (Northern Eastern Uganda).

In addition to sustainable use options for shea butter tree products, conservation of shea butter trees through on-farm vegetative propagation was foreseen during project formulation. On-farm vegetative propagation is a method for shortening the juvenile stage of the shea butter tree.

To that end, a total of 35,000 shea butter tree seedlings were produced by NFA and planted in Oliduro (Otuke district) and Langolebwal (Abim district) central forest reserves. This has made available root stocks for grafting with scions from mature shea butter trees in the wild so as to shorten the juvenile stage of the tree. The grafting is expected to be carried out after one year when the root stocks have established in the field.

Studies carried out for sustainable use options for tree resources include, a cost benefit analysis for shea butter use options in the districts of Abim, Agago, Kitgum and Otuke that has least social and environmental costs but with better environmental and livelihood benefits. The findings indicates the Net Present Value (NPV) of the shea oil use option is by far higher than the timber and charcoal production because production continues throughout the lifetime of the tree once it achieves maturity. In contrast, charcoal and timber use options were assumed to provide a one-time harvest on 20 years.

However, when the external costs and benefits such as climate regulation, biodiversity protection, carbon sequestration and erosion prevention were considered, the profitability gap, NPV (US\$ ha⁻¹), between shea oil and other options, timber and charcoal was further increased. Financially and economically, the shea oil options are more profitable than charcoal and timber options, and its use is more environmentally friendly because it maintains the ecosystem services.

In addition the above study, a value chain analysis of shea butter to assess options for value addition was showed that, there are many stakeholders, these are the shea nut collector, village processors, middle men or intermediary dealers, shea butter processors, retailers, and wholesalers. Currently the value chain's most popular mode of transport in the districts of Abim, Otuke, Agago and Kitgum is foot and bicycles. The sustainable development benefits of shea butter, and its fruiting trees ranged from 156,184 to 1,306,084 while the shea nut population ranged from 476,430 to 19,472,400kg per year with each household being able to collect up to 300kg of shea nuts per year.

The shea nuts and butters have contributed to improving household incomes, providing edible vegetable oil for nutritional benefits, and for comestic use. However, most of the shea nuts collected (63%) were being sold in local markets at the mean price of Ushs 1,650 per kg while the total she butter production of approximately 1000 tons from the last three years (2014- 2016). Therefore Government should support the different she aunt collectors and processors to establish the national shea butter association to advocate for the shea butter sector.

On sustainable use options for wildlife, the project supported one group of women with 30 members in Kaabong district to establish a cultural centre for staging cultural performances to tourists and selling of their traditional craft materials. This has resulted into generation of income for the women group including an understanding of the importance of having wildlife in their area.

To mitigate human/wildlife conflict (elephants and humans in particular) on the other hand, two community groups of 30 members each (45

women and 15 men) in Agago district were supported to plant chilli. Sixty (60) acres of chilli gardens were planted and the first harvest done. A total average of 120 sacks of chilli, each weighing 80kgs, were harvested and sold at UGX 5,000= per kilo. This resulted into a total income of UGX 48,000,000= from chilli growing for the community. At the same time, the communities reported a drastic reduction in incidences of elephants crossing to destroy their crops.

Mercury Convention

Mercury's unique characteristics and availability as a material throughout the ages has allowed it to be widely used in many products and applications in Uganda as is the practice globally. However, manufacture, use and disposal of products containing mercury contributes to global mercury pollution thus the conception of the Minamata Convention on Mercury. Uganda became a signatory to the Minamata Convention in 2013. The objective of the Minamata Convention on Mercury is "to protect human health and the environment from the anthropogenic emissions and releases of mercury and mercury compounds. The Minamata Convention in its Article 3, seeks to reduce global mercury pollution through complementary measures to minimize mercury supply and demand. The anticipated sources of mercury emissions and releases in Uganda include Artisanal Scale Gold Mining (ASGM), open burning of waste and filling from dental amalgam among others.

Uganda has actively explored policies, regulations, programs, and strategies to support the formalization of the growing ASGM economy. This includes specific measures to curb smuggling; encourage licensing of mineral dealers and reporting of exports. From 2004 to 2011, Uganda implemented a projected titled "Sustainable Management of Mineral Resources Project (SMMRP)" that was funded by the World Bank, African Development Bank, Nordic Development Fund, and Government of Uganda." The project was focusing on artisanal and small-scale mining with the objective of strengthening the government's capacity to develop a sound minerals sector based on private sector investments and improvements (programs, policies for training, organizational development, formalization, among others) in selected ASGM areas. The work culminated in a National Strategy for the Advancement of ASGM and a National Strategy for Promotion of Gender Equality in Mining, both of which provided a platform for formalized government support to ASGM. The project achieved a number of important outcomes that may provide useful insight for formalization of ASGM in other jurisdictions.

The National Environment Management Authority implemented the "East African Dental Amalgam Phase Down Project (EADP)-Phase I" in 2012. The EADP-Phase I was implemented in relation to the Minamata Convention on Mercury which identifies and describes in its Article 4 and Annex A Part II, measures to be taken to phase down the use of dental amalgam taking into account the Party's domestic circumstances and relevant international guidance.

The project was aimed at increasing national capacity to reduce the need; demand and use of dental amalgam; reducing the releases of dental amalgam wastes to water and land in a measureable; equitable and sustainable manner; increasing adoption and use of standardized

guidance, resources and tools to reduce the need, demand and use of dental amalgam; and dispose of dental amalgam waste in an environmentally sound manner. Project activities included awareness raising, training of dental health staff, production of dental awareness materials, installation of amalgam separators at demonstration sites (Jubilee dental, Mengo hospital and Mulago hospital), documentation of country dental amalgam trade data and waste management practices among others. The project revealed that there was low adaptability of alternatives to dental restorations to dental amalgam by dentists.

From 2015 and 2016, the NEMA on behalf of Uganda implemented a project entitled “Development of Minamata Convention on Mercury Initial Assessments (MIAs) in Africa”, undertook studies relating to national infrastructure and capacity for the management of mercury, including national legislation; existing studies and sources of information on mercury and mercury management in Uganda; and mercury inventory development using the UNEP mercury toolkit and strategies to identify and assess mercury contaminated sites and identify challenges, needs and opportunities to implement the Minamata Convention on Mercury.

