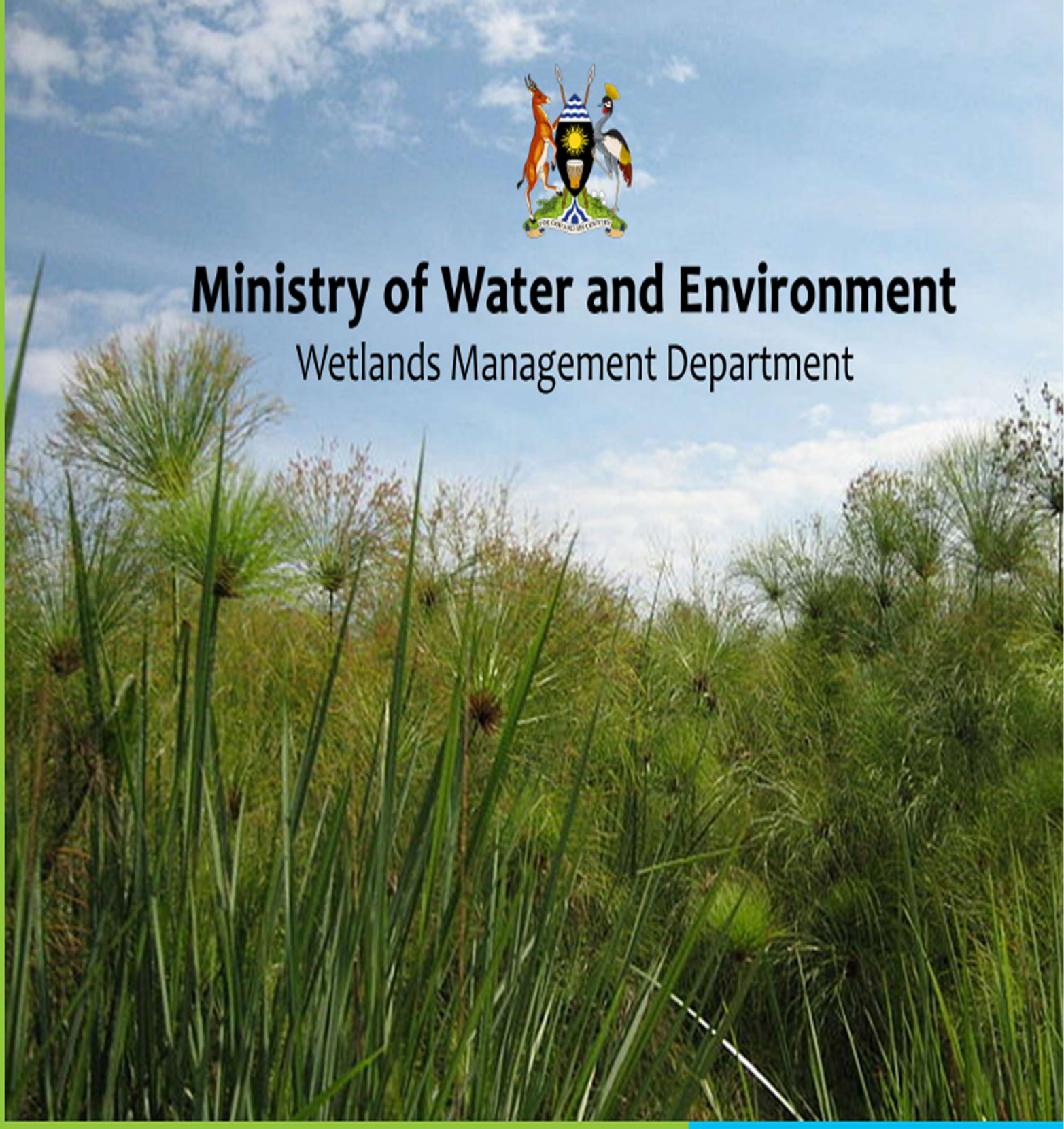

Ministry of Water and Environment

Wetlands Management Department

State of Wetland Report 2022

State of Wetland Report 2022

The State of Wetlands in Uganda 2022

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Foreword

Uganda is endowed with a vast coverage of wetland resources that provide a wide array of products and services. Wetland directly supports the livelihoods of about 4 million people in the country. Much as the wetlands are significant to Uganda's economy, there are also highly threatened by natural and artificial factors. Many wetlands, particularly those in urban Uganda are, however, getting degraded through infilling, construction, over-extraction, illegal agricultural and settlement activities. As a result, activities such as over-cultivation of wetlands and commercialisation of wetland resources reduces household diet diversity. To revamp the wetland ecosystem services and goods, there is a need by all concerned stakeholders to spearhead the protection of traditional rights of wetlands, domesticate commercially viable wetland resources and develop clean water sources for domestic use in areas adjacent to wetlands.

Uganda's Vision 2040 and NDP III emphasize the promotion of sustainable development through the preservation of natural resources such as forests and wetlands. This State of Wetlands report of 2022 comes at a time when there is increasing demand for information by many stakeholders to guide them in decision-making processes and light of the emerging issues of climate change, and oil and gas in the country. The peak period of wetland information is mostly during the development of annual sector performance reports, district development plans, contingency plans and during government/parliament meetings among others. 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. As a result, this will help monitor wetland cover changes; aid land-use planning and management; identify priority areas for conservation; promote awareness of wetland values and functions; stimulate discussions and cooperation amongst wetland resource stakeholders.

It is therefore my sincere hope that the information provided in this report if read will enrich your awareness about the state of wetlands in Uganda today, but most importantly guide all planning processes when needed. This will lead to a reduction in the continued degradation of these vital natural resources and hence contribute to the attainment of sustainable development in the country and region at large.

