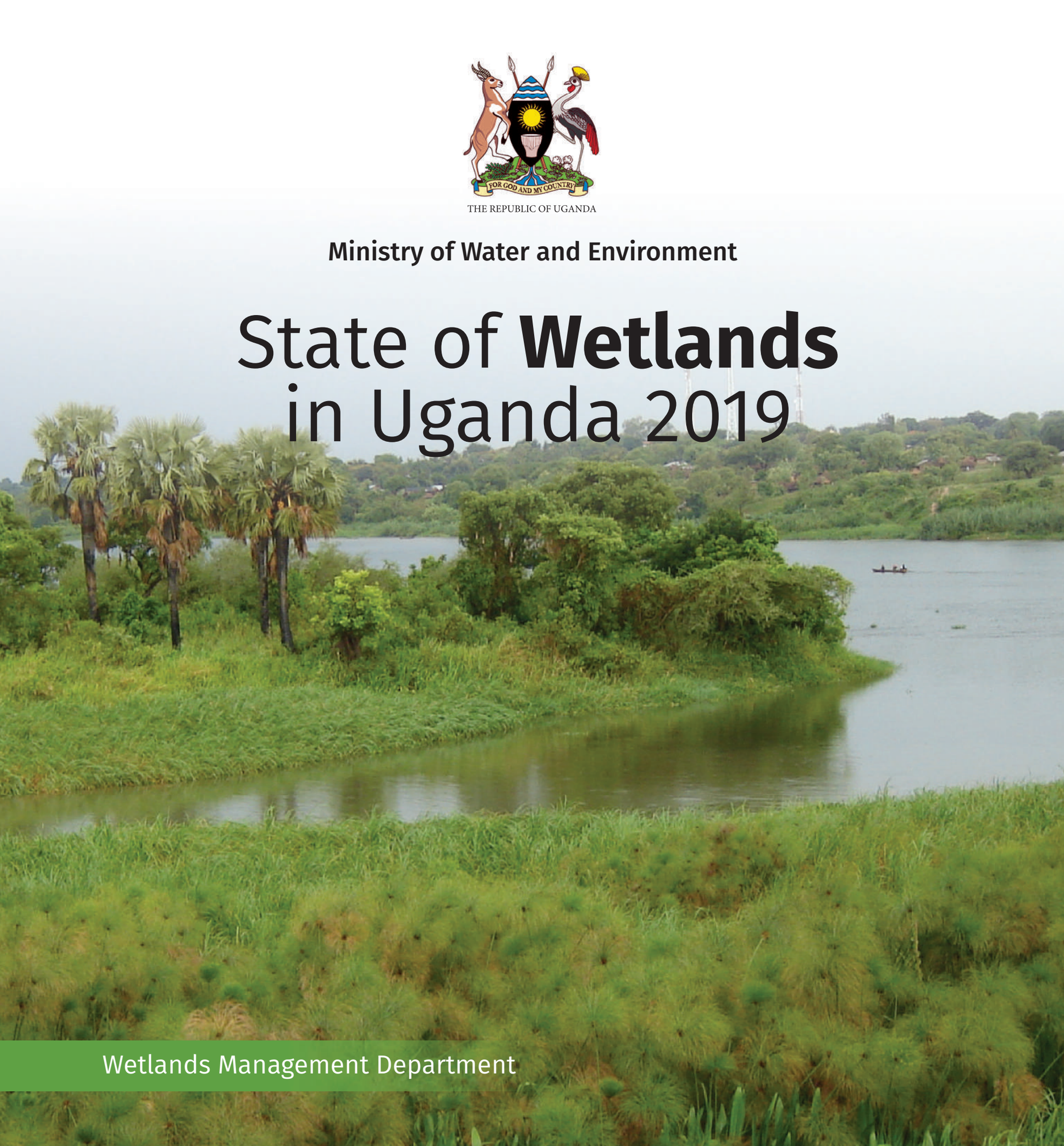
THE REPUBLIC OF UGANDA

Ministry of Water and Environment

State of **Wetlands** in Uganda 2019



Wetlands Management Department

State of Wetlands in Uganda 2019

Copyright:
Wetlands Management Department, Ministry of Water and Environment 2019
P.O Box 20026,
Tel: +256 414 505942
Fax: +256 414 505941
Kampala, Uganda
Website: http://www.mwe.go.ug

Authors and Contributors
This publication was prepared by a team from the Wetlands Management Department, Ministry of Water and Environment, Uganda

Contributors

- Mr. Oloya Collins
- Ms. Iyango Lucy
- Mr. Barugahare Vincent
- Mr. Kyambadde Richard
- Mr. Paul Mafabi
- Mr. Mafumbo Julius
- Mr. Businge Daniel
- Mr. Magara Nicholas
- Mr. Mukiibi Jackson
- Mr. Arimwesiga Moltar
- Mr. Wanyama Wilberforce
- Ms. Apiyo Kevin
- Mr. Afai Sylvano
- Kabaalu Deo

Authors

- Ms. Carol Kagaba Kairumba
- Dr. Barasa Bernard
- Mr. Asadhu Sebyoto
- Mr. Ssentongo Benard
- Mr. Wabwire Vincent
- Mr. Mulabbi Andrew

Citation:
Ministry of Water and Environment (2019). State of Wetlands Report for Uganda

ISBN:978-9970-467-01-3
The content in this document has been subjected to review and approved by the Ministry of Water and Environment. Any errors and omissions that could have unknowingly been made are highly regrettable.

THE REPUBLIC OF UGANDA

Ministry of Water and Environment

State of **Wetlands** in Uganda 2019

GREEN CLIMATE FUND

Foreword

Uganda is endowed with a vast coverage of wetland resources that provide a wide array of products and services. Wetlands provide employment to over 2.7million people in the country and are a source of livelihood to the majority of the rural poor. Wetlands provide water both for agriculture and house hold use throughout the country among the many functions and therefore their importance cannot be overlooked. Studies have shown that Lake Nabugabo Ramsar Site alone contributes about USD 6.4 million a year from the ecosystem services and this translates to an average of USD 350 per ha of the wetland habitat. Being a signatory to the Ramsar Convention, Uganda is bound by all the principles therein that include regularly reporting on the status of wetlands, designation of Ramsar sites and wise use of its wetlands. So far, 12 Ramsar sites have been designated, a National Wetland Policy is in place to ensure wise use of wetlands and the country has produced the first ever wetland status report.

What is important to note, is that all wetlands are unique and perform vital functions that range from regulatory, provisioning, supporting and cultural ecosystem services. Their capacities to perform those services may vary from wetland to wetland depending on the type of wetland. This dynamic nature of wetland ecosystems which leads to variations in their capacities to perform given functions makes each wetland unique and important to the community that benefit from it. Therefore, wetlands have multiple uses and users and this necessitates that wetlands should be monitored, inventoried and assessed from time to time.

According to the mapping exercises undertaken in 1994 and 2015, the wetland coverage has registered a decline from 15.6% in 1994 to 13% in 2015 and if this is not halted, Uganda risks losing all its wetlands by 2040. Although the wetland coverage is estimated at 13% of Uganda's surface area, only 8.9% (21,526km^2) of this is intact while 4.1% (9,885km^2) in under some form of degradation. This Decline has been driven by a number of factors including urbanization, population increase, uncoordinated planning and demand for more arable land.

This State of Wetlands report comes at a time when there is increasing demand for information to guide decision making and in light of the emerging issues of climate change and oil and gas in the country. This report is therefore aimed at providing information for decision–making to an array of stakeholders thereby fulfilling one of the strategic objectives in the Wetland Sector Strategic Plan which is to enhance the knowledge base of ecological process and socio-economic values of wetland and disseminate to all stakeholders. Specifically, the Report will; help monitor wetland loss/gain; assist land-use planning and management; identify priority areas for conservation; promote awareness of wetland values and functions; stimulate discussions and co-operation amongst wetland resource stakeholders.

It is my sincere hope that the information provided in this report will enrich your awareness about the wetlands in Uganda but most importantly provide great input into all planning processes so as to avoid the continued degradation of these vital natural resources hence contributing to attainment of sustainable development.

Finally, the Ministry of Water and Environment would like to extend its sincere thanks to all the partners that have supported wetland management in the country especially those that have contributed to the generation of this critical information over the years.

I wish you good reading

Hon. Cheptoris Sam
Minister of Water and Environment

Preface

The State of Wetlands report 2019 is the first publication of its kind in Uganda and provides an opportunity for decision makers and all stakeholders to appreciate the extent of wetlands in the country, their condition, values, the threats and opportunities available. It comes at a time where the country is facing enormous challenges arising from increased degradation of natural resources as well as climate change. Therefore, the enormous amount of information in this report provides a foundation for which the different players both at Central and Local government levels can base to make their decisions regarding wise use of wetlands.

Wetlands Management Department (WMD) in the Ministry of Water and Environment as a lead agency for the management of wetlands has been coordinating the implementation of the Wetlands Sector Strategic Plan that underpins the importance of promotion of knowledge on environment and natural resources. A number of strides have been undertaken to generate country wide and reliable data on wetlands in order to improve their management. Key among the actions have been to map the extent, classes and distribution of wetlands and also detail the wetland ecological features, types, activities in a wetland, threats to a wetland, ownership and conservation measures.

The National Wetlands Program (now Wetlands Management Department) carried out an extensive inventory of wetlands to develop baseline information for the assessment of wetlands in Uganda with the overall objective of assisting Government to understand the extent, location and composition of wetlands so as to enable a comprehensive policy on wetland management to be formulated. Therefore, the inventory data informed the development of the National Policy for the Conservation and Management of Wetland Resources. The process was originally piloted in a few districts namely: Masaka, Tororo, Kabale, Kampala, Mpigi and Iganga. In 1996, a systematic approach to wetland inventory was developed and this encompassed development of data collection sheets, a wetland inventory guide as well as other materials and equipment needed for the inventory exercise.

In 2008, another mapping exercise was undertaken that generated the 2008 wetlands cover dataset for the entire country. As a prerequisite by law, regular mapping and inventory of wetlands in essential. Another Wetlands dataset for 2015 was generated in collaboration with National Forestry Authority and a new mapping exercise for 2020 is underway. The Uganda State of wetlands report therefore has three datasets but emphasis has been placed on two major datasets (1994 and 2015) that have been compared to show the changes so far. The results have been provided as statistics, pie-charts, maps and qualitative descriptions. The analysis of the results is also presented at different levels namely: nationally, per drainage basin and per district among others.

However, we note that the pressures on wetlands have continued, resulting in the noted reduction in coverage and we envisage that the coverage could have been even reduced further given the current scenarios. However, the Ministry working together with Local Governments has put in place mechanisms to demarcate and restore critical wetland systems as a key priority area in order to reverse these trends. It is therefore my sincerer hope that this report will be utilised to inform integrated planning, resource allocation and implementation of government programs at all levels.

Alfred Okot Okidi
Permanent Secretary
Ministry of Water and Environment

Acknowledgement

Wetlands Management Department, Ministry of Water and Environment would like to thank all development partners, government departments, private sector and civil society institutions that have continued to support the work of wetlands Management in the country.

I would like to express gratitude to all the development partners that have supported development and production of this report. Special thanks go to the Royal Netherlands Government that supported the initial inventory exercise of all wetlands in the country, Government of Belgium through the Belgium Technical Cooperation that supported the mapping of wetlands in 2008, the Government of Japan for the upgrade of the National Wetland Information System and National Forestry Authority that has over the years been a partner in mapping wetlands as one of the land cover types. Thanks also go to UNDP/GCF that provided the funding to print this report.

Special thanks go to the technical team that analysed and compiled this report. The Assessment, Information and Management Division for their invaluable effort in spearheading the process and ensuring that this report is finalised. In Particular, appreciation goes to Ms. Iyango Lucy, Carol Kagaba Kairumba, Asadhu Sebyoto and Dr Benard Barasa for spearheading this process. Credit also goes to all contributors including Barugahare Vincent, Kyambadde Richard, Magara Nicolas, Wanyama Wilberforce, Afai Sylvano, Businge Daniel, Sentongo Bernard, Julius Mafumbo, Late Paul Mafabi, Apio Kevin, Mukiibi and Moltar Arimwesiga.

Collins Oloya
Ag. Director/ Directorate of Environment Affairs

Acronyms

AMCOW	African Ministerial Council for Water
CSO	Civil Society Organisations
EIA	Environmental Impact Assessments
EIS	Environmental impact statements
EPF	Environmental Protection Force
EURECCCA	Enhancing Resilience of Communities to Climate Change through Catchment Based Integrated management of Water and Related Resources in Uganda
FSSD	Forestry Sector Support department
FY	Financial Year
GCF	Green Climate Fund
GIS	Geographical Information Systems
GoU	Government of Uganda
GWP	Global Water Partnerships
IBA	Important Bird Areas
IGAD	Inter-governmental Agency for Development
LG	Local Governments
LVBC	Lake Victoria Basin Commission
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MDA	Ministries, Departments and Agencies
MWE	Ministry of Water and Environment
NBI	Nile Basin Initiative
NDP	National Development Plan
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
NEMA	National Environment Management Authority
NFA	National Forestry Authority
NWIS	Natioanl Wetland Information System
RCP	Representative Concentration Pathway
Sqkm	Square kilometres
UNDP	United Nations Development Programme
WMD	Wetlands Management Department
WMO	World Meteorological Organization
WMZ	Water Management Zone

Executive Summary

Introduction

Uganda's wetlands continue to provide ecosystem goods and services that positively affect the livelihoods of local communities, with the sub-sector employing over 2.7 million people. However, the coverage of wetlands in Uganda has been declining over time due to encroachment and degradation from natural and anthropogenic activities. It is against this backdrop that the Department of Wetlands Management takes stock of the state of wetlands in Uganda. The development of this report was guided by a literature review and analysis of existing wetland and population census geospatial datasets. The analytical representation of the status of wetlands was conducted between 1994 and 2015 at national, regional, district and drainage basin levels.

Summary of key findings

The findings revealed that between 1994 and 2015, Uganda experienced a decline of an estimated 6,146.6km^2 of wetlands spatial coverage representing 2.5% of Uganda's total surface area. This means that the country loses 293km^2 of wetlands every year and if this trend is not reversed, Uganda is likely to lose more 7,325km2 by 2040. The recovery of these wetlands can only be restored if the set targets in NDP III and Vision 2040 are realized. Other key findings were;

- As of 2015, the wetlands coverage was at 13% of Uganda's surface area with 21,526km^2 as intact wetlands (8.9%) and 9,885km^2 (4.1%) as degraded wetlands.
- Based on the wetland classification, the class grasslands was the biggest class in 1994 at 55%, followed by papyrus and sedges at 18%, in 2015 the wetland class grassland reduced to 28% while the class with small scale farmland increased to 30% from 7%.
- 2015 mapping showed that the most highest level of degraded wetlands were found in the eastern region (40%) followed by central (26%), northern (18%) and western (17%) regions . The degradation in Eastern Uganda was majorly attributed to conversion of wetlands into small scale and subsistence farmlands.
- There was a general decline in wetlands coverage across all drainage basins with Lake Kyoga drainage basin experiencing the highest change in area coverage followed by Lake Victoria. Lake Kyoga drainage basin was by far the most degraded basin by 42%, followed by Lake Edward (34%), Lake Victoria (29%).

Drivers of wetland degradation

The drivers of wetland degradation can be categorized into physical/structural (construction of electricity and valley dams, soil erosion, excessive water abstraction, burning of wetland vegetation, and infrastructural developments); extraction (sand, clay and gold mining, water extraction, wood, papyrus and grass harvesting, and overfishing); introduction of species and pollutants (pollutants, the establishment of washing bays, invasion of non-native water weeds, solid waste dumping, and introduction of excessive nutrients from agriculture); institutional (unclear land tenure, political interferences, unplanned urbanization and settlements, and limited knowledge base about wetlands).

Consequently, the observed and reported impacts of wetlands degradation on ecosystem services can also be classified into biodiversity impacts (loss of biodiversity and human-wildlife conflicts); hydrological impacts (increased cost of treating sewerage and wastewater, pollution of water bodies, increased/reduced water levels in lakes, and limited access to water sources); land-related impacts (open pits from mining activities, soil cracking and spontaneous fires); air-related impacts (climate variability) and provisioning-related impacts (overharvesting of wetland biomass).

Wetland interventions

In response, the Wetlands Management Department believes that enhanced investment in wetlands management between 2015 and 2040 will increase Uganda's GDP by 9% in 2040. To

track this goal, the department is widely involved in umpteen wetland restoration/conservation software and hardware programmes such as a review of National Wetland Policy and formulation wetland specific law; wetland restoration programs; designation of wetlands as Ramsar Sites; demarcation of wetlands; development of wetlands community and framework Management Plans, improvement in coordination, supervision and technical support to local governments; integration of Environment Protection Force (EPF) in environmental management; public awareness and sensitisation; improved international cooperation to restore transboundary wetlands; provision of alternative livelihood to the people who voluntarily left wetlands with alternative livelihoods; and establishment of sub-catchment level community management structures.

Challenges in wetlands management

Despite the recovery of some wetlands, the department is not spared of policy and management challenges. The management-related issues challenging wetland conservation in Uganda include inadequate staffing and budgetary allocation; insufficient public awareness and low capacity building; inadequate institutional synergies and coordination; conflicting land uses in wetlands; lack of updated wetland inventory database; and land conflicts whereas the policy-related issues include ineffective enforcement and compliance with policy, legal and regulations on the environment; lack of a wetland specific law; and re-encroachment of the restored wetlands.

Recommendations

Based on the findings and in light of the current challenges and the need to strengthen wetland management so as to ensure sustained benefits, this report recommends as follows;

- There is need review the wetland policy to cater for the emerging issues but also enact a wetland specific law supported by an independent environmental court to extra judiciously handle wetland encroachment cases.
- There is need to increase the funding for management of Wetlands at Central and Local Government levels.
- The need to strengthen coordination mechanisms across all sector and all stakeholders is pivotal in ensuring harmonised planning and implementation of programs that have an impact on wetlands.
- Wetlands enterprises and alternative livelihood programs should be prioritised and invested in so as to reduce the pressures on the wetland resource.

Contents

List of tables

List of Figures

List of Plates

Plate 1: Rwenzori Mountains Ramsar Site which was designated on May 13, 2009. Photo Credit: Carol Wafula

Chapter One: Wetlands in Uganda

1.1 Introduction

This chapter presents an overview of wetlands in Uganda, the importance of wetlands, wetlands management and institutional strategies adopted for wetland management in Uganda.

1.2 Overview of wetlands in Uganda

What are Wetlands? The Ramsar Convention (Article 1.1) defines wetlands as, " areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres, whereas, Uganda's National Policy for the Conservation and Management of Wetland Resources (1994) defines wetlands as areas "where plants and animals have become adapted to temporary or permanent flooding." It includes swamps, dambos, areas of mash, peatlands, high-altitude mountain bogs, as well as flood plains and grasslands.

The wetlands in Uganda can be distinguished as lacustrine wetlands, and riverine or flood plains (Baker et al., 2019). This is because they can be characterised by impeding drainage, which varies in detail depending on the period of flooding, depth of water, altitude, the fertility of the surrounding soil and other environmental factors (Wohlfart et al., 2018). These wetlands are believed to provide attributes, functions, and services that positively affect the daily livelihoods of members of the local community (Barakagira & de Wit, 2017). Overall, Uganda's wetland sector employs over 2.7 million people (almost 10% of the entire population) (GoU, 2010). About over 80% of the communities that live close to the wetlands use them to enhance their livelihoods (Turyahabwe et al., 2013).

The use-value of a wetland comprises both direct use of the wetlands such as the consumption of fish, trees and water and indirect use of the wetland through; retention capacity and nutrient recycling of wetlands. The non-use value of a wetland refers to the non-instrumental value, not associated with use (Schuijt, 2002; Langan et al., 2019) The main economic uses of wetlands in Uganda are water supply and transport, pollution control through the retention of sediment and toxins, irrigated agriculture, livestock, fisheries and tourist recreation activities (Richardson, 1993). The wetlands in Uganda could provide an average net contribution of about US$ 10,491 per hectare per year (Kakuru et al., 2013). Moyini et al. (2002) reported that the value of wetlands use to local households was about US$ 11.4 billion/year in Uganda. Thus, the value of Uganda's wetlands should not be underestimated.

Plate 2: Provisioning ecosystem services provided by wetlands. Left: Lake Bisina wetland system. Right: A lady making mats from Papyrus

The coverage of wetlands in Uganda has declined overtime since independence. In 1962, the size of wetlands was 32,000km^2 while in 1993 the country had 29,500 km^2 of land surface covered with permanent and seasonal wetlands (Richardson, 1993; NEMA, 2016). Wetlands have become severely degraded by anthropogenic activities such as unsustainable farming practises, wastewater discharge, deforestation and unplanned settlements among others (Emerton, 1998; Hartter & Ryan, 2010). An example of a wetland that has experienced high reductions is Namatala wetland system (Eastern Uganda). It was found out that the wetland suffered papyrus reductions in the lower Namatala wetland due to a 62% land cultivation in 2010 and pollution impacts (Namalwa et al., 2013). Also, wetland degradation explains the deterioration in lake water quality and increased episodes of devastating floods (Fuhrimann et al., 2016).

Although the wetlands in Uganda have continued to be threatened, the Wetlands Management Department is determined to reverse this trend. This is in line with the commitment made at the Ramsar Convention where the country is a party to promote the conservation and wise use of wetland habitats (Gardner & Davidson, 2011). It is also recognised that an enhanced investment between 2015 and 2040 in wetland management will increase GDP growth by 9% in 2040 (MWE, 2016). To ensure that the wise use concept is integrated into wetland access and use, the department has been able to develop wetland management plans and restore 270 hectares of wetlands (Water and Environment Performance Sector Report, 2019). However, the efforts to conserve wetlands are limited by inadequate funding and staffing in wetlands/environment thematic areas at district local government and national levels. An instance of such scenario is in 2014/15 to 2016/17, when UGX 8,476,170,818 billion was approved for the department, but only UGX 8,190,111,261 billion was released (OAS, 2018). This subsector fund release is still very low given the extent of wetlands to conserve in the country.

Therefore, it is worthy to note, that if the budgetary allocation to the Wetlands Management does not improve, all efforts geared at conserving wetlands will be limited and this could result into negative change of nearly all the wetlands by 2040.

Plate 3: L. BISINA wetland system RAMSAR SITE (Photo credit Deo Kabaalu)

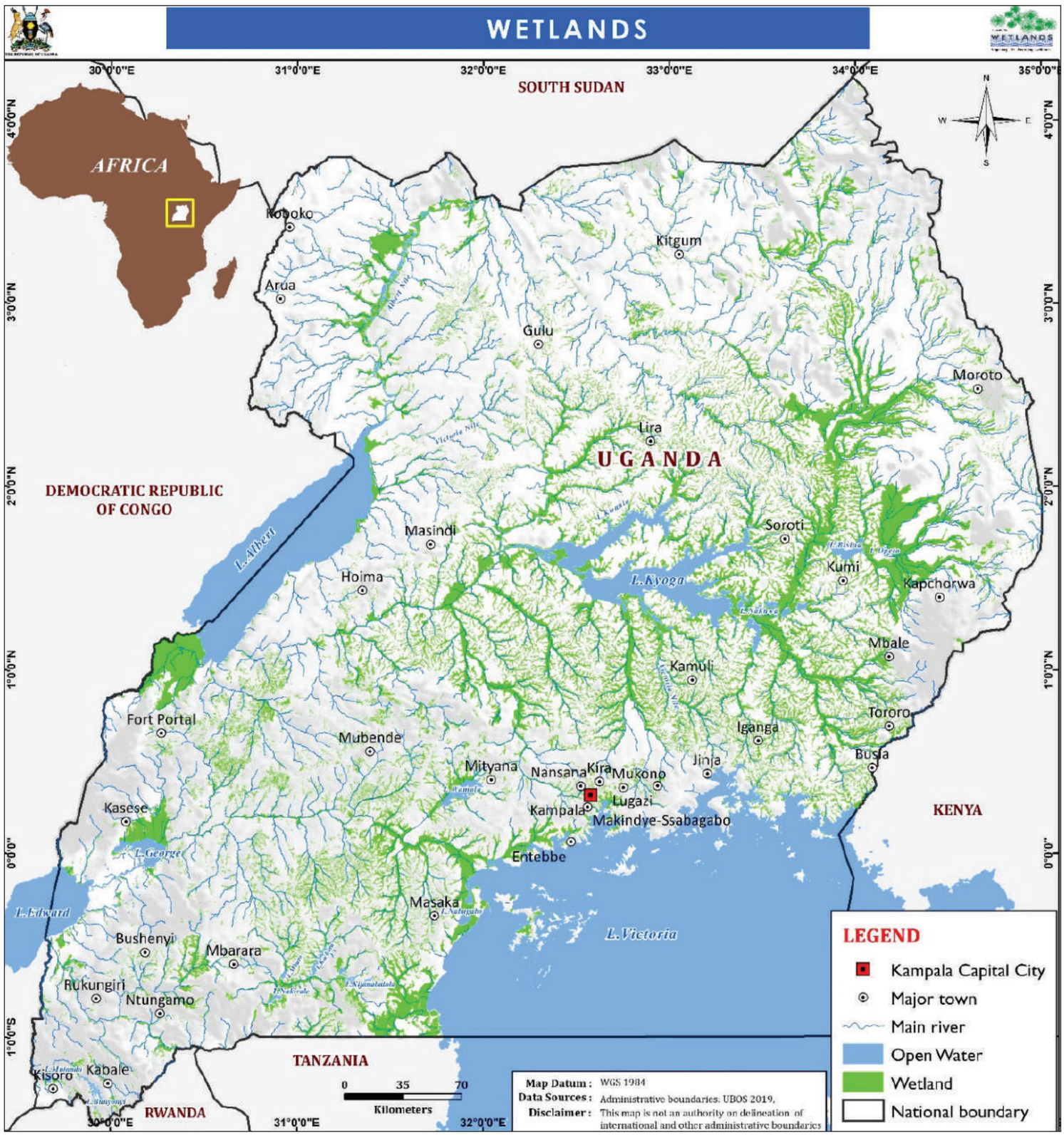


Figure 1: Location of wetlands in Uganda

1.3 Wetland classes in Uganda

Wetlands in Uganda have been classified under 3 main classifications;

1. **Classification by land cover/land use:** The wetland classification currently used was adopted from the Uganda National Biomass Study of 1994 which grouped wetlands according to the land cover or use. Table 1 presents the wetland class names and their descriptions.
2. **Classification by water regime:** The wetlands in the country are also classified based on the water regime that is permanent and seasonal water regimes. (Table 2), hence the permanent and seasonal wetlands.

Table 1: Wetland use/cover classes and description

Class code	Wetland class Name	Description
1	Broad-leaved Woodlots	Fully stocked woodlots
2	Woodland	Trees and shrubs >4metres
3	Bushland	Rangelands, pastureland open savannah including scattered trees and shrubs < 4metres
4	Tropical High Forest	Depleted/encroached
5	Swamp forest	Thick closed-canopy forests and woodlands
6	Palms and Thickets	Thick or sparse palm trees and or scattered trees and shrubs
7	Grassland	Rangelands, pasturelands, open savannah may include scattered trees shrubs and thickets
8a	Papyrus	Swamps with Papyrus as dominant species
8b	Sedges	Swamps with sedges as dominant species
8c	Floating vegetation	
9	Subsistence Farmland	Mixed farmland smallholdings in use or recently used with or without trees
10	Commercial farmland	Large uniform fields e.g. sugarcane/ rice plantations
11	Built-up areas	Urban centres
12	Open Water	Open water e.g. lake

Table 2: Wetlands classification by water regime

Wetland water regime	Wetland use/cover classes	Common habitat
Permanent	Papyrus and sedges	Lakes/ rivers
	Woodlands	Lakes/ rivers
	Bushlands and thickets	Lakes/ rivers/valleys
	Floats	Valleys/Lakes
	Commercial farmlands	Floodplain
	Built-up	Valleys/floodplain/Lakes
	Grasslands	Valleys/floodplain/Lakes
	Swamp forest	riverine swamps
	Woodlots	Lake
	Reeds	Lakes/ rivers
	Open water	Swamps
Seasonal	Seasonal Grasslands	Valleys/floodplain/Lakes
	Small-scale farming	Valleys/floodplain
	Commercial farmland	Floodplains
	Builtups	rivers/valleys
	Pastures	Flood plains
	Swamp forest	Lakes/ rivers/valleys
	Bushlands and thickets	Lakes/ rivers/valleys
	Broad leaved woodlots	Lakes/ rivers/valleys

Adopted from Huising (2002) with some modifications

Plate 4 below presents the wetland use/cover types that can be observed in Uganda. These include among others palms and thickets, farmlands, shrubs, grasslands, bogs and papyrus wetlands.

Palms and thickets

Farmlands in wetlands (Namakole wetland)

Grassland

Bush/shrubs

Papyrus

Bogs

Plate 4: Photos of wetland use/cover types

3. **Classification by complexity**: Wetlands are quite complex with a dense network of tributaries. The complexity varies from drainage basin, primary system, secondary, tertiary and quaternary systems. This system has been adopted with the aim to improve the management of wetlands taking into consideration the entire wetland system.

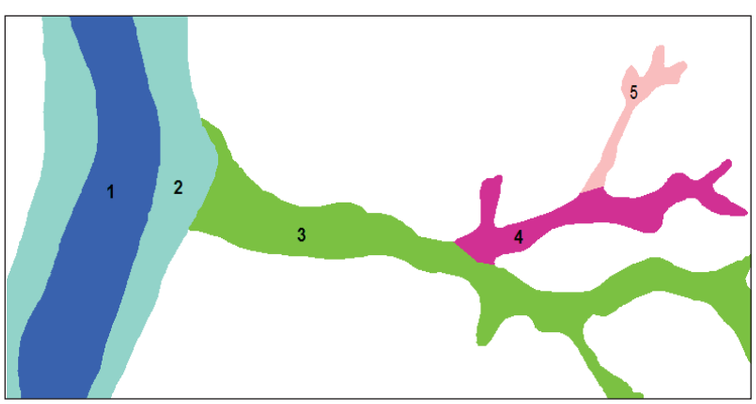


Figure 2: Illustration of wetland coding based on hydrology

Table 3: System and codes

System	Complexity	Code
1	Drainage Basin	01
2	Primary	01001
3	Secondary	01001001
4	Tertiary	01001001001
5	Quaternary	0100100100101

Using this coding system, the Various drainage basins were given codes from 01 to 08 as follows; Lake Victoria- 01, Lake Edward- 02, Lake Albert – 03, Lake Kyoga- 04, Victoria Nile- 05, Albert Nile- 06, Kidepo- 07 and Aswa- 08 (Figure 2). Therefore, all the wetland systems that drain into the various drainage basins have been coded.

1.4 Wetland Ecosystem services

According to the Millennium Ecosystem Assessment (2005), Ecosystem services are "the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious, and other nonmaterial benefits." The two important wetland services that may have strong linkages with human well-being include water availability and fish supply. The other services may also include water purification and detoxification of waters, climate regulation, mitigation of climate change and cultural services. In addition, wetlands also provide many nonmarketed and marketed benefits to people, and the total economic value of unconverted wetlands is often greater than converted wetlands (MA, 2005). For example, Lake Nabugabo Ramsar Site generates ecosystem services worth approximately USD 6.4 million a year: an average of USD 350 per ha of the wetland habitat (Emerton, 2014). Table 4 presents a qualitative assessment of ecosystem services provided by or derived from wetlands and their rating according to the water regime. The permanent wetlands could offer higher ecosystems services compared to the seasonal wetlands.

Table 4: Ecosystems services provided by or derived from wetlands

Ecosystem services	Description	Wetland water regime	
		Permanent	Seasonal
PROVISIONING			
Food	Production of fish, wild game, fruits and grains	High	Moderate
Freshwater	Storage and retention of water for domestic, industrial, and agricultural use	High	Moderate
Fibre and fuel	Production of logs, fuelwood, peat, fodder	Moderate	High
Biochemical	Extraction of medicines and other materials from biota	Moderate	High
Genetic materials	Genes for resistance to plant pathogens, ornamental species, and so on	High	High
REGULATING			
Climate regulation	Source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes	High	High
Water regulation (hydrological flows)	Groundwater recharge/discharge	High	Low
Water purification and waste treatment	Retention, recovery, and removal of excess nutrients and other pollutants	High	Low
Erosion regulation	Retention of soils and sediments	Moderate	High
Natural hazard regulation	Flood control, storm protection	High	Moderate
Pollination	Habitat for pollinators	High	High
CULTURAL			
Spiritual and inspirational	Source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems	Moderate	Moderate
Recreational	Opportunities for recreational activities	High	Moderate
Aesthetic	Many people find beauty or aesthetic value in aspects of wetland ecosystems	High	Moderate
Educational	Opportunities for formal and informal education and training	High	High
SUPPORTING			
Soil formation	Sediment retention and accumulation of organic matter	Moderate	High
Nutrient cycling	Storage, recycling, processing, and acquisition of Nutrients	High	Moderate

Source: Millennium Ecosystems Assessment, 2005 with modification according to wetland water regime in Uganda

Types of ecosystem services provided by the wetlands

Food supply

Wetlands have supported farming activities either on a small-scale or large scale. Over 80% of the people living adjacent to wetland areas in Uganda directly use wetland resources for their household food security needs (Turyahabwe et al., 2013). On a small-scale, communities have practiced edge gardening of crops for both sale and home use. Crops commonly grown on the wetland periphery included: *Dioscorea spp* (yams), beans, *Zea mays* (maize), *Ipomoea batatas* (L.) Lam. (sweet potatoes), *Manihot esculenta Crantz* (cassava), *Brassica oleracea* var. *capitata* (cabbages), *Saccharum officinale* (sugar cane) and low land rice (Turyahabwe et al., 2013). While on a large scale, the communities have planted crops such as sugarcane, rice etc., purposely for sale (Mwavu et al., 2018). Crop production in Nakivubo wetland contributed a gross value close to USh200 million per year (Kaggwa et al., 2009). Kakuru et al (2013) also reported that in Uganda, the economic value of wetlands to crop farming was estimated to be in the range of US$ 417,536 to 25.09 million due to fertility replenishment of the wetland ecosystems from sediment trapping and gradual settling of silt particles and rotting of organic matter from wetland vegetation.

The ecosystems have also provided fodder for animals. According to Kakuru et al. (2013), the wetlands provided livestock pastures worth US$ 4.24 million. About 10 percent of the total milk production in Bushenyi district originates from grazing in wetlands, which implied that the monthly productivity levels of 126,000 litres were wetland-supported.

Fish is also harvested in wetlands using traditional (use of spears etc) and modern tools (use of nets etc) for sale and home consumption. Kakuru et al (2013) in their economic valuation of wetlands in Uganda found out that on average, fish available for consumption from wetlands in the eastern, central and western Uganda was equivalent to US$ 0.49 per person.

Water availability

Wetlands have continued to provide fresh water for domestic, irrigation and industrial usage. Households have extracted water to meet their domestic needs such as cooking, washing, cleaning etc. This water has been directly extracted from the ecosystems or through a mechanism like springs, wells etc. The water has also been accessed for livestock drinking and irrigation purposes. The same water has similarly been used to support brick making activities in the mixing of clay and when burnt and sold has increased household income levels. In the study conducted in the wetlands of central, southwestern and eastern Uganda, Turyahabwe et al. (2013) found out that water from wetlands was reported by 60% of the households to be the most important product directly extracted for domestic and livestock use.

The Wetland Sector Strategic Plan (2001–2010) estimated that approximately five million people depended directly on wetlands for their water supply, valued at US$25.0 million per year. For the wetlands in western, central and eastern Uganda, the gross annual value of domestic water supply was estimated to be worth US$ 13.9 million because the wetlands were the only source of water for domestic use at both household and community levels.

Plate 5: A water source for a community in Kawooya wetland

Water regulation

The wetlands of Uganda can receive, retain, release and exchange water. These processes facilitate treatment of pollutants and sustainability of water sources in the downstream sections of the catchments. Wetlands can remove up to 95 percent of the sediments in water and considerable amounts of heavy metals and nutrients (Kaggwa et al., 2009). Fringing papyrus wetlands are important buffer zones for the protection of lakes from eutrophication. For example, growing papyrus can absorb organic nutrients from both water and sediment and thus trap nutrients especially nitrogen and phosphorus (Mugisha et al., 2007; Kiwango & Wolanski, 2008). Similarly, Namaalwa et al. (2013) also observed that the discharge of wastewater from the urban area of Mbale into Namatala wetland provided an opportunity for recycling nutrients and preventing their release into the areas downstream of Namatala wetland towards Lake Kyoga, but also presented the risk of contamination with chemical and bacterial pollutants.

Plate 6: Wetland water regulation in Rufuha wetland Ntungamo Rweikiniro subcounty

Economic valuation studies that included a broader set of non-marketed regulating services, such as water purification and carbon sequestration, suggested a per ha value of UShs15 million (MFPED, 2004). For flood control and water discharge, the annual wetland contribution ranged from US$ 7.06 million for water recharge and regulation to US$ 1.70 billion for flood control in the study conducted by Kakuru et al (2013) in the wetlands located in eastern, western and central Uganda. Papyrus generates income in three major ways: selling raw papyrus, making rough mats and harvesting papyrus to make fine mats. In Nakivubo wetland, annual yields of papyrus were estimated to be 200 tonnes of dry papyrus per year at nine-month harvesting intervals and re-growth cycle, which corresponded to the utilization of just under 9 ha of wetland (Kaggwa et al., 2009). Additionally, Kakuru et al (2013) observed that the annual value of papyrus raw materials in the wetlands found in central, western and eastern Uganda was US$ 4.63 million.