The MIAs assessment have so far revealed that despite the existence of the legal framework for chemicals management in Uganda, specific focus on mercury lifecycle management is missing. The legislations are silent on supply, handling, storage and disposal of mercury; mercury in products and mercury containing waste. The capacity of Ministries, Agencies and Departments to detect, assess mercury content in products, process is inadequate. Assessments of mercury contaminated sites and bioaccumulation. Inadequate mainstreaming of chemicals management in plans, budgets was revealed.

Furthermore, NEMA, on behalf of Government of Uganda will be implementing a project entitled “Regional project on the Development of National Action Plans for the Artisanal and Small Scale Gold Mining in Africa” in Uganda. The project is aimed at assisting participating countries to develop national plans to reduce the use of mercury and mercury compounds in, and the emissions and releases to the environment of mercury from, artisanal and small-scale gold mining and processing in accordance to ANNEX C of the Minamata Convention. Participating countries will among others benefit from new and updated information about the use of mercury in the ASGM sector in the country and from increased capacity in managing the risks of mercury emitted and released from such activity.

The Stockholm Convention

Stockholm Convention (SC) on Persistent Organic Pollutants (POPs) is a global treaty adopted on 22nd May 2001 and entered into force on 17th May 2004. Uganda acceded to the Convention on the 20th July 2004 and at the time, twelve chemicals “the dirty dozen” had been listed as POPs. The Convention seeks to protect human health and the environment from chemicals that remain intact in the environment for long periods of time, become widely distributed geographically and accumulate in the fatty tissue of humans and wildlife. These chemicals include agricultural pesticides, industrial chemicals and some unintentionally produced chemicals from anthropogenic processes. The Convention

seeks to eliminate production and use of chemicals listed under Annex A of the Convention text, restrict production and use of those listed in Annex B and through Best Available Techniques (BAT) and Best Environmental Practices (BEP) reduce emissions and releases of POPs from anthropogenic sources (Annex C chemicals).

In fulfilment of Article 7 of the Convention; the first National Implementation Plan (NIP) was developed and transmitted in 2009 to the Conference of Parties (COP). At its 4th meeting of the Conference of Parties in May 2009, the Stockholm Convention was amended to include new POPs in Annex A (Alpha hexachlorocyclohexane, Beta hexachlorocyclohexane, Chlordane, Hexabromobiphenyl, Hexabromodiphenyl ether and heptabromodiphenyl ether, Lindane, Tetrabromodiphenyl ether and Penta bromodiphenyl ether Pentachlorobenzene (also listed in Annex C) and Annex B (Perfluorooctane sulphonic acid (PFOS), its salts and Perfluorooctane sulfonyl fluoride), respectively.

Following the addition of ten new POPs to the original twelve, it was imperative for the Parties to review and update their NIPs. Therefore, in the year 2014, the Government of Uganda through the National Environment Management Authority (NEMA) as the executing agency embarked on the process of revising the NIP to incorporate the aforementioned additions to the Stockholm Convention. The process of reviewing and updating the NIP was implemented under the Project entitled “Enabling activities to review and update the NIP for Stockholm Convention on POPs” which was funded through the Global Environment Facility (GEF) with technical oversight from the United Nations Industrial Development Organization (UNIDO). The project consisted of four major components: (i) Coordination mechanism and awareness raising; (ii) Inventories of new POPs and NIP review; (iii) National capacities assessment and priority setting for management of new POPs and (iv) NIP formulation, endorsement and submission. The review process was supported by stakeholders from Government and non-governmental agencies, private sector and Civil Society Organizations (CSO). The review process was finalized and the updated NIP submitted to the secretariat of the Stockholm Convention in November 2016.

Key issues from NIP Update Assessments

From the inventories conducted throughout the country between November 2014 and April 2015, the key findings with respect to management of POPs were as follows:

- (1) POPs are not intentionally produced in Uganda; they are mainly imported as pesticides and in consumer articles.
- (2) Major POPs imported into the country include:
 - Endosulfan pesticide with wide applications in Agriculture. This agricultural pesticide is mainly used on coffee against coffee borers and cotton bollworm. There is a planned phase-out while promoting cost effective alternatives.
 - +Polybrominated diphenyl ethers (PBDEs) in transport and electronic sectors. The most likely sources of PBDE emissions are old Electrical and

Electronic Equipment (EEEs) imported into the country, such as, computers, Cathode Ray

- Tube (CRT) computer monitors, TV sets and end-of-life vehicles (ELVs) in which PBDEs were used as flame retardants. The inventory concluded that 69% of the 3 million (2,070,000) TVs in Uganda are CRTs. In 2014, Uganda generated 33,000 tonnes of domestic e-wastes, 25% of which consisted of plastic components estimated to contain about 1.2 to 6 tonnes of OctaBDEs. The conservative estimate of Octa-BDEs in imported articles (CRT computers and TVs) was 13 kg while the amount stocked in households was estimated to be 54,000 kg. The estimated amount of Penta-BDEs in currently used vehicles and those that have reached their end of life was 8,462 Kg.
- Perfluorooctane sulfonate (PFOS) in firefighting foam, textiles, synthetic leathers, shoes and bags. The four (4) main priority issues arising from this assessment are:
- Large amount of PFOS is present in PFOS-containing synthetic textiles and leather articles and products imported into the country;
- Large quantity of PFOS is contained in the wastes of PFOS-containing articles and products, especially synthetic textiles, synthetic leather and carpets, collected at waste dumpsites;
- Large stocks of PFOS are contained in firefighting foams (FFFs) and the various contaminated sites where FFFs have been applied;
- There are chemical wastes which contain PFOS, especially, FFFs and hydraulic fluids whose disposal is not monitored.

(i) Polychlorinated biphenyls (PCB)

These are found in PCB contaminated transformer oils and equipment. Waste associated with PCB contamination is not being managed in an environmentally sound manner, although companies have demonstrated willingness to do so. Scrapped power transformers are stored in the open yard because there is no policy for their disposal. In some cases, faulty transformer oils are stored in the open and unpaved yard with the potential risk to the environment. The final destinations of used oils and scrapped distributions transformers are not certain although companies claim to use the services of licensed waste handlers.

(3) Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/PCDF, commonly called dioxins and furans)

Plausible emission sources for these POPs mainly include medical waste incinerators, iron and steel production, open waste burning and accidental fires, amongst others. The estimated total release of UPOPs for 2014 was 3823 g TEQ/a compared to the 2007 estimate of 1370 g TEQ/a. According to inventory results recorded, air is the environmental vector receiving the highest release of 2309.6 g TEQ/a) and water the least (0.2 g TEQ/a).