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 and those that have contributed to the generation of wetland data and information over the years.

I, therefore, endorse this report and wish you a good reading,

Hon. Cheptoris Sam
Minister of Water and Environment

Preface

This State of Wetland report 2021 is the second 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 the Central and Local government levels can base to make their decisions regarding wise use of wetlands.

The report presents wetland data and information in the mind of administrative levels in Uganda. The aim is to facilitate decision-making processes geared towards the attainment of Uganda's Vision 2040, NDP III and Parish Development Model. Thematically, the information in this report is structured in a way that the users can understand the broad characteristics of wetlands in Uganda, methodologies used to map wetlands, and the status of wetlands. Additional content is also provided on the drivers and impacts of wetland changes, and their associated interventions are undertaken in the country as of the 2020/21 financial year. This is based on the wetland user needs in the country and internationally. The development of this report kicked off in January and ended in November 2021. The activities undertaken included wetland mapping using satellite images, countrywide field visits, key informant interviews and national consultations. These were conducted to update the wetland dataset, generate new information on wetlands and modify the wetland nomenclature. A methodology and QGIS based plugin were developed to facilitate more accurate future mapping of wetlands in the country. Analysis of wetland information in this report is presented at national, regional and district levels purposely to facilitate planning initiatives. This information is also provided in wetlands designated as Ramsar sites.

The results in this report reveal that wetlands in Uganda continue to be threatened by natural and man-made drivers. The impacts are highly felt on biodiversity, land, hydrology and provisioning services. In response, the Ministry of Water and Environment working together with Local Governments has put in place mechanisms to demarcate and restore critical wetland systems as a key priority area to reverse these trends. It is therefore my sincere hope that this report will be utilised to inform wetland integrated planning, promote wetland wise-use, resource allocation and implementation of government programs at all levels.

Appreciation goes towards the Wetlands Management Department technical team, contributing authors and all the stakeholders that facilitated the development of this report.