Climate regulation

Wetlands have an important primary function in the regulation of climate as they represent a great global carbon sink (Moses, 2008). Storage and sequestration of carbon by wetlands play an important role in the regulation of the global climate. Peatlands contain the largest carbon sinks and sequester approximately as much carbon as do global forests, although freshwater wetlands also represent the largest natural source of methane (Ramsar Convention on Wetlands, 2018). Peatlands cover over 4 million km^2 worldwide (3% of the world's land area), contains 30% of all global soil carbon, occur in over 180 countries and represent at least a third of the global wetland resource (Erwin, 2009). This could occur due to slow organic matter decomposition rates as a result of waterlogged soils and large organic matter accumulation due to high biomass productivity that makes wetland soils significant sinks of carbon as opposed to the other ecosystems with transient carbon pools such as biomass (Mitsch et al., 2015). Similarly, Saunders et al. (2014) in their study of tropical wetlands in Africa including Uganda also found out that carbon stocks in the aboveground and belowground plant components of papyrus wetlands were as much as 88 t C ha-1, which were comparable to forest ecosystems that are often regarded as the primary land-based reserve of carbon. Therefore, climate regulation has an impact on the hydrological status of wetland ecosystems through regulated precipitation and temperature.

Cultural heritage

The World Heritage list includes sites designated for cultural value (as opposed to natural value) that are not Ramsar designated but which nevertheless include wetland areas. Wetlands in Uganda are home to several plant and animal species, which are part of the country's heritage. Lake Nabugabo Wetland System Ramsar Site Management Plan (2017-2027) shows that the wetlands around Lake Nabugabo, have been traditionally used as important sites for religious activities. Lake Birinzi has two cultural shrines, one of which is a cultural cleansing site for the Kasimba clan, while the other is a shrine for the Catholic Church. These two shrines attract big gatherings every year when people travel to pay homage to spiritual cleansing.

Aesthetically, the findings from the Ministry of Water and Environment (2017) on the Lake Nabugabo wetland system Ramsar site showed it has good scenic beauty, especially when viewed from the Kako hills or Bwala area. From these hills, Lake Victoria could be viewed. The scenery could be more exciting at the shores, where one could view a variety of shorelines which may include the forested sections, clear sandy beaches and sedge fringed shores.

Recreation and tourism

Uganda boasts of several wetlands that have been listed as Wetlands of International Importance under the Ramsar convention. All these sites are recognized by Birdlife International as Important Bird Areas as well as providing a vital habitat for other threatened plants and animals. Examples may include Mabamba swamp, Lake Bisina and Opeta.

Wetlands are homes to birds including Papyrus Gonolek, the Great Blue Turaco, the Snowy-Headed Robin-Chat, the Black-and-White Casqued Hornbill and the Emerald Cuckoo. They also host primate species (red colobus monkey, baboon, black & white colobus monkey, blue monkey grey cheeked, mangabey, vervet monkey, red tailed monkey and the L'Hoest monkey), mammals (Mammals such as chimpanzees, Sitatunga, mongooses, bush pigs etc) and an abundance of butterflies and rich vegetation, such as wild palms, polita figs and the dominant papyrus (Kaggwa et al., 2009). They attract both local and foreign tourists who pay entry fees to the wetlands and also buy art crafts generating income to local households. Bikangaga et al. (2007) reported that in Nabugabo wetland, about 94% of local persons indirectly benefited from tourism activities by taking advantage of tourist flows to sell food and craft items. Other fascinating wetland tourism sites include Bigodi Wetland Sanctuary located in Magombe swamp and Kihingami wetland sanctuary in Fort portal District.

Plate 7: Musambwa-Kagera wetland

1.5 Mandates of key players in wetland management

The key stakeholders with the mandate of managing wetlands in Uganda include Wetlands Management Department, NEMA, Ministry of Lands, Housing and Urban Development, District Land Boards and Area Land Committees, District Wetland/ Environment Officers and Lower Local Government Councils (Table 5).

Table 5: Mandates of key players in wetland management

Entity	Roles and responsibilities
Wetlands Management Department	- Maintaining an up-to-date inventory for wetlands - Promoting the wise use of wetlands - Developing wetland policy, guidelines, standards and legislation; - Sensitisation of the public on the importance of wetlands; - Restoration and protection of wetlands. - Technical backstopping and capacity building of local governments - Monitoring and supervision - Compliance monitoring and enforcement - Reviewing environment and Social Impact Assessments (ESIAs) and Environment Audits (EAs) for projects in or around wetlands;
National Environment Management Authority	- Review and Approve all ESIAs countrywide, including projects in wetlands; - Issue (and revoke) Wetland resource use permits to (of) applicants who (do not) satisfy conditions laid out in the Wetlands Regulations or specified by NEMA; - Conduct periodic inspection and monitoring of wetlands and enforce compliance to the wetland legislation; - Ensure the integration of environmental concerns in overall national planning through coordination with the relevant ministries, departments and agencies of government.
Ministry of Lands, Housing and Urban Development	- Issue all land titles countrywide and ensure none are issued in wetlands; - Cancel titles erroneously issued in wetlands; - Develop countrywide base maps indicating land available for titling, and that which is not, such as wetlands.
District Local Governments	- Conduct due diligence on applications for titles within the Local Government to ensure titles are not issued in known wetlands. - Assist District and Local Environment Committees to conserve wetlands within their locality and enforce legal compliance. - Ensure activities in the catchment area of wetlands do not affect the water level of the wetland. - Authorise research activities in a protected wetland. - Formulate by-laws, guidelines and directives for management of wetlands. - - With approval of the District Environmental Officer (DEO), order an Environment and Social Impact Assessment (ESIA) for projects that involve the use of a wetland within ten metres of the edge of the wetland.

Source: adopted from the Office of the Auditor General, 2018 report with changes

1.6 Policy and legal framework for wetland management

International legal and policy frameworks

Ramsar Convention. The Convention on Wetlands is the intergovernmental treaty that provides the framework for the conservation and wise use of wetlands and their resources. Under the "three pillars" of the Convention, the Contracting Parties commit to (i) work towards the wise use of all their wetlands; (ii) designate suitable wetlands for the list of Wetlands of International Importance (the "Ramsar List") and ensure their effective management; and (iii) cooperate internationally on transboundary wetlands, shared wetland systems and shared species.

Convention on Wetlands of International Importance. Article 2 stipulates that Wetlands should be selected for the list on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology. In the first instance, wetlands of international importance to waterfowl at any season should be included.

Convention on Biological Diversity. Uganda is also a party to the Convention on Biological Diversity (CBD) of 1992. The Convention obliges member states to establish a system of protected areas, develop guidelines for the selection, establishment and management of protected areas, promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings and integration of sustainable utilization of natural resources in national strategies.

The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA): is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. Uganda has Important Bird Areas (IBAs) such as Lutembe Bay wetland that hosts the different migratory species.

National Planning Frameworks

Uganda Vision 2040: The Vision emphasizes sustainable development through preservation of natural resources such as forests and wetlands and recognises environment and natural resources are a key social transformation sector. It outlines the efforts to ensure restoration and value addition to the ecosystems and this would be achieved through the implementation of catchment –based systems, gazettment of vital wetlands plus monitoring of ecosystems among others.

National Development Plan III: Recognises natural resource management as a critical avenue for reduction of disaster losses, achievement of increased household incomes and improvement of quality of life of the population. One of the goals is to reduce environmental degradation and improve utilisation of natural resources for sustainable economic growth and livelihood security. This will be achieved among others by increasing the land area covered by wetlands from 8.9 percent to 9.57 percent.

Key National legal and policy frameworks

The Constitution of the Republic of Uganda (1995): Clause 2 (b) of Article 237 provides that the Government or a local government shall hold in trust for the people and protect natural lakes, rivers, wetlands, forest reserves, game reserves, national parks and any land to be reserved for ecological and touristic purposes for the common good of all citizens.

National Environment Act, No. 5 of 2019: It provides the legal and institutional framework for the protection of the environment in general. In the act, wetlands are specifically protected under Sections 54(9), 55(2) and 181(2). This is an improvement to the already existing National Environment Act, Cap 153 of 1995 where protection and management of wetlands were provided in sections 36 and 37.

The Uganda National Wetlands Policy of 1995: Is one of the initial efforts by the government to protect wetlands in Uganda. In summary, the policy prohibits and criminalizes drainage of wetlands, promotes the sustainable use of wetland resources to ensure their continued availability for present and future generations, and promotes environmentally sound management practices for wetlands to ensure that other aspects of the environment are not adversely affected.

The Land Act, 1998 - Cap 227: Section 44(1) of the act provides that the government or local government shall hold in trust for the people and protect wetlands, and any other land reserved for ecological and touristic purposes for the common good of the citizens of Uganda.

The Local Government Act (1997): Decentralized service delivery to district and sub-county levels. Wetland management is one of the functions that were decentralized under the above act. The implication of this is that local governments are responsible for managing the wetlands within the framework of the National Environment Act.

The National Environment (wetlands, Riverbanks, and Lakeshores Regulations 2000): Provides for the conservation and wise use of wetlands and their resources in Uganda. It gives effect to clause 2 of article 237 of the Constitution of Uganda and section 4 of the land act, Cap 227.

The National Land Use Policy of 2008: The land use policy also recognizes continuous abuse and conversion of wetlands through drainage, disposal of untreated or poorly treated effluents from industries and expansion of agriculture. It, therefore, states very clearly under policy statement 18 the need to protect and maintain all water sources and catchments in the country through policy enforcement, harmonization of sectoral policies and gazettement of areas that serve catchments.

Wetland user guidelines

1. Guidelines for prioritizing wetlands in need of management measures in Uganda.
2. A vision statement for wetland management in Uganda.
3. Guidelines for smallholder paddy rice cultivation in seasonal wetlands.
4. District Rapid Appraisal of Wetlands (DRAW).
5. Wetlands and the law.
6. General guidelines for wetland management.
7. Guidelines for capture fisheries in wetlands.
8. Guidelines for fish farming in wetlands.
9. Guideline for sand and clay mining in wetlands and for the rehabilitation of sand and clay mining area.
10. Guidelines for defining wetlands boundaries.
11. Guidelines for wetland edge cultivation.
12. Guidelines for reporting wetland abuse.
13. A guideline for Rapid assessment of wetland ecosystems Uganda.
14. Guidelines for the formulation of sub country and district wetland action plans.
15. Guideline for wetland restoration.
16. Management planning guideline.

Wetlands contribution to the attainment of Sustainable Development Goals?

The multiple benefits and services provided by wetlands are essential in achieving the Sustainable Development Goals (SDGs). The SDGs represent an ambitious agenda to eradicate poverty and achieve sustainable development by 2030 (Table 6). This 2030 Agenda for Sustainable Development provides a comprehensive roadmap for a sustainable future. Seventeen goals, each with several concrete targets, translate this programme into action.

Table 6: Wetlands and SDGs

Sustainable Development Goals (SDGs)	Relationship between wetlands and SDGs
SDG 1 – No Poverty	More than a billion people depend on wetlands for a living
SDG 2 – Zero Hunger	Rice, grown in wetland paddies, is a stable diet for 3.5 billion people
SDG 3 – Good Health and Well-being	Half of the international tourists seek relaxation in wetland areas, especially coastal zones
SDG 4 – Quality Education	Safe water access enhances educational opportunities, especially for girls
SDG 5 – Gender Equality	Women play a central role in the provision, management and safeguard of water
SDG 6 – Clean Water and Sanitation	Almost all of the world's consumption of freshwater is drawn either directly or indirectly from wetlands
SDG 7 – Affordable and Clean Energy	Sustainable upstream water management can provide affordable and clean energy
SDG 8 – Decent work and economic growth	Wetlands sustain 266 million jobs in wetland tourism and travel
SDG 9 – Industry, Innovation and Infrastructure	Healthy wetlands form a natural buffer against the increasing number of natural disasters
SDG 10 – Reduced Inequality	Healthy wetlands mitigate the risk to an estimated 5 billion people living with poor access to water by 2050
SDG 11 – Sustainable Cities and Communities	Urban wetlands play a vital role in making cities safe, resilient and sustainable
SDG 12 – Responsible Consumption and Production	Wetland areas properly managed can sustainably support increased demands for water in all sectors
SDG 13 – Climate Action	Peatlands cover only 3% of global land but store twice as much carbon as the entire world's forest biomass
SDG 14 – Life Below Water	Healthy and productive oceans rely on well-functioning coastal and marine wetlands
SDG 15 – Life on Land	40% of all the world's species live and breed in wetlands
SDG 16 – Peace, Justice and Strong Institutions	Effective management of transboundary wetlands contributes to peace and security
SDG 17 – Partnerships for the goals	The Ramsar Convention works in partnerships with other MEAs to support governments in achieving the SDGs

Adopted and modified from the Ramsar Secretariat, 2018

Chapter Two: Status and Trends of Wetlands

2.1 Introduction

This chapter discusses the status and trend of wetlands in the country. The discussion will take four different levels i.e. National Level, Regional level, District level and Drainage basin level. Status in this chapter refers to the physical, chemical and biological state of wetlands. The chapter will also highlight the status of wetlands of international importance and transboundary wetlands.

21.1 Scope of the report

Thematically, the development of this report was based on the concepts of interacting human-environment systems, Millennium Ecosystem Assessment and the Drivers-Pressures-State-Impacts-Responses models. These frameworks are widely used as the basis of reporting human-environmental interactions to inform policy measures to curb wetland degradation. The wetlands assessed included inland wetlands and transboundary wetlands. The investigations were based on the availability of spatial and non-spatial datasets. Based on this condition, the studied period was between 1994 and 2015. It is also worthy to note that significant wetland changes in Uganda, given its climate and soils can only be relatively detected after 5 years if the nature of developments remain constant.

2.1.2 Datasets, analysis and limitations

Datasets used

The datasets used in the determination of wetland status and trend, wetland degradation and its sensitivity with the socio-economic data were: wetland shapefiles (1994, 2008 and 2015), wetland degradation, Ramsar sites, drainage basins and national population census of 2014. Apart from the population dataset which was acquired from the Uganda Bureau of Statistics, the rest were obtained from the Wetlands Management Department at the Ministry of Water and Environment.

The content presented in this report was synthesised from a review of literature obtained from the Wetland Management Department and online resources. Examples of literature reviewed included policy briefs, Ministry performance reports, wetland atlases, wetland user guidelines, and Millennium Ecosystems Assessment Reports. The other form of data captured and inserted into the report were scenes of high-resolution satellite images obtained from Google Earth-Pro platform to illustrate the location of transboundary wetlands.

To understand the relationship between socio-economic data and wetland degradation, a multiple linear regression was performed using the data extracted at the district level. The socio-economic data that was extracted concerning wetland degradation included subsistence farming, illiteracy, household size, fuelwood harvesting and thatch grass harvesting.

2.1.3 Limitations

The status and trend of wetlands were determined using wetland datasets of 1994 and 2015 in a GIS environment using a gains and losses analytical tool. However, the wetland dataset of 2008 was not incorporated into this analysis because of the differing methodology used to produce it and number of wetland classes. It also had a higher percentage of geometrical errors compared to that of 1994 and 2015 and therefore could not be used to detect changes between the analytical period. The additional data analytical limitation of the obtained GIS layers was that the defined wetland categories were inconsistent over time and this hampered transitional and future projection of wetland scenarios.

2.2 Status and Trends of Wetlands

2.2.1 National Wetland Coverage and Trends between 1994 and 2015

In 1994, wetlands were estimated to cover 37,559.4km2 of Uganda's surface area. The coverage of wetlands represented 15.6 percent of Uganda's total surface area by 1994 (figure 3). The major wetland categories were grasslands (55%), papyrus and sedges (18%) and woodlands (16%). The other classes that carried substantial land included bush, palms and thickets, farmlands and floating vegetation in the same year. Figure 6 presents wetland cover types mapped in Uganda by 1994. This could reveal that a good number of wetlands were permanent.

In 2015, the wetland coverage was 31,412.8km2 representing 13% of Uganda's total surface area (Figure 4). The wetland types classified as small-scale farmlands (30%) and grasslands (28%) occupied the biggest land extent in the country. These were followed by papyrus and sedges, bushlands, woodland and commercial farmlands. However, between 1994 and 2015, an estimated 6,146.6km2 of wetlands representing 2.5% of Uganda's total surface area could not be detected as wetland anymore (Figure 7). On average Uganda experiences a decline of about 293km2 of wetland coverage annually in the country. This means that if business remains as usual, Uganda is likely to face a decline of more 7,325km2 of wetland cover by 2040.

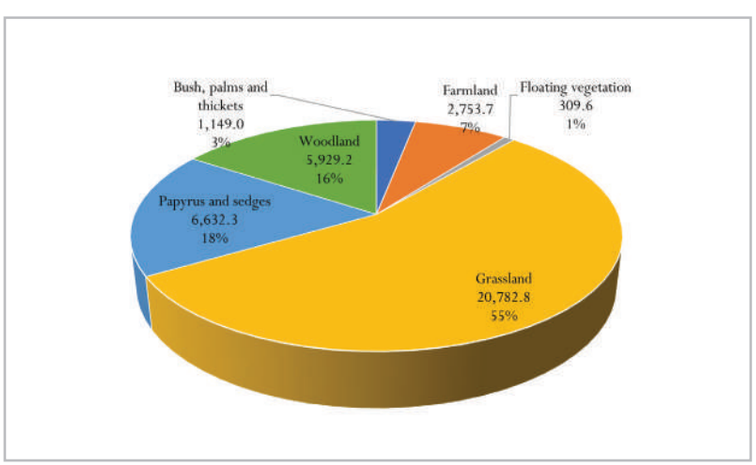


Figure 3: Wetland use/cover types in 1994

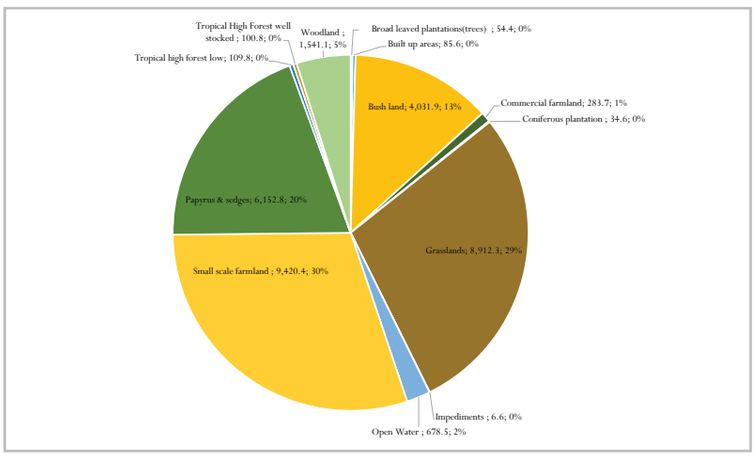


Figure 4: Wetland cover types in 2015

Whereas the coverage of wetlands was at 13% in 2015, the intact wetlands spatial estimations showed that the wetlands in Uganda were decreasing in size. They decreased from 15.6 percent in 1994 to 8.9 percent in 2015. Implying that 4.1% was under degradation of some form. Out of the studied wetland cover types, the major reductions were experienced in grasslands and woodlands. The grasslands suffered by 29 percent while the woodlands by 5 percent. It was only small-scale farming and bushlands that gained substantially (Figure 6 and 7). The trend in grasslands and woodland could be placed on the increasing practices of cultivation and deforestation of bush and woody units (Byenkya et al., 2014). The highest reduction was experienced from 1994 to 2008 (4.7 percent) as indicated in Figure 5 below. Wetlands are perceived by the households to have fertile soils to support their agricultural needs (Turyahabwe et al., 2013).

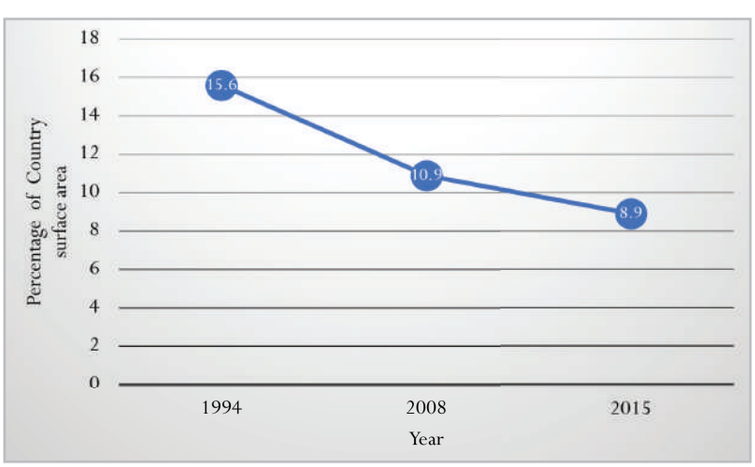


Figure 5: Intact wetland trend between 1994 and 2015

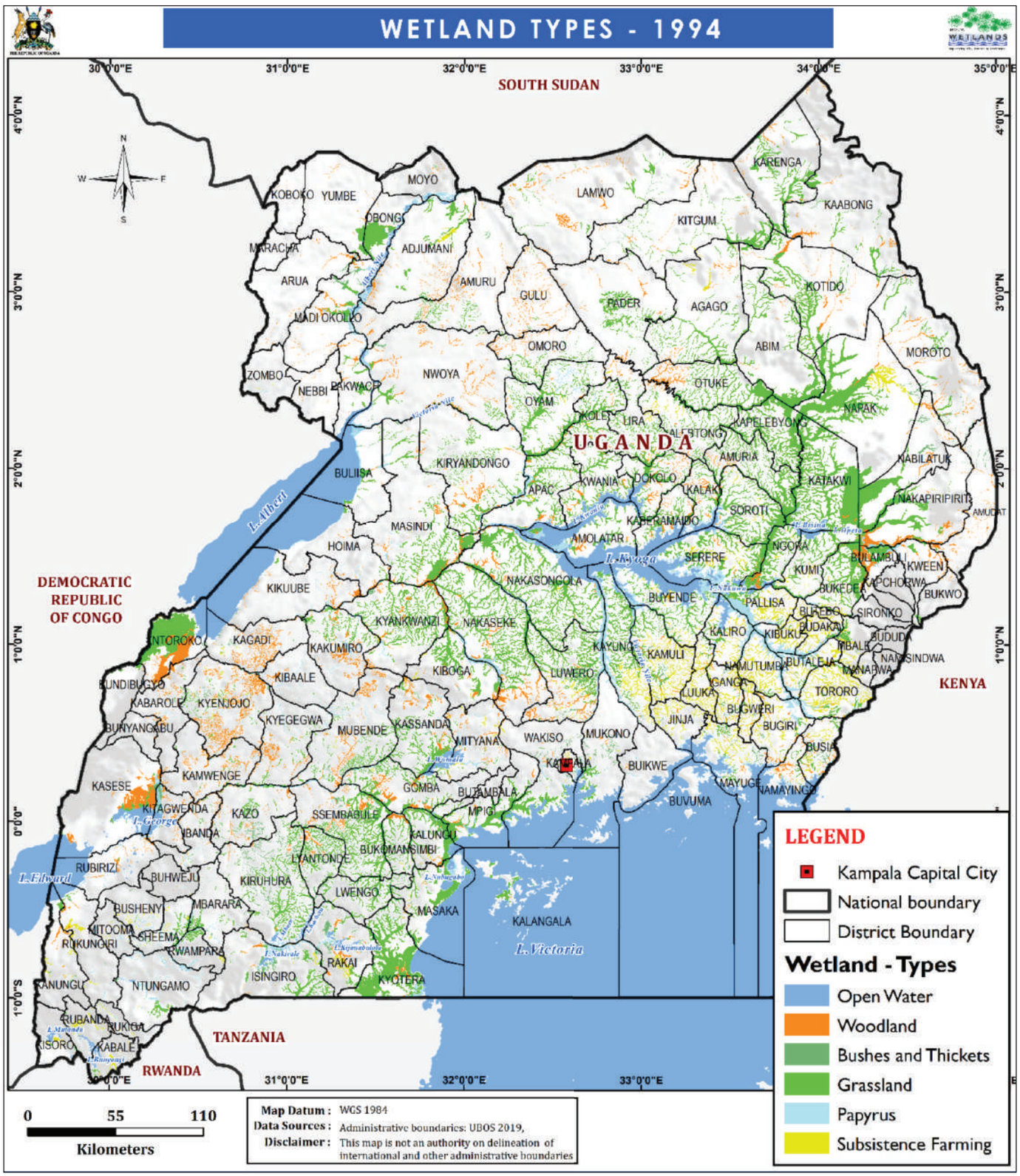


Figure 6: Wetland use/cover types in 1994 by distribution

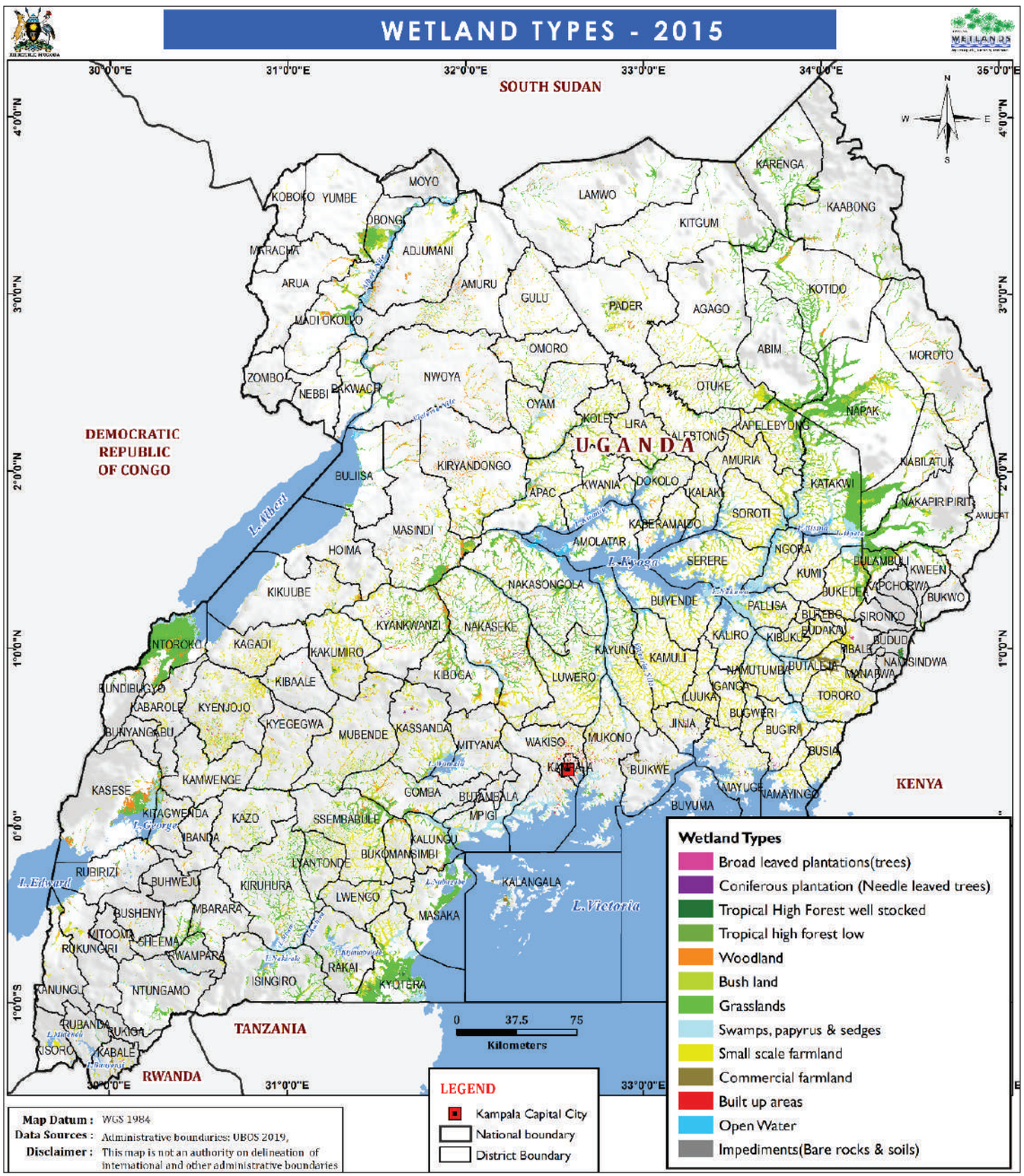


Figure 7: Wetland use/cover types in 2015 by distribution

2.2.2 Wetland Coverage and Trend by Region

Wetland coverage estimates were also conducted at the regional level. By extent, in 1994, the coverages of wetlands were between 19.7% and 27.4%. The western region had the least coverage of wetlands in Uganda at 19.7% while the Northern region had the highest with 27.4%. In 2015, the central region had a slightly higher coverage of wetland followed by eastern, northern and western regions. Table 6 shows the wetland extent per region between 1994 and 2015.

Although there were slight differences in wetland acreages, decreasing trends of wetland coverage were observed. The Northern region experienced the highest reduction in the spatial coverage of wetland by 34.3 percent followed by Western with 27.9 percent, Eastern (20.9 percent) and central (16.9 percent) (Figure 8). The reductions are in terms of irrecoverable benefits and functions of wetlands. In Pece wetland in Gulu district, sections of the wetland were sacrificed for socio-economic activities (cultivation, livestock grazing, vehicle washing etc) in the 1990s by the adjacent communities because of insecurity that caused poor coordination and lack of management plans (Opio et al., 2011). This trend could also be partly due to increment in human encroachment of wetlands by local communities for livelihood diversifications hence increased reduction of wetland coverage (Naigaga et al., 2010).

Table 7: Wetlands extent per region between 1994 and 2015

YEAR	1994		2015		1994 - 2015	
REGION	Area (Sq. km)	%	Area (Sq. km)	%	Relative change (Sq.km)	%
Central	10,002.2	26.6	8,964.2	28.5	-1,038.1	-16.9
Eastern	9,878.6	26.3	8,592.5	27.4	-1,286.0	-20.9
Northern	10,275.5	27.4	8,167.1	26.0	-2,108.4	-34.3
Western	7,403.1	19.7	5,689.0	18.1	-1,714.1	-27.9
Total	37,559.4	100	31,412.8	100	-6,146.6	100

2.2.3 Wetland coverage and Trend by Districts

Out of 135 districts in Uganda as of 2019, the estimations of wetland spatial extents in 1994 and 2015, remained higher in Katakwi, Nakaseke, Nakasongola, Napak, Ntoroko, Luwero and Kyotera. The proportion of wetlands in Katakwi and Nakaseke districts were 3.4 percent of the total wetlands representing 0.5 percent of Uganda's

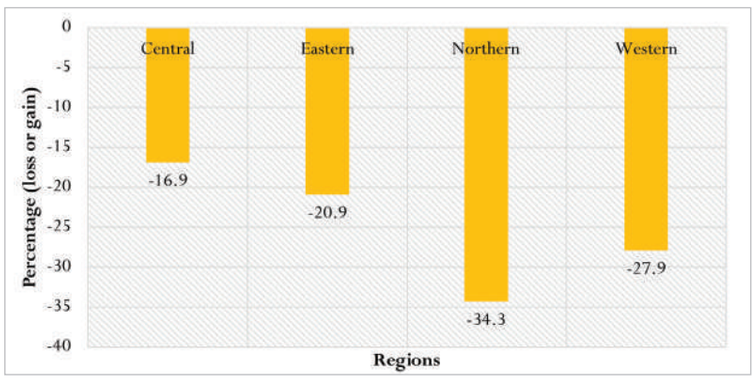


Figure 8: Trend of wetlands extent per region between 1994 and 2015

total surface area (Figure 9). The coverage of wetlands in Napak was 3 percent representing 0.39 percent of Uganda's surface area. However, the districts with the least coverage of wetlands were Kapchorwa with 0.8km2 (0.003%), Namisindwa with 2.1km2 (0.006%) and Koboko with 2.2km2 (0.07%). Districts with the highest coverages of wetlands could be attributed to large surface area and location in floodplains.

The districts that experienced the biggest wetlands irrecoverable area change included Buliisa with 664.6km2 (32.8% of district's surface area); Katakwi with 250.2km2 (10.3% of district's surface area); Mukono with 244.4km2 (8.8% of district's surface area); Soroti with 243.1km2 (17.1% of district's surface area); Abim with 230km2 (8.4% of district's surface area); and Otuke with 226.8km2 (13.8% of district's surface area) as shown in table 8 below.

Table 8: Districts with the biggest wetlands area change between 1994 and 2015

YEAR	1994	2015	Relative change (1994 - 2015)
District	Area (Sq.km)		
Abim	537.2	307.1	230.1
Buliisa	776.1	111.5	664.6
Katakwi	1,325.7	1,075.4	250.2
Mukono	140.1	384.5	244.4
Napak	1,153.1	948.8	204.3
Otuke	564.2	337.4	226.8
Soroti	652.3	409.2	243.1
Ssembabule	789.3	581.3	208.0

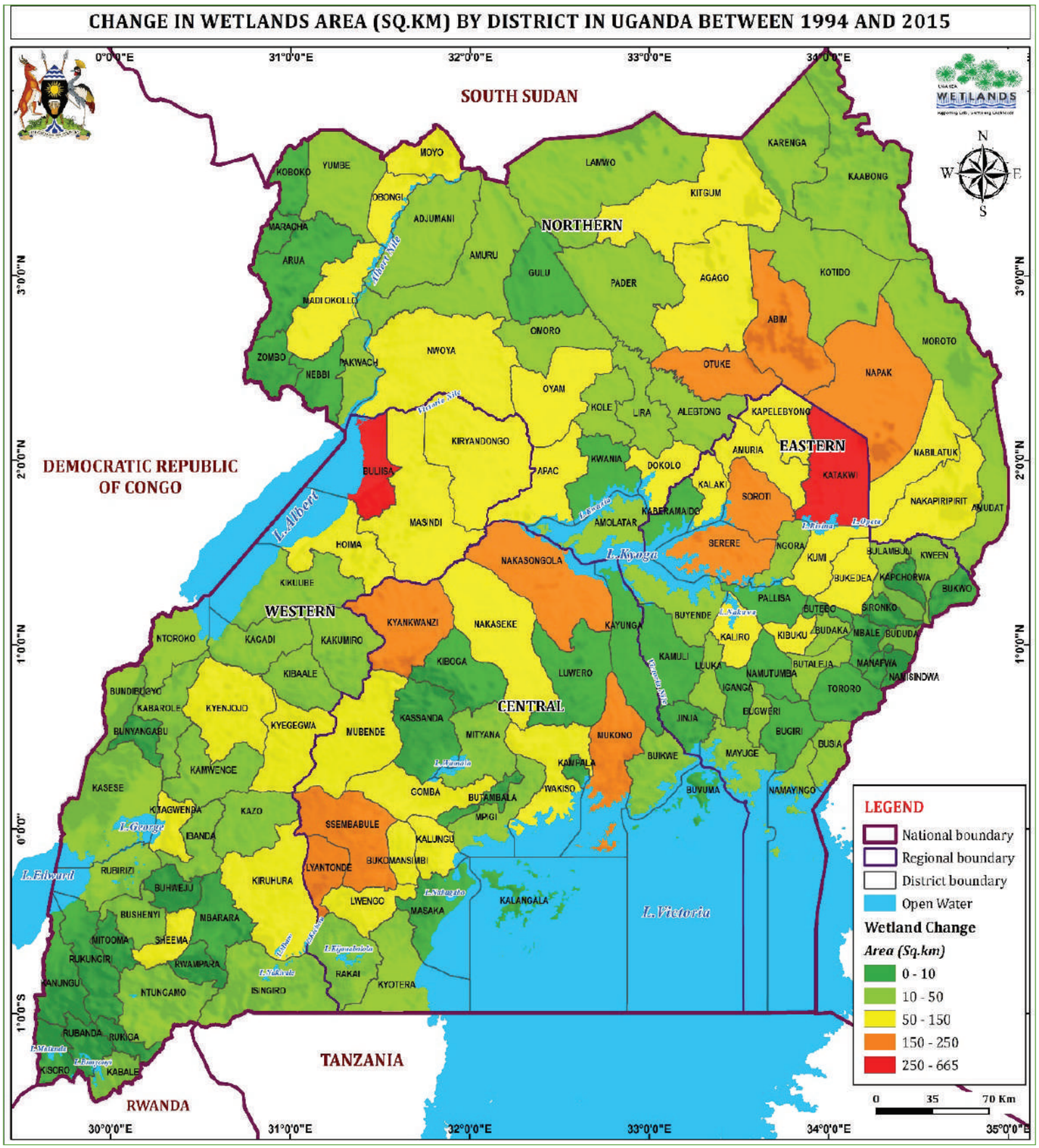


Figure 9: Wetland area change by the district in Uganda between 1994 and 2015

However, between 1994 and 2015, they are some districts whose wetland coverage increased. This could be attributed to efforts by the Wetlands Management Department, NEMA, District Local Governments and other development partners in wetland protection and restoration. The districts with the biggest increment in wetland coverage included Mukono with 244.4km2 (3.9%), Wakiso with 51.8km2 (0.8%), Buikwe with 48.4km2 (0.8%), Bulambuli with 22.9km2 (0.4%) and Kabale with 18.5km2 (0.3%) as shown in figure 10 below.