Other notable observations from the inventories included;

- a) Most of the POPs in the articles (electronics, car seats shoes, bags etc) end up in waste streams in the environment;
- b) There is limited public education about POPs, their potential health, environment effects and the socio-economic implications of mismanagement of these chemicals;
- c) There are inadequate capacities of key institutions to soundly manage chemicals (POPs inclusive) throughout their life cycle;

- d) POPs contaminated sites in need of remediation exist in the country; and;
- e) A continuous research and monitoring programme for POPs in Uganda's environment is lacking except for a few isolated cases of research work carried out.

National priorities to address the issues identified during the revision of the NIP

The priority areas under the revised NIP for Uganda are based on the findings of the national POPs inventory process, stakeholder priority setting, action planning and NIP development workshops held in 2015. The revised NIP identified and prioritized eight strategic areas of intervention, namely:

1. Phase out of use of Endosulfan as an agricultural pesticide and identification of cost effective alternatives.
2. Development of national awareness creation and educational programmes on the effects of POPs and other hazardous chemicals on human health and the environment.
3. Strengthening of the regulatory framework and institutional capacities for the management of POPs and other chemicals.
4. Reduction of emissions of PBDEs and PCBs through Environmentally Sound Management (ESM) of wastes in Electrical and Electronic Equipment (WEEE); End of Life Vehicles (ELVs) and PCB contaminated transformer oils and equipment.
5. Introduction of cleaner management practices for products, articles and wastes containing PFOS and other hazardous chemical wastes.
6. Reduction of emission of unintentionally produced POPs from dumpsites, open burning of wastes, metal production processes, waste incineration amongst others.
7. Enhancement of environmental monitoring programmes for POPs and other hazardous chemicals.
8. Introduction of environmentally sound management practices for sites and equipment contaminated by POPs.

The Government of Uganda is committed towards implementing the strategic areas of interventions identified in this NIP document. The revised NIP was developed in line with the National Development Plan (NDPII 2015-2020) which is the second in a series of six 5-year Plans aimed at achieving Uganda Vision 2040. The Environment and Natural Resources (ENR) sector made a submission on chemicals management in the second National Development Plan, including POPs management as a specific category. The revised NIP document seeks to contribute towards attaining sound management of these chemicals in the ENR sub-sector of the NDP.

Through a 5 year regional project (2011-2016), '*Capacity Strengthening and Technical Assistance for the Implementation of Stockholm Convention National Implementation Plans (NIPs) in African Least Developed Countries (LDCs)*', Uganda has implemented some of the priority areas of action recommended in the first NIP; including:

- (i) POPs and other chemical management aspects have been included into the revised National Environment Act.
- (ii) Preparation of draft sound chemical management regulations including POPs issues. The regulation, however, is still in draft form and

awaits finalization and operationalization.

- (iii) Raising awareness of POPs and other chemicals related to multilateral environmental agreements among district level staff. There is still need for wider scale awareness-raising and education campaigns and trainings among all levels of the population.
- (iv) Building national capacity to identify and assess sites which are contaminated by POPs.
- (v) Initiation of action to establish a national network for chemical information exchange.

The Montreal Convention

The **Vienna Convention on the Protection of the Ozone Layer** was adopted by participating countries and came into force in **September, 1985**. The Convention under-scores the urgency of taking appropriate measures to protect human health and the environment from the harmful effects of Ozone Layer depletion. The **Montreal Protocol on Substances that Deplete the Ozone Layer** came into force in **January, 1989**. The provisions of the Protocol are intended to directly reduce and/or phase out completely the production, consumption, export, import and use of ODSs. Uganda acceded to the Vienna Convention on 24th June, 1988, and ratified the Montreal Protocol on Substances that Deplete the Ozone Layer on 15th September, 1998.

The main sectors of Uganda which have over the years been associated with the phase-out of ozone depleting substances (ODSs) are the: **(a) Refrigeration and Air-Conditioning Sector** – dependent on Chlorofluorocarbons (CFCs) as refrigerants; **(b) Aerosols Sector** (*including asthma inhalers*) – containing CFCs as propellants; **(c) Solvents Sector** – Carbon tetrachloride used mainly as laboratory solvents in science laboratories, and dry-cleaning facilities; **(d) Halons Sector** – for fire-fighting; **(e) Floriculture** – Methyl bromide use in the cut-flower sector to control soil-borne pests; **(f) Foam Sector** – manufacture of flexible polyurethane foam (mattresses, among others).

There many alternatives (*HCFCs, HFCs, HCs, Ammonia, Propane, Iso-butane, water as a blowing agent in manufacture of foam, among others*) now on the world market that are being used to replace the use of ODSs mentioned above.

The **Project for CFC Phase-Out** was implemented from 2002 – 2007; and Uganda again achieved earlier **phase-out of CFCs by the year 2007 (three years ahead of the 2010 global target year/date)**. Since then CFCs are no longer being imported into the country. As provided for under the Regulations mentioned above, there are also authorized dealers in and importers of refrigerants and related equipment, as well as servicing companies, and include those below as at December, 2016.

Furthermore, to address the coordination of the Multilateral Environmental Agreements among institutions in Uganda, the targets identified in the National Capacity Strategy Action Plan (NCSA) among others; is to establish and strengthen inter-institutional collaboration framework among the three Rio Conventions on biodiversity conservation, climate change and desertification with promoting synergies between the three conventions into the future. NEMA on behalf of GOU will be implementing the Rio project to ensure the proper coordination with

other initiatives.

In addition to coordinating the Rio Conventions, NEMA is also further focusing on bringing biodiversity and ecosystem services to the heart of GOU decision making through using biodiversity and ecosystem services information, through mainstreaming biodiversity into the heart of government decision making. This will be achieved through implementation of the upcoming CONNECT project.

United Nations Framework Convention on Climate Change (UNFCCC)

Uganda signed and ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, and adopted the Kyoto protocol on 2002. Uganda adopted the Paris agreement in 2015, which entered into force in 2016. At National level, a climate change office housed at the Ministry of Water and Environment (MWE), has been established. Domestication of the convention has led to the development of various legal and policy framework which include the establishment of a National Greenhouse Gas Inventory System, the development of the National Climate Change Policy and a costed Implementation Strategy, 2015 and the Nationally Determined Contributions (NDCs).