Dr. Alfred Okot Okidi
Permanent Secretary
Ministry of Water and Environment

Acknowledgement

Wetlands Management Department under the Ministry of Water and Environment would like to thank all the development partners, government agencies and 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 the development and production of this report. Special thanks go to the Ugandan government that financially supported the development and compilation of 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, Dr. Bernard Barasa, Prof. Majaliwa Gilbert and Dr. Gabiri Geofrey for spearheading this process. Credit also goes to all contributors including Mr. Barugahare Vincent, Mr. Mr. Magara Nicolas, Mr. Wanyama Wilberforce, Mr. Afai Sylvano, Mr. Businge Daniel, Mr. Ssentongo Benard, Mr. Magaya Paul, Dr. Joshua Zaake, Mr. Arafa Kamoga, Mr. Adama Charles, Mr. Augustine Kooli and Dr. Diana Nalwanga Wabwire and finally Nature Uganda team that provided information on Birds.

List of Acronyms

CSO	Civil Society Organisations
CWMP	Community Based Wetland Management Planning
DEA	Department of Environmental Affair
DEO	District Environment Officer
DESSS	Department of Environment Services
DLG	District Local Government
DWRM	Department of Water Resources Management
EPPU	Environmental Police Protection Unit
ESA	European Space Agency
ESIA	Environment and Social Impact Assessments
FY	Financial Year
GCF	Green Climate Fund
GDP	Gross Domestic Product
GIS	Geographical Information Systems
GoU	Government of Uganda
GPS	Global Positioning Systems
LCCS	Land Cover Classification System
MAAIF	Minister of Agriculture, Animal Industry and Fisheries
MLHUD	Ministry of Lands, Housing and Urban Development
MoFPED	Ministry of Finance, Planning and Economic Development
MWE	Ministry of Water and Environment
NBS	National Biomass Study
NDPIII	National Development Plan III
NEMA	National Environmental Management Authority
PIP	Public Investment Plan
RIA	Regulatory Impact Assessment
SOP	Standard Operating Procedures
UBOS	Uganda Bureau of Statistics
UNDP	United Nations Development Programme
UNMA	Uganda National Meteorological Authority
WMD	Wetlands Management Department

Executive Summary

Introduction

Wetlands are a source of livelihood to the majority of Ugandans and hence directly contribute to National Development Plan III, Vision 2040 and attainment of the Sustainable Development Goals. However, wetlands are under a lot of pressure from conversion for industrial development, illegal settlements, intensified agriculture, and over mining of sand and clay. Most of these degrading activities are perceived to be of greater importance than wetland conservation itself.

This is an annual report compiled on the state of wetlands in Uganda as of 2022. The development of this report involved activities such as mapping wetlands using high-resolution satellite images, review of literature, holding key informant interviews, field visits and stakeholder consultations. This report takes stock of the current coverage of wetlands, drivers of wetland degradation and conservation interventions implemented. This knowledge is important in wetland resources planning and management from the national level to local governments through budgeting, enactment of policy reforms and livelihood enhancement.

It is against this background, that this report was developed to show the current status of wetlands, trends, drivers, impacts of wetland degradation and wetland interventions undertaken as of 2020/21/22 financial year. It is envisaged that this report will increase awareness and facilitate decision-making processes from community to national levels regarding wetland wise use and conservation.

Status and trend of wetlands

The coverage of wetlands in 1994 was 37,559.4km^2 (15.6% of Uganda's surface area) and 31,412.7km^2 (13% of Uganda's surface area) in 2015. While in 2021, the coverage of wetlands is 33,762.6 sq.km (13.9% of Uganda's surface area). While, between 2015 and 2021, the coverage of wetlands increased by 2,349.9 sq.km (0.9% of Uganda's surface area). This can be explained by intensification of wetland restoration interventions and increase in lake water levels (lake inundation).

Drivers and impacts of wetland degradation

The drivers of wetland degradation are categorized into physical/structural (construction of electricity transmission lines, roads, valley dams, soil erosion, burning of wetland vegetation); 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, planting eucalyptus trees and introduction of excessive nutrients from agriculture); institutional (unclear land tenure, political interferences, unplanned urbanization and settlements). Consequently, the observed and reported impacts of wetlands degradation on ecosystem services are 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

Uganda's wetlands can offer a strong base for the increment of Gross Domestic Product on the condition that those degraded are restored, while the intact ones continue to be conserved. For this purpose, the interventions undertaken by stakeholders include demarcation of critical wetlands, cancellation of land titles acquired in wetlands, wetland restoration, compliance monitoring and enforcement, development of wetland management plans, development of wetland wise use demonstration sites and diversification of livelihoods.