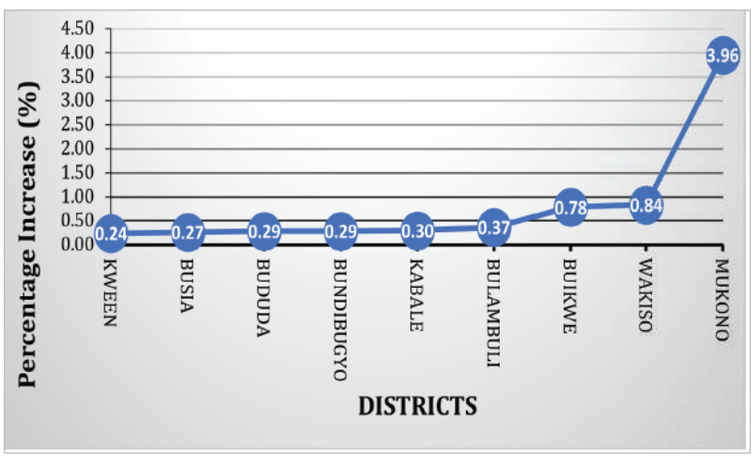


Figure 10: Districts with the biggest percentage increase in wetlands coverage between 1994 and 2015

2.2.4 Wetland coverage and Trend by Drainage Basins

Uganda has been demarcated into eight drainage basins and these include; L. Victoria, L. Edward, Victoria Nile, L. Albert, Albert Nile, Aswa, Kidepo and L. Kyoga. For the years 1994 and 2015, estimations of wetland extent at drainage basin level revealed that Lake Kyoga had the biggest coverage of wetlands followed by Lake Victoria. Kidepo and Aswa drainage basins had the least extent of wetland coverages. Table 9 shows the wetland extent by drainage basins between 1994 and 2015. Despite most of the drainage basins experiencing a decline in the wetland area overtime, those in Kidepo drainage basin gained slightly more land by 0.2% between 1994 and 2015 (Figure 11). Kidepo drainage basin sustained a slighter increment in wetland extent which could be as a result of strict management regime by national park authorities. This trend could be explained by the changing climatic conditions that have caused severe droughts. A study by Yiiki et al. (2016) on Uganda's wetlands discussed that climate change has threatened the integrity of many wetlands, and thus forced adjacent households to opt for wetlands for livelihood diversifications.

Table 9: Wetland extent by drainage basins between 1994 and 2015

	1994		2015		1994-2015	
Drainage Basin	Area (Sq.Km)	%	Area (Sq.Km)	%	Area (Sq.Km)	%
Lake Kyoga	15,008.0	40.2	13,182.0	42.0	-1,826.0	-30.8
Lake Victoria	7,167.6	19.2	6,022.7	19.2	-1,144.9	-19.3
Lake Albert	2,838.6	7.6	1,935.6	6.2	-903.0	-15.2
Victoria Nile	5,728.3	15.3	4,873.5	15.5	-854.8	-14.4
Aswa	3,028.0	8.1	2,347.8	7.5	-680.2	-11.5
Albert Nile	1,736.3	4.6	1,421.0	4.5	-315.3	-5.3
Lake Edward	1,671.1	4.5	1,447.8	4.6	-223.3	-3.8
Kidepo	168.1	0.5	180.9	0.6	12.8	0.2
TOTAL	37,346.30	100.00	31,411.40	100.00	-5,934.9	100.0

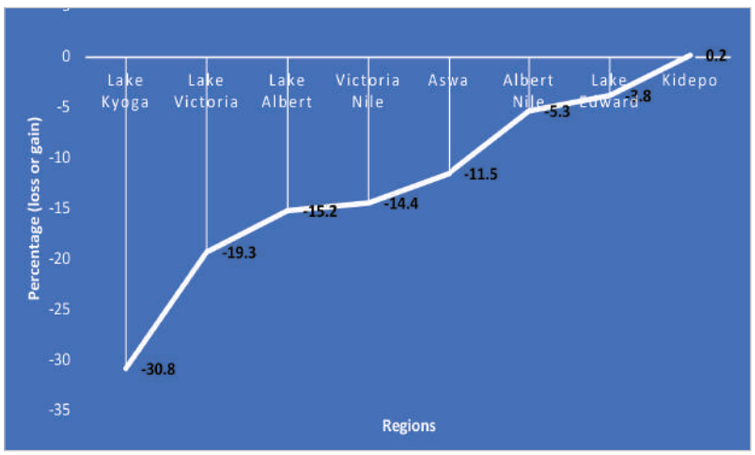


Figure 11: Trend of wetland coverage by drainage basin

2.2.5 Wetland Coverage in Strict Management regimes

Strict management regimes in Uganda are categorised as central forest reserves, local forest reserves, national parks and wildlife local reserves. Table 10 shows wetland coverage by strict management areas (protected areas). By area, between 1994 and 2015, spatial estimations made showed that the areas that had the highest coverage of wetlands were central forest reserves, wildlife reserves and national parks. Though, more wetland size decreases were experienced in wildlife local reserves and central forest reserves. The wetlands in the wildlife local reserves reduced by 54 percent while those in the central forest reserves declined by 31 percent. For example, areas around Budongo forest were converted from forests/woodlands and grassland to sugarcane plantations, settlements and shifting cultivation (Mwavu & Witkowski, 2008). Wildlife reserves are highly prone to burning and overgrazing practices by the neighbouring communities (Naughton Treves, 1999). In Kibale forest reserve, Jacob et al. (2014) reported that several ecological and hydrological mechanisms could account for fluctuations in wetland size within Kibale. Anecdotal evidence indicated that elephant activities could maintain or increase the size of wetlands, at least by small scales.

Table 10: Wetland coverage in strict management areas between 1994 and 2015

YEAR	1994		2015		1994 - 2015	
Category of Protected Area	Area (Sq.km)	%	Area (Sq.km)	%	Area (Sq.km)	%
Central Forest Reserves	6,594.9	44.2	5,715.9	47.2	-878.9	-31.4
District Joint Management	8.9	0.1	11.7	0.1	2.9	0.1
Local Forest Reserves	1,082.1	7.3	934.6	7.7	-147.5	-5.3
National Parks	1,484.7	10.0	1,224.4	10.1	-260.3	-9.3
Wildlife Local Reserves	5,739.5	38.5	4,228.3	34.9	-1,511.3	-54.1
Total	14,910.1	100.0	12,115.0	100.0	-2,795.2	100

2.2.6 National Wetlands Coverage and Trend by Water Regime

Wetlands in Uganda can also be classified by water regimes (i.e. permanent and seasonal). The regimes are characterised by flooding or ponding duration. Water regimes define the survival of flora and fauna in wetlands and thus, sustain the existence of wetlands in most parts of the country. By area, between 1994 and 2015, the seasonal wetlands occupied the largest portion of land compared to the permanent wetlands with the difference of 43% (Figure 12). Table 11 displays the wetland coverage by water regime in Uganda between 1994 and 2015. Both permanent and seasonal wetlands reduced in area. Seasonal wetlands were more susceptible to degradation than permanent wetlands. In principle, about 3,055km2 of permanent wetlands representing 1.25 percent of Uganda's total surface area were degraded, while a decline of an area of 3,091.1km2 of seasonal wetlands representing 1.28 percent of national coverage was experienced (Figure 11). The sharp decline in seasonal wetlands could be justified by unending manmade unsustainable exploitative practises (such as agriculture, fishing, overharvesting etc) in the wetlands (Moses, 2008).

Table 11: Wetland coverage by water regime between 1994 and 2015

YEAR	1994		2015		1994 - 2015	
Season-ality	Area (Sq. km)	%	Area (Sq. km)	%	Area (Sq. km)	%
Permanent	10,381.0	27.6	7,325.5	23.3	-3,055.5	-49.7
Seasonal	27,178.4	72.4	24,087.3	76.7	-3,091.1	-50.3
Total	**37,559.4**	**100**	**31,412.8**	**100**	**-6,146.6**	**100**

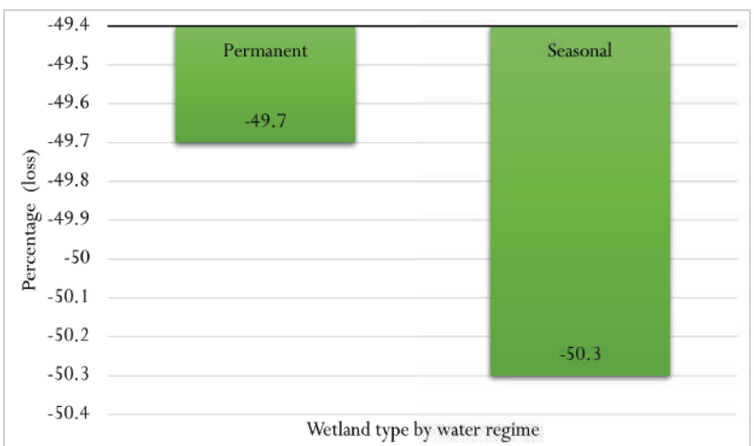


Figure 12: Trend of wetland coverage by water regime between 1994 and 2015

Regional Wetlands Coverage and Trend by Water Regime

At the regional level, in 1994, permanent wetlands were relatively higher in eastern (34%) region followed by central (27%), western (23%) and northern (16%) regions, while the aerial extent of seasonal wetlands was slightly considerable in the northern region (32%) followed by central, eastern and western regions. Table 12 confirms the regional wetland coverage by water regime between 1994 and 2015. In 2015, by area, the scope of permanent wetlands was moderately higher in eastern and central regions compared to the western and northern regions, whereas the seasonal wetlands were slightly higher in the northern, central and eastern regions.

Although both permanent and seasonal wetland extents estimated between 1994 and 2015 experienced a decrease in the land area, the seasonal wetlands were the most affected. Across the regions, the biggest portions of this decreasing trend in permanent wetlands were experienced in the western region by 40 percent and eastern region by 32 percent followed by northern and central, while for the seasonal wetlands, the most affected regions were northern that experienced a decline by 51 percent and central with 23 percent (Figure 13). The permanent wetland size reductions could be attributed to the dwindling water levels in most wetlands (Saunders et al., 2007). Degradation of land in seasonal wetlands such as bushes and thickets could be explained by easier conversions into farming activities (Turyahabwe et a., 2013). Farming is the most lethal threat to the survival of wetlands in Uganda. Therefore, it is worthy to note that permanent flooding sustains the existence of permanent wetland while seasonal flooding results in grassy wetlands (Arinaitwe, 1999).

Table 12: Regional wetland coverage by water regime between 1994 and 2015

YEAR	1994				2015				1994 - 2015			
Season-ality	Permanent		Seasonal		Permanent		Seasonal		Permanent		Seasonal	
Region	Area (Sq. km)	%	Area (Sq. km)	%	Area (Sq. km)	%	Area (Sq.km)	%	Area (Sq.km)	%	Area (Sq.km)	%
Central	2,797.4	26.9	7,204.9	26.5	2,465.1	33.7	6,499.1	27.0	-332.3	-10.9	-705.8	-22.8
Eastern	3,528.1	34.0	6,350.5	23.4	2,561.1	35.0	6,031.4	25.0	-967.0	-31.6	-319.0	-10.3
North-ern	1,625.5	15.7	8,650.0	31.8	1,077.5	14.7	7,089.6	29.4	-548.0	-17.9	-1,560.4	-50.5
Western	2,430.1	23.4	4,973.0	18.3	1,221.9	16.7	4,467.2	18.5	-1,208.3	-39.5	-505.8	-16.4
Total	10,381.0	100	27,178.4	100	7,325.5	100	24,087.3	100	-3,055.5	100	-3,091.1	100

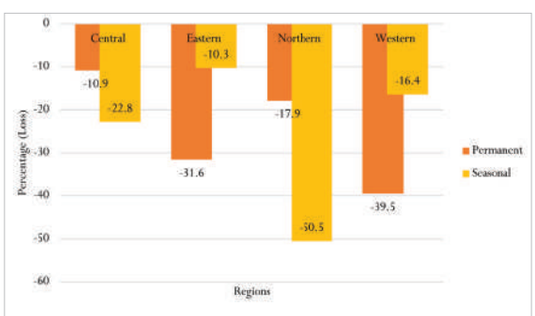


Figure 13: Regional trend of wetlands by water regime

Drainage Basin Wetland Coverage and Trend by Water Regime

By water regime, in 1994, Lake Kyoga drainage basin had the biggest coverage of permanent wetlands followed by Lake Victoria and Lake Albert. Seasonal wetland estimations were higher in Lake Kyoga followed by Lake Victoria, Victoria Nile, and Aswa drainage basins. Table 13 demonstrates the drainage basin of wetland coverage by water regime between 1994 and 2015. In 2015, Lake Kyoga and Victoria simultaneously had the highest portions of permanent wetlands followed by Lake Albert and Albert Nile.

Nevertheless, estimations of the trends of both permanent and seasonal wetlands between 1994 and 2015 in the eight drainage basins showed a moderate decline. In permanent wetlands, a significant trend was recorded in Lake Kyoga and Lake Albert drainage basins, while for the seasonal wetlands the basins that were highly affected were Lake Victoria, Lake Kyoga and Aswa. In the Kyoga basin, this trend could be explained by subsistence farming activities mainly due to intensification of growing paddy rice in Kyoga floodplains (Turyahabwe et al., 2013). These activities were characterised by the removal of natural wetland vegetation and river diversions (Kayendeke, 2018).

Plate 8: Permanent wetland in Lira Municipality (Lira-Abim road)

Table 13: Drainage basin wetland coverage by water regime between 1994-2015

Year	1994		2015		1994 - 2015			
Seasonality	Permanent	Seasonal	Permanent	Seasonal	Permanent		Seasonal	
Basin	Area (Sq.km)	Area (Sq.km)	Area (Sq.km)	Area (Sq.km)	Area (Sq.km)	%	Area (Sq.km)	%
Albert Nile	614.6	1101.5	381.1	1028.1	-233.5	-7.6	-73.4	-2.4
Aswa	70.5	2979.0	59.1	2278.7	-11.4	-0.4	-700.2	-22.7
Kidepo	0.0	174.2	0.0	180.0	0.0	0.0	5.8	0.2
Lake Albert	1262.5	1662.1	379.7	1530.1	-882.8	-28.9	-132	-4.3
Lake Edward	464.5	1209.2	362.4	1108.6	-102.1	-3.3	-100.6	-3.3
Lake Kyoga	4299.7	10536.3	3313.4	9773.3	-986.2	-32.3	-763	-24.7
Lake Victoria	2250.9	4895.1	1896.5	4070.6	-354.4	-11.6	-824.5	-26.7
Victoria Nile	1418.4	4621.2	933.3	4117.9	-485.1	-15.8	-503.3	-16.3
Total	10381.0	27178.4	7325.5	24087.3	-3055.5	100	3,091.10	100

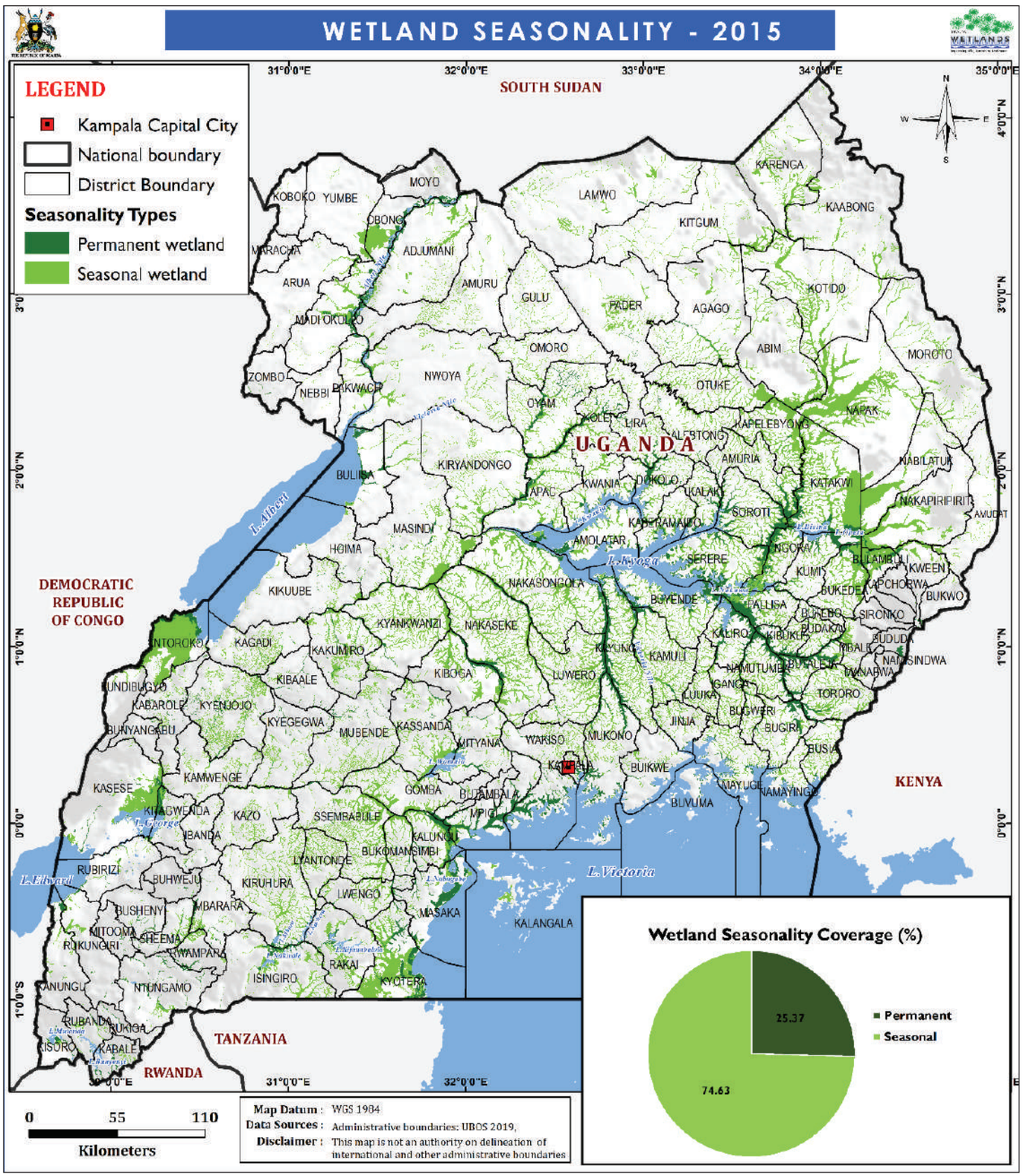


Figure 14: Wetland coverage by water regime

2.3 Wetland status & level of Degradation

Wetland degradation is the process by which wetland area, structure and function have degenerated and at times even disappeared under the effect of natural and human activities. The indicators of wetland degradation are an anthropogenic disturbance, wetland changes and change in wetland productivity. Turyahabwe et al (2013) reported that the most frequent signs or features perceived to indicate wetland degradation are a decline in quantity and quality of wetland vegetation (54%), reduced water level (22%), local farmers cultivating close to the boundaries of the wetlands (13%), drainage channels in wetlands and cutting trees or deforestation with 10% respectively (Figure 16).

The wetland changes statistics between 1994 and 2015 were epitomised as degradation to represent wetland degradation status of Uganda. Change detection was performed to extract intact and degraded wetlands in a GIS environment. In this report, intact wetlands were referred to as those wetlands that were less or undisturbed, while degraded wetlands meant wetlands that had declined in functions and structure.

Figure 15 shows the intact and degraded wetland coverage between 1995 and 2015. Sixty-nine percent of Uganda's wetlands were intact. By area, intact wetlands covered 21,526km^2 (representing 8.9 percent of national coverage), while the estimated degraded wetlands were 9,885km^2 (representing 4.1 percent of national coverage). The four percent of degraded wetlands can be restored if the set targets in NDP III and Vision 2040 can be realised. In Katonga basin western Uganda, Aggrey et al. (2010) found out that wetland degradation was positively linked to high poverty levels by the local communities who seek cultivatable and grazing spaces. Secondly, wetland death could be due to increased human population surrounding these fragile ecosystems and due to their engagements in illegal activities, they pollute the wetlands with water and solid wastes (Safari et al., 2012).

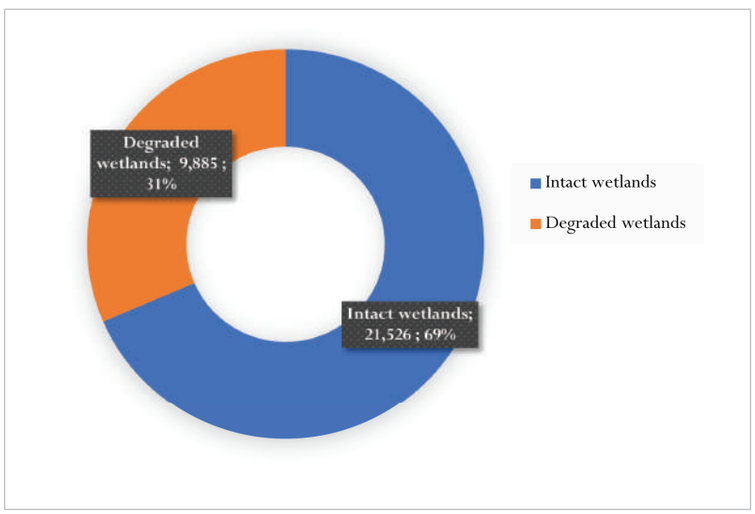


Figure 15: Wetland degradation as of 2015

Figure 16: Status of wetlands in 2015

2.3.1 Wetland Degradation by Region

Overall, every region in Uganda has degraded wetlands but with varying extents. The spatial analysis conducted showed that in 2015, the most degraded wetlands were found in the eastern region (40%) followed by central (26%), northern (18%) and western (17%) regions (Figure 17). This degradation is not location and wetland type-specific but widespread in the different districts. Whereas, the central and northern regions enjoyed the highest coverage of less disturbed (intact) wetlands, the eastern and western regions were more encroached.

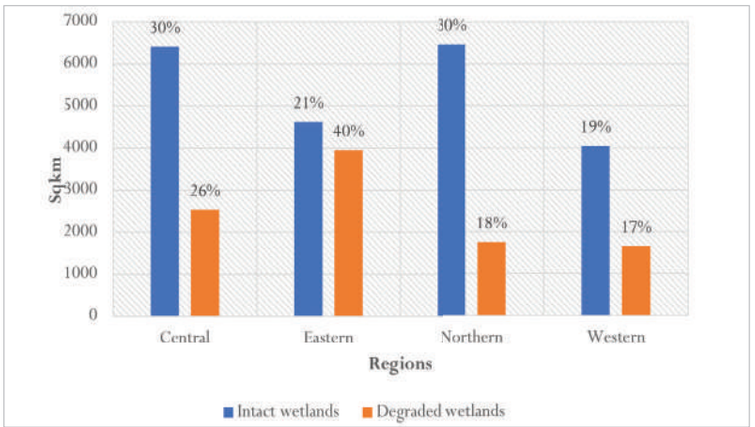


Figure 17: Extent of intact and degraded wetlands between 1990 and 2015

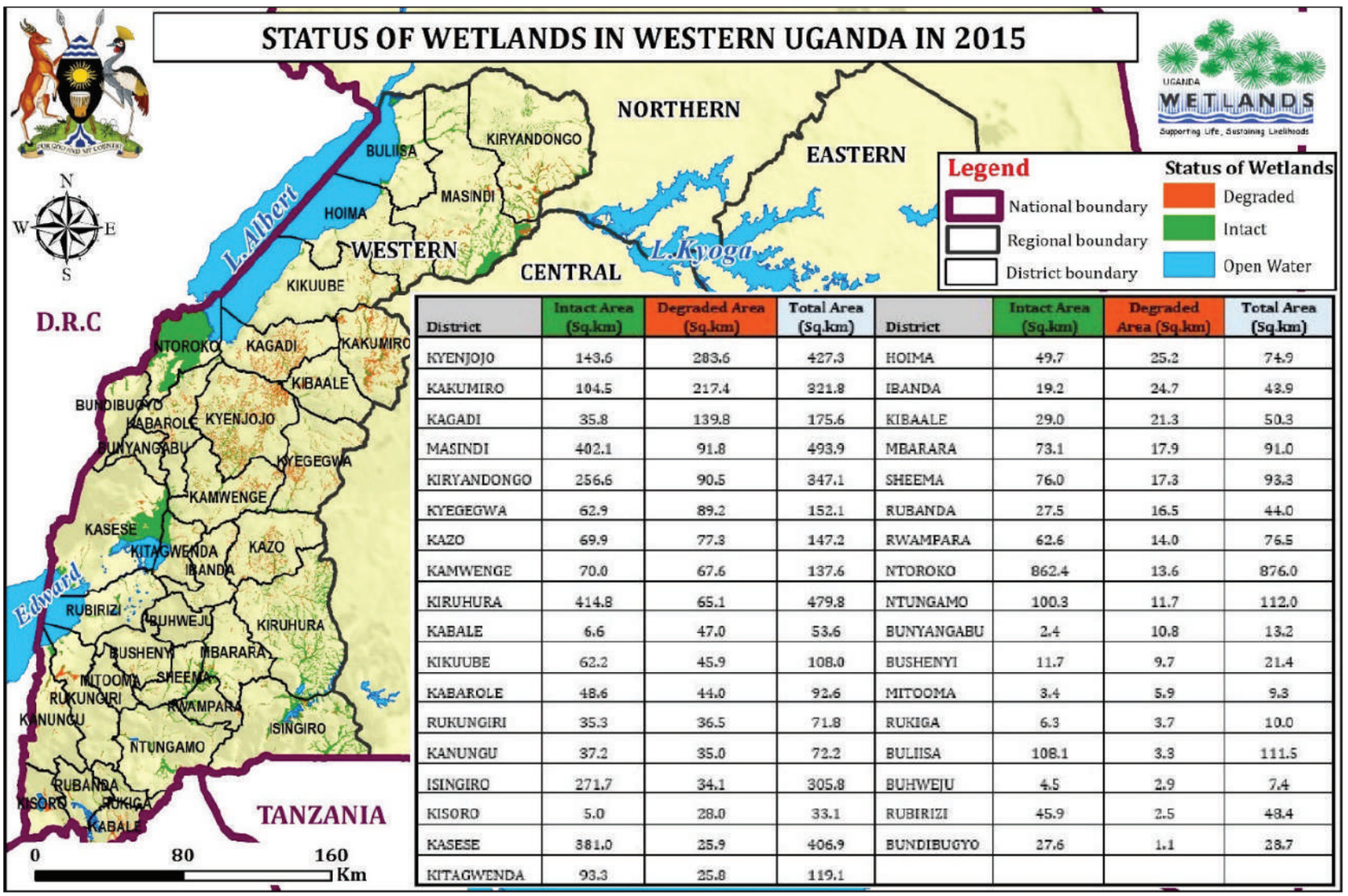
Plate 9: Burnt cycads in Kitagwenda district, western Uganda

In the Central region, Nakaseke district had the biggest coverage of intact wetlands with 798.7km^2 whereas Buvuma district had the least coverage of intact wetlands with 7.9km^2. Luwero district sustained the biggest coverage of degraded wetlands with 250.3km^2 while Butambala district had the least coverage of degraded wetlands with 4.7km^2 as shown in figure 18 below.

District	Intact Area (Sq.km)	Degraded Area (Sq.km)	Total Area (Sq.km)
LUWERO	359.9	250.3	610.3
KAYUNGA	339.9	247.4	587.3
SSEMBABULE	338.2	243.1	581.3
KYOTERA	656.1	175.7	831.8
MUBENDE	145.6	159.1	304.7
KASSANDA	171.9	159.1	331.0
MUKONO	246.7	137.8	384.5
WAKISO	244.7	136.3	381.1
NAKASEKE	798.7	131.1	929.8
KYANKWANZI	431.5	106.9	538.4
RAKAI	149.0	88.5	237.4
LWENGO	78.8	88.1	166.9
GOMBA	261.9	75.4	337.3
NAKASONGOLA	787.1	73.8	860.9
BUKOMANSIMBI	75.3	70.2	145.5
MITYANA	81.6	70.1	151.7
LYANTONDE	137.7	61.5	199.2
KALUNGU	204.9	56.8	261.7
BUIKWE	19.3	54.2	73.5
KIBOGA	287.3	46.7	334.0
MASAKA	278.3	42.0	320.3
MPIGI	280.2	22.6	302.8
KAMPALA	12.1	21.2	33.3
KALANGALA	26.7	11.2	37.9
BUVUMA	7.9	4.8	12.8
BUTAMBALA	39.1	4.7	43.8

Figure 18: Status of wetlands in Central Uganda in 2015

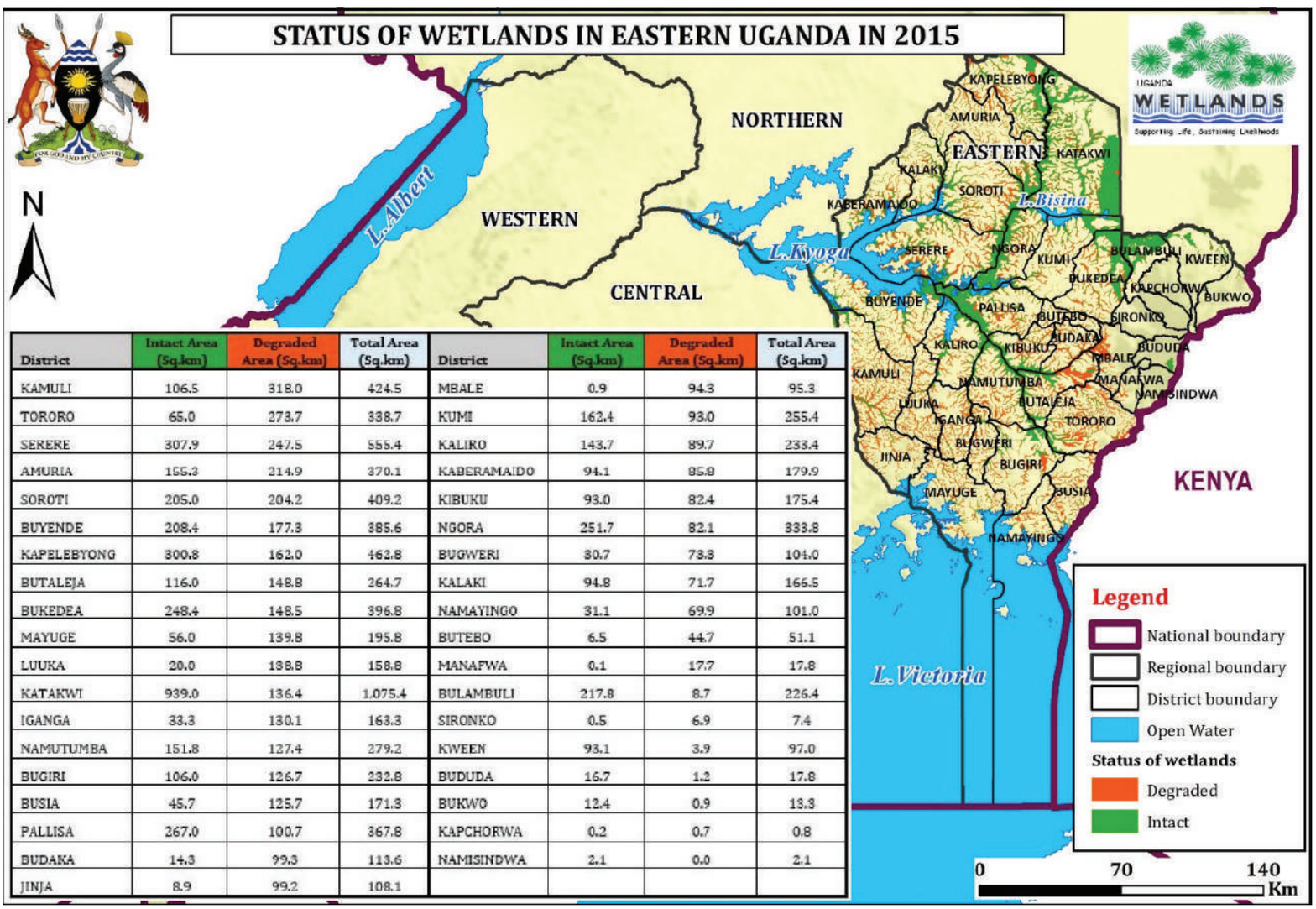
In the Western region, Kyenjojo district had the biggest coverage of degraded wetlands with 283.6km2 whereas Bundibugyo district had the least coverage of degraded wetlands with 1.1km2 as shown in figure 19 below. Ntoroko district had the biggest extent of intact wetlands with 862.4km2 while Bunyangabu district had the least coverage of intact wetlands with 2.4km2.



District	Intact Area (Sq.km)	Degraded Area (Sq.km)	Total Area (Sq.km)	District	Intact Area (Sq.km)	Degraded Area (Sq.km)	Total Area (Sq.km)
KYENJOJO	143.6	283.6	427.3	HOIMA	49.7	25.2	74.9
KAKUMIRO	104.5	217.4	321.8	IBANDA	19.2	24.7	43.9
KAGADI	35.8	139.8	175.6	KIBAALE	29.0	21.3	50.3
MASINDI	402.1	91.8	493.9	MBARARA	73.1	17.9	91.0
KIRYANDONGO	256.6	90.5	347.1	SHEEMA	76.0	17.3	93.3
KYEGEGWA	62.9	89.2	152.1	RUBANDA	27.5	16.5	44.0
KAZO	69.9	77.3	147.2	RWAMPARA	62.6	14.0	76.5
KAMWENGE	70.0	67.6	137.6	NTOROKO	862.4	13.6	876.0
KIRUHURA	414.8	65.1	479.8	NTUNGAMO	100.3	11.7	112.0
KABALE	6.6	47.0	53.6	BUNYANGABU	2.4	10.8	13.2
KIKUUBE	62.2	45.9	108.0	BUSHENYI	11.7	9.7	21.4
KABAROLE	48.6	44.0	92.6	MITOOMA	3.4	5.9	9.3
RUKUNGIRI	35.3	36.5	71.8	RUKIGA	6.3	3.7	10.0
KANUNGU	37.2	35.0	72.2	BULIISA	108.1	3.3	111.5
ISINGIRO	271.7	34.1	305.8	BUHWEJU	4.5	2.9	7.4
KISORO	5.0	28.0	33.1	RUBIRIZI	45.9	2.5	48.4
KASESE	381.0	25.9	406.9	BUNDIBUGYO	27.6	1.1	28.7
KITAGWENDA	93.3	25.8	119.1				

Figure 19: Status of wetlands in Western Uganda in 2015

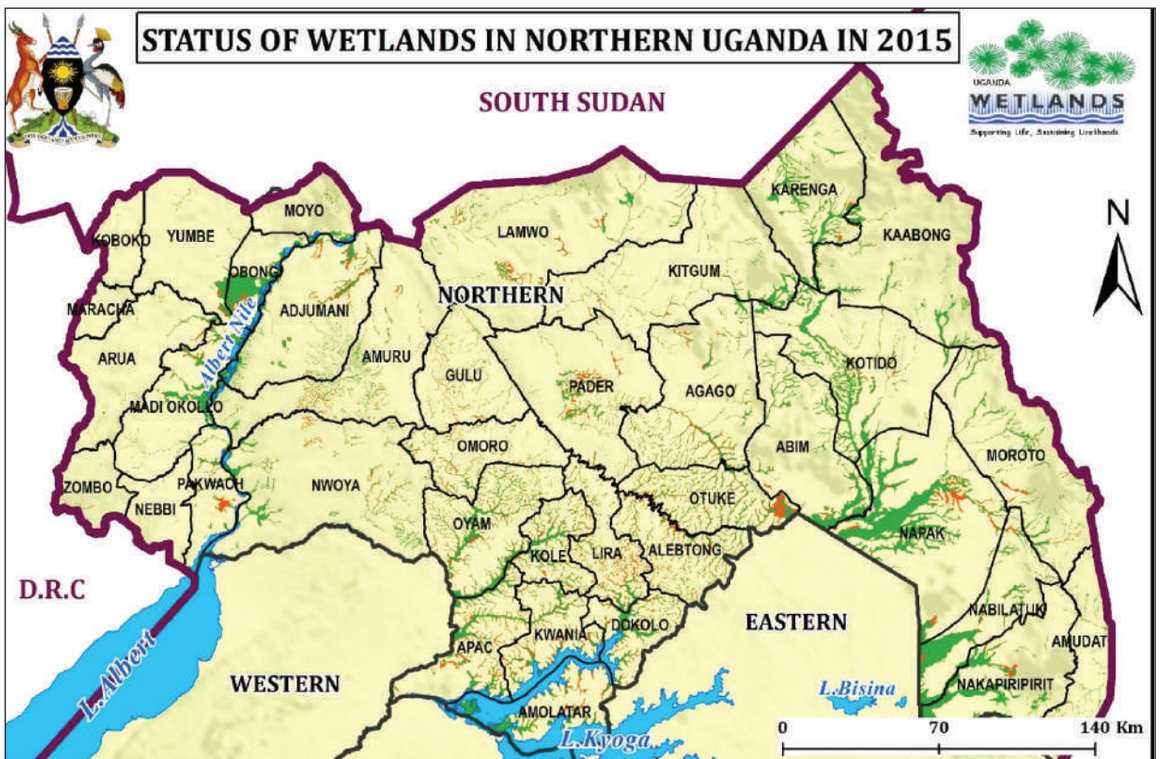
In Eastern Uganda, Kamuli district had the biggest coverage of degraded wetlands with 318km^2 while Namisindwa district did not have disturbed wetlands. Katakwi district had the biggest coverage of intact wetlands with 939km^2 whereas Manafwa district had the least coverage of intact wetlands with 0.1km^2 as shown in figure 20 below.