The Clean Development Mechanism (CDM) Carbon Trading, Sustainable Development (SD) criteria template for the CDM Projects has been developed to facilitate documentation of the project contribution to national sustainable development. Because of the awareness created by CCD, many project ideas in different sectors have been developed and submitted to the CDM-DNA Secretariat (CCD). 14 Projects have received Letters of Approval (LoA) from the DNA and 5 Approved Projects have already been registered by the CDM-Executive Board, making Uganda the best performing country among the 48-Member Least Developed Countries and 4th best in Africa.

Some of these CDM Projects include the Bujagali Hydropower, Uganda Nile Basin Reforestation Project, Bugoye 13.0 MW Run-of-River Hydropower Project, Municipal Solid Waste Composting Project (MSWC), Improved Cook stoves, and water purification. In addition, there are a number of voluntary carbon market schemes in the country such as tree planting, briquettes, biogas, and biofuels in different parts of the country besides bagasse cogeneration. All in all over 1, 000 green jobs have been created and more than US\$ 800 million of carbon investments have been realized with an annual cumulative offset of more than 1 million tons of carbon dioxide equivalent. The Projects have also contributed to the development of the social services infrastructure in their respective areas of operation.

Some of the major mitigation measures aimed at promoting additional investments to contribute to economic growth, wealth creation and employment opportunities include the Nationally Appropriate Mitigation Actions (NAMAs). These include Agriculture Sector NAMAs, Energy Sector NAMAs, Transport Sector NAMA and Waste Sector NAMAs. There are equally opportunities to be tapped from our efforts in forest conservation through Reducing Emissions from Deforestation and Forest Degradation (REDD Plus); Wetlands conservation, climate smart

agriculture and increased generation of electricity from renewable sources such as solar and geothermal under the country's Nationally Determined Contributions and the National Green Growth strategy.

The promotion of rainwater harvesting from roof tops and run-off water after downpour by MAAIF is expected to augment the current efforts of diffusion of the solar-powered water irrigation technology for domestic use and water for production. In addition, there are ongoing initiatives to scale up climate smart agriculture practices for both adaptation and mitigation measures in different agro-ecological zones and encouraging the use of high yielding drought resistant, early maturing seed varieties, improved livestock breeding for enhancing resilience and adaptive capacity in the advent of changing climate.

Advanced efforts to mobilize grants to undertake a comprehensive Technology Needs Assessment and the feasibility studies for geothermal power generation in the country are on-going through Uganda National Council for Science and Technology (UNCST), the Designated Entity on Technology Transfer.

ENVIRONMENT MANAGEMENT AND SECTOR REFORMS

Environment Management in Uganda is mandated to NEMA with powers to monitor, supervise, and coordinate all activities in the field of environment. Since establishment in 1995, NEMA has worked in collaboration with Lead Agencies such as Ministries, Departments and Agencies (MDAs), Civil Society Organizations (CSOs), Private Sector, Academia and the Media. Key areas of intervention are discussed below.

Environmental Planning

NEMA has made a case for integrated planning for environment and as a result all sectors are required to designate an environmental liaison officer. In addition the ongoing reforms led to the development of the SEA Regulations and guidelines to promote effective and environmentally sound policies, plans and programs.

Environmental audits, standards and licensing

NEMA has carried out continuous inspections and audits with the help of gazetted environmental inspectors, to ensure that all projects approved comply with the requirements of the Environmental Act. The Authority has certified and registered persons and partnerships as Environmental Practitioners, for purpose of carrying out Environment Impact Assessment (EIA), Environmental Audit (EA) and/or to coordinated, conduct EIA/EA respectively.

In addition, training of technical officers from the District Local Governments in particular the District Environment Officers (DEOs) and MDAs, has assisted NEMA to coordinate its role in environmental management, because these gazetted officers, use their assigned roles to ensure that, there is responsible use of environment and natural resources in the districts and Local Peoples and Indigenous Communities (IPLCs),

coupled with NEMA's inspections and audits of all facilities and projects approved by the institution.

Support from the LAs, such as the District Environment Officers, who review the EIAs, has been of tremendous benefit to the Authority. Uganda had 33 districts which increased to 81 districts by 2008. The districts increased to 113 by 2011, however, the number of districts has kept growing, hence increasing the challenges of coordinating, supervising, and monitoring of environmental management in all the 113 districts. This requires more additional funding and additional staffing.

Public awareness and participation

Mentoring of District Local Governments (DLGs) is an ongoing process that requires engagement with the districts leaders and communities in order to ensure the level of integration of environmental issues into development plans, programs and budgets is done and implementation of mitigation measures ascertained. In all the districts visited by NEMA during the quarterly activities, inform the Authority, that environment issues have been adequately identified and integrated into the DDP. However, districts still have challenges of inadequate resources, inadequate staffing at sub country levels, inadequate use of ICT, specific conditional grants allocation to wetland management only, among others.

Use of economic Instruments and incentives

The use of economic instruments (EIs) for environmental management to improve standards of living; leading to economic growth focus on priorities in the National Development Plan II (NDPII), which is energy, infrastructure, water and sanitation, among others. The use of economic instruments and social incentives in conservation, is a participatory approach through using the communities for example in the wildlife sector. The coordination between NEMA and Uganda Wildlife Authority (UWA), with mutual planning, transparency and cohesion of stakeholder involved, creates ownership and commitments of both stakeholders. This has been particularly seen in the management of Protected Areas in Uganda.

In the agricultural sector, the reflection on commitments to environmental management is seen with banks exempting tax on incomes earned from lending, however this was seen to be happening 8 years ago (Kazooru, Mwerinde, Birungi, & Yaron, 2009), between 2014 and 2016, the allocation of resources towards environment and natural resource was still low, however, the growth rate is much lower than 5.4 per cent that was anticipated in the previous updates (World Bank, 2016). Significantly, this is almost more than a percentage point lower than the government's original projection 7 per cent GDP; given the infrastructural gap, hence impacting on the policy pursuit and widening fiscal deficit. (Bank of Uganda: State of the Economy Report, March 2016).

The take-off of Karuma and Isimba dams helped sustain economic activity in spite of the weak economic environment (NEMA, 2016), and the below-par performance of some of the government's other planned investments such as the planned oil investments. Furthermore, such investments are expected to increase in tandem with aspirations of transformation stated in the National Development Plan and the National

Vision 2040. For instance, up to US\$9 billion worth of investment is expected in Uganda's oil sector over the next two to three years (World Bank, 2016).