Challenges in wetlands management

The major challenges facing the management of wetland resources in Uganda include the resistance of wetland encroachers to vacate wetlands due to uncoordinated enforcement by the relevant institutions, delayed and intermittent release of funds for implementing planned outputs and activities, lack of sustainability of the interventions, lack of preposition of alternative sources of income, inadequate human resource to effectively undertake planned outputs and activities and political interventions at all governance levels.

Recommendations

This report proposes the following recommendations:

1. There is also need to harmonise the planning and implementation of all activities in and around wetlands
2. The need to incentivize conservation of wetlands needs to be explored so that those who conserve their resources are rewarded with incentives
3. There is an urgent need to fast track gazettement of wetlands
4. Strengthen research on inland and transboundary wetlands

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A swamp forest in bwizibwera wetland in Kibaale District

1. Chapter One: Overview of Wetlands in Uganda

1.1 Introduction

Globally wetlands occupy about a minimum of 1.5-1.6 billion hectares (GWO, 2021). Wetlands are important as they contribute to biodiversity, climate mitigation and adaptation, freshwater availability, world economies and more (Convention on Wetlands, 2021). In

Definition of 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”. This definition was further customised into Uganda’s context of wetlands by the Uganda’s National Policy for the Conservation and Management of Wetland Resources (1994) by defining wetlands as “areas where plants and animals have become adapted to temporary or permanent flooding”.

Uganda, occurrence and re-occurrences of wetlands is highly dependent on natural factors, such as lakes, rivers, valleys and rainfall patterns. These determine seasonal or permanent water logging, but also adaptability of wetland biodiversity. On appearance, the wetlands can be further described as, swamps, dambos, areas of marsh, peatlands, high-altitude mountain bogs, as well as flood plains and grasslands.

Wetland in Uganda are a rich source of ecosystem services and supplies. They provide direct and indirect ecosystem services, such as raw materials (i.e., papyrus, sand, clay); food sources (i.e., as fish, yams, vegetables, wild game) and services (i.e., water regulation, aesthetic value etc). For instance, Nabugabo wetland buffers Lake Nabugabo against surface runoff from the catchment, while Nakivubo and Kirinya wetlands provides a water treatment function for wastewater from Kampala City and Jinja town respectively (Kansiime et al., 2007). The supply of services is as a result of wetland network of healthy floating and emergent vegetations that are able to filter wastewater. All these have a bearing on the health of biodiversity species and food security of adjacent communities. In biodiversity conservation, there are rich habitats for flora and fauna. For example, Rushebeya-Kanyabaha wetland is futile habitat for Sitatungas. Plant leaves in wetland act as a source of food, much as they also invade adjacent croplands (Tweheyo et al., 2010). The wetlands are further habited by local and migratory birds, reptiles, amphibians and plants, such as *papyrus*, *Phragmites*, *Miscanthidium.* The conducive climate, wetland resources, and conservation efforts by government have sustainability of availability of biodiversity.

Despite the importance of wetlands, there are the most threatened ecosystems, impacting 40% of the world's plant and animal species that live or breed in wetlands (IPBES, 2019). Much as Uganda's wetlands are lately able to supply ecosystem services, there are highly threatened by natural and anthropogenic threats. For example, the notable threats include drought, bush burning, over extraction of wetland resources, development of infrastructural development and unsustainable farming methods among others. These have continued to affect Uganda's wetland systems, principally because of limited funding allocated to monitor wetlands, high poverty rates, high population growth rates and absence of physical development plans among others. Therefore, if these activities remain unchecked, the threat levels of Uganda's wetlands are likely to increase further, and the implication is that, the country is more likely to loss more wetlands in the near future.