District	Intact Area (Sq.km)	Degraded Area (Sq.km)	Total Area (Sq.km)	District	Intact Area (Sq.km)	Degraded Area (Sq.km)	Total Area (Sq.km)
KAMULI	106.5	318.0	424.5	MBALE	0.9	94.3	95.3
TORORO	65.0	273.7	338.7	KUMI	162.4	93.0	255.4
SERERE	307.9	247.5	555.4	KALIRO	143.7	89.7	233.4
AMURIA	155.3	214.9	370.1	KABERAMAIDO	94.1	85.8	179.9
SOROTI	205.0	204.2	409.2	KIBUKU	93.0	82.4	175.4
BUYENDE	208.4	177.3	385.6	NGORA	251.7	82.1	333.8
KAPELEBYONG	300.8	162.0	462.8	BUGWERI	30.7	73.3	104.0
BUTALEJA	116.0	148.8	264.7	KALAKI	94.8	71.7	166.5
BUKEDEA	248.4	148.5	396.8	NAMAYINGO	31.1	69.9	101.0
MAYUGE	56.0	139.8	195.8	BUTEBO	6.5	44.7	51.1
LUUKA	20.0	138.8	158.8	MANAFWA	0.1	17.7	17.8
KATAKWI	939.0	136.4	1,075.4	BULAMBULI	217.8	8.7	226.4
IGANGA	33.3	130.1	163.3	SIRONKO	0.5	6.9	7.4
NAMUTUMBA	151.8	127.4	279.2	KWEEN	93.1	3.9	97.0
BUGIRI	106.0	126.7	232.8	BUDUDA	16.7	1.2	17.8
BUSIA	45.7	125.7	171.3	BUKWO	12.4	0.9	13.3
PALLISA	267.0	100.7	367.8	KAPCHORWA	0.2	0.7	0.8
BUDAKA	14.3	99.3	113.6	NAMISINDWA	2.1	0.0	2.1
JINJA	8.9	99.2	108.1				

Figure 20: Status of wetlands in Eastern Uganda in 2015

In Northern Uganda, Napak district had the biggest coverage of intact wetlands with 864.8km^2 whereas Koboko district had the least coverage of intact wetlands with 0.5km^2 as shown in figure 21 below. Otuke district had the biggest extent of degraded wetlands with 130.3km^2 while Moyo district had the least coverage of degraded wetlands with 1.3km^2.



District	Intact Area (Sq.km)	Degraded Area (Sq.km)	Total Area (Sq.km)	District	Intact Area (Sq.km)	Degraded Area (Sq.km)	Total Area (Sq.km)
OTUKE	207.1	130.3	337.4	PAKWACH	68.3	32.4	100.7
ALEBTONG	100.4	129.1	229.4	MADI OKOLLO	209.5	26.9	236.4
LIRA	83.6	115.3	198.9	MOROTO	176.9	26.2	203.1
APAC	250.5	102.6	353.1	KOTIDO	437.7	23.2	460.9
OYAM	281.0	98.7	379.7	NABILATUK	353.6	22.3	375.9
KWANIA	122.7	96.9	219.6	OBONGI	241.0	21.4	262.4
PADER	110.3	92.8	203.1	NAKAPIRIPIRIT	368.1	18.5	386.6
AGAGO	170.6	88.9	259.5	ABIM	290.0	17.1	307.1
NAPAK	864.8	84.0	948.8	KARENGA	247.5	14.8	262.3
KOLE	135.6	72.3	207.9	ARUA	25.2	13.0	38.2
ADJUMANI	230.9	63.8	294.6	YUMBE	59.4	12.8	72.2
DOKOLO	166.3	59.1	225.4	KAABONG	196.3	5.4	201.6
OMORO	54.6	58.9	113.5	NEBBI	4.4	3.8	8.2
GULU	35.9	56.7	92.6	AMUDAT	80.1	3.4	83.5
AMURU	116.9	55.7	172.6	ZOMBO	2.3	2.4	4.7
LAMWO	138.2	53.7	191.9	KOBOKO	0.5	1.6	2.1
AMOLATAR	191.2	53.1	244.4	MOYO	41.6	1.3	42.8
NWOYA	211.7	48.0	259.7	MARACHA	0.0	0.0	0
KITGUM	149.3	39.5	188.8				

Figure 21: Status of wetlands in Northern Uganda in 2015

2.3.2 Wetland Degradation by Districts

In 2015, the districts that had the biggest area coverage of degraded wetlands included Kamuli with 318km^2 (74.9%), Kyenjojo with 283.6km^2 (66.4%), Tororo with 273.7km^2 (80.8%), Luwero with 250.3km^2 (41%), and Serere with 247.5km^2 (44.6%) as shown in figure 22 below.

The districts that had the highest proportion of degraded wetlands by land area were Manafwa with 99.4% (17.7km^2), Mbale with 99% (94.3km^2), Sironko with 93.7% (6.9km^2), Jinja with 91.7% (99.2km^2), and Kabale with 87.7% (47km^2) as highlighted in figure 23 and 24 below.

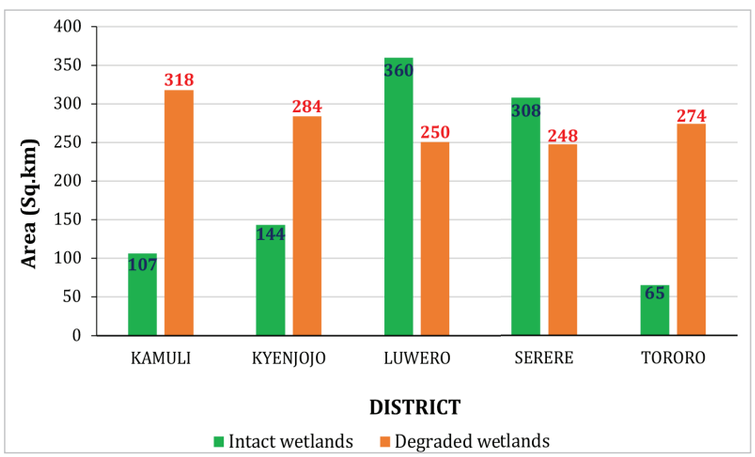


Figure 22: Districts with the biggest area coverage of degraded wetlands

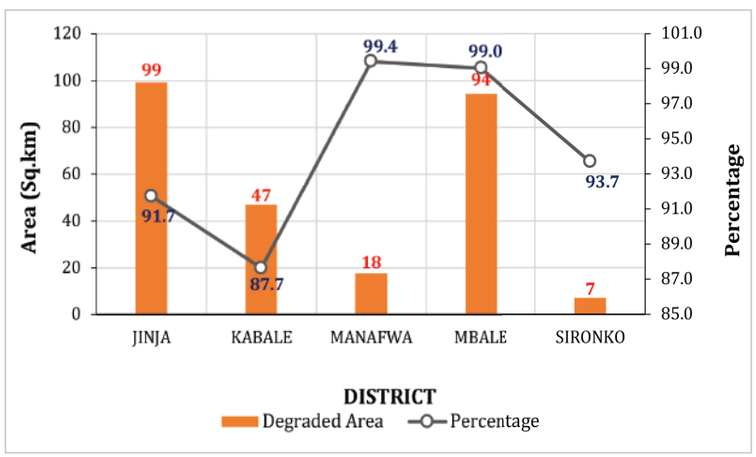


Figure 23: Districts with the biggest proportion of degraded wetlands

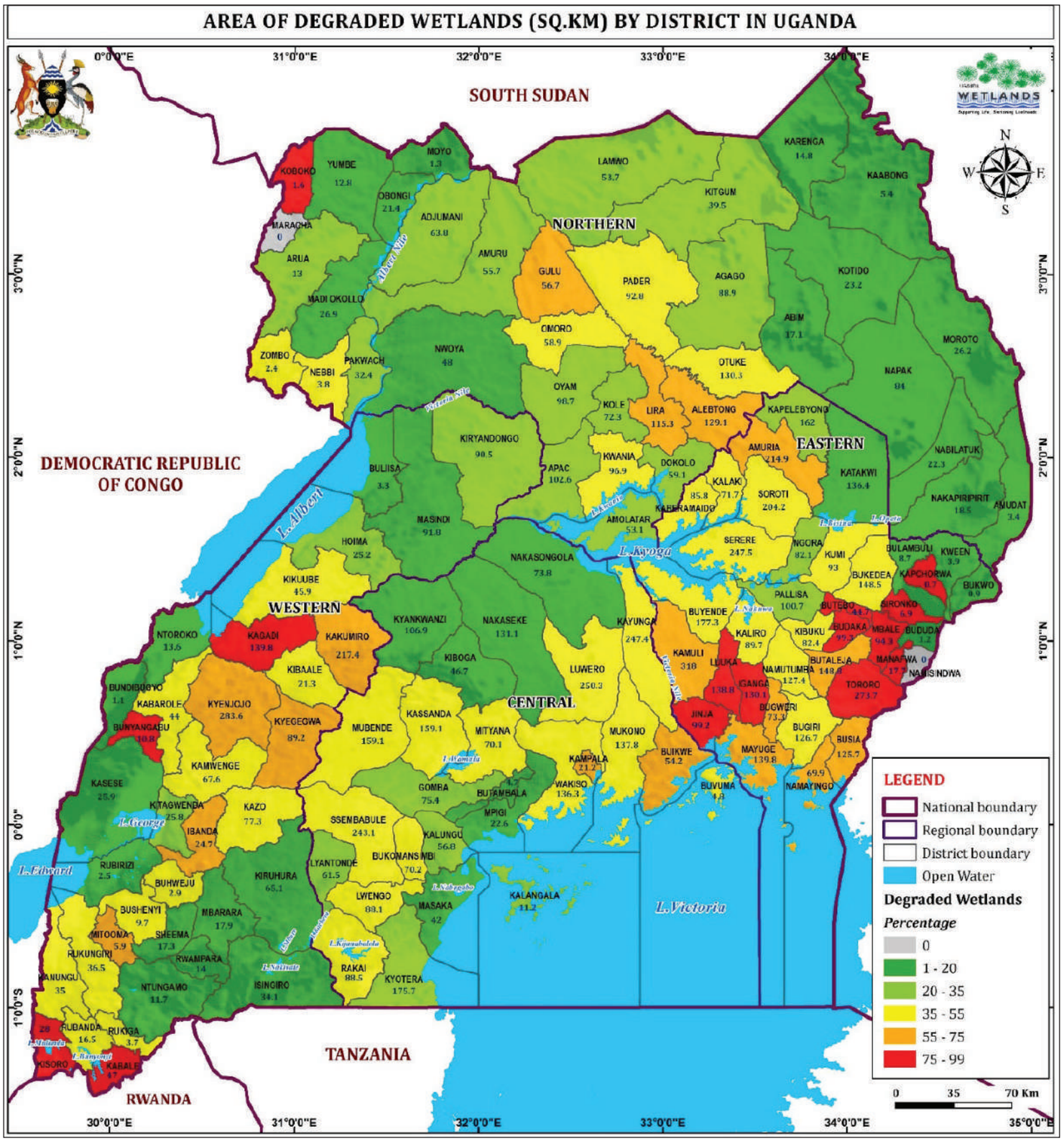


Figure 24: Wetland degradation by district in 2015

2.3.3 Wetland Degradation by Drainage basins

By the estimation of degraded wetlands in drainage basins, Lake Kyoga drainage basin was by far the most degraded basin by 42 percent. This was followed by Lake Edward (34%), Lake Victoria (29%), Lake Albert (28%) and Victoria Nile with 27 percent. Figure 25 displays the coverage by area of wetland degradation by drainage basins. The least coverages of degraded wetlands were found in Aswa and Kidepo drainage basins. On the other hand, the basins that held the most intact wetlands were Lake Kyoga, Lake Victoria and Victoria Nile. The indicators of wetland degradation in Kyoga basin were also reported by many scholars such as Nalukenge et al. (2009) in Pallisa District; Yikii et al. (2017) in Lake Kyoga Basin.

Lacustrine wetland systems seemed to have suffered the highest rates of degradation between 1994 and 2015 than the riverine wetlands. The Office of the Auditors General (2018) reported that the drop in wetland coverage was due to intensive rice cultivation in Lake Kyoga basin, and rapid, unplanned urban expansion in Lake Victoria Basin. Other major forms of degradation noted in the drainage basins included commercial agriculture (e.g. flower farming and tree planting), extraction (e.g. sand mining and stone quarrying), construction of houses, industries, commercial buildings, schools, and establishment of washing bays (Table 14).

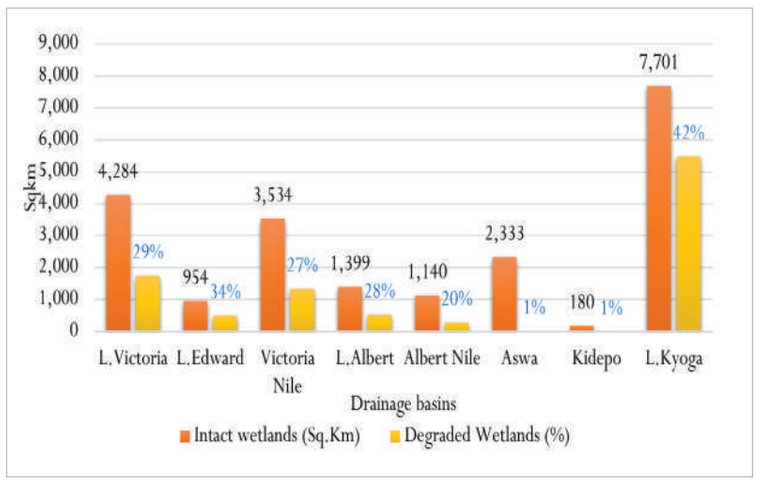


Figure 25: Wetland degradation by drainage basin

Table 14: Major forms wetland degradation in selected wetland systems

	Forms of wetland degradation				
Wetland system	Construction	Agriculture	Mining (extraction)	Dumping of waste	Washing bays
Enyau	X	x	x		x
Namatala-Doho		x	x		
Lake George		x	x		
River Kafu	X	x	x		
Nomuremu-Reshebeya-Kashambya	X	x	x	x	
Nyangahia	X	x	x	x	x
River Rwizi	X	x	x		
Lake Wamala (Mityana)	X	x	x		
Lwajjali	X	x		x	
Lake Wamala (Mubende)	X	x			
Mpologoma	X	x			
Lumbuye		x			
Aswa		x		x	x

Source: Office of the Auditor General, 2018

Plate 10: Building constructed in wetland

In 2015, Lake Kyoga drainage basin had the biggest coverage of intact and degraded wetlands with 8,416km^2 (39.1% of intact wetlands) and 4,675km^2 (47.2% of degraded wetlands) respectively. At catchment level within the basin, Kapiri catchment had the biggest coverage of intact wetlands with 2,338.6km^2 (27.8% of intact wetlands in Lake Kyoga basin) whereas Kwania catchment had the least extent of intact wetlands with 592.2km^2 (7% of intact wetlands in Lake Kyoga basin) as highlighted in figure 25 below. Mpologoma catchment had the biggest coverage of degraded wetlands with 1,900.4km^2 (40.7% of degraded wetlands in Lake Kyoga basin) while Kwania catchment had the least coverage of degraded wetlands with 290.3km^2 (6.2% of degraded wetlands in Lake Kyoga basin) as shown in figure 26 below.

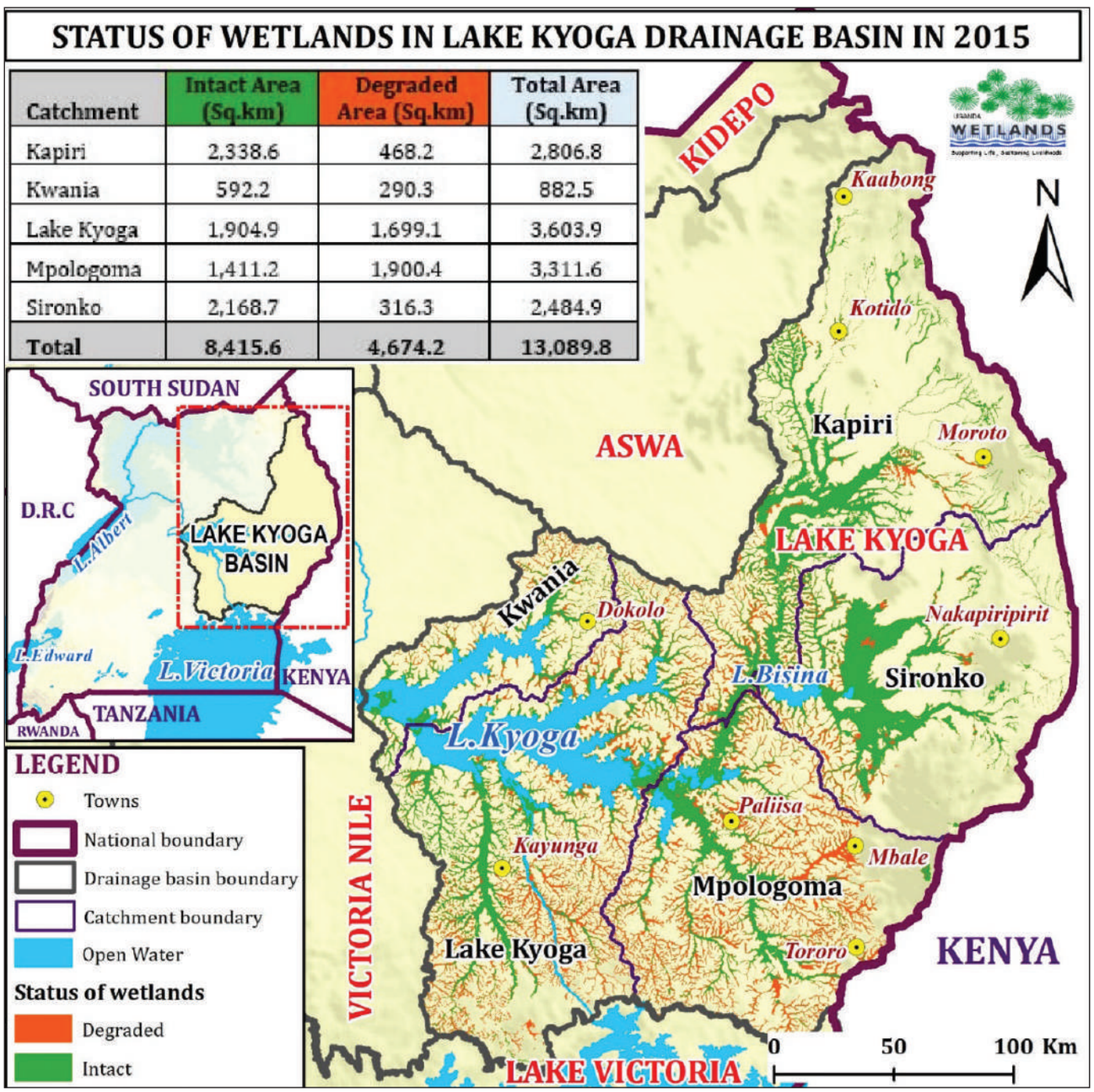
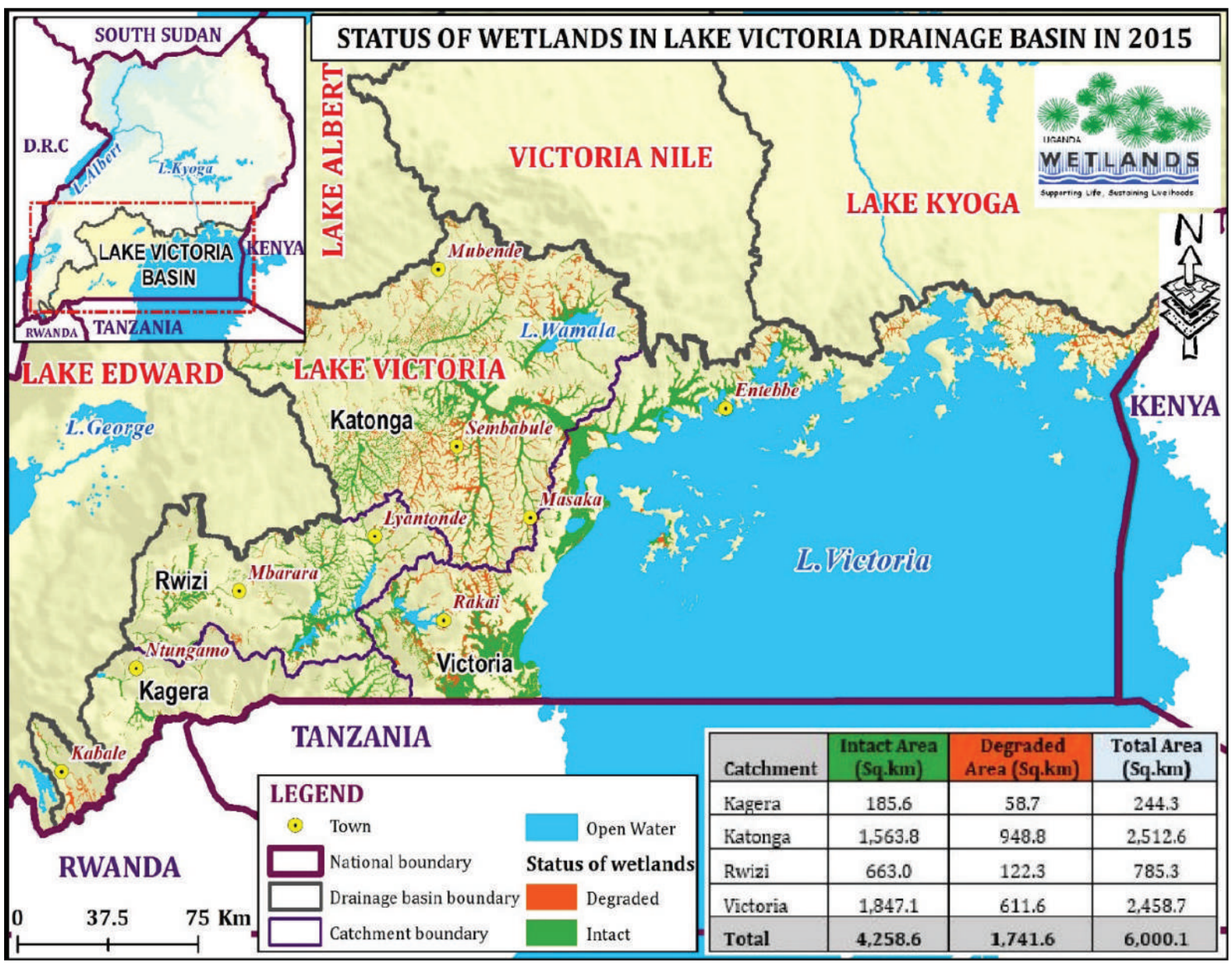


Figure 26: Status of wetlands in Lake Kyoga drainage basin in 2015

In 2015, Lake Victoria drainage basin had a total of 6,000km^2 wetlands coverage (19.1% of all wetlands in Uganda), of which, 70.9% were intact wetlands (4,258.6km^2) and 29% were degraded wetlands (1,741.6km^2). At catchment level within the basin, Victoria catchment had the biggest coverage of intact wetlands with 1,847.1km^2 (43.4% of intact wetlands in Lake Victoria basin) while Rwizi catchment had the least coverage of intact wetlands with 663km^2 (15.6% of intact wetlands in Lake Victoria basin). Katonga catchment had the biggest coverage of degraded wetlands with 948.8km^2 (54.5% of degraded wetlands in Lake Victoria basin) while Kagera catchment had the least coverage of degraded wetlands with 58.7km^2 (3.4% of degraded wetlands in Lake Victoria basin) as shown in figure 27 below.



Catchment	Intact Area (Sq.km)	Degraded Area (Sq.km)	Total Area (Sq.km)
Kagera	185.6	58.7	244.3
Katonga	1,563.8	948.8	2,512.6
Rwizi	663.0	122.3	785.3
Victoria	1,847.1	611.6	2,458.7
Total	**4,258.6**	**1,741.6**	**6,000.1**

Figure 27: Status of wetlands in Lake Victoria drainage basin in 2015

In 2015, Victoria Nile drainage basin had a total wetlands coverage of 5,051km^2 (16.1% of all the wetlands in Uganda), of which, 67% (3,385km^2) were located in Kafu catchment and 33% (1,666km^2) were situated in Kamdini catchment as shown in figure 28 below. Kafu catchment had the biggest coverage of intact and degraded wetlands with 2,498km^2 (67.3% of intact wetlands in Victoria Nile basin) and 887km^2 (66.2% of degraded wetlands in Victoria Nile basin) respectively (Figure 28).

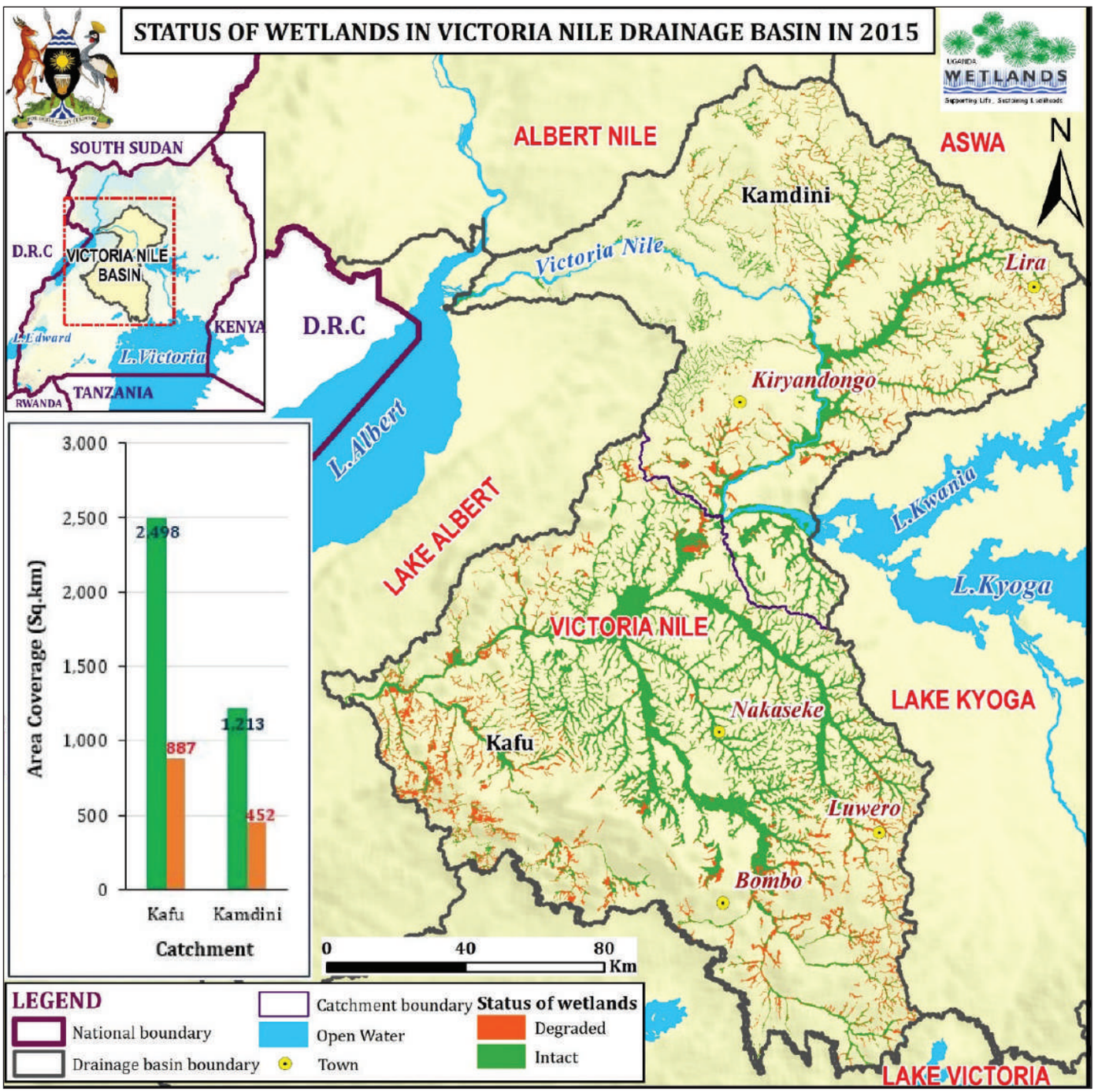


Figure 28: Status of wetlands in Victoria Nile drainage basin in 2015

Lake Albert drainage basin had a total of 1,913km^2 spatial wetlands coverage (6.1% of all the wetlands in Uganda) in 2015. Of this, 72% were intact wetlands (1,342km^2) and 28% were degraded wetlands (532km^2) as highlighted in figure 29 below.

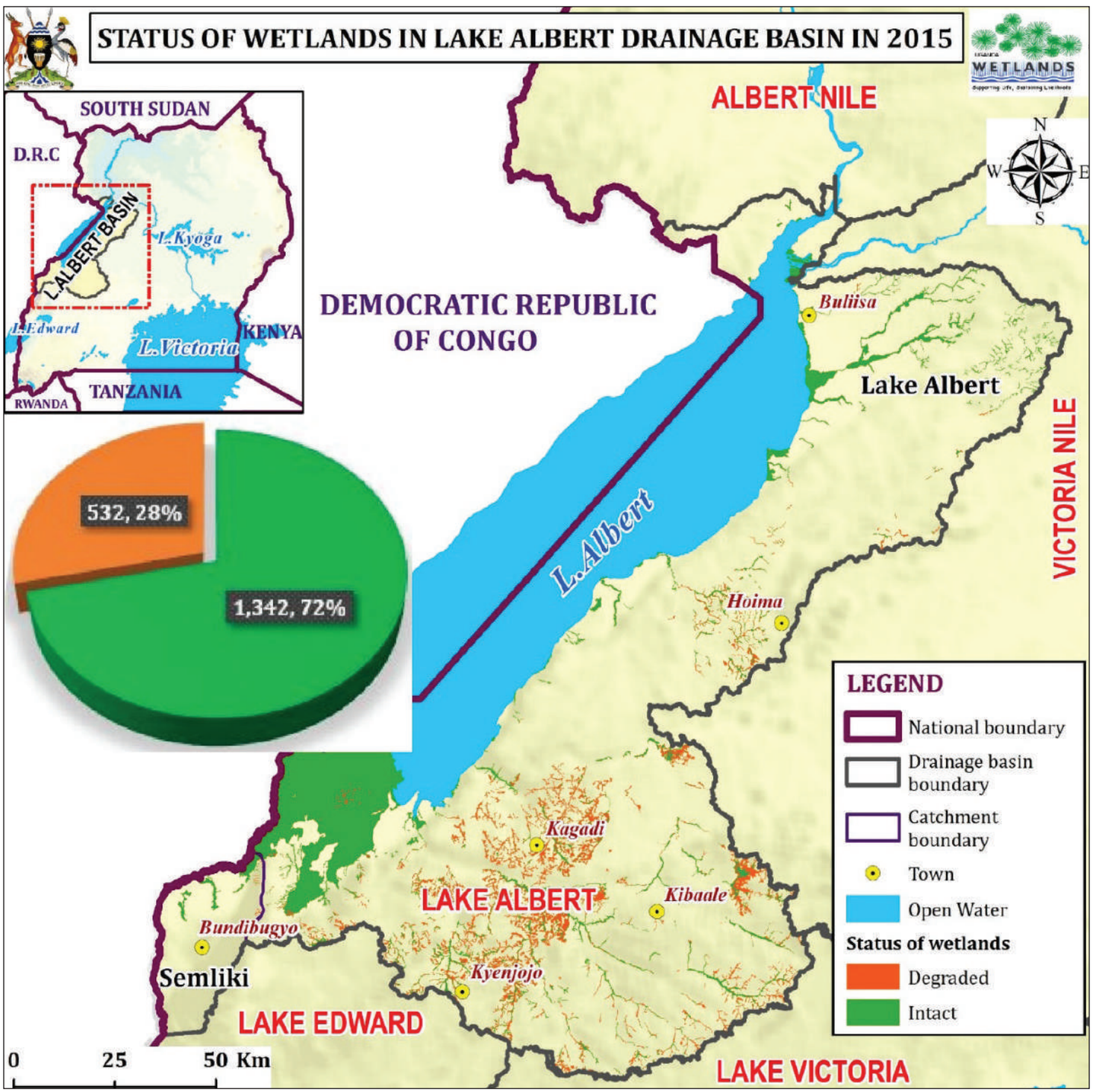


Figure 29: Status of wetlands in Lake Albert drainage basin in 2015

In 2015, Lake Edward drainage basin had a total of 1,439km2 wetlands coverage (4.6% of all the wetlands in Uganda). Of this, 65.7% were intact wetlands (946km2) whereas 34.2% were degraded wetlands (492km2) as shown in figure 30 below.

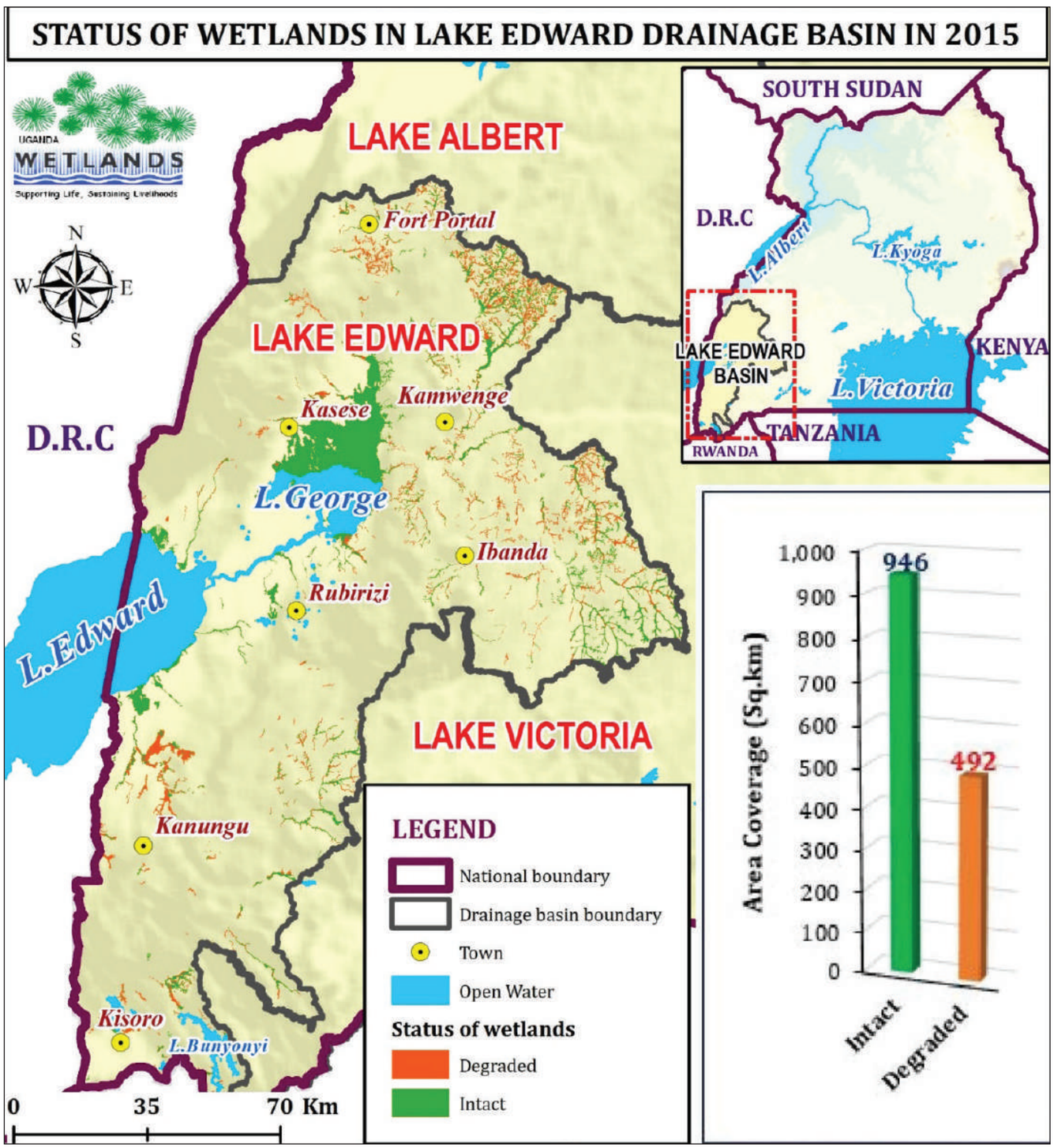


Figure 30: Status of wetlands in Lake Edward drainage basin in 2015

The Albert Nile basin had a wetlands coverage of 1,409.5km^2 (4.5% of all the wetlands in Uganda), of which, 1,125km^2 were intact wetlands (5.2% of all intact wetlands in Uganda and 79.8% of wetlands in Albert Nile drainage basin) and 284km^2 were degraded wetlands (2.9% of all degraded wetlands in Uganda and 20.1% of wetlands in Albert Nile drainage basin) as shown in figure 31 below.