Therefore, planning, appraisal, independent review or evaluation, selection of financing solutions or mechanisms, implementation and adjustments due to changes in the environments and processes should be used to increase economic resilience and, improve on weak coordination and implementation within Government.

Environment Sector Reforms

The review of the NEMP 1994 equally necessitated the review of the National Environment Act (NEA) Cap 153 and similarly several other laws are under review including: the Uganda Wildlife Act 1996, the Water Act, Cap 152, the Land Act, and the Mining Act, 2003, among others.

To bridge the gap and ensure that the reforms are effectively incorporated, several regulations under the NEA have been revised and await the enactment of the National Environment Bill 2018 into law. It is important to note that due to the changing environmental challenges in Uganda, several modifications and changes to the NEA were made and endorsed, hence mere amendments would not enable the NEA to curb and match up to the said challenges. Therefore, a total overhaul of the law was paramount and the National Environment Bill 2018 once enacted is intended to replace the 1995 NEA Cap 153. This is also because the Bill introduces new aspects such as Sound Management of Chemicals and Product Control, terminologies like Environment and Social Assessment to replace the Environment Impact Assessment, Payment for Ecosystem Services, and the establishment of the Environmental Tribunal to ensure that expeditious handling of environmental cases, among other introduced aspects as described below;

(a) **Sound chemical management throughout their life cycle.** The life cycle of industrial and consumer chemicals is not sufficiently covered in the current law. **Given that emerging trends indicate that** chemicals need to be managed throughout their life cycle, from production, importation, exportation, transportation, storage, use and disposal. The amendments in the Bill are intended to protect human life and the environment from improper use of chemicals. Although the Agricultural chemicals are managed by the Agricultural Chemicals Board and the pharmaceutical chemicals will be managed under the proposed Food and Drug Act, there is need for a central body to coordinate the management of chemicals to ensure that they are properly handled and managed in an environmentally sound manner.

(b) **Strategic environmental assessment (SEA).** Whereas SEA is a very important consideration especially for transboundary activities or activities that are undertaken across a large landscape, SEA is not provided for in the current law in this context. The Bill provides for SEA in order to guide the planning process at all levels of governance for national plans, policies, programmes and strategies, and to complement the environmental impact assessment process which targets projects. This provides a framework for strategic environmental planning and management.

(c) **Environmental concerns arising from petroleum activities and midstream operations.** Although petroleum exploration in Uganda started as early as the 1980s, the issues related to the management of the environmental aspects of petroleum activities and operations were not taken squarely into account during the enactment of the National Environment Act in 1995. Environmental concerns related to the petroleum sector therefore need to be addressed in the Bill, especially as there is a requirement for this in the Petroleum Petroleum (Exploration, Development and Production) Act, 2013 and the Petroleum (Refining, Conversion, Transmission and Midstream Storage) Act, 2013, both of which laws make repeated reference to the National Environment Act on environmental matters, including waste management and pollution control.

(d) **Climate change concerns.** The existing law has very general provisions related to climate change. Under the Bill, climate amelioration, adaptation and mitigation measures and practices have been incorporated to operationalise the Climate Change Policy of Uganda adopted by the Policy Committee on Environment in 2013 and the Global Agreement on Climate Change concluded by the international community in Paris in December 2015.

(e) **Sustainable development goals.** The United Nations Conference on Sustainable Development (UNCSD), also known as Rio 2012, provided a platform for the development of Sustainable Development Goals (SDGs) and a set of measurable targets aimed at promoting sustainable development globally. In 2015, the international community adopted the Sustainable Development Agenda containing 17 Sustainable Development Goals with 169 associated targets which are integrated and indivisible. The Bill handles this development in the international sphere by ingraining provisions on environment and sustainable development both in its principles of environmental management and in modalities related to environmental literacy and environmental management practices.

(f) **World Environment Day (WED).** The current law does not provide legal recognition of the World Environment Day and yet the event is celebrated every 5th day of June. It is important to provide for a National Environment Day reflecting the global theme in order for resources to be allocated to the commemoration of that day to engender national planning and a common recognition of the importance of environment in sustainable development.

(g) **Structures for environmental appeals.** Although the current law provides for administrative dispute resolution, it falls short of providing for structures for environmental appeals. Considering the need to prevent and arrest environmental harm before it occurs, and to ensure that the polluter pays in a timely manner, it is important to ensure that structures are put in place to handle environmental issues in a timely manner. It is, therefore proposed that the law shall provide for an administrative complaints' recourse structure and an environmental tribunal. The tribunal shall be the first stage of the appeal system after NEMA has administratively handled the complaint and before recourse to courts of law.

(h) **Punitive action against environmental degradation-express penalties.** The current Act does not adequately provide for measures for immediate punitive action against environmental degradation. These include the on-spot fining measures which would be an effective deterrent mechanism to improper behaviour detrimental to the environment. There is need to empower the National Environment Management Authority (NEMA) to prescribe express penalties by statutory instrument.

(i) **Enhanced Penalties.** The penalties in the current Act are inadequate and do not provide for effective enforcement and deterrence. Some of the penalties in the current Act are not strong or sufficiently deterrent. This has partly encouraged recurrent breach of the law. In relation to fines, it is imperative to change the fines into currency points in order to ensure that fines do not lose value and also to conform to the current tradition of legislative drafting and the Law Revision (Fines and Other Financial Amounts in Criminal Matters) Act, 2008.

(j) **The Environment Protection Force.** There is need to have a dedicated force for the protection of the environment. The proposal is to have a force appointed by the Board in consultation with the Uganda Police.

(k) **Acute Pollution.** Although the current Act provides for pollution, there is need to specifically make provision for acute pollution, including oil spills. This will require a developer or operator engaged in an activity which may result into acute pollution to provide the necessary emergency response system designed to detect, prevent, stop, remove and limit the impact of the pollution and also creates a duty to provide assistance during acute pollution.

(l) **Preparedness for environmental emergencies and disasters.** Currently, the law does not provide for a mechanism for handling environmental disasters. The new law proposes to empower the Minister by regulations, to establish a coordination mechanism for national responses to environmental emergencies and disasters in consultation with key lead agencies.