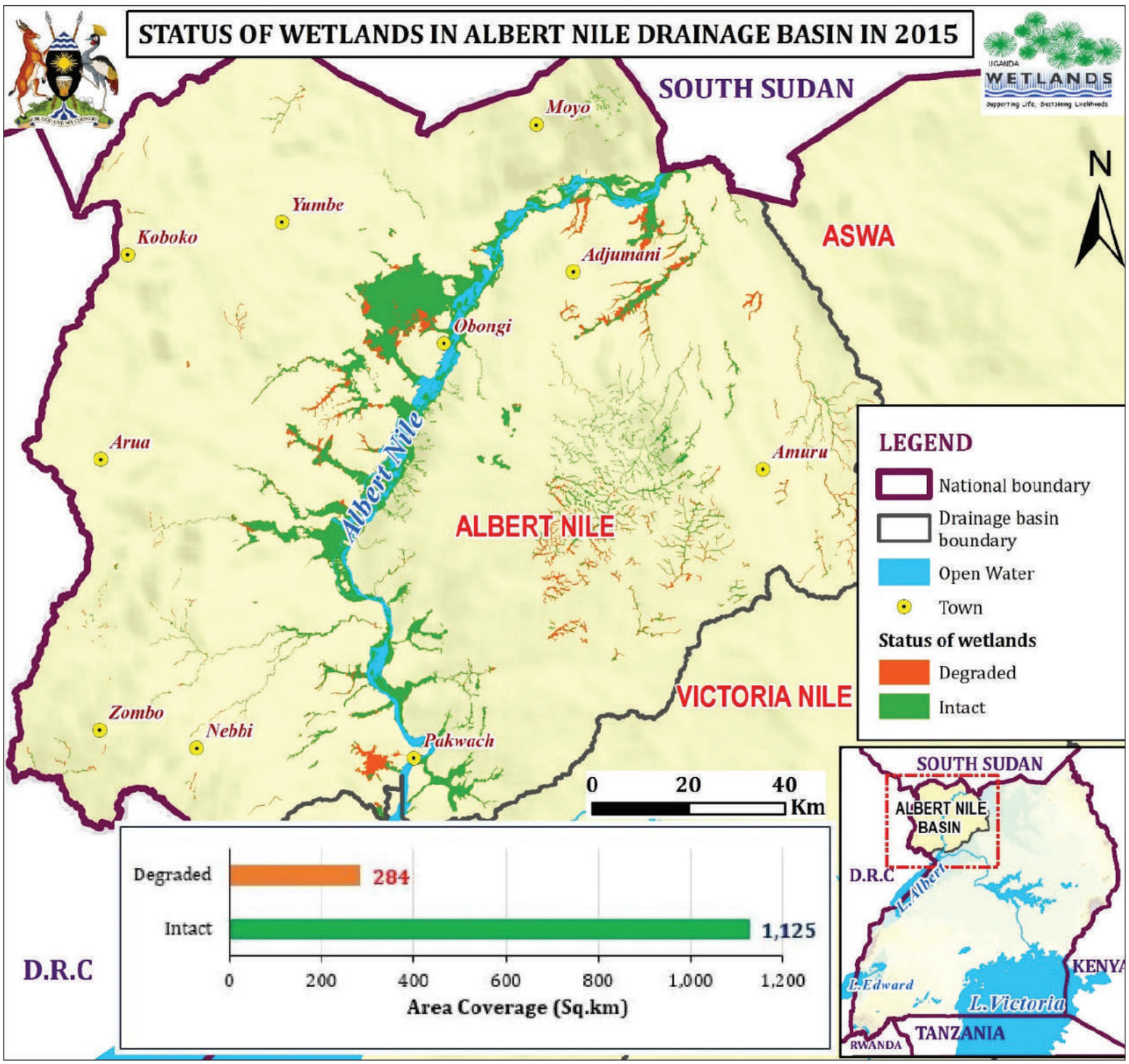


Figure 31: Status of wetlands in Albert Nile drainage basin in 2015

The Aswa drainage basin hosted a total of 2,340.5km^2 wetlands coverage (7.4% of all the wetlands in Uganda) in 2015. Of this, 1,509km^2 were intact wetlands (7% of all intact wetlands in Uganda and 64.5% of wetlands in Aswa drainage basin) and 831km^2 were degraded wetlands (8.4% of degraded wetlands in Uganda and 35.5% of wetlands in Aswa drainage basin) as shown in figure 32 below.

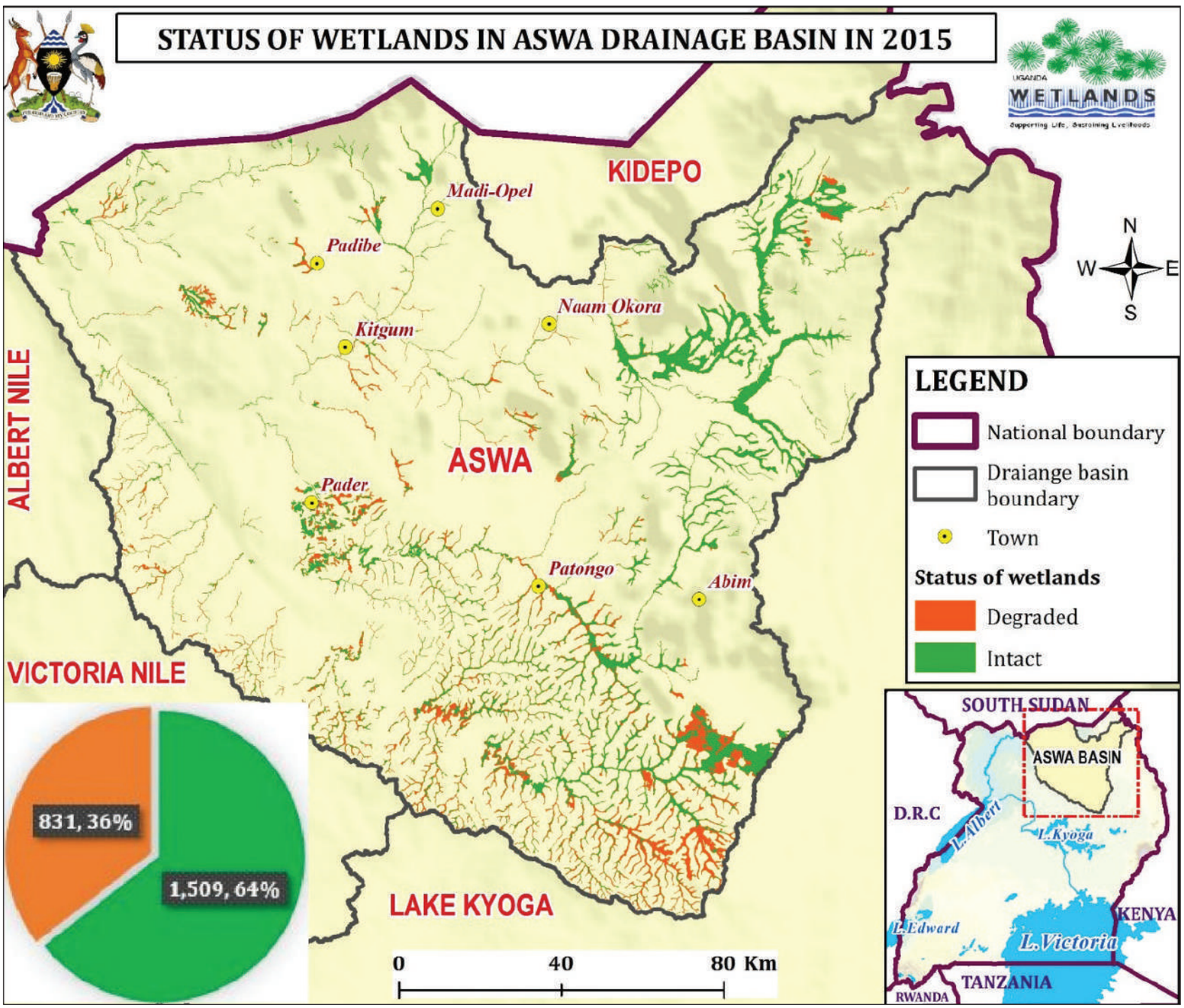


Figure 32: Status of wetlands in Aswa drainage basin in 2015

In 2015, Kidepo drainage basin had the least coverage of wetlands owing to its size with an area of 179.8km² (0.6% of all the wetlands in Uganda). Of this, 178.7km² were intact wetlands (0.8% of intact wetlands in Uganda and 99.4% of wetlands in Kidepo basin) and 1km² were degraded wetlands (0.01% of degraded wetlands in Uganda and 0.6% of wetlands in Kidepo basin) as highlighted in figure 33 below. Most of the wetlands in this basin are located in Kidepo national park which is protected by the Uganda Wildlife Authority (UWA) and this could be the reason for the low degradation in Kidepo drainage basin.

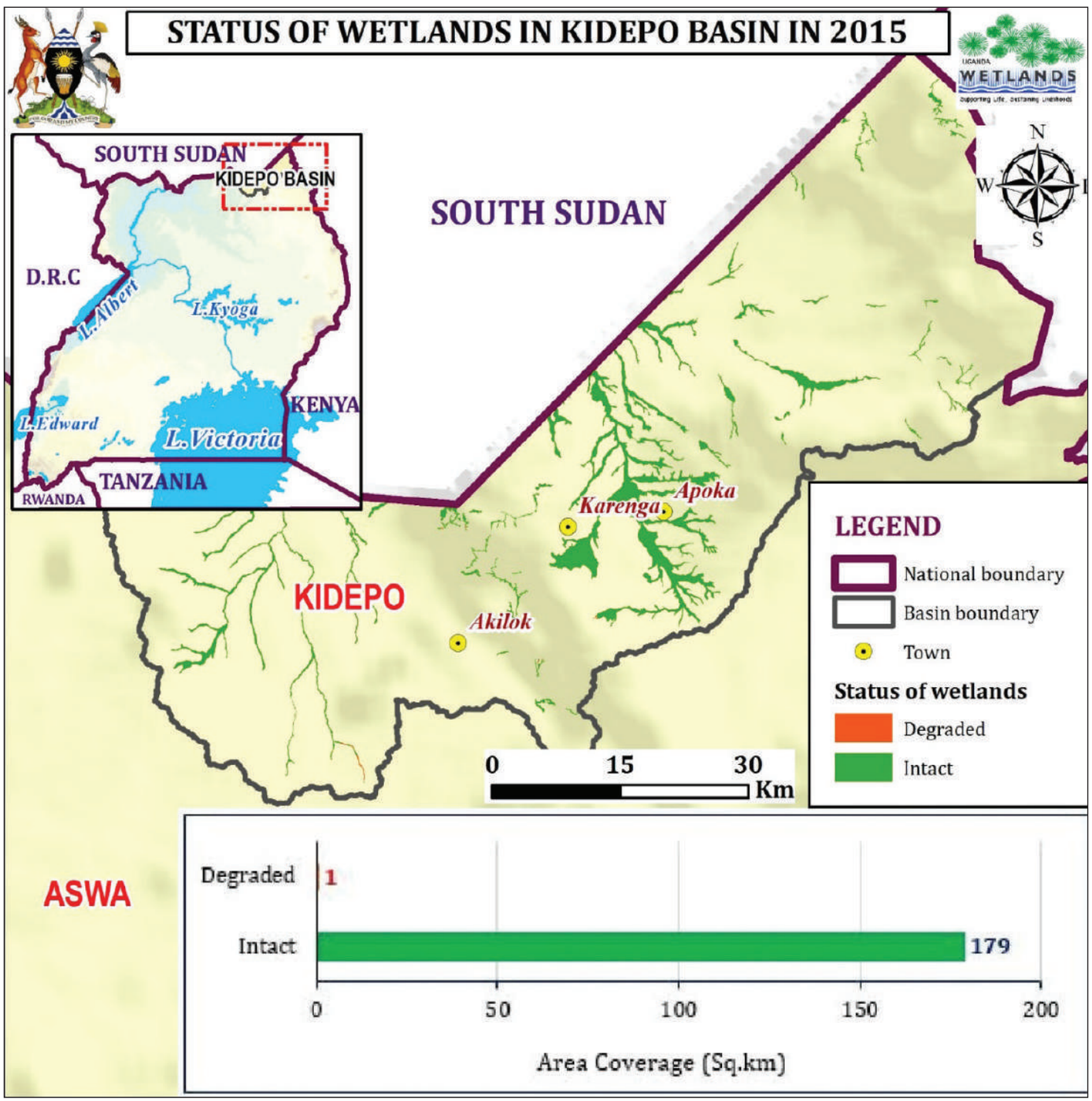


Figure 33: Status of wetlands in Kidepo drainage basin in 2015

2.3.4 Wetland Degradation by cover types

The wetland cover types that were prone to wetland degradation were largely subsistence and commercial farmlands. Other marginal contributors to wetland degradation were built-up areas and commercial tree plantations. Table 15 reveals wetland degradation by wetland cover/use types in 2015. The nature of subsistence farming conducted seemed to be more detrimental to the morphologies and functioning of wetlands. Growing practices that were common are conversions to rice growing, deforestation, drainage of wetlands, deforestation and burning among others. These practices have led to increment in costs of restoration and degradation of ecosystems. A study by Adonia (2013) in the wetlands around Lake Nakivali in Isingiro District reported that the cost of poor land-use practices on vital wetlands was estimated at USD 2,943,960.3 per annum and was expected to continue increasing in the future, putting the livelihoods of residents in dilemma.

Table 15: Wetland degradation by cover types in 2015

Wetland use types	Area (Sqkm)	%
Built up areas	85.6	0.9
Commercial farmland	283.7	2.9
Commercial tree plantations	89.0	0.9
Small scale farmland	9,420.1	95.3
Bare rocks & soils	6.5	0.1
Total	**9,884.9**	**100**

2.4 Biodiversity Status and Trend

Taxonomy in Wetlands

Wetlands in Uganda, host a diversity of flora and fauna that are of global and national importance because of the presence of several major biomes (Plumptre et al., 2019). Most of the biodiversity can be found in natural forests, but a considerable number is also found in other natural ecosystems such as mountains, savannahs, wetlands, lakes and rivers.

Figures 34 and 35 shows the taxonomy (plantae and animalia) found in Uganda's wetlands. The IUCN Red List of Plantae kingdom showed that in Uganda, the critically endangered (CR) species were 8%, Endangered (EN) species were 32% while the vulnerable species were (59%). The habitats that hosted the highest numbers of plant species were terrestrial (84%), inland waters (10%) and both terrestrial and inland water with 6%. Most of the plant species were placed in forests (over 8 hectares) and wetlands followed by grasslands and rocky areas.

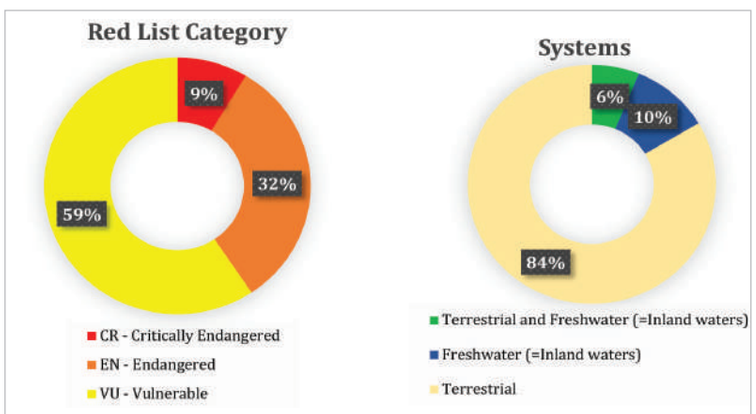


Figure 34: IUCN Red list of Plantae Kingdom (https://www.iucnredlist.org/)

For the animalia kingdom, the IUCN Red list showed that the critically endangered (CR) species are 20%, endangered (EN) species are 28% while the vulnerable species accounted for 52%. The habitats with many species were terrestrial (53%) and freshwater (inland waters) with 32% followed by terrestrial and freshwater (9.5%). At the habitat level, the majority of the animal species were found in wetlands followed by grasslands. The other ecosystems that had higher numbers of species were forests and shrublands.

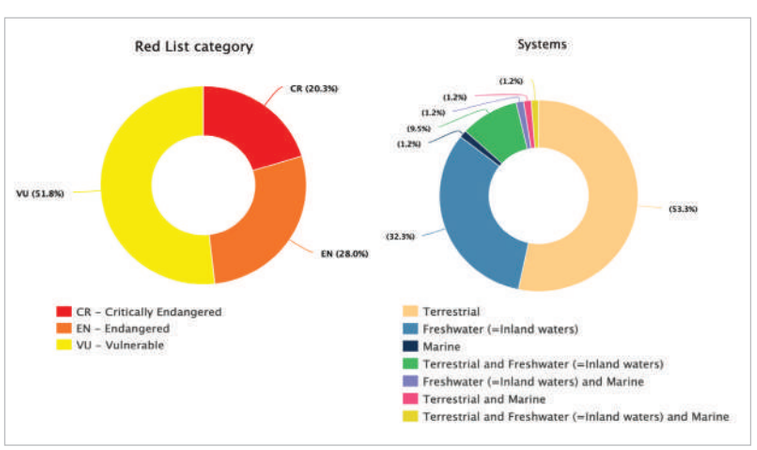


Figure 35: IUCN Red list of Animalia Kingdom (https://www.iucnredlist.org/)

Plate 11: Crested cranes in Lutembe wetland

The number of globally listed threatened (CR, EN, and VU) terrestrial vertebrates in Uganda totalled 57 species, together with an additional 42 plant species (Table 16). While the national red listing process identified 208 terrestrial vertebrates and 80 plants as threatened in Uganda with an additional 135 DD species (Plumptre et al., 2019).

The trend of Plant and animal population. According to the IUCN Red List (2019), Uganda had about 4 plant species that were globally critically endangered, 14 were endangered and 16 vulnerable. The trend (2004-2019) of critically endangered species and endangered species showed a decline. While, for the animal species, the critically endangered species were 35, endangered 25 and those vulnerable were 41. Similarly, the trend of animal species was decreasing.

Table 16: Numbers of globally and nationally threatened terrestrial vertebrates and plants in Uganda

	Taxon	Mammals	Birds	Reptiles	Amphibians	Terrestrial Vertebrates	Plants
	Total Species	396	1,043	220	83	1,742	3,662
Globally threatened	CR	1	4	0	1	6	3
	EN	9	8	0	1	18	4
	VU	17	11	2	3	33	35
	DD	12	2	1	7	22	3
	Total global	39	25	3	12	79	45
Nationally threatened	CR	14	9	4	1	28	15
	EN	25	24	8	9	66	27
	VU	38	52	17	7	114	38
	DD	40	28	48	16	132	3
	Total national	117	113	77	33	340	83

Source: (Plumptre et al., 2019)

2.5 Status of Ramsar Sites in Uganda

Uganda has designated a total of 12 wetland areas as Ramsar Sites that are wetlands of international importance, for their role in supporting habitats for birds including migratory birds but also as habitats for endemic and threatened species such as the insectivorous plant in L. Nabugabo Ramsar site. Table 17 and Figure 36 shows the locations of Ramsar sites and their acreages. In terms of acreage, Lake Nakuwa Wetland System, Lake Nabugabo, Lake George, Lake Opeta Wetland System and Lake Bisina are the largest Wetland Systems.

The Uganda Ramsar Sites are also part of the country's Important Bird Areas (IBAs). These sites play the following vital roles: Contribute to the development and the implementation of national biodiversity conservation strategies in line with the Convention on Biodiversity (CBD), and in particular, assist national organizations and agencies to identify and conserve areas of high biodiversity value; Assist the government in the implementation of and active participation in international, and regional agreements such as the CBD and Ramsar Conventions; Inform decision-makers and their advisers at all levels regarding the importance of these vital sites so that policies and zonation's for wetlands use will be formulated or modified accordingly.

Table 17: Location of Ramsar sites in Uganda

	Name of Ramsar sites	Designation date	Area (ha)	Location by district
A	Nabajjuzi Wetland system	2006	80,352	Masaka, Sembabule, Kalungu, Bukomasimbi, Lwengo
B	Lutembe Bay Wetland System	2006	1,993	Wakiso
C	Mabamba Bay Wetland System	2006	49,635	Wakiso and Mpigi
D	Lake Mburo-Nakivali Wetland System	2006	127,049	Isingiro, Rakai, Kiruhura, Lwengo, Lyantonde
E	Lake Bisina Wetland System	2006	182,568	Kumi, Katakwi, Soroti, Serere, Ngora, Amuria
F	Lake Nakuwa Wetland System	2006	417,254	Kamuli, Pallisa, Namutumba, Budaka, Kibuku, Kumi ,Kaliro, Luuka, Buyende, Soroti districts
G	Lake Opeta Wetland System	2006	186,459	Nakapiripirit, Sironko, Katakwi, Kumi, Kweni, Bukedea, Bulambuli, Nabilatuk
H	Murchison Falls-Albert Delta Wetland System	2006	34,076	Nwoya, Buliisa, Masindi
I	Sango Bay-Musambwa Island-Kagera Wetland System (SAMUKA)	2006	172,839	Masaka, Rakai, Kyotera
J	Rwenzori Mountains Ramsar Site	2008	99,839	Kasese, Bundibugyo, Bunyangabu, Ntoroko
K	Lake Nabugabo wetland system	2002	186,835	Masaka, Gomba, Butambala, Mpigi, Kalungu
L	Lake George	1988	180,639	Kasese, Rubirizi, Ibanda, Kitagwenda, Kamwenge, Kabarole, Bunyangabu

Note: Districts are according to the revised administrative boundaries in the country as of 2019

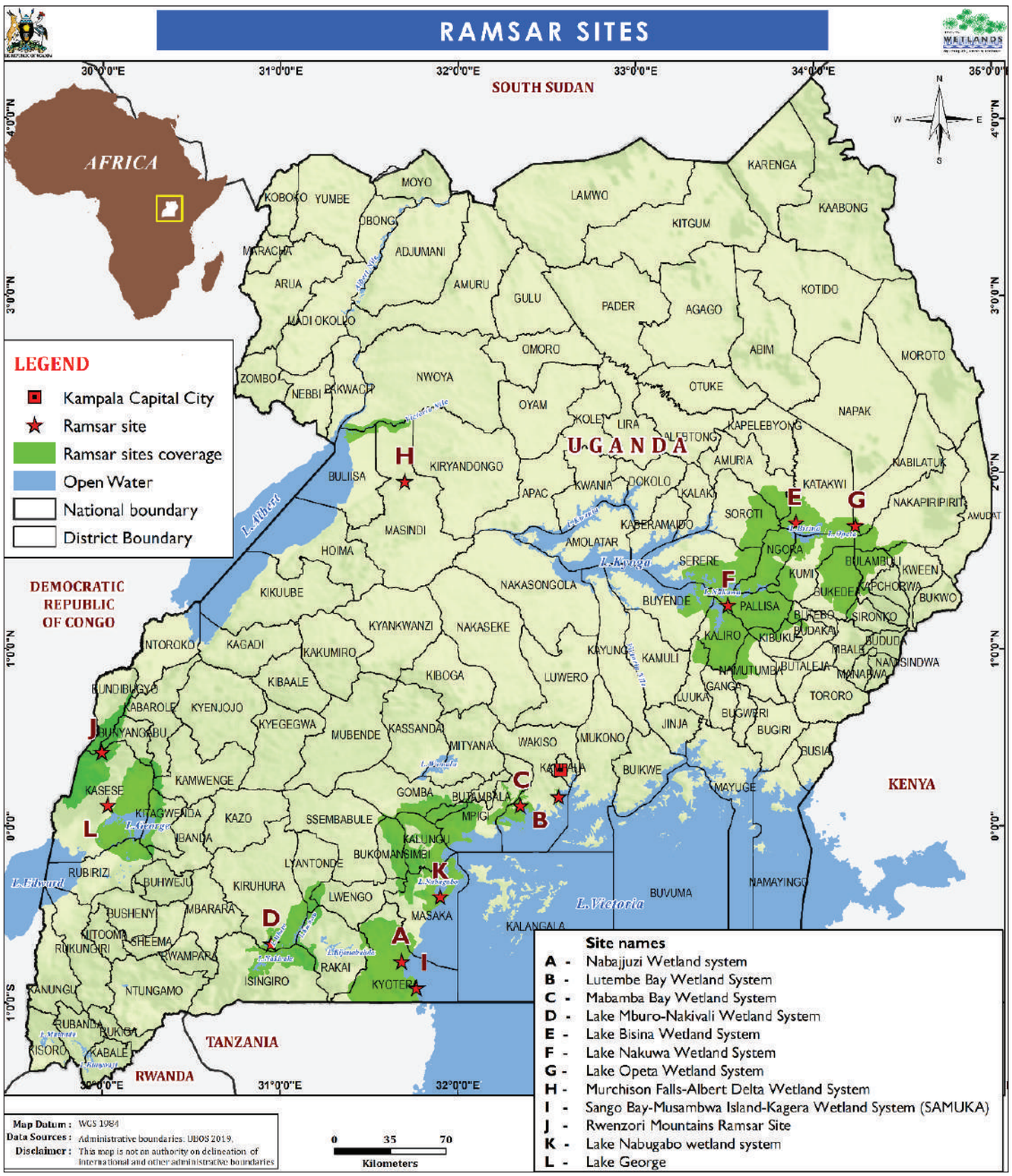


Figure 36: Location of Ramsar sites in Uganda

Plate 12: Wetland flora (Palms) in Butiaba, shoreline of Lake Albert. Photo credit Carol K. Kairumba

2.6 Hydrological Status of Wetlands

Water regimes of many wetlands in Uganda could be highly influenced by the water balance components. Most of the wetlands lie in the flow paths of rivers/streams. When this flow reaches the wetlands, it may be regulated by saturation/impoundment, stored and released at different variations. To add on, wetlands also receive direct raindrops during rainfall periods that contribute to variations in water levels. The same wetlands also receive water through subsurface flow processes due to runoff, infiltration, saturation and flow into the wetland. However, wetlands can lose stored water through evapotranspiration influenced by anthropogenic activities and morphology of the wetland or river channel. This observation is supported by the findings of Kayendeke & French, (2019) in Mpologoma wetland system, where land-use changes played an important role of influencing infiltration rates, wetland water levels, and flow dynamics within the catchment. They also observed a 1-month lag between rainfall and channel flows. The wetland's retention time between the inlet and outlet culverts varied between 2 hours and 7 days during periods of high and low flows. Their estimates of total potential evapotranspiration rates were 30% higher than total precipitation.

Similarly, John et al. (2018) observed that for an urban wetland like Lubigi in Kampala city, its water balance was dominated by influents which accounted for about 93% of the total water influx and water effluent outflux of 97.7% between 2016 and 2017. The residence time of outflow during the peak flows was 6 hours to 10 hours during the low flows. Water impoundments in wetlands can play a critical role in the facilitation of the biogeochemical processes, transformation and removal of pollutants in wetlands (Hinckley et al., 2019). Plate 15 shows the drainage channel flowing from Rweikiniro Sub county to Ngoma Sub-county created in Rufuha wetland, Ntugamo district which blocks off the natural flow of the wetland.

Plate 13: Wetland drainage for agriculture in Ntungwa Nyabushoro wetland, Kanungu District (Photo credit Busunge Daniel)

2.7 Status of Trans-boundary Wetlands

Sio-Siteko wetland system (Kenya and Uganda)

The wetland traverses Busia districts in Kenya and Uganda. The system is part of the wider Sio-Malaba-Malakisi catchment (World Bank, 2009) as shown in figure 37 below. The wetland consists of several interconnected secondaries and tertiary wetland subsystems that drain into Lake Victoria. The Sio River originates from the foothills of the Kenyan segment of Mount Elgon (Barasa et al., 2011) and has a total length and catchment area of about 85km and 1,338 sq.km respectively (GoK, 2009). Ecosystem goods and services provided by the Sio-Siteko wetland system include water storage and purification that flows into Lake Victoria; storage and supply of water for domestic and livestock use; source of food (especially fish and fingerlings) and construction materials such as sand, clay and poles; and also supports crops such as yams, arrowroot, sugar cane, potato, maize and millet in addition to water purification from urban areas (Ouma, 2010).

The Sio River catchment and its associated wetlands are a rich fauna and flora repository and provide a habitat for over 206 plants, 29 fish, 25 mammals, eight reptiles and several invertebrate species (Ouma, 2010). The dominant plant species are Cyperus papyrus, C. latifolius and Phragmites mauritianum. Most of the species (72.1%) are herbaceous while shrubs and trees or woody climbers are few (SCWMP, 2009). The wetland is also an Important Bird Area (IBA) as more than 300 bird species including the globally threatened Papyrus Gonolek (Laniarius mufumbiri) and Pallid Harrier (Circus macrourus) have been recorded (Bird Life International, 2008). Commercially valuable fish species in the catchment include Oreochromis niloticus, Lates niloticus, Labeo victorianus and Rastrineobola argentea (SCWMP, 2009). Some of the mammals that commonly occur in the area include the Vervet monkey, Otter, Sitatunga, hippo and water mongoose with the implication that the wetlands have considerable ecotourism potential. This, in turn, can improve local community livelihoods which are currently primarily based on fishing and horticulture (Ouma, 2010).

The Sio-Siteko wetland system is threatened by changes in the hydrological cycle, land use changes, and conflicts over resource use. Canal construction, over-abstraction of water and sand harvesting in the Sio-Siteko wetlands have led to hydrological changes and fluctuations in their water levels. This affects the hydrological characteristics of the wetlands, leading to increasingly impervious surfaces in the catchment and to significant inundation that spans widths of up to three kilometres near its outfall to Lake Victoria, disrupting water supply and adversely affecting crops that are intolerant to waterlogged conditions (GoK, 2009). Increasing human pressure is leading to the intensification of land use and overgrazing, overfishing, sand harvesting, brickmaking and the drainage of the Sio-Siteko wetlands, mostly for agriculture.

The synergistic effect of the above has been, reduced water levels and other resources such as sand and clay, organic matter and grasslands with the latter reducing the amount of nitrogen available in the top and sub-soils (Barasa, 2011). Some of the transboundary initiatives to curb the fore-mentioned challenges have been the formulation of the Sio-Siteko Transboundary Wetland Community Based Management Plan with guidance from Kenyan and Ugandan stakeholders (SCWMP, 2009).

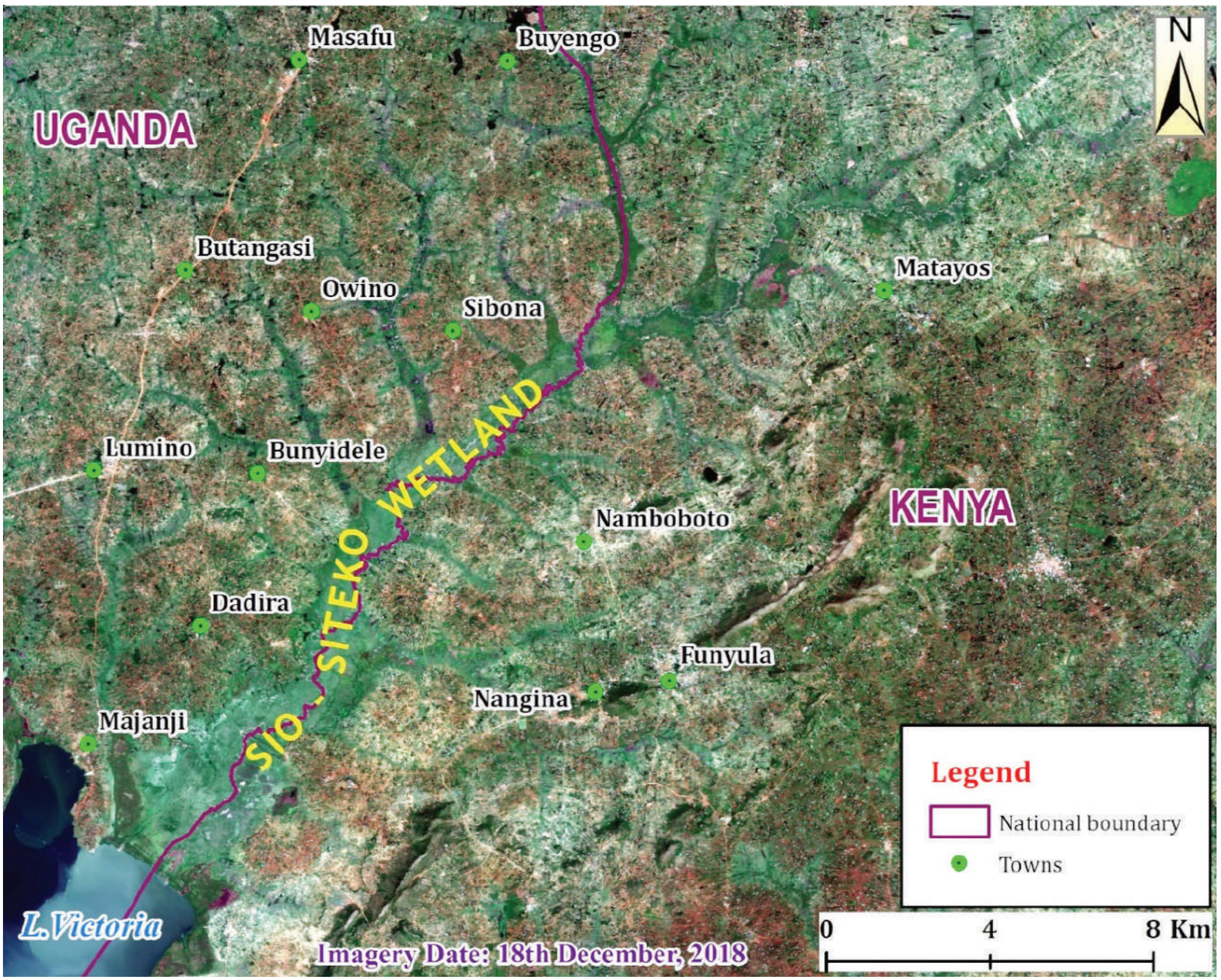


Figure 37: The trans-boundary Sio-siteko wetland system

Sango Bay/ Minziro wetland system (Tanzania and Uganda)

The Kagera wetland system is found along the Uganda-Rwanda-Tanzania border (Figure 38) and is part of the larger Kagera River basin, which extends up to Burundi (NBI, 2008). The wetland consists of many interconnected secondaries and tertiary wetland subsystems that drain into Lake Victoria. Kagera River basin encloses a total area of 59,700km^2 spread over four countries i.e. Burundi (23%), Rwanda (34%), Tanzania (35%) and Uganda (8%) (NBI, 2008). The most important river in the basin and wetland system is River Kagera (400km long) with an annual inflow of 7.5km^3 into Lake Victoria (Berakhi, 2013). Kagera wetland also has an important international feature i.e. Sango bay-musambwa Island – Kagera wetland system (SAMUKA), a Ramsar site in Uganda's Masaka and Rakai districts with total coverage of 551.1km^2.

The vegetation of the Kagera wetland system consists of very tall, dense grasses, dominated by Cyperus spp. among dense stands of Papyrus (NBI, 2008). They are composed of a mosaic of emergent plant communities including (i) homogenous stands forming a floating mat of sedge ***Cyperus papyrus*** (ii) mixed helophyte beds with *Cladium mariscus, Typha capensis and T. domingensis, Miscanthus violceus and Thelypteris totta* (iii) short floating meadows of smaller cyperaceae, notably *Cyperus denudatus and C. pectinatus, Pycerus mundtii,* and *Leersia hexandra and* (iv) communities of rooted, floating leaved and freefloating euhydrophytes including *Nymphaea nouchali, Utricaularia gibbosa and U. inflexa and Pistia stratiodes.*

Swamps are more extensive on the Rwandan side of the Kagera River. In the dry season, swamps are frequently burnt for hunting purposes, rather than to facilitate grazing. Globally threatened species and restricted-range species, such as water turtles, crocodiles, snakes, otters and a large variety of water birds including herons, egrets, ducks, warblers and weavers have been identified in Kagera wetland system. Some 180 bird species have also been identified in the wetland habitats of Rwanda, including 6 European migrants (BirdLife International, 2008).

Kagera wetland system is currently threatened by encroachment for the establishment of settlements and industries, cattle grazing, overexploitation of wetland resources, conflict over resource use, excessive effluents from industries, water hyacinth (Eichornia crassipes) which leads to severe losses of aquatic fauna and flora both in terms of species diversity and populations (Albright, 2004) among others.