(m) **Import, export and re-export of hazardous waste and transboundary movement of hazardous waste.** The revised law should have provisions clearly addressing these issues, especially in view of the menace of dumping of hazardous waste in unsuspecting community areas.

(n) **The Management of plastics and plastic products.** Although the Finance Act, 2009 attempted to address the issues related to plastic, it is not comprehensive enough and additionally, this prohibition needs to come under the National Environment Act. The revised law should therefore clearly prohibit the importation, local manufacture, sale or use of sacks and polymers of ethane and polythene or plastics and plastic products; and also empower the Minister by regulations to ban or restrict the importation, exportation, manufacture, or use and re-use of categories of plastics and plastic products.

The Authority will be empowered to establish a criteria for the categorisation, documentation, handling, storage, recycling, reuse and disposal of plastics and plastic products, taking into account the hazards they present to human health and to the environment.

The regulations reviewed to underpin the policy changes include: The draft National Environment (Waste Management) Regulations 2017/2018; the draft National Environment (Standards for Discharge of Effluent into Water or on Land) Regulations, 2017; The National Environment (Environmental Impact Assessment) Regulations, 2017; among others.

Conclusion

Several conclusions can be drawn. First, since the year 1992 – the year of the Earth Summit that influenced subsequent environmental policy processes, Uganda as a country is in charge of the developments and has put in place sound environmental measures to ensure sustainable development. This end Uganda has developed and put in place an elaborate policies, legislative and institutional frameworks for environmental and natural resources management. This also accounts for the many international conventions and treaties well integrated and reflected in national policies and laws. Although the environmental challenges remain the same over the years, strategies to address them have been evolving.

Secondly, despite comprehensive policy and legal frameworks being in place, environmental degradation and natural resources depletion continues to occur. This is because the regulated community are aware of the dangers but intentionally fail to adhere to the measures because of weakness in policy implementation and enforcement of environmental legislation in some areas of the country.

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The Crested Crane, Uganda's national symbol, is one of the most cherished birds in the country



PART 4

FUTURE OUTLOOK AND RECOMMENDATIONS

Forestry

Projection of demand and stocks of forest resources

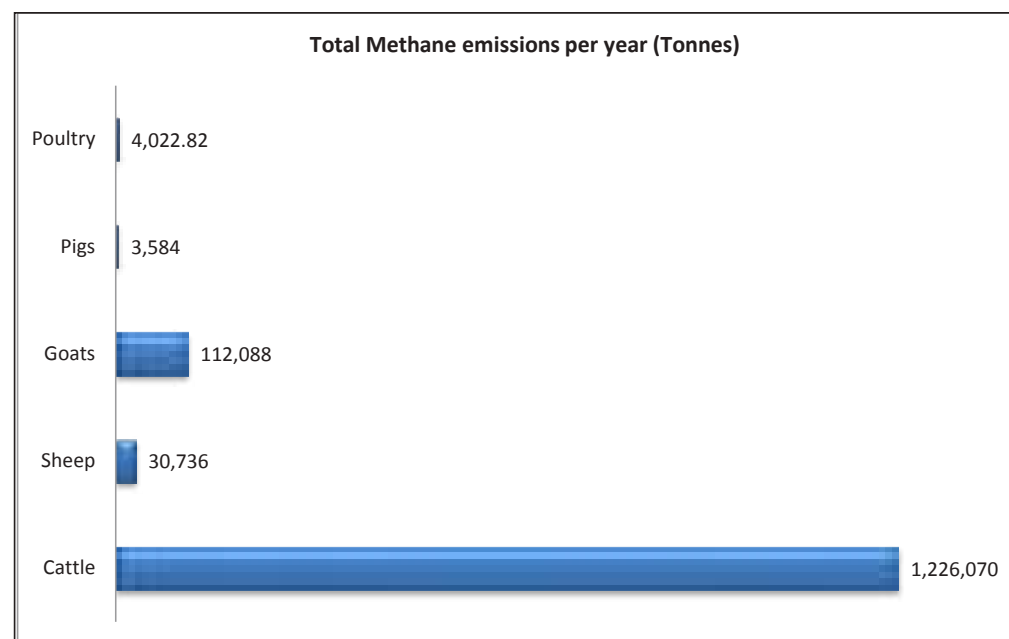
On average about 110,428.7 ha of forest cover was lost each year through extracting the products listed in Figure 10.3. If the current consumption of the forest cover is maintained and the population growth is contained or reduced, it is estimated that the natural forest of Uganda will be extinct in about 42 years from now. If the current population growth and uncontrolled consumption are maintained, forest cover be cleared in about 26 years. If, however, the consumption behavior is controlled, the current forest cover will last about 76 years.

Livestock farming

The growing number of livestock has had an impact on the environment in terms of livestock related GHG emissions. Agriculture is the dominant source of both methane and nitrous oxide emissions (Krapivin et al., 2004). The emissions of these gases lead to climate change outcomes like reduction of annual rainfall and greater variability in weather patterns (Tubiello et al., 2013) that are predicted to threaten agricultural production through the increased frequency of extreme weather events such as droughts, heat waves and floods, disease outbreaks among others (Patra, 2012, DIICCS RTE, 2013).