Plate 14: Local Cattle trough in Rufuha wetland, Ntungamo district

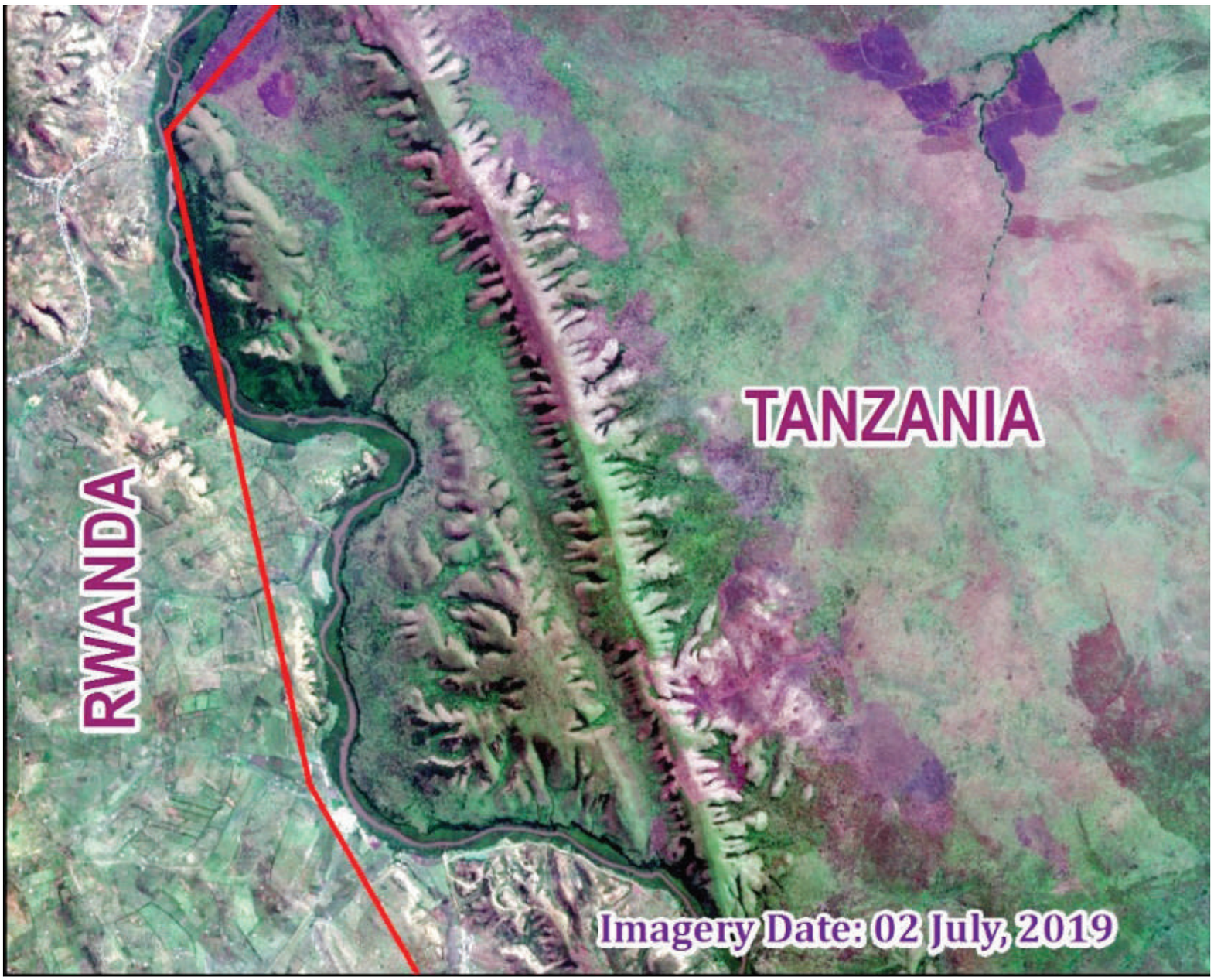


Figure 38: The trans-boundary Kagera Wetland System

Semliki Delta Wetland (DR Congo and Uganda).

Semliki delta wetland system is found at the border of Uganda and the Democratic Republic of Congo (D.R.C) in Lake Albert drainage basin. River Semliki is the main river in this wetland system, originating in Nyamulagira Mountains in the D.R.C and is also fed by precipitation and snow from Rwenzori Mountains, and forms an international border between Uganda and D.R.C (UWA, 2016). This wetland system has a large expanse of permanent wetlands on the floor of the rift valley in Ntoroko district and is dominated by papyrus, phragmites and dense growth of ambatch (UWGMP, 2019) (See Figure 39).

Like other wetlands, ecosystem goods and services provided by Semliki wetland system include water storage and purification that flows into Lake Albert; storage and supply of water for domestic and livestock use; source of food (especially fish) and construction materials such as sand, clay and poles; and also supports crops such as yams, sugarcane, potato, maize and millet in addition to the purification of water from urban areas (UWA, 2016).

The Semliki delta wetland system is currently threatened by cattle grazing, boundary conflict between Uganda and D.R.C due to changing course of River Semliki, wetland encroachment for settlement and farming due to population increase in the area, overexploitation of wetland resources among others (UWGMP, 2019). Demarcating a zone of non-utilization along the Semliki riverbanks should be done to allow vegetation to regenerate to stabilize the riverbanks and control erosion.

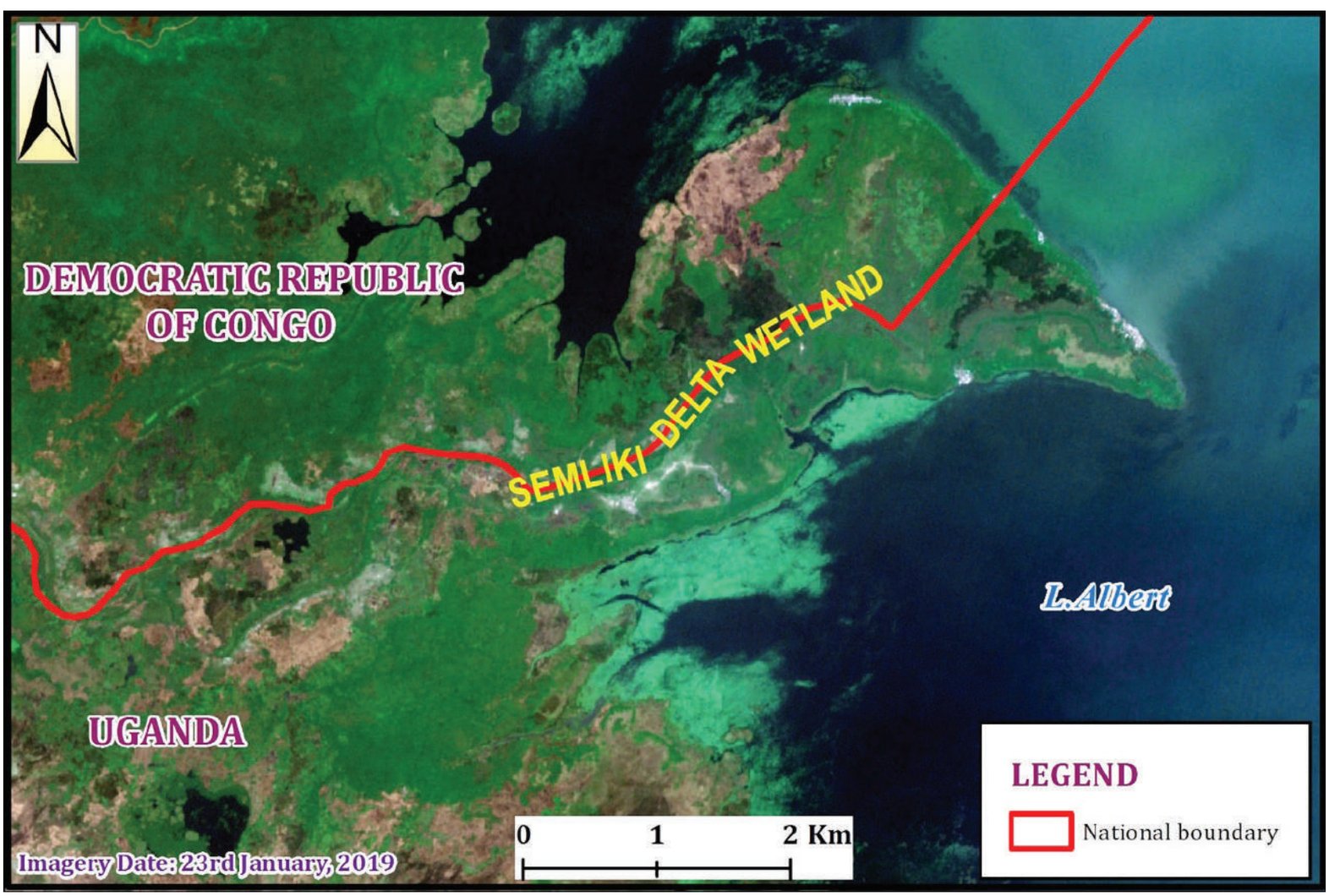


Figure 39: Semliki delta wetland system

Chapter Three: Drivers of Wetland Changes

3.1 Introduction

This chapter presents the drivers that cause changes in wetland ecosystems. Understanding factors that cause changes in ecosystems and ecosystem services are essential to designing interventions that capture positive impacts and minimize negative ones (Leemans & De Groot, 2003). A driver is any factor that causes a change in the aspect of an ecosystem. Direct drivers (pressures) refer to natural or human-induced causes of biophysical changes at a local to regional scale, while indirect drivers have a broader, diffuse effect, mostly by influencing direct drivers and often relate to institutional, socio-economic, demographic and cultural processes (Ramsar Convention on Wetlands, 2018).

The drivers can cause both positive and negative effects. This report focused on the drivers of wetland degradation that yielded negative impacts on the morphology and functioning of wetlands in Uganda. These drivers were further categorised as physical/ structural, extraction and introduction drivers. Physical drivers were related to inflow quantity, frequency and changes in the ecological morphology of wetlands and their immediate environment. Extraction from wetlands included removal of water, species and soil. Introduction drivers referred to the addition of nutrients, chemicals and solid waste. Institutional drivers were as a result of gaps in coordination by government ministries/departments/ agencies in the management of wetlands. These are hereby discussed below:

Plate 15: Buildings constructed in wetland in Wakiso District

3.2 Direct and indirect drivers of wetland changes

3.2.1 Physical and structural drivers

Construction of electricity and valley dams: The most susceptible wetlands to valley dam constructions are found in Nakasongola and Buliisa districts because they could sustain runoff up to the dry periods (Byenkya et al., 2014). Riverine wetlands are also prone to the construction of ongoing hydroelectric power projects. For example, the Karuma dam was designed initially to generate 200 MW but was redesigned to produce between 500 and 600 MW of electricity according to the Energy Policy for Uganda (Mark, 2012); consequently resulting in siltation/sedimentation and aquatic weed encroachment in the reservoir (Nsubuga et al., 2014).

Soil erosion: Wetland cultivation practices are considered a key factor in promoting soil mobilization and surface runoff, related indirect effects of soil loss (Navas et al., 2014). Wetlands are susceptible to soil erosion effects because of their locations in valleys, and destruction of protective vegetation in the buffer zones. Soil erosion effects result in loss of soil fertility, water quality problem, and elevated riverbed (Yoon, 2009). An elevated wetland

bed could cause the elimination of root growth of vegetation and migration of fauna. Therefore, there is a need to consider the effect of upland cover and land management on the wetland.

Excessive water abstraction: Many households in Uganda drew water from wetlands at points designated as springs, wells and dams. Because the wetlands are able to routinely release water throughout the year that enables the households to have access to it. The households use the water to meet their domestic and animal consumption needs. However, wetlands have suffered more from excessive water drainage in the dry periods. Excessive abstraction affects the wetland hydrological regime and use of water in large quantities, for example, the from industrialists and road construction companies.

Burning of wetland vegetation: Wetlands are also burnt and this affects vegetation and fauna abundance and distribution. The growth of human population together with grazing have led to rapid increases in biomass burning in wetlands by the adjacent communities for pasture management and hunting (Odeke, 2019). Examples of areas that have been affected include Opeta/ Bisina/Awoja Namatala/ Manafwa/Doho/Malaba/ Kibimba/ Mpologoma wetlands. This threatened the survival of the Grey-crowned cranes because their habitats were burnt (Mafabi, 2000; Olupot, 2016). Heim et al. (2019) also noted that wildfires affected biodiversity at multiple levels, where vegetation is directly changed by fire events, animals are often indirectly affected through changes in habitat and food availability.

Plate 16: Burning in Ogwette wetland

Plate 17:Industrial development in Nakivubo wetland

Plate 18: Dumping of murram to create roads

Infrastructural developments: Wetlands are also threatened by human intervention in the form of infrastructure developments (Ludwig et al., 2019). Structural developments that are detrimental to wetlands among others included the construction of the airport, road highways, railway line, buildings and factories. Wetlands have seen mega projects constructed in them limiting their functional abilities to filter and store water. These projects included the Kampala-Entebbe Express Highway, the National Water and Sewerage Corporation treatment plant among others.

Factories like Abacus Parenteral Drugs Ltd (APDL), Tian Tang Group, Global Paper, Landy and others still under construction in addition to the Namanve Industrial Park, have unfortunately been erected in what were once wetlands, right from Kampala to Jinja District. Construction in wetlands deprived the marshland of its water storage and filtration roles, killed plants and animals whose only habitats were wetlands.

3.2.2 Extraction drivers

Plate 19: Brick making along Nyamirembe wetland

Sand, clay and gold mining: Mining activities in the wetlands are responsible for the improper functioning of wetlands (Muwanga & Barifaijo, 2006). Sand is often mined and used in manufacturing for example as an abrasive or in concrete (Kusemererwa, 2019). The mining activities around Lake Victoria affected the quality of water and biodiversity in the Lake. In Lwera wetland system, commercial sand mines are recent, and their emergence over the years is wholly attributed to a growing demand for clean sand. Excessive mining affects wetlands through changing of river structures, increment in sedimentation and release of pollutants including mercury. Similarly, Barasa et al (2016) also found out that small-scale gold mining in wetlands in Busia District had a more significant impact on sedimentation of wetlands and streams than rainfall runoff. Mineral extraction also caused death and migration of wetland soil macro-invertebrates in the wetlands around Lake George (Lwanga et al., 2003). Therefore, any type of mining activity demands an environmental and social impact assessment (ESIA) to assess the potential for both positive and negative impacts to the environment and to use the produced results to mitigate the negatives and optimise the positives (Kasimbazi, 2019).

Water extraction from wetlands: Smallholding farming activities and tree nurseries are sustained by extracting water from wetlands for irrigation purposes. Wetlands can store and supply water within their systems throughout the year and therefore this prompted the adjacent communities to establish gardens at the edge of wetlands. For example, the communities that are neighbouring Nakivubo wetland have extracted water and used it to irrigate their cropped vegetables, yams and sugarcane. In response, these activities have caused a return-flow of wastewater into wetlands and changed the structure of floating wetlands (Schneeberger et al., 2019).

Wood, papyrus and grass harvesting: Wetlands are also encroached to harvest art and craft materials, timber and thatch grass. The wetland ecosystems are the only ones where households could frequently harvest papyrus (Cyperus papyrus L.) and thatch grass. Wasswa et al., (2019) observed the in Kampala-Mukono corridor the decrease in palms and thickets by 1986 were attributed to deforestation in search of timber to construction, settlement and brick making. Therefore, excessive extraction of these plant resources from wetlands triggered the occurrences of devastating flash floods that wiped out household lives and property (Kayendeke et al., 2018).

Overfishing or use of illegal fishing methods: Excessive harvesting of fish for feeds, sale and household consumption and application of illegal fishing methods caused profound impacts on the structure and water quality and flow regimes of wetlands in the country. Fishing activities are undertaken by the households as a means of diversifying their sources of income (Tumusiime et al., 2018).

Plate 20: Fishing in Limoto wetland Pallisa District

3.2.3 Introduction of species and pollutants in wetlands

Pollutants (point and non-point): In Uganda, most wastes that are disposed into wetlands are untreated leading to pollution (Walakira & Okot-Okumu, 2011). Naturally, wetlands have the capacities to transform and remove pollutants if they are well conserved such as nitrogen and faecal coliform pollution (Kayima et al., 2019). However, excessive dumping of wastes in the wetland affected their ecological functions. For example, industrial effluents were reported to have reduced the water quality of Namanve stream in Kampala Industrial Park (Wanasolo et al., 2018).

Establishment of washing bays: The establishment of washing bays has also led to the silting and discharge of oils into wetland streams. For example, in Kinawataka wetland in Kampala, washing vehicles has taken place for many years but since the wetland was reclaimed, the water has turned to very black and toxic to human skin. The water is also very smelly. The water has turned toxic and harmful to aquatic life and people.

Plate 21:Oil and waste from washing cars directly into the wetland-Kinawataka wetland

Invasion of non-native water weeds: Invasive species have altered wetland water flow, food webs and keynote fauna in wetlands (Charles & Dukes, 2008). Water hyacinth is recognized as one of the world's worst invasive weeds (Hopper et al., 2019). The wetlands are prone due to changes in water regimes, overharvesting and sedimentation of wetland that facilitated the colonisation by non-native species. Wetlands have been shown to serve as structural and low oxygen (hypoxic) refugia for fish. The non-native species are a threat to abundance and richness of aquatic biota in wetlands (Musinguzi et al., 2016).

Solid waste dumping in wetlands: The wastes have made wetlands inhabitable for aquatic life and micro-organisms. Fish breeding places have been compromised by the sludge build-up and the only living creatures are maggots. The pollution of wetlands was composed of faecal matter and all the rubbish from the cities and towns which are washed into wetlands.

Plate 22: Poor solid waste management

Introduction of excessive nutrients from agriculture or aquaculture: The demand for increased income and agricultural productivity coupled with adverse weather conditions have driven people into wetlands for agricultural activities. Most people prefer cultivating in wetlands because of the high presence of soil moisture that supports crop and pasture growth during both the wet and dry seasons. The activities undertaken in these wetlands include cultivation of crops (rice, maize, sorghum, sugarcanes and vegetables etc), fish farming and rearing of livestock (cattle, sheep, goats etc). It must be noted that seasonal wetlands are more at risk of human conversion to agriculture. Additionally, rice growing is often associated with the use of pesticides and chemicals that in contact with biodiversity they kill or foster them to migrate.

Furthermore, fishponds could alter water quality variables in wetlands and cause flooding due to application of feeds and poor management options. This is still a challenge today due to insufficient sensitisation programmes for communities on wise use of wetlands. The productivity of wetlands to support food production is steadily lowering. Tumusiime et al (2018) also noted that most farmers in the Lake Kyoga basin resorted to using wetlands for crop farming due to declined fertility of the upland agricultural areas.

Plate 23: Commercial sugar cane growing in Lumbuye wetland, Kaliro district

3.2.4 Institutional drivers

Unclear land tenure: Conflicting land tenure systems also exposed wetlands to further destructions. Wetlands are perceived by the communities to be common property and so they think they have full rights to exploit them for their selfish interests. For example, Qawwali swamp, behind Kajjansi trading centre, on Entebbe Road, was part of Lumpewo wetland system however due to unclear tenures, it has been encroached on. Secondly, some wetlands lack demarcation boundaries to separate between the wetlands and land suitable for settlement or farming. Hence, encroachments based on unclear land tenure are responsible for the dumping of laterite soils in the wetland that changed watercourses in wetlands, death of standing biomass and reductions of wetland extents.

Political interventions/interferences: Government's main weakness in environmental governance is the lack of consistency in the implementation of policies and enforcement of laws. In 2015, the Environmental Protection Police Unit (EPPU) evicted encroachers in Butabika wetland, but because of political influence, the police officers who took part in the eviction were suspended. The politicians and leaders can influence and direct on the implementation of wetland laws because they are always compromised to protect their votes.

Unplanned urbanization and settlements: Insufficient monitoring mechanisms of wetlands, uncoordinated physical planning and illegal settlements poses a serious threat to the survival of wetlands. People get engaged in illegal settlements because of land fragmentation and unclear boundaries of wetlands among others. These have led to the destruction of wetland vegetation, draining of water and change of wetland morphology to create space for building. Examples of such affected places in Kampala include Bwaise, Kalerwe, Kasokoso and Nateete. These settlements have also become harbingers of environmental diseases such as cholera, malaria, dysentery and typhoid that have downplayed the health of people resulting from flooding. If these activities do not come to a complete stop, most of the urban wetlands will be wiped away soon.

Limited awareness and poor knowledge base about wetlands: Ignorance among the communities about the importance and conservation of wetlands poses a serious threat to the management of wetlands in the country. This has continued to exist because of limited campaigns undertaken towards creating awareness.

Plate 24: Flooding in Kinawataka wetland Kampala

3.2.5 Demographic pressure

Population increase: The population of Uganda has increased from 4.8 million in 1948 to approximately 35 million in 2014 and is likely to reach 130 million by 2050 (UBOS, 2014). At 3.2%, Uganda's population growth rate is one of the highest in the world. Factors such as poverty, illiteracy, migrants from DR Congo, Rwanda, South Sudan and culture among others have triggered this increase. This has amplified wetland infringement by people (for settlement and farming) and industrialists with the desire to derive livelihood. Within the communities, the establishments of farming activities are associated with cutting down of wetland vegetation, construction of drainage channels and tampering with the soil structure that is disastrous to wetlands. Nevertheless, this pattern has continued due to weak enforcement measures taken and inadequate funding of natural resources departments.

A multiple linear regression was performed to assess the influence of demographic characteristics on wetland degradation. Population census database of 2014 and wetland degradation data of 2015 was used to determine this relationship. This finding reveals that fuelwood harvesting, illiterate and literate but ignorant population are the major drivers of wetland degradation in Uganda (Table 18). Increase in population does not directly threaten wetlands but the unsustainable activities that the people are engaged in. Nelson et al., (2017) also argues that in Uganda despite the awareness of wetland policy and regulations amongst the educated and higher-income earners, wetlands are more degraded among the rich and educated in urban and peri-urban areas. This could be attributed to (i) industrial expansion in Uganda that targets wetlands in urban areas; (ii) a situation of having many urban poor who depend on subsistence farming especially in the Lake Victoria Crescent agro-ecological zone comprising wetlands adjacent Kampala-the capital city of Uganda and nearby towns of Wakiso, Entebbe and Mukono and Jinja (formerly, an industrial city). This finding is relevant to policymakers to find solutions for conserving energy but also reducing taxes on efficient sources of energy so that they are affordable.

Table 18: Socio-economic drivers of wetland degradation in Uganda

Demographics	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		Std. Error	Beta		
(Constant)	139.92	33.54		4.17	0.00
Subsistence Farming	0.00	0.00	-0.03	-0.11	0.91
Illiterate	0.01	0.01	1.42	2.12	0.04**
Literate but ignorant population	-0.01	0.01	-1.41	-1.84	0.05**
Total Households	0.00	0.00	0.10	0.80	0.43
Thatch Houses	0.00	0.00	-0.10	-0.84	0.40
Water harvesting in wetland wells/springs	0.00	0.00	0.01	0.05	0.96
Fuelwood harvesting	-0.01	0.00	-0.32	-2.55	0.01**

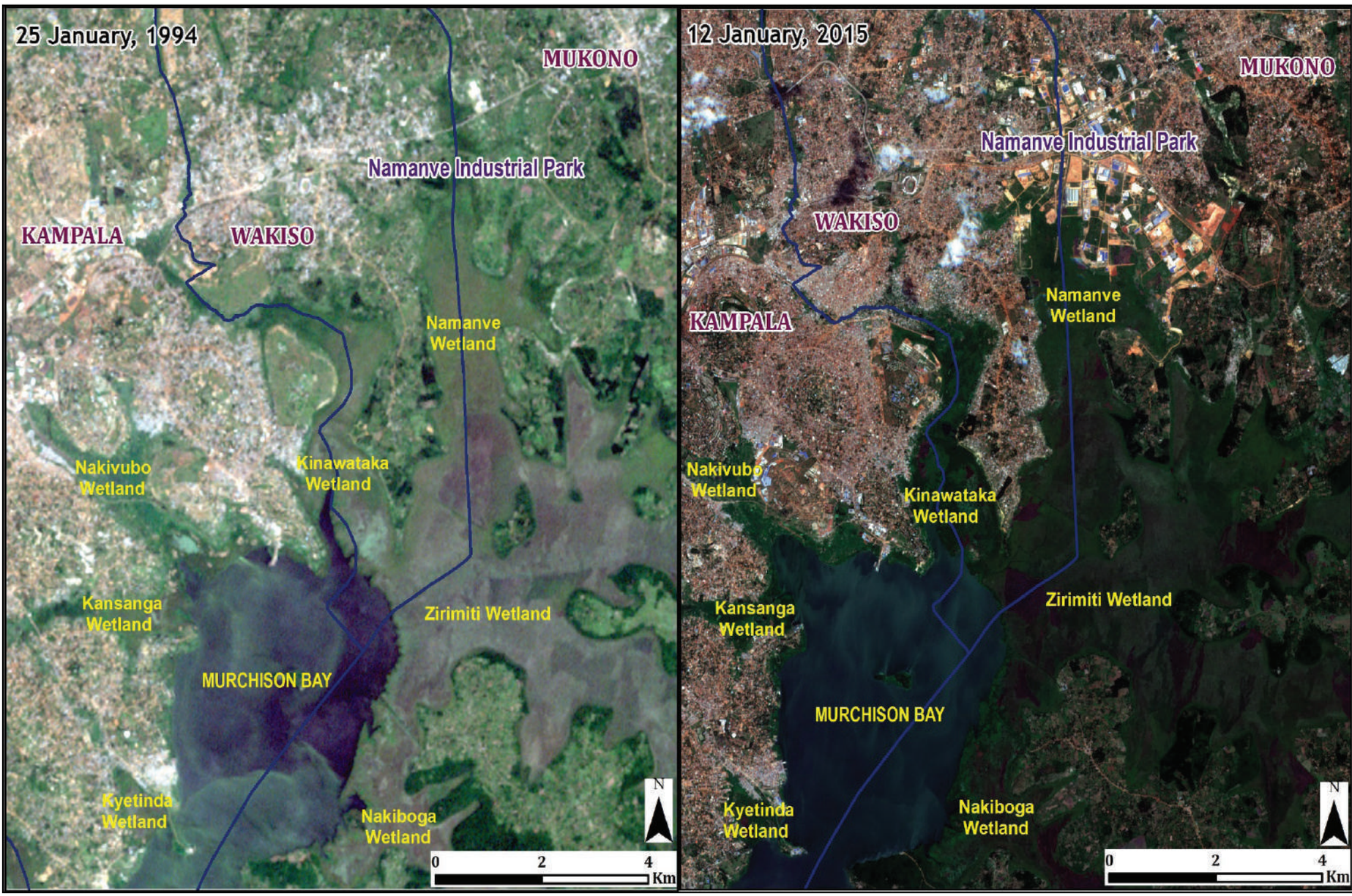


Figure 40: Encroachment on wetlands around Murchison bay between 1994 and 2015

Chapter Four: Impacts of Wetland Degradation

4.1 Introduction

The drivers of wetland degradation transcend to many impacts. These can be categorised as biodiversity impacts, hydrological, land-based impacts, air-related and provisioning impacts. Chapter 4 presents the impacts that were pronounced as a result of wetland degradation in the country.

4.2 Impacts on Ecosystem Services

4.2.1 Biodiversity impacts

- Decline of biodiversity status

  Wetland degradation affects aquatic life such as micro-organisms which are food for mudfish. However, with the current rate of wetland degradation, mudfish might be no more in about five years and this would deprive thousands in the country off lucrative economic activity. Competing anthropogenic activities could be the ones to blame for this negative trend. In the study of wetlands around Lake Victoria Basin in Uganda, Naigaga et al. (2011) discovered that gradual anthropogenic changes due to the urbanization increased discharges of sewage, industrial and municipal wastewater into the environment that resulted into eutrophication which exerted its influence on water, nutrient levels, oxygen levels and electrical conductivity that consequently affected fish diversity. In western Uganda, if the current human-induced siltation of Lake Nakivale is not checked, residents are likely to lose fisheries resources worth above Ug. Shs 1 billion (US $ 400,000) per annum (Adonia, 2013).

  Similarly, Kansiime et al. (2003) further noted that in Nakivubo wetland system, on average papyrus vegetation under the influence of wastewater had higher nutrient content in the above-ground biomass (1.6% N and 0.23% P on a dry weight basis) than those not affected (0.98% N and 0.18% P). For example, harvesting 10, 20 and 30% of the papyrus biomass per year in a lacustrine papyrus dominated wetland could increase nitrogen retention capacity of the wetland to 32.3, 36.8 and 38.1 g m–2 year–1, respectively (Van Dam et al., 2007). Although wetland disturbances were observed to affect biodiversity, Ndawula et al. (2011) found out that papyrus-dwelling passerines, except papyrus gonolek, were tolerant to low intensities of distance in Rushebeya-Kanyabaha wetland in Uganda.

Plate 25: Yam cultivation in Nyamirembe wetland in Bushenyi District.

- Human-wildlife conflicts

  The drivers of wetland degradation are also responsible for the rise in the human-wildlife conflicts in the areas with sizeable and highly encroached wetlands. The conflicts were as a result of the search for food by the animals on the upland areas and in the process, they destroyed household's crops in the gardens especially maize and bananas and thus causing confrontations. For example, around Lake Kacheera in Isingiro district, all waterlogged areas that dry up ignite human-wildlife

conflicts. Most of the wild pigs and hippopotamuses that were displaced from their habitats return to terrorise neighbouring villages and people lose lives and property in the occurrences of events.

4.2.2 Hydrological impacts

- Increased costs of treating sewage and wastewater

  The National Water and Sewerage Corporation (NWSC) spends more than it would normally on the treatment of sewage and wastewater before it enters Lake Victoria. McConville et al. (2019) reported that the overall sewage regime operating budget is estimated to be 94% of the total NWSC sanitation operating budget. Wetland degradation is the main cause of these increments in the operational costs because the wetland could no longer filter the wastewater appropriately. As a consequence, the NWSC customers have to meet the brunt of increased costs. The sanitation fees paid by each customer type connected to the system (households, industries, commercial entities, and institutions) are estimated from NWSC annual revenues. Also, the costs meant to restore degraded wetlands have also increased.

- Pollution of water bodies

  The water bodies have been polluted since there are few wetlands to filter the wastewater. This is because organic matter including sewage and solid waste keeps on feeding algae (tiny aquatic plants) which manifests in green colour. As a result of pollution, some places like Murchison Bay on the northern part of Lake Victoria has turned green. According to the Uganda Wetlands Atlas (2016), the contamination of water resources is partly caused by the reduced buffering capacity of wetlands near open water bodies, and this has costed the country about sh38b annually in the past couple of decades. Elsewhere, in Namatala wetland systems, Namaalwa et al. (2013) discovered that pollution and encroachment due to agriculture, and pollution originating from the urban catchment of Mbale presented a rapidly growing pressure on the water quality regulation function of Namatala wetland.

Case study: Water quality in selected wetlands in Kampala, Wakiso and Mukono. For all the wetlands studied in Kampala, Wakiso and Mukono by UNDP (2015), Dissolved Oxygen (DO) was below the World Health Organisation critical value for drinking water for both the inlets and the outlets. It ranged from 3.21 mg/L (Kinawataka) to 8.2 mg/L (Sezibwa). Biochemical Oxygen Demand ($BOD_{5)}$ varied from 0 mg/L (Kinawataka) to 5.6 mg/L (Kato) and Chemical Oxygen Demand (COD) varied from 18 mg/L (Mayanja Wasswa) and 42.35 mg/L (Kansanga). For the Outlet, DO varied from 1.9 mg/L (Kinawataka) and 8.35 mg/L (Sezibwa). BOD5 varied between 0 mg/L (Kansanga and Kinawataka) and 8.8 mg/L (Mbalala). Generally, the inlets had relatively higher DO, BOD_5 and COD values than those of the outlet, except Kansanga, Kyabazala, Namanve, and Sezibwa (see table 19).

The difference in BOD5, DO and COD between Kampala wetlands and those in Wakiso and Mukono is linked to the level of encroachment of the wetlands, the type of vegetation in the wetlands, land cover, topography and human activities contributing to the pollution loads into the wetlands.

Table 19: Water quality at the inlets and outlets of selected wetlands in the study area

Wetland	DO (mg/L)		BOD5 (mg/L)		COD (mg/L)	
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Kajansi	4.75	4.89	2.50	3.26	31.95	30.15
Kansanga	3.90	2.05	0.19	0.00	42.35	42.50
Mayanja Kato	7.60	6.40	5.60	3.20	19.60	29.20
Kinawataka	3.21	1.90	0.00	0.00	44.00	41.50
Kyabazala	5.40	5.40	3.60	3.20	27.60	29.20
Lubigi	4.00	1.85	1.08	1.725	38.50	29.55
Lutembe	5.00	2.05	1.15	1.70	38.15	32.55
Nalukolon-go	3.85	2.80	0.45	0.80	40.90	38.80
Namanve	4.40	2.40	2.40	1.00	32.40	38.00
Seeta	11.00	11.00	3.40	8.80	28.40	11.20
Sezibwa	8.20	8.35	6.00	5.40	18.00	21.10
Mayanja Wasswa	4.40	12.00	1.00	8.20	38.00	24.80

Source: UNDP, 2015

Plate 26: Water pollution in Lubigi wetland, Bwaise Kampala

Plate 27: Flooding and displacement of people in Wakiso District

- Increased/Reduced water levels in lakes

Just like other lakes in Uganda. Currently, water is flowing on the land surface, looking for its path into Lake Victoria, and in the process, it carries soil into the lake because the areas were cleared of wetland vegetation. This has increased siltation into the lakes resulting in inundation that has had greatly impacted on the biodiversity and households surrounding the water bodies. On the other hand, the wetlands are also no longer able to retain and regulate water whenever it is required by the lakes. In the long run, these have negatively impacted the economic activities on the lakes such as fishing, transport and tourism among others. The effects of poor land use practices have also already been exhibited in the form of receding Lake Nakivale and associated water levels and scarcity of essential wetland resources (Adonia, 2013).

- Limited access to water sources

Whenever wetland resources are destroyed, water dries up, then women and children in rural areas trek for long miles to access clean water. Siltation is one of the major factors causing dwindling water levels in wetlands and rivers. Serious cases of siltation have been observed in Kichwamba sub-county, where the communities have cultivated food crops on the Mpanga river banks causing silting of the river. If water sources dry out in wetlands, it means the crops adjacent these ecosystems would not be irrigated.

4.2.3 Land-based impacts

- Open pits from mining activities

The open pits resulting from sand mining are habitats for disease-carrying vectors, such as mosquitoes (Kusemererwa, 2019). They are also habitats for invasive aquatic plants like the water hyacinth and Kariba weed. The pits bring out water stagnation that favours the breeding of vectors. Additionally, Omara et al. (2019) in their study of artisanal gold mining in Busia district reported that the impacts from erosion, including sedimentation and siltation that are evident in Namukombe stream. Siltation is a hindrance to allowing light penetration into water bodies, causing reduced photosynthetic activity in aquatic organisms as well as increased biochemical oxygen demand, clogging of fish gills thus the death of aquatic organisms.

- Soil cracking

The wetlands in Uganda also suffer from the impacts of fire burning. Most burning incidences could be attributed to land clearing for cultivation, hunting and grazing. Fires have destroyed wetland biomass and heat the soil structure which later opens up with wide cracks allowing ash to enter causing further burning. This could lead to the death of below-ground biodiversity and migration of surface biodiversity, and also exposure of the soil to direct sunlight resulting in further cracks and decline of ecosystem functions.

Plate 28: Burnt soil structure of wetland in Ogwette wetland system Otuke District

The occurrences of wetland fires in the different wetlands of Uganda were assessed using Fire Information for Resource Management System (FIRMS), NASA of 2019. The findings showed that Kidepo drainage basin was the most prone basin to fires with a mean fire radiative power (FRP) of 12.8 followed by Albert Nile, Lake Kyoga and Aswa, while Victoria Nile and Lake Edward drainage basins had the least number of fire incidences and severity. Figure 41 below shows the distribution of fires in the wetlands of Uganda.

Figure 41: Fires prone wetland areas in Uganda

4.2.4 Air related impacts

- Climate variability

Wetlands are also fragile ecosystems which are directly and indirectly affected by climate and variability. The impacts such as floods, prolonged droughts and increasing temperatures worsen the impacts on wetlands from illegal conversion through human activities including agriculture, unregulated urbanisation, illegal sand mining, and indiscriminate waste disposal. Water regimes in wetlands are highly sensitive to the effects of climate change. The effects of climate variability in wetlands could be seen on swampy plants and vegetation, water and soils through created hard swamp beds and reducing water levels (Baker et al., 2019). However, despite the degradation of Kashambya wetland by anthropogenic influences, Langan et al. (2019) maintained that it remained a large store of water (7.0 ± 1.3 m^3) and carbon (0.5 ± 0.04 M t). Secondly, owing to the perception of more frequent and severe droughts, households around wetlands could continue to use wetlands for farming and other livelihood needs (Yiiki et al., 2016).

4.2.3 Provisioning related impacts

- Overharvesting of wetland biomass

The dominant vegetation in Uganda's wetlands include papyrus (Cyperus papyrus), Typha, Miscanthidium, Phragmites and palm trees (Phoenix species). Papyrus is the dominant vegetation in most of Uganda's permanent wetlands (Kayendeke, 2018). They occur along shorelines of Lakes Victoria and Albert; in valley swamps and rivers of central and western Uganda. But, the vegetation of many wetlands has been harvested to be used for thatching, crafts and mulching. For instance, in Iganga district, communities around Naigombowa and Lumbuye wetlands have harvested papyrus for roofing because of its long-life span than thatch grass. This thus has tremendously reduced the scale of papyrus density in both wetlands.