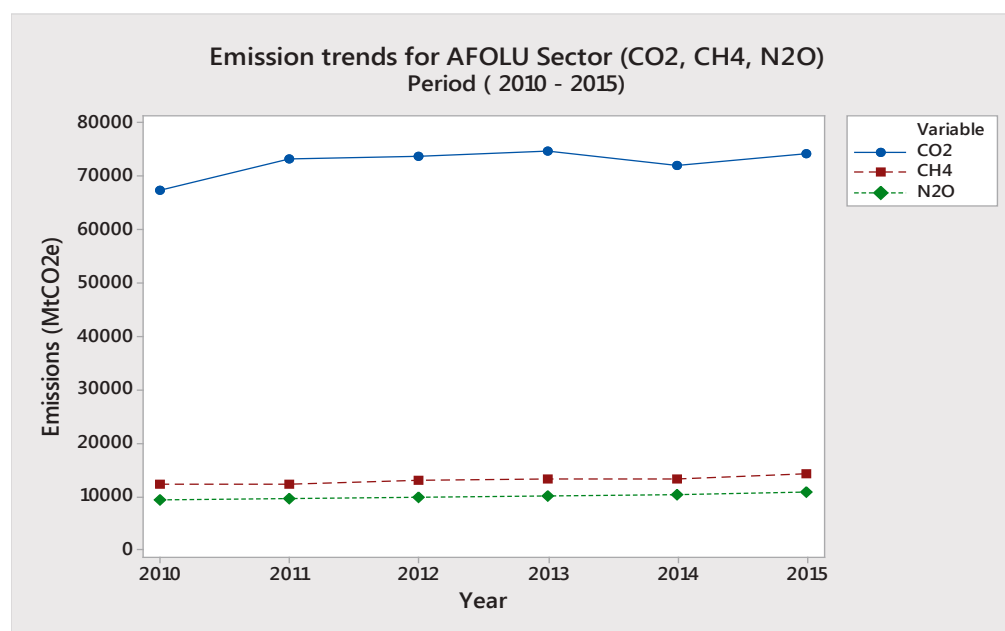
Figure 8.3 shows that ruminant animals have emitted more methane than non-ruminants, above all; cattle have emitted more than a million tons of methane. Emissions seem to have increased since numbers of animals have been increasing over the past years. Therefore, in Uganda, the main sources of methane are cattle, goats, sheep (ruminants) and others (non-ruminants) are pigs and poultry (UBOS, 2015). With Uganda's scenario, by 2014 we have 34,222,350 tons of CO₂ equivalent emissions. Such excessive emissions of methane are expected to continue to increasing as animal numbers increase, if no action is taken to curb them down (CWF, 2009, USAID, 2014, UASSP, 2016).

Estimated methane emissions from livestock to the environment



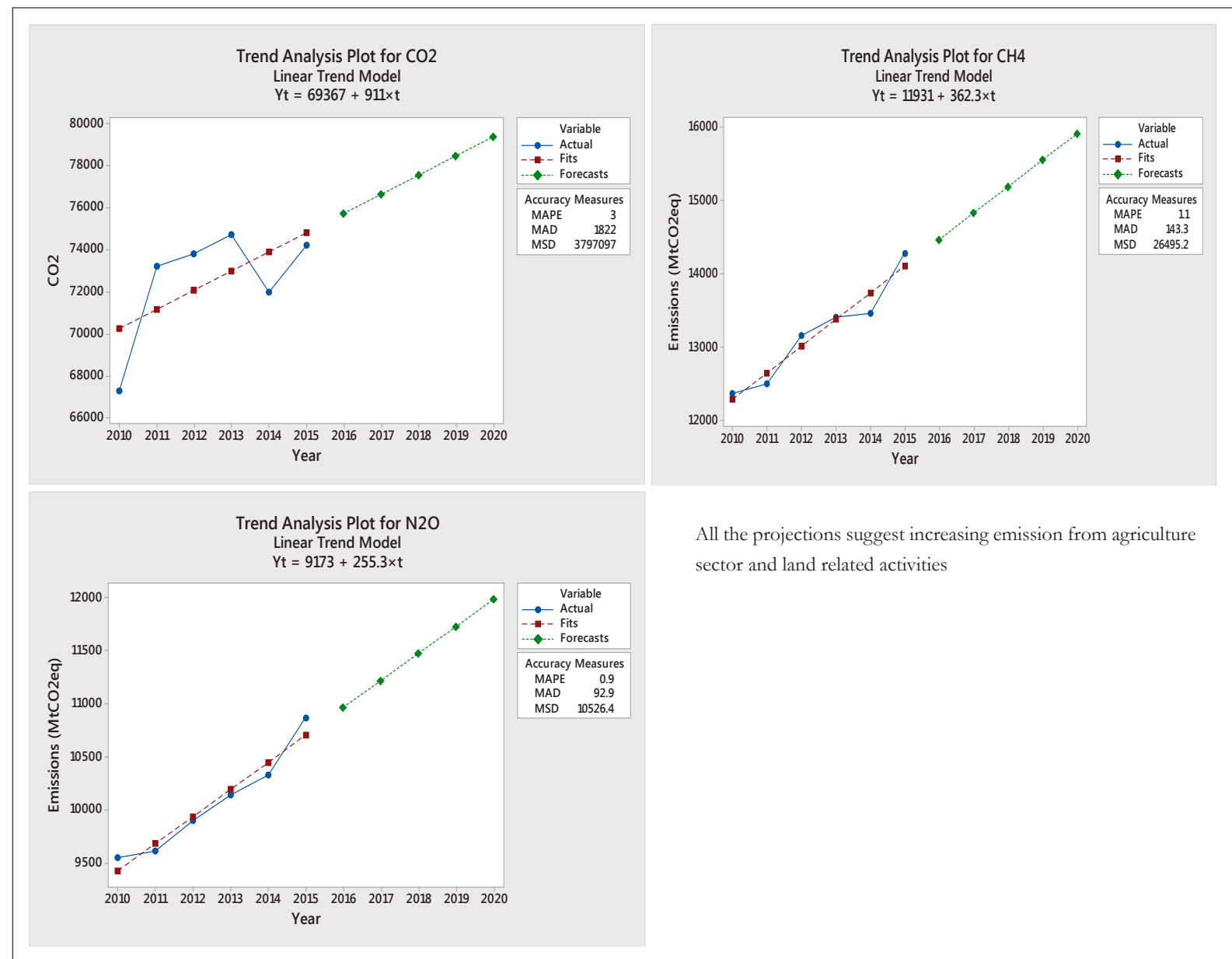
Source: Author's computation from UBOS data, 2015

Emissions from Agriculture, Forestry and Land Use (AFOLU) Sector Emission Trends for AFOLU SECTOR between 2010 and 2015



Source: Uganda National Greenhouse Gas Inventory Management System, 2016

In this sector, Carbon Dioxide (CO₂) was the most emitted gas with a significant variance between the levels emitted of Carbon dioxide and the other two gases of Nitrous Oxide (N₂O) and Methane (CH₄) that remained relatively low in the period between 2010 and 2015.