Furthermore, the reductions in the pasture quality and quantity in the wetlands found in western Uganda especially around Lake Nakivali could be attributed to overgrazing by the households. Adonia (2013) observed that in Lake Nakivali, based on the average market price of animal feeds of Shs 1,600 per kilo, residents were likely to lose Ug. Shs 3,128,868,000 (US $ 1,251,547) per annum if the current poor land use practices were not checked and the remaining grazing area converted to crop fields.

Chapter Five: Wetland Interventions

5.1 Introduction

In response to the growing threats to the wetlands arising from natural and manmade activities, chapter 5 presents the wetland conservation initiatives that meet to counteract the mapped drivers of wetland degradation in Uganda by the government and other stakeholders. The proposed interventions aim to ensure the sustainable management of wetland resources and optimize the socioeconomic and ecological benefits to local, national and international communities. The chapter also highlights the challenges and emerging issues identified while undertaking wetland interventions in the country.

5.2 Responses

5.2.1 Review of National Wetland Policy and formulation wetland specific law

To halt the swiftness at which wetlands are being degraded, there is an urgent need to expedite the processes of reviewing the National Wetland Policy of 1994 to ensure wise use of wetlands. In addition, a formulation of a wetland specific law (National Wetlands Management Bill) is highly prudent for the country. This is because the current laws and policies are not enforced effectively (Rwakakamba, 2009). Therefore, the review and this policy should strengthen the enforcement processes and also reduce the rates at which the wetlands are degraded. However, the implementation of these policies shall depend on the thorough review of existing environment legislations, concise documentation, wider public stakeholder consultations and popularisation amongst the different decision-makers in the country. It is worthy to note that the MWD established a functional Wetlands Management Advisory Group comprising of major stakeholders which meets periodically to discuss wetland management issues including harmonization of policy, strategies and activities.

5.2.2 Wetland restoration programs

Cultivation in most wetlands in the country is now an unsustainable livelihood strategy because of the increasing demand for restoration (Kabumbuli & Kiwazi, 2009). Despite the importance of wetlands to support the lives of many Ugandans, many stakeholders have come on board to restore degraded wetlands, nonetheless, the Wetland Management Department should be on the forefront. This is partly because the Department developed a Restoration Strategy to guide in the ecological restoration of wetlands where the rate of degradation is 70 times the restoration rate. For example, the Ministry of Water and Environment together with local governments have intensified the restoration of wetlands in the country. With support from Government and key development partners such as UNDP and with funding from the Green Climate Fund, intensive restoration activities are being undertaken in selected districts in Eastern and Western Uganda.

In the FY 2018/19, a total of 270 hectares of the critical wetlands were restored by the Wetlands Management Department. Wetlands with the highest acreage restored included Orapada, Mpologoma, Pece and Okole followed by Agu-Kyere. A total of 79 hectares of Limoto wetland system was restored and about 300 people were evacuated from the wetlands. Overall, to reverse the negative trend of wetland degradation, the WMD plans to restore 8,613.2 sqkm of degraded sections from the current 2592.3 sqkm aimed at increasing wetland coverage from the present 8.4% to 12% by the year 2030. Similarly, the National Environment Management Authority (NEMA) also restored degraded wetlands in critical shoreline wetlands of Lakes Victoria, Kyoga; Kachera and Nakivale. In FY 2018/19, NEMA began initial restoration activities in the upper catchment of Kafu, particularly focusing on the wetlands and riverine systems in the upper part of the catchment, in the districts of Kyankwanzi, Kiboga, Kakumiro and Hoima.

Therefore, for the intensification of restoration interventions, there is need to timely integrate these activities in many plans (e.g. strategic plans, sector plans, district development plans) and budgeted for based on the assessments conducted of wetlands that are in dare need to be restored. However, the success of these interventions will depend on stakeholder participation, community sensitisation, acquisition of appropriate restoration materials and monitoring of implemented activities. But the big question remains, whether these wetlands too will restore ecosystem services.

Plate 29: Before and after restoring Lubigi wetland in Busega

5.2.4 Designation of wetlands as Ramsar Sites

Over the past decade, the wetlands in Uganda have been increasingly being threatened by communities in urban and rural areas. The final score of wetland encroachment is degradation of critical biodiversity and wetland reclamation. Therefore, to curb these threats, the Wetland Management Department (WMD) advocated for the designation of wetlands as Ramsar sites. Recognising wetlands as of international importance has quickly chased away encroachers in these ecosystems.

Plate 30: Restoration of Rufuha wetland in Ntungamo district

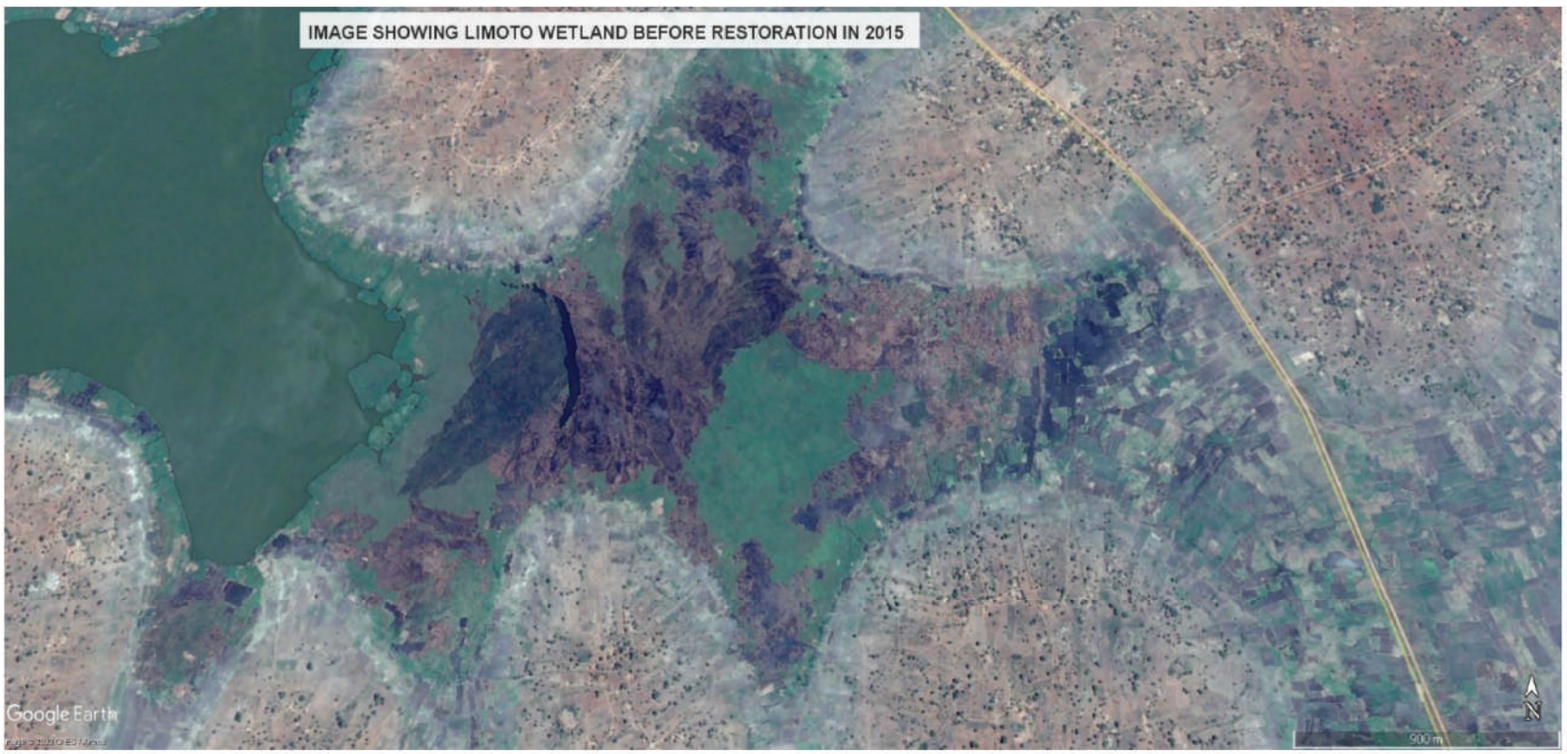


Figure 42: Limoto Wetland before restoration 2015 (source: Google Earth)

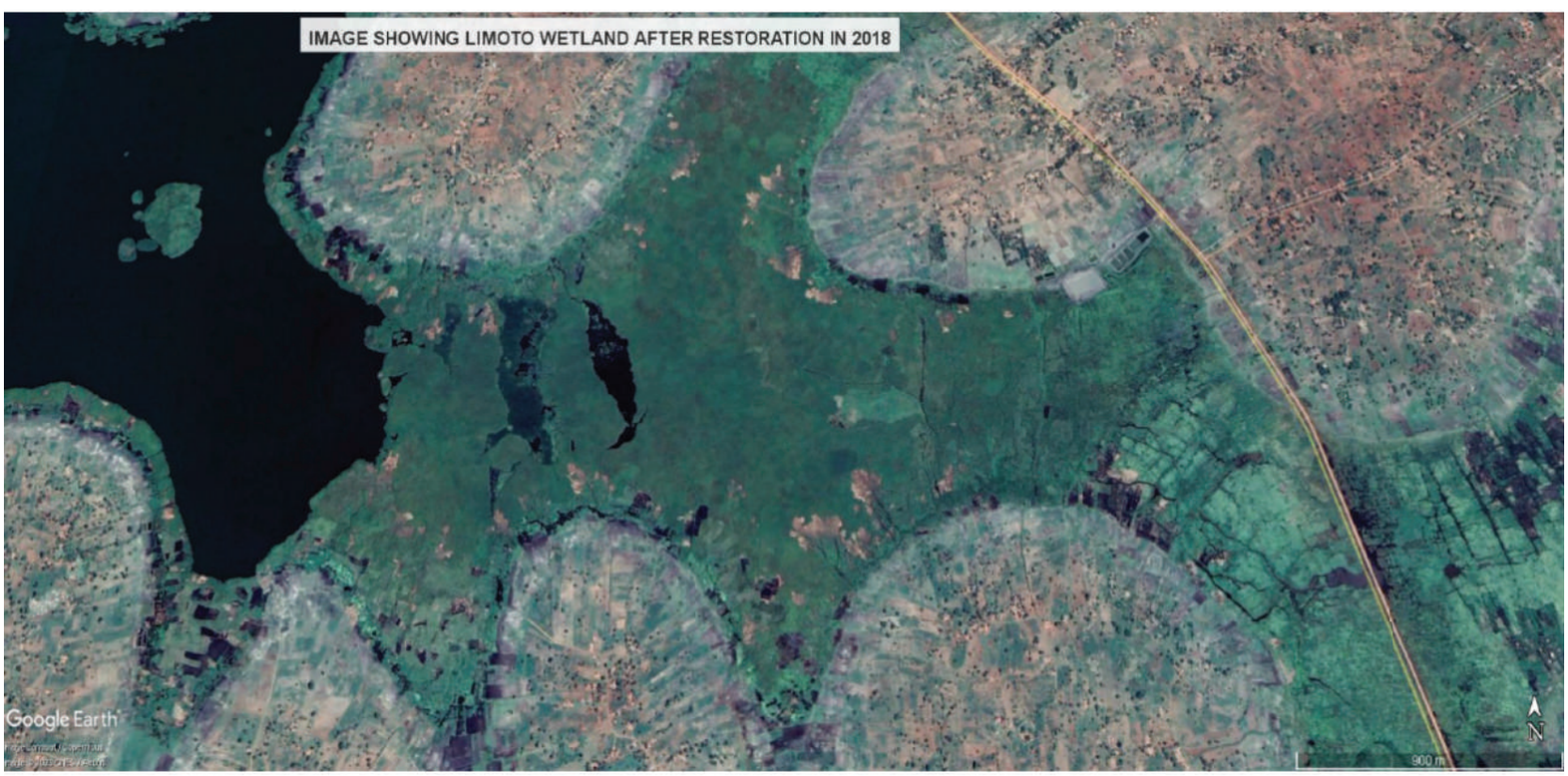


Figure 43: Limoto wetland after restoration 2018 (source: Google Earth)

5.2.4 Demarcation of wetlands

Defining the boundaries of wetlands can help to curb encroachment. For a comprehensive demarcation of wetlands in Uganda, this activity should be budgeted for with substantial funds, communities need to be sensitised and wetlands demarcated using concrete pillars. This activity must be implemented by the local communities for ownership. This activity is highly supported by the Wetlands Management Department through the developed wetland demarcation strategy.

In 2018/19 FY, the Wetlands Management Department demarcated a total distance of 148 km representing over 50% of the planned target of 330 km in 2018/19. Examples of demarcated wetlands included Kokong and Agero in Ngora district, Nabigaga in Buyende town council, Owei in Amuru and Nawaibete in Namutumba District. While in the in FY 2017/18, the wetlands that were demarcated included Orisindura I in Sheema, Limoto in Pallisa/Kibuku, Aminkwac in Dokolo, Ayi in Maracha, Ssezibwa in Nakasongola, Lumansi-Lugogo in Luwero, Nabitende in Buyende/Kamuli and Nyamirembe in Bushenyi district.

In the same line, some districts managed to demarcate wetlands in the 2018/2019 FY, for example, 7kms were demarcated in Omukagyegye wetland in Rubirizi district, 2kms were demarcated in Oraa riverbank in Pakwach district, 49kms were demarcated in Kokong and Agero wetlands in Ngora district, 2kms were demarcated in Tochi wetland in Oyam district, 12kms were demarcated in Nawaibete wetland in Namutumba district, 6kms were demarcated in Nkuyazu wetland in Kakumiro district, 2kms were demarcated in Ruzaire wetland in Kagadi district, 47kms were demarcated in Nabigaga wetland in Buyende district, 17kms were demarcated in Owei wetland in Amuru district, and 4kms were demarcated in the lake shores of Kyoga in Amolatar district. Refer to Annex 2 for demarcated wetlands in central Uganda

To add on, the International Union for Conservation of Nature supported communities to demarcate 68km of river banks and 10 hectares of wetlands in Mutu parish (Agago district) and Akileng parish (Amuria district). The efforts were aimed at restoring the functionality of the river banks and wetlands to be able to provide ecosystem goods and services to the communities (Water and Environment Sector Performance Report, 2018/19).

Plate 31: Wetland demarcation a) Wetland pillars used to demarcate wetlands, b) installed pillar at a wetland boundary, c) Setting controls before actual surveying and demarcation of wetlands

5.2.5 Development of wetlands community and framework Management Plans

To ensure that the wise use concept is integrated into wetland access and use, the Wetlands Management Department has been able to develop wetland management plans. For FY 2018/19 two management plans were developed including Lubigi located in Kampala and Wakiso and Kibimba wetlands in Gomba District. The strength of this activity is that it points out the priority activities that should be immediately implemented to restore the wetlands in short, medium and long-term. The development of wetland management plans is meant to regulate the users, indicate the seasons, and the amount of natural resource that can be extracted.

Plate 32: Update of the Lutembe Bay Wetland Ramsar site management plan

Additionally, several frameworks have been developed that in the long run will lead to the conservation of wetlands such as the development of a Management Framework for faecal Sludge Service chain in 2019. Similarly, all water sources and catchment protection activities were implemented in conjunction with the Water Management Zone (WMZ) teams.

Box 1: Developed Wetland Management Plans Financial year 2019/20

Wetland Management Plans developed

- Developed Ntungwa-Nyabushoro wetland Management Plan with the management structure in Nyamirama sub-county Kanungu district covering 1,000 hectares of wetlands.
- Developed Kyenjogera wetland management plan and the implementation structures in Buhweju district covering 500ha to ensure regulation and the maintenance of the wetland.
- Developed management plan for Limoto wetland covering 1,025ha
- Developed management plan Mpologoma wetland in Mazuba sub-county in Namutumba district covering over 400ha of wetland section.
- Developed community wetland management plan for Ongino wetland in Kumi with management structure covering
- *Total area under approved wetland management plans is 2,925ha in FY 2019-20*

5.2.6 Improvement in coordination, supervision and technical support to local governments

The Wetlands Management Department has been able to coordinate, supervise and backstop district Local Governments to ensure compliance with existing environmental regulations and standards. In the FY 2018/19, the department provided technical supervision and monitoring to 127 District Local Governments representing 100% achievement. With this success, the department envisages that this will have a multiplier effect in ensuring that some degraded wetlands are stored and also ensure compliance of wetland laws by all the citizens.

In collaboration with the MWE, CSOs, with funding from the Adaptation Fund, are participating in the development of management plans for wetlands in the catchments of Aswa, Kyoga,

and Maziba under the 'Enhancing Resilience of Communities to Climate Change through Catchment Based Integrated management of Water and Related Resources in Uganda (EURECCCA) Project'. Wetland restoration activities have been conducted in Ogwette wetland system in Otuke District and Karenga wetland in Karenga district.

5.2.7 Integration of Environment Protection Police (EPPU) in environment management

The Government of Uganda has put in place a special force to address issues of the rampant degradation of the environment. The EPF has continued to support environmental management across the country through monitoring activities, community policing, enforcement of restorations orders, violations of EIA conditions of approval and regulation of environmentally violating activities. During FY 2018/19, 182 cases (13.6%) of halting illegal environmental activities were registered by the force, implying that there are high levels of encroachment in the country. However, out of the reported cases, about 148 cases were recorded out of which, 24 cases were prosecuted, 49 cases were subjected to further inquiry and 75 were put away due to lack of evidence to support prosecution.

Plate 33: Community involvement in restoration of their wetland- Kinawataka wetland system

Plate 34: Wetland restoration in Rufuha, Ntungamo. Photo credit: Asadhu Ssebyoto

5.2.8 Public awareness and sensitisation

One of the avenues of raising wetland awareness is the frequent commemoration of the World Wetlands Day as per the Ramsar convention. The other initiatives undertaken by the Wetland Management Department and other stakeholders include holding of sensitisation meetings, radio and Television talk shows, publications in the print media and establishment of demonstration visits etc. The Wetland Management Department develops and disseminates fact sheets to educate the population on the importance and the impact of degrading wetlands. In the FY 2019/20, the department developed and disseminated over 285 wetland maps to guide developers on the environmental aspects of their plots before undertaking development activities. However, what is hindering the implementation of sensitisation campaigns is the insufficient availability of funds to conduct awareness operations in the country. Nonetheless, a sizeable number of community groups have been sensitized and are aware of the wise use of wetlands.

Plate 35: Community sensitisation on wetland restoration

5.2.9 Improve international cooperation to restore transboundary wetlands

Towards, the conservation of wetlands too, the Government fulfilled part of its obligations to supporting international organisations by paying USD175,804.49 towards Nile Basin Initiative operations and maintaining of the institution's personnel, equipment and governance meetings. Some of the operations included developing catchment management plans. The government also supervised and coordinated the development of the Wetlands Management and Conservation Investment Plans of the trans-boundary wetlands of; Sio -Siteko (Kenya and Uganda), Sango Bay/ Minziro (Tanzania and Uganda) and Semliki Delta Wetland (DR Congo and Uganda).

In improving the management of transboundary wetlands, the Ugandan government has helped in the building of the national capacities for the coordination of the trans-boundary water resources activities.

5.2.10 Provision of alternative livelihood options

In Limoto wetland, about 40 hectares have been restored and evidence of immediate improvements in both water quality and quantity throughout the year are immediately observable. Wetlands species have already begun the process of recolonizing the once degraded area. The water detention facility (valley tank) in Limoto has been able to harness some of the additional water which has become available. In turn, this water has been used for irrigating vegetables and watering animals as alternative sources of livelihoods. A total of five community fish ponds at the edge of Limoto wetland have been constructed to support the livelihood of communities. In total, 100 households benefitted from this intervention targeting 50 % women and men house heads (Water and Environment Sector Performance Report, 2019).

In addition, the ministry is piloting a project in 10 districts whereby it will provide solar-powered irrigation pumps to communities adjacent to the wetlands. These pumps will help them pump water upstream to irrigate their fields and gardens instead of going into the wetlands and draining them for rice, tea, and sugarcane plantations.

Plate 36: Apiary as an alternative livelihood option in Bududa District

Plate 37: HE the President touring one of the alternative livelihood interventions that is being implemented with support from GCF (Photo credit Malinga Joseph).

5.3 Challenges and emerging issues in wetland conservation

The implementation of wetland initiatives to reverse the trend of degradation is faced with several challenges related to management and policy gaps that also need to be noted for remedies. These are hereby reported below:

5.3.1 Management-related challenges

1) There is inadequate staffing in wetlands/environment thematic areas at national and district local government levels. This continues to pose challenges towards monitoring and managing wetland programmes

2) Insufficient public awareness, education and funding. Many communities are still not aware of the value of ecosystem services, and sustainable use of natural resources

3) Low capacity building of local governments and lead agencies in the environment and natural resources management due to inadequate funding, and limited equipment. Failure to train staff and key stakeholders have hampered their ability to contribute effectively to wetland management through their application of skills that would have been obtained.

4) Inadequate institutional synergies and coordination among Government Ministries, Departments and Agencies (MDAs) in the implementation of policies and enforcement of the respective laws on environment and natural resources. For

example, there is an unclear delineation of the respective roles, responsibilities and expected outputs between WMD and NEMA resulting in duplication of outputs such as restoration and demarcation

5) Demarcation of wetlands. Bigger proportions of wetlands in the rural areas are not demarcated and are affected by agricultural expansion especially by large scale farms and industrial parks.

6) Promotion of exotic tree species (pine and eucalyptus) in favour of indigenous species that tend to change soils and micro-climate as they create their own. These tend to destabilize the environment.

7) Coordination; Coordination of activities of the key players is still a challenge. There are overlaps in the execution of activities by different actors. There is a need for harmonisation of roles of the different key players. There are weak coordination and conflicting mandates among institutions charged with wetland management such as NEMA, WMD, LG etc

8) The department is faced with limited funding. The Department currently receives about shs.3.5billions for the wetland management in the entire country and additional 10billion annually from Green Climate Fund (GCF) for wetland restoration in 22 districts in southwestern and eastern Uganda

9) Conflicting land uses being implemented in wetlands such as the Ministry of Agriculture, Animal Industry and Fisheries promoting rice growing in wetlands

10) Lack of updated wetland inventory dataset: The wetlands inventory data is not updated and needs to be recomputed to facilitate restoration programmes. The WMD had developed an inventory of all wetlands in the country, it is not up to date and was last published in 2000. It houses information such as e.g. the location of the wetland; type of fauna and flora; the soil and hydrological characteristics; the discharge and composition of water; the volume, flow and quality of water, major land use forms; the density of population in the wetland catchment, conservation status; the area of the wetland / coverage, however, only data on wetland coverage and major land use forms are updated up to 2015.

11) Land conflicts: The WMD is also faced with a challenge of land conflict. For example, Bunambutye wetland took long to be demarcated because it was at the centre of a land use conflict between Bulambuli and Kapchorwa, while the land use conflict in Apaa has delayed demarcation of Acwee wetland in Amuru District

5.3.2 Policy related challenges

12) Ineffective enforcement and compliance with policy, legal and regulations on the environment. The litigation function involves handling and management of litigation cases of both civil and criminal nature. Bureaucracies and sluggish responsiveness of duty bearers to resolve the reported cases (such as land titles in wetlands and forest reserves, the use of polyethene bags among others). There are delays in completion, and dismissal of court cases, which is attributed to backlogs in the Judiciary.

13) There is a lack of wetland specific law coupled with weak penalties which results in losses in court or even dropping of cases

14) Re-encroachment: The Office of the Auditor General (2018) found out that wetlands in Kampala (Kinawataka- Butabika wetland), Kisoro (Sereri and Kigezi wetlands), Masindi (Kyabagenyi), Mbarara (Nyakikara and Rwemigyina wetlands), Mityana (Wabiruko and Nyakitundu) and Kaliro (Kyanfuba wetland) were encroached on again even after restoration. The reasons advanced for the re-encroachment included scarcity of water in Masindi, poor physical planning of expanding urban areas, declining soil fertility in farmlands and population increase, inadequate post-restoration monitoring to keep away encroachers, and in the case of Kinawataka-Butabika, differences between MWE and the Uganda Police Force regarding the eviction of encroachers during restoration Re-encroachment resulted in financial loss to the government since funds had already been spent on restoration and denied Ugandans the benefits of fully restored wetlands e.g. UGX.13,380,000 in the case of Kinawataka - Butabika wetland.

Chapter Six: Scenarios of Wetland Outlook in Uganda

6.1 Introduction

Although there are several interventions undertaken to manage wetlands in Uganda, this chapter presents the scenarios of wetland status in the future by 2050. A Millennium Ecosystem Assessment (2005) methodology was adopted to examine the future scenarios of wetlands in the country. The technique explores the consequences of wetland ecosystem services and human wellbeing of four plausible futures to the year 2050. The methodology supports sustainable development and in the context of the Ramsar Convention, the wise use of wetlands.

Scenarios are plausible and relevant stories about how the future might unfold. They are not forecasts, projections, predictions, or recommendations, rather, they are designed to explore the implications of different plausible changes in driving forces based on current knowledge of underlying socio-ecological processes. The four scenarios are Global Orchestration, ***Order*** *from Strength, Adapting Mosaic,* and *TechnoGarden.* It is also important to note that no scenario represents business as usual, although all begin from current conditions and trends.

The four scenarios, assumptions and implications to explore plausible futures for wetland ecosystems and human wellbeing in Uganda are as follows:

a) *Global Orchestration:* This scenario depicts a globally connected society that focuses on global trade and economic liberalization and takes a reactive approach to ecosystem problems but that also takes strong steps to reduce poverty and inequality and to invest in public goods such as infrastructure and education. Economic growth in this scenario is the highest of the four scenarios, while it is assumed to have the lowest population in 2050.

The *Global Orchestration* shows that the wetland spatial extents shall be low throughout the country. This shall be attributed to high intensification of wetland cultivation and over-extraction of wetland products. By 2050, the country could start to realise the impacts of climate change because the country would not have wetlands unless its management is prioritised now. In this period, a lot of climate information would be available, many wetlands would be degraded, several climate change adaptation strategies would take shape and the country would incur higher costs of treating wastes, mitigating floods and import of wetland products. This scenario implies that there would be increased research on wetland degradation and climate change impacts and high participation of local communities in wetland management.

b) *Order from Strength:* This scenario represents a regionalized and fragmented world concerned with security and protection, emphasizing primarily regional markets, paying little attention to public goods, and taking a reactive approach to ecosystem problems. Economic growth rates are the lowest of the scenarios (particularly low in developing countries) and decrease with time, while population growth is the highest.

For the Order from Strength scenario, the country is presently experiencing high degradation of wetland cover with all the other factors held constant. What is observed today could be due to high population growth caused by overexploitation of wetland products (papyrus, sand etc), inadequate allocation of funding towards wetland management, lack of wetland specific laws and weak enforcement of wetland laws, inadequate staff to manage wetlands, increase in unplanned settlements and poor dumping of wastes in wetlands. This has led to the deterioration of services provided by wetlands such as freshwater, food, fruits, fuel wood etc. By 2050, wetlands will lose acreage faster, there will be higher cases of devastating floods reported,

higher costs of treating wastewater increased occurrences of diseases and planning for species conservation under the changing climate. This scenario implies that it will result into increased costs of purchasing wetland goods and services, the increased annual rate of wetland conversion to other land use types, high investment in wetland research and increased protection of threatened or sensitive wetland biodiversity.

c) *Adapting Mosaic:* In this scenario, regional watershed-scale ecosystems are the focus of political and economic activity. Local institutions are strengthened and local ecosystem management strategies are common; societies develop a strongly proactive approach to the management of ecosystems. Economic growth rates are somewhat low initially but increase with time, and the population in 2050 is nearly as high as in Order from Strength.

Adapting Mosaic scenario: With the current state of affairs, if the wetland management institutions are strengthened through increased funding by government, increased level of community engagement, increased capacity of personnel, the formation of wetland specific laws and review of current wetland laws, good political will and no conflicts exist between natural resources management institutions. There would be a less severe decline in the services provided by freshwater, food supply and biomass etc. by the wetlands. By 2050, the country would realise rejuvenated wetland ecosystem services, improved household food security, increased water supply, increased numbers of tourists (revenue) and resettlement of local communities from wetlands. The implications of this cause would be increased coverage of wetlands, the impacts of climate change would begin to manifest, there are would be also increased investment in climate-resilient infrastructure and increased collaboration and partnership with many stakeholders in wetland management in the country.

d) *TechnoGarden:* This scenario depicts a globally connected world relying strongly on environmentally sound technology, using highly managed, often engineered, ecosystems to deliver ecosystem services, and taking a proactive approach to the management of ecosystems to avoid problems. Economic growth is relatively high and accelerates, while the population in 2050 is in the midrange of the scenarios.

While for the *TechnoGarden* scenario, the Wetlands Management Department has taken proactive steps towards the conservation of wetlands in Uganda. For example, the department has demarcated few wetlands in different parts of the country, developed wetland management plans, restored wetlands, conducted wetland valuation exercises, formed wetland advisory stakeholder working group, developed national wetland information system, trained local government stakeholders and conducted community sensitisation campaigns on the wise use of wetlands. If these can be strengthened and/or improved, there would be less severe declines in ecosystem services provided by the wetlands in the country. By 2050, under this scenario, the country will have high coverage of wetlands restored, wetland management plans will have been developed for all the wetlands, the contributions of wetlands to the national economy shall be known and tracked, and ecosystem services valuation methodologies shall be robust and up to date. This scenario implies that the country will experience the improved provision of water and foods from wetlands, improved household income levels, reduced costs of treating wastewater, increased research on wetland conservation, increased impacts of climate change and many wetlands shall be restored.

6.2 Implications of the four scenarios on wetland ecosystem services in Uganda

- Provisioning services: From the studied four scenarios of state of wetlands in Uganda, the demand for provisioning services such as food, fibre, and water, will strongly increase due to expected growth in population and economies and changing consumption patterns. However, it is expected that there would be a deterioration of services such as freshwater, fish production and water supply under the *Global Orchestration and Order from Strength* scenarios. A less severe decline is also expected under the *Adapting Mosaic*, and *TechnoGarden* scenarios, which would proactively increase efficiency in resource use through environmental policies and their emphasis on the application of technology for environmental benefits. After 2050, climate change and its impacts

(such as floods) could have an increasing effect on the provision of ecosystem services.

- Regulatory services: the demand for regulatory services in all the four scenarios is likely to increase such as waste retention, recovery, and removal of excess nutrients and other pollutants, flood control and retention of sediments among others, while the provisioning of these services by the wetlands is likely to decrease. The wetlands are likely to be under pressure to remove or synthesize pollutants and also to buffer the communities from floods and Lake water level rise.
- Cultural services: the four scenarios indicate that there will be some form of human and wetland interaction and therefore if this is not monitored, many wetlands could lose distinguishable biodiversity unless there is an offset between extraction of wetland products and conservation.
- Formulation of wetland policies: many wetland policies are geared towards the provisioning of wetland services due to changing consumption patterns and increased population compared to other services such as regulatory, cultural and supporting that are less considered in these processes.

Plate 36: Wetland restoration launch in Nyaruzinga wetland, Bushenyi district (Photo credit Malinga Joseph).

Chapter Seven: Conclusion and Policy Recommendations

7.1 Conclusion

On average Uganda experiences a decline of about 293km^2 of wetland coverage annually in the country. This means that if business remains as usual, Uganda is likely to face a decline of more 7,325km^2 of wetland cover by 2040. To curb this situation, there is need to enforce wetland legislations, policies, and programmes on wetland threats such as population growth, unplanned settlements, economic and industrial developments, urban agriculture, unclear boundaries and land ownership among other factors. In addition, it is also important to educate the public about wetland benefits, conservation and management, and if the public does not recognize the benefits of wetland conservation, wetlands will be totally reclaimed.

7.2 Policy Recommendations

This report proposes the following policy recommendations:

1) Enact wetland policies, bylaws and courts

   The prevalent wetland laws are inadequate to prosecute encroachers and ensure timely restoration of degraded wetlands and therefore the wetlands management bill should be fast-tracked and passed into law to reinforce conservation measures that are already in the playing field. The government should also consider establishing an environmental court to fast-track hearing and prosecution of wetland degradation cases that slog for ages in courts.

2) Increase funding to the Wetland Management Department

   The national and local government budgetary allocation by the government to the wetland units is not enough much as it has been increasing over time in the last decade. With limited funding, for instance, the department has not been able to recruit more personnel at national and local government levels meant to maintain wetland conservation and wise use throughout the country. The small pocket has too highly affected the allocation of funds to public education, awareness and literacy programmes which are at the centre of wetland conservation. Therefore, the government should include wetland conservation on its hotlist of priorities if, for example, restoration is to be effectively and widely implemented in the country.

3) Strengthen coordination mechanisms

   Of recent, many government agencies and development partners have come on board with interesting components of wetland conservation such as awareness, restoration etc, however, because of inadequate coordination mechanisms in place; there is a duplication of roles and differing mandates that have caused conflicts. Therefore, the government should review and harmonise the mandates of the relevant institutions to ensure that each carries out its expected duties within the provided scope of work.

4) Promote alternative livelihood options and wetlands enterprises as a mechanism to promote wise use but also to discourage encroachment.

Glossary

Biodiversity: The variety of life or species in an area, plus the genetic wealth within each species plus the component ecosystems which these organisms live.

Catchment: All the area containing a wetland from which water drains into the wetland; the surrounding catchment is that part of the catchment excluding the wetland.

Conservation: Looking after and managing a resource, such as a wetland, so that it remains able to fulfil its functions and provide goods for present and future generations. Conservation is one of a wide range of environmental management options.

Conversion: Changing the former condition of the wetlands to something else e.g. changing seasonal wetland edges by removing the natural vegetation and replacing it with crops.

Degradation: The reduction in the quality of habitats, soils, water and other components of the natural world.

Drainage: The artificial large-scale removal or exclusion of water from a wetland by whatever means. This includes diversion or abstraction of water by channels or pumping; exclusive growing of water demanding trees (e.g. Eucalyptus); the building of upstream dams; infilling with murrum or other solid materials or wastes.

Encroachment: The act or process of converting a wetland edge to some other use e.g. building a house or starting a vegetable garden; the area taken is then increased little by little.

Permanent wetland: A wetland that has water covering the soil surface for parts of the year, even in the dry season.

Seasonal wetland: A wetland that has water covering the soil surface for some parts of the year usually in the wet season. In the dry season, waterlogged conditions remain beneath the surface.

Sustainable use: Wetland utilization which will ensure that the production of goods and services derived from use, are available at the same level that can be maintained for the foreseeable future. Meaning, goods should not be over harvested, soil degraded or the hydrology disrupted.

Threat: The likelihood that a wetland site, or portion thereof, will be destroyed or degraded directly or indirectly through human actions.

Trans-boundary wetlands: Wetlands shared by two or more countries. Since ecosystems are not constrained by geographic jurisdictional limits, Uganda shares wetlands with Kenya, Tanzania, Rwanda, Democratic Republic of Congo, and Sudan.

Waterlogged: Soil or lands saturated with water long enough for anaerobic conditions to develop

Wetland benefits: the services that wetlands provide to people, e.g., flood control, surface water purification, supplies of potable water, fishes, plants, building materials and water for livestock, outdoor recreation and education.

Wetland demarcation: The processing of defining wetland boundaries and placing mark stones or pillars to clearly show the extent of the wetland.

Wetland hydrology: Wetland hydrology is associated with the spatial and temporal dispersion, flow, and physio-chemical attributes of surface and ground water in its reservoirs. Based on hydrology, wetlands can be categorized as riverine (associated with streams), lacustrine (associated with lakes and reservoirs), and palustrine (isolated).

Wetland values: The roles that wetlands play in natural ecosystem functioning, e.g. flood attenuation and control, maintenance of underground and surface water supplies, sediment trapping, erosion control, pollution abatement and provision of habitat.

Wetland: Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres.

Wise use: Is the sustainable utilization of wetlands for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem.