All the projections suggest increasing emission from agriculture sector and land related activities

Source: Uganda National Greenhouse Gas Inventory Management System, 2016

Atmospheric Resources

Rainfall Prediction

Prediction of monthly rainfall for the period 2012-2015 was modelled using trigonometric functions. The model estimated from the monthly data is given by

$$\text{Rainfall} = 114.2 - 49.46 \sin(1.152 \times t) \text{ where } 0 \leq t \leq 11$$

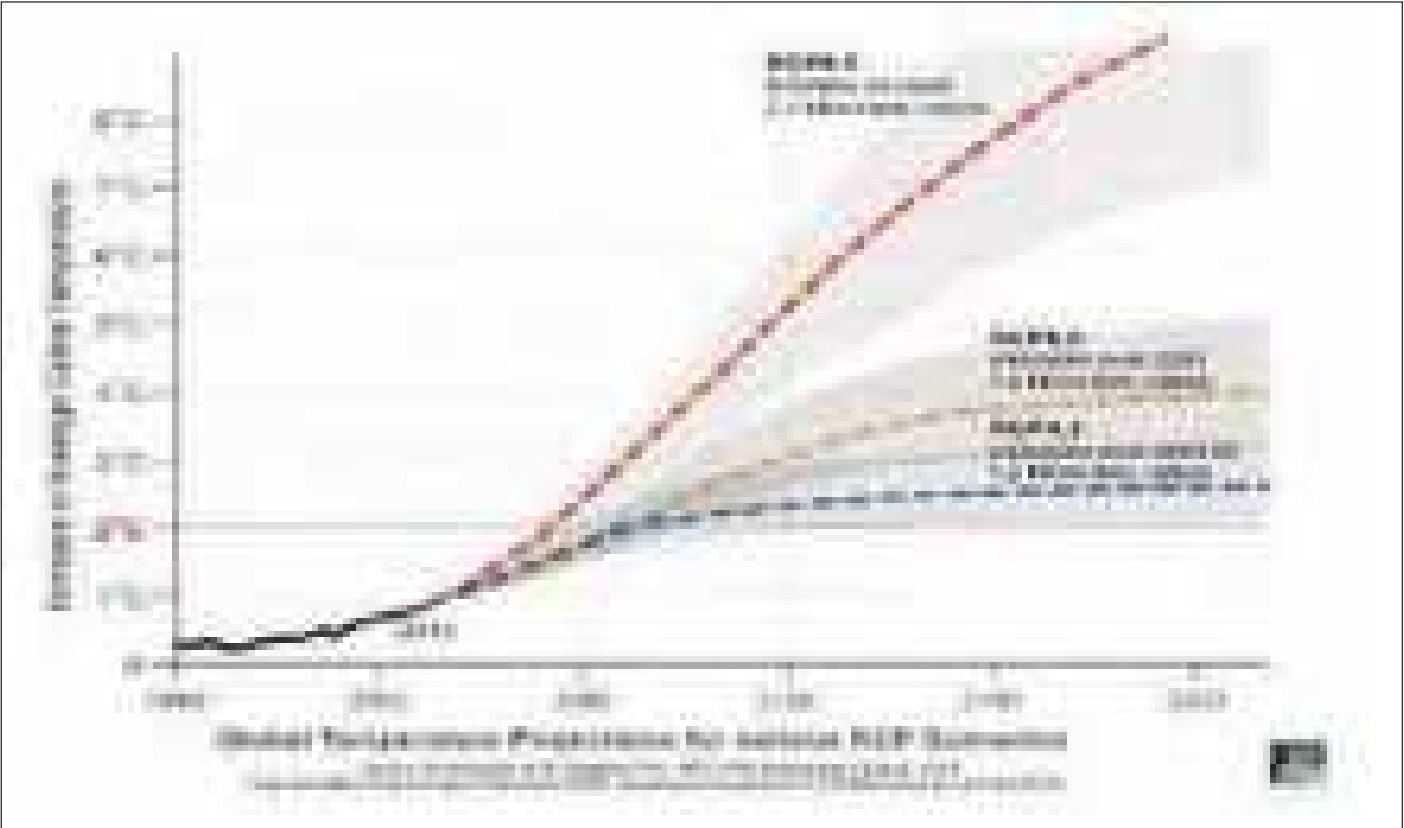
The prediction shows that average monthly rainfall has a cyclic behavior which manifests after a period of about 5 months. The model further shows that the average monthly rainfall is higher in the first season but for a shorter period of time and lower in the second season for a longer period of time of about 7 months. This implies that for an agricultural country like Uganda, the first season would better for crops that require less rains and second season for crops that require more rains.

Climate Change Projections

At the global level, the IPCC in its AR5 projected that continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems.

According to the Fourth Intergovernmental Panel on Climate Change Assessment Report, the global climate change models project an increase in average temperatures in Uganda by up to 1.5°C in the next 20 years and by up to 4.3°C by the 2080's.

Graph Showing the Global Temperature Projections according to various Representative Concentration Pathways (RCP)



Changes in rainfall patterns and total annual rainfall amounts are also expected. Based on the models, predictions indicate an increase in rainfall of 10 – 20% over most of the country with a decrease expected over the semiarid cattle corridor. From the precipitation predictions, it is estimated that there will be 10 to 20% increase in runoff under future climate change scenarios for most of Uganda. Recent recorded rainfall data indicate some significant variations and changes in various parts of the country.

The decrease in rainfall in most of Uganda, combined with a significantly wetter DJF season, will result in significantly drier conditions for the rest of the year (longer wet season that extends from SON towards DJF);

This is combined with significant temperature increases, especially during the MAM and JJA seasons; overall, those changes will require a number of adaptation strategies that have been studied in the Economic Assessment.

A significant drop of total rainfall over Lake Victoria (-20% from present), combined with about 1°C temperature increase will impact the lake water level.

Specificities of some of the regions where case-studies have been conducted (e.g. in the Mount Elgon area and the western districts of the country, where more rainfall is expected)

Summary of Climate Projections for Uganda under RCP 4.5 and RCP 8.5

Parameter	Representative Concentration Pathway RCP (4.5)	Representative Concentration Pathway (RCP 8.5)
Annual temperature changes from the median	In +50 years to present: +1.5°C to +2°C in most continental parts of Uganda In +80 years from present: +2°C to +2.5°C in most of Uganda	In +50 years to present: +2°C to +3°C in most continental parts of Uganda In +80 years from present: +4°C to +5°C in most of Uganda
Annual rainfall changes from the median	In both +50 and +80 years: -5 mm (mostly in the northern half) to -10mm per month (mostly in the southern half). Up to -70mm per month over lake Victoria	In both +50 and +80 years: -10mm to -20mm (mostly in the northern half) to -30mm per month (mostly in the south). Over --100mm per month over lake Victoria

Source: Economic Assessment of the Impacts of Climate Change in Uganda Report (2015)



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