References

1. Adonia, B. K. K. (2013). The cost of poor land use practices in Lake Nakivale Wetland in Isingiro District, Uganda. African Journal of Environmental Science and Technology, 7(6), 448-456.
2. Aggrey, N., Wambugu, S., Karugia, J., & Wanga, E. (2010). An investigation of the poverty-environmental degradation nexus: a case study of Katonga Basin in Uganda. Research Journal of Environmental and Earth Sciences, 2(2), 82-88.
3. Albright, T. (2004). The rise and fall of water hyacinth in Lake Victoria and the Kagera River Basin, 1989-2001.
4. Arinaitwe, J. (1999). Wetlands and waterbird conservation in East Africa. Wetlands International Publication, 55, 46-47.
5. Baker, M., Sarfo, I., Darko, G., & Bi, S. (2019). Loss of wetland resources in Uganda: The case of lake Wamala in Mityana District.
6. Barakagira, A., & de Wit, A. H. (2017). Community livelihood activities as key determinants for community-based conservation of wetlands in Uganda. Environmental & Socio-economic Studies, 5(1), 11-24.
7. Barasa, B. (2011). Assessing the magnitude of land use/cover changes and their effect on soil properties in the transboundary River Sio catchment (Uganda/Kenya border). A thesis submitted in partial fulfilment of the requirements for the award of the Masters of Science in Environment and Natural Resources Degree of Makerere University.
8. Barasa, B., Kakembo, V., & Karl, T. (2016). Characterization of artisanal gold mining activities in the tropics and their impact on sediment loading and stream flow in the Okame River catchment, Eastern Uganda. Environmental Earth Sciences, 75(14), 1076.
9. Barasa, B., Majaliwa, J. G. M., Lwasa, S. and Obando, J. (2011). Magnitude and transition potential of land-use/cover changes in the trans-boundary River Sio catchment using remote sensing and GIS. Annals of GIS Vol. 17(1): 73-80.
10. Berakhi, R. O. (2013). Implication of human activities on land use land cover dynamics in Kagera Catchment, East Africa (Doctoral dissertation, Southern Illinois University Carbondale).
11. Bikangaga, S., Picchi, M. P., Focardi, S., & Rossi, C. (2007). Perceived benefits of littoral wetlands in Uganda: a focus on the Nabugabo wetlands. Wetlands Ecology and Management, 15(6), 529-535.
12. Bird Life International (2008). State of the world's birds: Indicators for our changing world.
13. Byenkya, G. S., Mugerwa, S., Barasa, S., & Zziwa, E. (2014). Land use and cover change in pastoral systems of Uganda: Implications on livestock management under drought induced pasture. African Crop Science Journal, 22, 1013-1025.
14. Cambridge, UK.
15. Charles, H., & Dukes, J. S. (2008). Impacts of invasive species on ecosystem services. In Biological invasions (pp. 217-237). Springer, Berlin, Heidelberg.
16. Emerton, L., Iyango, L., Luwum, P., & Malinga, A. (1998). The present economic value of Nakivubo urban wetland, Uganda. Nairobi: IUCN.
17. Emerton, L. (2014). Summary of the economic value of biodiversity and ecosystem services in Lake Nabugabo Wetland Complex, Uganda
18. Erwin, K. L. (2009). Wetlands and global climate change: the role of wetland restoration in a changing world. Wetlands Ecology and management, 17(1), 71.
19. Fuhrimann, S., Winkler, M. S., Kabatereine, N. B., Tukahebwa, E. M., Halage, A. A., Rutebemberwa, E., ... & Cissé, G. (2016). Risk of intestinal parasitic infections in people with different exposures to wastewater and fecal sludge in Kampala, Uganda: a cross-sectional study. PLoS neglected tropical diseases, 10(3).
20. Gardner, R. C., & Davidson, N. C. (2011). The ramsar convention. In Wetlands (pp. 189-203). Springer, Dordrecht.
21. GoK (2009). Flood mitigation strategy. http://www.wescoord.or.ke/documents/Keydocs/FloodMitigationStrategy_MoWI_200906.pdf
22. Hartter, J., & Ryan, S. J. (2010). Top-down or bottom-up?: Decentralization, natural resource management, and usufruct rights in the forests and wetlands of western Uganda. Land Use Policy, 27(3), 815-826.

23. Heim, R. J., Hölzel, N., Heinken, T., Kamp, J., Thomas, A., Darman, G. F., ... & Heim, W. (2019). Post-burn and long-term fire effects on plants and birds in floodplain wetlands of the Russian Far East. Biodiversity and Conservation, 28(6), 1611-1628.

24. Hinckley, B. R., Etheridge, J. R., & Peralta, A. L. (2019). Wetland conditions differentially influence nitrogen processing within waterfowl impoundments. Wetlands, 1-15.

25. Hopper, J. V., McCue, K. F., Pratt, P. D., Duchesne, P., Grosholz, E. D., & Hufbauer, R. A. (2019). Into the weeds: Matching importation history to genetic consequences and pathways in two widely used biological control agents. Evolutionary applications, 12(4), 773-790.

26. Huising, E. J. (2002). Wetland monitoring in Uganda. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 36, 127-135.

27. IUCN (2019) IUCN Redlist

28. Jacob, A. L., Bonnell, T. R., Dowhaniuk, N., & Hartter, J. (2014). Topographic and spectral data resolve land cover misclassification to distinguish and monitor wetlands in western Uganda. ISPRS journal of photogrammetry and remote sensing, 94, 114-126.

29. John, K. K., Aloyce, W. M., & Joel, K. N. (2018). Hydrology And Hydraulics Of The Lubigi Wetland In Uganda. Tanzania Journal of Engineering and Technology, 37(1).

30. Kabumbuli, R., & Kiwazi, F. W. (2009). Participatory planning, management and alternative livelihoods for poor wetland-dependent communities in Kampala, Uganda. African journal of ecology, 47, 154-160.

31. Kaggwa, R., Hogan, R., & Hall, B. (2009). Enhancing wetlands' contribution to growth, employment and prosperity. Environment and Natural Resources Report Series.

32. Kakuru, W., Turyahabwe, N., & Mugisha, J. (2013). Total economic value of wetlands products and services in Uganda. The Scientific World Journal, 2013.

33. Kansiime, F., Nalubega, M., Van Bruggen, J. J. A., & Denny, P. (2003). The effect of wastewater discharge on biomass production and nutrient content of Cyperus papyrus and Miscanthidium violaceum in the Nakivubo wetland, Kampala, Uganda. Water science and technology, 48(5), 233-240.

34. Kasimbazi, E. (2019, January). Regulating environmental impacts associated with mining in Uganda. In Law| Environment| Africa (pp. 665-696). Nomos Verlagsgesellschaft mbH & Co. KG.

35. Kayendeke, E. J. (2018). Water storage dynamics of papyrus wetlands and land use change in the Lake Kyoga basin, Uganda.

36. Kayendeke, E. J., & French, H. K. (2019). Characterising the Hydrological Regime of a Tropical Papyrus Wetland in the Lake Kyoga Basin, Uganda. In Agriculture and Ecosystem Resilience in Sub Saharan Africa (pp. 213-236). Springer, Cham

37. Kayendeke, E. J., Kansiime, F., French, H. K., & Bamutaze, Y. (2018). Spatial and temporal variation of papyrus root mat thickness and water storage in a tropical wetland system. Science of the total environment, 642, 925-936.

38. Kayima, J. K., Mayo, A. W., & Nobert, J. K. (2019). The Fate of Nitrogen and Faecal Coliform in the Lubigi Wetland in Uganda. Tanzania Journal of Engineering and Technology, 37(2).

39. Kayima, J. K., Mayo, A. W., & Norbert, J. (2018). Ecological characteristics and morphological features of the Lubigi Wetland in Uganda. Environment and Ecology Research, 6(4), 218-228.

40. Kiwango, Y. A., & Wolanski, E. (2008). Papyrus wetlands, nutrients balance, fisheries collapse, food security, and Lake Victoria level decline in 2000–2006. Wetlands Ecology and Management, 16(2), 89-96.

41. Kusemererwa, E. I. (2019). Impacts of sand mining on Komuchwezi wetland: a case study of Katente parish, Kyegegwa district (Doctoral dissertation, Makerere University).

42. Langan, C., Farmer, J., Rivington, M., Novo, P., & Smith, J. U. (2019). A wetland ecosystem service assessment tool; Development and application in a tropical peatland in Uganda. Ecological indicators, 103, 434-445.

43. Leemans, R., & De Groot, R. S. (2003). Millennium Ecosystem Assessment: Ecosystems and human well-being: a framework for assessment.

44. Ludwig, C., Walli, A., Schleicher, C., Weichselbaum, J., & Riffler, M. (2019). A highly automated algorithm for wetland detection using multi-temporal optical satellite data. Remote Sensing of Environment, 224, 333-351.

45. Lwanga, M. S., Kansiime, F., Denny, P., & Scullion, J. (2003). Heavy metals in Lake George, Uganda, with relation to metal concentrations in tissues of common fish species. Hydrobiologia, 499(1-3), 83-93.

46. Mafabi, P. (2000). The role of wetland policies in the conservation of waterbirds: the case of Uganda. Ostrich, 71(1-2), 96-98.

47. Mark, E. (2012). Assessing the use of power generation technologies in Uganda: a case study of Jinja Municipality. Stockholm University

48. McConville, J. R., Kvarnström, E., Maiteki, J. M., & Niwagaba, C. B. (2019). Infrastructure investments and operating costs for fecal sludge and sewage treatment systems in Kampala, Uganda. Urban Water Journal, 1-10.

49. Millennium Ecosystem Assessment, 2005. Ecosystems and human well-being: wetlands and water synthesis. World Resources Institute, Washington, DC.

50. Ministry of Water and Environment (2017). Lake Nabugabo Wetlands System Ramsar Site Handbook Ministry of Water and Environment, Kampala, Uganda.

51. Mitsch, W. J., Bernal, B., & Hernandez, M. E. (2015). Ecosystem services of wetlands.

52. Moses, O. (2008). An institutional analysis of the management of wetland resources: A comparative study of Flóahreppur municipality in South Iceland and Oyam district in Uganda. Land restoration training programme. Agricultural University of Iceland.

53. Moyini, Y., Muramira, E., Emerton, L., & Shechambo, F. (2002). The costs of environmental degradation and loss to Uganda's economy with particular reference to poverty eradication. Policy Brief, 3.

54. Mugisha, P., Kansiime, F., Mucunguzi, P., & Kateyo, E. (2007). Wetland vegetation and nutrient retention in Nakivubo and Kirinya wetlands in the Lake Victoria basin of Uganda. Physics and Chemistry of the Earth, Parts A/B/C, 32(15-18), 1359-1365.

55. Musinguzi, L., Efitre, J., Odongkara, K., Ogutu-Ohwayo, R., Muyodi, F., Natugonza, V., ... & Naigaga, S. (2016). Fishers' perceptions of climate change, impacts on their livelihoods and adaptation strategies in environmental change hotspots: A case of Lake Wamala, Uganda. Environment, development and sustainability, 18(4), 1255-1273.

56. Muwanga, A., & Barifaijo, E. (2006). Impact of industrial activities on heavy metal loading and their physico-chemical effects on wetlands of Lake Victoria basin (Uganda). African Journal of Science and Technology, 7(1).

57. Mwavu, E. N., & Witkowski, E. T. F. (2008). Land use and cover changes (1988–2002) around Budongo forest reserve, NW Uganda: Implications for forest and woodland sustainability. Land degradation & development, 19(6), 606-622.

58. Mwavu, E. N., Kalema, V. K., Bateganya, F., Byakagaba, P., Waiswa, D., Enuru, T., & Mbogga, M. S. (2018). Expansion of Commercial Sugarcane Cultivation among Smallholder Farmers in Uganda: Implications for Household Food Security. Land, 7(2), 73.

59. MWE (2016) The Contribution of Water Resources Development and Environmental Management to Uganda's Economy

60. N. Turyahabwe, W. Kakuru, M. Tweheyo, and D. Tumusiime, "Contribution of wetland resources to household food security in Uganda," Agriculture and Food Security Journal, vol. 2, p. 5, 2013.

61. Naigaga, I., Kaiser, H., Muller, W. J., Ojok, L., Mbabazi, D., Magezi, G., & Muhumuza, E. (2011). Fish as bioindicators in aquatic environmental pollution assessment: a case study in Lake Victoria wetlands, Uganda. Physics and Chemistry of the Earth, parts A/B/C, 36(14-15), 918-928.

62. Naigaga, I., Kyangwa, M., & Mugidde, R. (2010). Gender Analysis of Risks from Exposure to Chemical Contaminants among Kiriny a Wetland Resources Users in Jinja District of Uganda. Natural Resource Management, 127.

63. Nalukenge, I., Antle, J., & Stoorvogel, J. (2009). Assessing the feasibility of wetlands conservation: Using payments for ecosystem services in Pallisa, Uganda. In Payment for

Environmental Services in Agricultural Landscapes (pp. 239-253). Springer, New York, NY.

64. Namaalwa, S., Funk, A., Ajie, G. S., & Kaggwa, R. C. (2013). A characterization of the drivers, pressures, ecosystem functions and services of Namatala wetland, Uganda. Environmental science & policy, 34, 44-57.

65. Naughton Treves, L. (1999). Whose animals? A history of property rights to wildlife in Toro, western Uganda. Land Degradation & Development, 10(4), 311-328.

66. Navas, A., López-Vicente, M., Gaspar, L., Palazón, L., & Quijano, L. (2014). Establishing a tracer-based sediment budget to preserve wetlands in Mediterranean mountain agroecosystems (NE Spain). Science of the Total Environment, 496, 132-143.

67. NBI. 2008. Kagera basin monograph. Basin development report.

68. Ndawula, J., Tweheyo, M., Tumusiime, D. M., & Eilu, G. (2011). Understanding sitatunga (Tragelaphus spekii) habitats through diet analysis in Rushebeya Kanyabaha wetland, Uganda. African Journal of Ecology, 49(4), 481-489.

69. Nelson, T., Tumusime, D. M., Yikii, F., Kakuru, W., & Barugahare, V. (2017). Awareness, perceptions and implementation of policy and legal provisions on wetlands in Uganda. African Journal of Rural Development, 2(2), 161-174.

70. NEMA (2016), National Biodiversity Strategy and Action Plan II (2015-2025)

71. Nsubuga, F. N., Namutebi, E. N., & Nsubuga-Ssenfuma, M. (2014). Water resources of Uganda: an assessment and review. Journal of Water Resource and Protection, 6(14), 1297.

72. Odeke, C. (2019). Wetland Degradation and Carbon Sequestration Potential (Doctoral dissertation).

73. Office of the Auditor General (OAS) (2018). Value for money audit report on the management of wetlands in Uganda by the Wetlands Management Department under the Ministry of Water and Environment

74. Olupot, W. (2016). Grey Crowned Crane threat assessment around the wetlands of eastern Uganda. Ostrich, 87(3), 263-270.

75. Omara, T.; Karungi, S.; Ssebulime, S.; Kiplagat, K.M.; Bongomin, O.; Ogwang, R.; Akaganyira, S. Artisanal and Small-Scale Gold Mining in Syanyonja, Busia Gold District, South Eastern Uganda: Impacts on the Mining Population and the Environment. Preprints 2019, 2019100298 (doi: 10.20944/preprints201910.0298.v1).

76. Opio, A., Lukale, J. K., Masaba, I. S., & Oryema, C. (2011). Socio–economic benefits and pollution levels of water resources, Pece Wetland, Gulu Municipality-Uganda. African Journal of Environmental Science and Technology, 5(7), 535-544.

77. Ouma,F. (2010). Joint effort to conserve border wetland. Reject Vol. 21. http://issuu.com/awcfs/docs/reject21?mode=window&pageNumber=8

78. Plumptre, A. J., Ayebare, S., Behangana, M., Forrest, T. G., Hatanga, P., Kabuye, C., ... & Nampindo, S. (2019). Conservation of vertebrates and plants in Uganda: Identifying Key Biodiversity Areas and other sites of national importance. Conservation Science and Practice, 1(2), e7.

79. Ramsar Convention (2018) Scaling up wetland conservation wise use and restoration to achieve the Sustainable Development Goals

80. Ramsar Convention on Wetlands. (2018). Global Wetland Outlook: State of the World's Wetlands and their Services to People. Gland, Switzerland: Ramsar Convention Secretariat.

81. Richardson, B. J. (1993). Environmental management in Uganda: the importance of property law and local government in wetlands conservation. Journal of African Law, 37(2), 109-143.

82. Rwakakamba, T. M. (2009). How effective are Uganda's environmental policies?. Mountain Research and Development, 29(2), 121-127.

83. Safari, D., Mulongo, G., & Tumwesigye, W. (2012). Impact of Human Activities on the Quality of Water in Nyaruzinga Wetland of Bushenyi District-Uganda. International Science Congress Association.

84. Saunders, M. J., Jones, M. B., & Kansiime, F. (2007). Carbon and water cycles in tropical papyrus wetlands. Wetlands Ecology and Management, 15(6), 489-498.

85. Saunders, M. J., Kansiime, F., & Jones, M. B. (2014). Reviewing the carbon cycle dynamics and carbon sequestration potential of Cyperus papyrus L. wetlands in tropical Africa. Wetlands ecology and management, 22(2), 143-155.

86. Schneeberger, P. H., Fuhrimann, S., Becker, S. L., Pothier, J. F., Duffy, B., Beuret, C., ... & Utzinger, J. (2019). Qualitative microbiome profiling along a wastewater system in Kampala, Uganda. Scientific reports, 9(1), 1-9.

87. Schuijt, K. (2002). Land and water use of wetlands in Africa: economic values of African wetlands.

88. SCWMP, 2009. Sio-Siteko Trans-boundary Community Based Wetland Management Plan. Nile Transboundary Environmental Action Project, Nile Basin Initiative (NBI).

89. Tumusiime, David Mwesigye, Nelson Turyahabwe, Willy Kakuru, and Bernard Barasa. "Wetland use/cover changes and local perceptions in Uganda." (2018).

90. Tumusiime, David Mwesigye, Nelson Turyahabwe, Willy Kakuru, and Mnason Tweheyo. "Contribution of wetland resources to household food security in Uganda." (2018).

91. Turyahabwe, N., Tumusiime, D. M., Kakuru, W., & Barasa, B. (2013). Wetland use/cover changes and local perceptions in Uganda. Sustainable Agriculture Research, 2(526-2016-37853).

92. UBOS (2014) Uganda National Population Census report

93. Uganda wetland atlas (2016) Ministry of Water and Environment

94. UNDP (2015) Social, Economic and Environmental Implications of Policy Actions on the Restoration and Conservation of Wetlands in Wakiso, Kampala and Mukono Districts, Uganda

95. UWA 2016. Uganda Wetlands Atlas, 2016. Ministry of Water and Environment. https://www.mwe.go.ug/library/uganda-wetlands-atlas

96. UWGMP 2019. Uganda Wetlands Governance and Management Profile, 2019. Nile Basin Initiative. http://www.nilebasin.org/wetlands/wp-content/uploads/2019/03/Uganda-Wetlands-Governance-and-Management-Profile.pdf

97. Van Dam, A. A., Dardona, A., Kelderman, P., & Kansiime, F. (2007). A simulation model for nitrogen retention in a papyrus wetland near Lake Victoria, Uganda (East Africa). Wetlands ecology and management, 15(6), 469-480.

98. Walakira, P., & Okot-Okumu, J. (2011). Impact of industrial effluents on water quality of streams in Nakawa-Ntinda, Uganda. Journal of Applied Sciences and Environmental Management, 15(2).

99. Wanasolo, W., Kiremire, B. T., & Kansiime, F. (2018). Evaluation of Industrial Effluent Levels in Kinawataka Stream, Its Tributaries and Kinawataka Swamp, Prior to Discharge into Lake Victoria. American Journal of Chemistry and Materials Science, 5(4), 49-56.

100. Wasswa, H., Kakembo, V., & Mugagga, F. (2019). A spatial and temporal assessment of wetland loss to development projects: the case of the Kampala–Mukono Corridor wetlands in Uganda. International journal of environmental studies, 76(2), 195-212.

101. Water and Environment Performance sector report, 2019

102. Wohlfart, C., Winkler, K., Wendleder, A., & Roth, A. (2018). TerraSAR-X and wetlands: A review. Remote Sensing, 10(6), 916.

103. World Bank (2009). Integrated safeguards data sheet: Concept stage. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/08/25/000104615_20090825113307/Original/Integrated0Saf10Sheet1Concept0Stage.doc

104. Yiiki, F., Bashaasha, B., & Turyahabwe, N. (2016). Household perception of climate change in wetland adjacent areas in Uganda. Uganda Journal of Agricultural Sciences, 17(2), 139-155.

105. Yikii, F., Turyahabwe, N., & Bashaasha, B. (2017). Prevalence of household food insecurity in wetland adjacent areas of Uganda. Agriculture & food security, 6(1), 63.

106. Yoon, C. G. (2009). Wise use of paddy rice fields to partially compensate for the loss of natural wetlands. Paddy and Water Environment, 7(4), 357.

Annex 1 – Wetland coverage 1994-2015

Wetland coverage by district (1994-2015)

YEAR	1994		2015		Change (1994 - 2015)	
DISTRICT	Area (Sq. km)	%	Area (Sq. km)	%	Area (Sq. km)	%
ABIM	537.2	1.43	307.1	0.98	-230.1	-3.73
ADJUMANI	312.3	0.83	294.6	0.94	-17.7	-0.29
AGAGO	353.5	0.94	259.5	0.83	-93.9	-1.52
ALEBTONG	245.2	0.65	229.4	0.73	-15.8	-0.26
AMOLATAR	266.8	0.71	244.4	0.78	-22.4	-0.36
AMUDAT	72.7	0.19	83.5	0.27	10.9	0.18
AMURIA	505.1	1.35	370.1	1.18	-135.0	-2.19
AMURU	198.9	0.53	172.6	0.55	-26.4	-0.43
APAC	432.1	1.15	353.1	1.13	-79.0	-1.28
ARUA	41.2	0.11	38.2	0.12	-3.0	-0.05
BUDAKA	130.2	0.35	113.6	0.36	-16.6	-0.27
BUDUDA	0.1	0.00	17.8	0.06	17.7	0.29
BUGIRI	236.1	0.63	232.8	0.74	-3.3	-0.05
BUGWERI	116.7	0.31	104.0	0.33	-12.7	-0.21
BUHWEJU	7.4	0.02	7.4	0.02	0.0	0.00
BUIKWE	25.1	0.07	73.5	0.23	48.4	0.78
BUKEDEA	448.4	1.19	396.8	1.26	-51.6	-0.84
BUKOMANSIMBI	216.2	0.58	145.5	0.46	-70.7	-1.14
BUKWO	10.5	0.03	13.3	0.04	2.8	0.04
BULAMBULI	203.6	0.54	226.4	0.72	22.9	0.37
BULIISA	776.1	2.07	111.5	0.36	-664.6	-10.76
BUNDIBUGYO	11.0	0.03	28.7	0.09	17.7	0.29
BUNYANGABU	7.7	0.02	13.2	0.04	5.5	0.09
BUSHENYI	34.8	0.09	21.4	0.07	-13.4	-0.22
BUSIA	155.0	0.41	171.3	0.55	16.4	0.27
BUTALEJA	284.4	0.76	264.7	0.84	-19.7	-0.32
BUTAMBALA	50.6	0.13	43.8	0.14	-6.8	-0.11
BUTEBO	44.9	0.12	51.1	0.16	6.3	0.10
BUVUMA	12.4	0.03	12.8	0.04	0.4	0.01
BUYENDE	416.9	1.11	385.6	1.23	-31.3	-0.51
DOKOLO	284.6	0.76	225.4	0.72	-59.2	-0.96
GOMBA	446.6	1.19	337.3	1.07	-109.3	-1.77
GULU	94.6	0.25	92.6	0.30	-2.0	-0.03

YEAR	1994		2015		Change (1994 - 2015)	
DISTRICT	Area (Sq. km)	%	Area (Sq. km)	%	Area (Sq. km)	%
HOIMA	185.9	0.50	74.9	0.24	-111.0	-1.80
IBANDA	60.0	0.16	43.9	0.14	-16.1	-0.26
IGANGA	167.6	0.45	163.3	0.52	-4.2	-0.07
ISINGIRO	346.3	0.92	305.8	0.97	-40.4	-0.65
JINJA	101.3	0.27	108.1	0.34	6.8	0.11
KAABONG	212.6	0.57	201.6	0.64	-11.0	-0.18
KABALE	35.0	0.09	53.6	0.17	18.5	0.30
KABAROLE	116.6	0.31	92.6	0.29	-24.0	-0.39
KABERAMAIDO	188.9	0.50	179.9	0.57	-8.9	-0.14
KAGADI	218.6	0.58	175.6	0.56	-43.0	-0.70
KAKUMIRO	352.3	0.94	321.8	1.03	-30.4	-0.49
KALAKI	256.4	0.68	166.5	0.53	-89.9	-1.46
KALANGALA	47.0	0.13	37.9	0.12	-9.1	-0.15
KALIRO	295.1	0.79	233.4	0.74	-61.6	-1.00
KALUNGU	341.0	0.91	261.7	0.83	-79.3	-1.28
KAMPALA	33.2	0.09	33.3	0.11	0.1	0.00
KAMULI	428.8	1.14	424.5	1.35	-4.4	-0.07
KAMWENGE	184.3	0.49	137.6	0.44	-46.7	-0.76
KANUNGU	72.1	0.19	72.2	0.23	0.1	0.00
KAPCHORWA	1.2	0.00	0.8	0.00	-0.4	-0.01
KAPELEBYONG	564.8	1.50	462.8	1.47	-102.0	-1.65
KARENGA	277.1	0.74	262.3	0.84	-14.8	-0.24
KASESE	439.7	1.17	406.9	1.30	-32.8	-0.53
KASSANDA	336.1	0.89	331.0	1.05	-5.1	-0.08
KATAKWI	1325.7	3.53	1075.4	3.43	-250.2	-4.05
KAYUNGA	585.2	1.56	587.3	1.87	2.1	0.03
KAZO	195.0	0.52	147.2	0.47	-47.7	-0.77
KIBAALE	63.7	0.17	50.3	0.16	-13.4	-0.22
KIBOGA	332.9	0.89	334.0	1.06	1.1	0.02
KIBUKU	228.3	0.61	175.4	0.56	-52.9	-0.86
KIKUUBE	130.4	0.35	108.0	0.34	-22.4	-0.36
KIRUHURA	560.6	1.49	479.8	1.53	-80.7	-1.31
KIRYANDONGO	425.9	1.13	347.1	1.11	-78.8	-1.28

YEAR	1994		2015		Change (1994 - 2015)	
DISTRICT	Area (Sq. km)	%	Area (Sq. km)	%	Area (Sq. km)	%
KISORO	25.7	0.07	33.1	0.11	7.4	0.12
KITAGWENDA	214.4	0.57	119.1	0.38	-95.3	-1.54
KITGUM	328.3	0.87	188.8	0.60	-139.5	-2.26
KOBOKO	2.0	0.01	2.1	0.01	0.1	0.00
KOLE	232.6	0.62	207.9	0.66	-24.8	-0.40
KOTIDO	486.7	1.30	460.9	1.47	-25.8	-0.42
KUMI	313.6	0.84	255.4	0.81	-58.2	-0.94
KWANIA	214.6	0.57	219.6	0.70	5.0	0.08
KWEEN	82.2	0.22	97.0	0.31	14.9	0.24
KYANKWANZI	718.5	1.91	538.4	1.72	-180.1	-2.92
KYEGEGWA	205.9	0.55	152.1	0.48	-53.9	-0.87
KYENJOJO	547.3	1.46	427.3	1.36	-120.0	-1.94
KYOTERA	844.3	2.25	831.8	2.65	-12.5	-0.20
LAMWO	207.0	0.55	191.9	0.61	-15.1	-0.24
LIRA	242.3	0.65	198.9	0.63	-43.3	-0.70
LUUKA	179.6	0.48	158.8	0.51	-20.8	-0.34
LUWERO	602.4	1.60	610.3	1.94	7.9	0.13
LWENGO	256.9	0.68	166.9	0.53	-90.0	-1.46
LYANTONDE	360.2	0.96	199.2	0.63	-161.0	-2.61
MADI OKOLLO	306.6	0.82	236.4	0.75	-70.2	-1.14
MANAFWA	17.3	0.05	17.8	0.06	0.4	0.01
MARACHA	0.0	0.00	0.0	0.00	0.0	0.00
MASAKA	322.8	0.86	320.3	1.02	-2.5	-0.04
MASINDI	577.6	1.54	493.9	1.57	-83.7	-1.36
MAYUGE	207.1	0.55	195.8	0.62	-11.3	-0.18
MBALE	88.4	0.24	95.3	0.30	6.8	0.11
MBARARA	83.6	0.22	91.0	0.29	7.4	0.12
MITOOMA	15.8	0.04	9.3	0.03	-6.5	-0.11
MITYANA	162.7	0.43	151.7	0.48	-11.1	-0.18
MOROTO	235.1	0.63	203.1	0.65	-32.0	-0.52
MOYO	112.7	0.30	42.8	0.14	-69.8	-1.13
MPIGI	348.2	0.93	302.8	0.96	-45.4	-0.74
MUBENDE	385.1	1.03	304.7	0.97	-80.4	-1.30
MUKONO	140.1	0.37	384.5	1.23	244.4	3.96
NABILATUK	495.4	1.32	375.9	1.20	-119.5	-1.94
NAKAPIRIPIRIT	487.1	1.30	386.6	1.23	-100.5	-1.63

YEAR	1994		2015		Change (1994 - 2015)	
DISTRICT	Area (Sq. km)	%	Area (Sq. km)	%	Area (Sq. km)	%
NAKASEKE	1,054.4	2.81	929.8	2.96	-124.6	-2.02
NAKASONGOLA	1,013.8	2.70	860.9	2.74	-152.9	-2.48
NAMAYINGO	88.9	0.24	101.0	0.32	12.1	0.20
NAMISINDWA	0.0	0.00	2.1	0.01	2.1	0.03
NAMUTUMBA	278.1	0.74	279.2	0.89	1.1	0.02
NAPAK	1,153.1	3.07	948.8	3.02	-204.3	-3.31
NEBBI	7.4	0.02	8.2	0.03	0.8	0.01
NGORA	382.7	1.02	333.8	1.06	-48.9	-0.79
NTOROKO	914.5	2.44	876.0	2.79	-38.5	-0.62
NTUNGAMO	138.9	0.37	112.0	0.36	-26.9	-0.44
NWOYA	385.2	1.03	259.7	0.83	-125.4	-2.03
OBONGI	356.2	0.95	262.4	0.84	-93.9	-1.52
OMORO	155.7	0.41	113.5	0.36	-42.3	-0.68
OTUKE	564.2	1.50	337.4	1.08	-226.8	-3.67
OYAM	509.0	1.36	379.7	1.21	-129.2	-2.09
PADER	237.6	0.63	203.1	0.65	-34.5	-0.56
PAKWACH	142.6	0.38	100.7	0.32	-41.9	-0.68
PALLISA	373.8	1.00	367.8	1.17	-6.0	-0.10
RAKAI	283.9	0.76	237.4	0.76	-46.4	-0.75
RUBANDA	42.7	0.11	44.0	0.14	1.3	0.02
RUBIRIZI	70.3	0.19	48.4	0.15	-21.9	-0.35
RUKIGA	12.5	0.03	10.0	0.03	-2.6	-0.04
RUKUNGIRI	73.6	0.20	71.8	0.23	-1.8	-0.03
RWAMPARA	82.8	0.22	76.5	0.24	-6.3	-0.10
SERERE	714.5	1.90	555.4	1.77	-159.1	-2.58
SHEEMA	172.1	0.46	93.3	0.30	-78.8	-1.28
SIRONKO	2.3	0.01	7.4	0.02	5.0	0.08
SOROTI	652.3	1.74	409.2	1.30	-243.1	-3.94
SSEMBABULE	789.3	2.10	581.3	1.85	-208.0	-3.37
TORORO	343.6	0.91	338.7	1.08	-4.8	-0.08
WAKISO	329.2	0.88	381.1	1.21	51.9	0.84
YUMBE	85.4	0.23	72.2	0.23	-13.2	-0.21
ZOMBO	5.0	0.01	4.7	0.01	-0.3	0.00
TOTAL	**37,553.9**	**100**	**31,378.8**	**100**	**-6175.1**	

Annex 2 – Current and planned restoration and demarcation of wetlands

A cumulative total of 450.39Km of wetland boundaries, representing 90.1% of the planned target of 500 Km for the FY 2019/20, were demarcated across the country during the Financial Year. The following wetlands were demarcated.

SN	District	Wetland Name	Hectares restored
1	Gomba	Kibimba Wetland	**80.55**
2	Wakiso	Kato - Mayanja Wetland	**43.34**
3	Sheema	Nyakambu Wetland	**20**
4	Bushenyi	Nyamirembe Wetland	**60.9**
5	Mbale	Opiya Wetland	**25.7**
6	Soroti	Asuret Wetland	**25.3**
7	Bukedea	Lwere Wetland	**50**
8	Bukedea	Kawo Wetland	**26**
9	Namutumba	Nawaibete Wetland	**16**
10	Ngora	Odaka Wetland	**22**
11	Adjumani	Ayugi (tete) Wetland	**5**
12	Pakwach	Ora Wetland	**2**
13	Lira	Kulu Amata Wetland	**5**
14	Nebbi	Nyarwodo Wetland	**6**
15	Napak	Okok and Okere Wetland	**1**
16	Nakapiripirt	Chosen - Cholol Wetland	**36.3**
Total			**450.39**

Area of Wetlands Demarcated in Central Uganda

S/N	District	Wetland system	Boundary Demarcated (KM)
	District	Wetland System.	Boundary in Kms.
	Luwero	Lumansi-Lugogo	46.71KM
	Nakasongola	Ssezibwa Wetland	44.53KM
	Kiboga	Kiyanja Wetland	48 KM
	Wakiso	Mayanja-Kato	43.34 KM
	Gomba	Kibimba Wetland	52.15km
Total			234.73

Restoration of Degraded areas

A cumulative total of 5,142.939 ha of critical wetlands were restored across the country out of planned 10,300ha making an achievement of 49.93%. The following wetlands were restored.

SN	District	Wetland Name	Hectares restored
1	Mbale	Mpologoma	**40**
2	Ngora	Agu	**500**
3	Ngora	Adoka	**10**
4	Serere	Kyere	**400**
5	Kibuku Serer and Ngora	Kawo	**400**
6	Lira	Kulu Amata	**43**
7	Alebtong	Okole	**25**
8	Apc	Aricha	**28**
9	Kyotera	Kyombo and Bukoola	**78.539**
10	Ntungamo	Rufuha	**700**
11	Sheema	Kandekye - Ruhorobero	**600**
12	Kanungu	Ntungwa	**30**
13	Mitooma	Nyamirizi - Kagog	**500**
14	Buhweju	Kyenzogyera- Mushasha - Rugongo	**530.72**
15	Kisoro	Mutanda - Murehe	**600**
16	Pallisa	L.Lemwa	**457.68**
17	Bukedea	Kachuru	**200**
Total			**5,142.94**

Area of wetlands Restored in central Uganda

S/N	District	Wetland system	Area Restored (Ha)
	Masaka	Mikomago Wetland	44.718
	Wakiso	Lubigi Wetland	275
	Wakiso	Mayanja-Kato	50
	Kayunga	Musamya-Ssezibwa Wetland System	110
	Gomba	Lake wamara shoreline wetlands	40
	Mityana	Lake Wamara wetland system	38
	Lakai	River Bukola & Kyombo Wetlands	78.539
Total			636.257

RESTORATION

Wetland Restoration- Planned vs. Actual

FY	Wetlands planned for restoration (and area in ha)	Wetlands actually restored (and area in ha)
2014/15	Planned restoration of 80 hectares in 28 District Local Government	Akwoyo wetland -4 ha of degraded section restored Aromo Sub-County in Lira district
2015/16	50 hectares of wetlands in districts Local Government respectively restored	Computer virus crashed the consolidated data. Thus, need to revisit the individual district reports for the FY
2016/17	50 hectares of wetlands in districts Local Government respectively restored	No filtered data because of the damage by the computer virus; need to revisit the district reports for the FY
2017/18	50 hectares of wetlands in districts Local Government respectively restored	*26.5ha from districts and cumulative from Riperian wetlands of Lake Kwania in Akokoro scty, section of Enyau wetland in Arua, 2ha of Laropi wetlands in Moyo, Pakwach, Apac, Oyam and Arua districts for Aminkwac wetland in Dokolo; Namrwodo wetland in Nebbi (Details can be obtained from respective District local Governments).*
2018-2019	64 Ha Restore wetlands in North, East, Central Western	*20.4 km of wetlands (17.3km Oweei wetland in Amuru; and 3.2km of Ayele wetland in Dokolo District*
2019-2020	70 Ha Restore wetlands in North,	43hectares restored in Lira, Kulu Amata wetland Iin Lira t; Okole wetland Kole and Arocha wetland in Apac Municipality
2020-2021	70 Ha planned for restoration	*Awaits funds*

DEMARCATION

Wetland Demarcation- Planned vs. Actual

FY	Wetlands planned for demarcation (and length/ distance in km)	Wetlands actually demarcated (and length/ distance in km)
2014/15	Pece wetland planned 20km Okole wetland planned 20km	Pece wetland 20km in Gulu Wetland of Okole demarcated 54km including areas outside Lira Municipality
2015/16	Oyitino wetland 20km	Oyitino wetland 23km demarcated in Gulu
2016/17	Enyau wetland 20km	Enyau wetland 15.4km
2017/18	Planned 20km of Namrwodho wetland 20km of Ayii wetland in Maracha District demarcated	Wetland demarcated 14km 16km of Ayii riverine wetland demarcated in Maracha districtm
	2Okm of Aminkwac wetland in Dokolo	34km of Aminkwac wetland demarcated
2018-2019	20km of Oweei wetland in Amuru District	17.2km of the wetland demarcated
2019-2020	140 Km of wetlands demarcated North	19 km demarcated in Northern region. The details were as follows: 5km of Ayugi (Tete) wetland system (in Adjumani; ,2km of Ora wetland system Pakwach, 5km of Kulu Amata wetland in Ojwina division-Lira Municipality; Lira, 6kmof Nyanrwodo wetland in Nebbi, 1km of Okok and Okere wetland in Napak and Amudat demarcated with live markers
2020-2021	Planned 120km	Demarcation awaits funds

Wetlands Management Department, Ministry of Water and Environment

P.O Box 20026, Kampala, Uganda

Tel: +256 414 505942 | Fax: +256 414 505941 | Website: http://www.mwe.go.ug