Plate 1: Sezibwa wetland system

To curb the threats, the policies related to wetland management in Uganda are informed by the international conventions on wetlands (i.e., Ramsar Convention, Convention on Wetlands of International importance etc); national legal and policy framework, such as, the Constitution of Uganda (1995), Land Act (1998) and wetland user guidelines among others. Reforms are always proposed and tabled in Parliament for enactment, such as, the Wetland Bill which is under review. For Uganda's cases, the Ministry of Water and Environment through

the Wetlands Management Department is mandated to protect and conserve wetlands on behalf of Ugandans. The management services are further decentralized at regional (Eastern, Northern, Central and Western), and local government levels to facilitate coordination and monitoring of wetland resources. It is worth to note, that the availability of community-based natural resource management programmes has also facilitated the conservation and management wetlands in the country. These have promoted the principle wise use of wetlands and holistic engagement of communities in conservation efforts.

1.2 Objectives of this Report

The objectives of developing this State of Wetlands Report of 2022 were:

1. To update the wetland spatial dataset and class nomenclature
2. To assess the state (physical, biological and chemical) and trend of wetland changes over time
3. To examine the drivers and impacts of wetland degradation in Uganda
4. To ascertain the wetland intervention measures implemented and associated challenges faced in the country

1.3 The Scope of this Report

This report has been developed purposively to provide and update on the state of wetlands in Uganda. As such, the activities that have been undertaken include mapping wetlands using satellite images. The images used are freely available online and have a high temporal resolution. The utilized images also had a better spatial resolution compared to what had been used previously to define wetland boundaries and their associated classes. The results from the mapping exercises were used to define the state of wetlands as of 2022, while the wetland data of 2015 was used to demonstrate the trend of wetland changes over time.

This report further reveals the drivers and impacts of wetland degradation at different levels, such as the national, regional and district levels. It also provides evidences at drainage basins and Ramsar site levels. This is informative since the management of wetlands is apparently decentralized in the country, to facilitate monitoring and conservation. It is also imperative to note, the report captures both inland and transboundary wetlands. This was done to facilitate resource information sharing and collective mobilization of communities and resources geared towards the conservation of these wetlands. This wetland report of 202 has been compiled between 2022 and 2023. Within this time, the activities that took place included: collection of satellite data, image interpretation, field visits and validation of the report by the stakeholders from 19th to 20th December 2022 at the Ministry of Water and Environment headquarters.

1.4 Purpose of this Report

The general purpose of this report is to provide evidence of the current state of wetlands in the country. We envisage that this information will help increase awareness of wetland values and conservation, but also it can be used to mobilize resources that can be put to use to conduct wetland inventories and conservation measures. Presentation of state of intact and degraded wetlands is vital to inform budgetary allocations at national and district level activities geared towards monitoring and restoring degraded wetlands. Wetland statistics provided in the report should be referred to

inform the budgeting processes. Lastly, it is also anticipated that this report will inform current and planned wetland research activities that aim at collecting more data on wetland inventories, implementation of sustainable restoration technologies and effective community engagement in wetland management among others especially on the wetland systems to be studied.

1.5 International and National Legal Frameworks Wetland Management

1.5.1 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.

1.5.2 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, gazettement 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.

1.5.3 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.

National Agriculture Policy, 2013: The overall objective of the agriculture policy is to achieve food and nutrition security and improve household incomes through coordinated interventions that focus on enhancing sustainable agricultural productivity and value addition; providing employment opportunities, and promoting domestic and international trade. Agriculture is the major livelihood activity undertaken in wetlands through smallholder farming. Therefore, this policy agitates for wise use of wetlands, while maintaining their integrity.

The National Policy on disaster preparedness and Management (2010): whose overall goal is to promote national vulnerability assessment, risk mitigation, disaster prevention, preparedness, effective response and recovery in a manner that integrates disaster risk management with

development planning and programming. This approach will ensure people of Uganda build capacities that would enable them minimise serious social and economic disruption as a result of disaster events. Wetland degradation has been reported as the major cause of floods and droughts, and therefore, this policy aims to conserve wetlands so that vulnerability to these risks is reduced.

Fish Act CAP 197**:** makes provision for the control of fishing, the conservation of fish, the purchase, sale, marketing and processing of fish and matters connected with these activities. Therein are provisions on restrictions (Part II), licences (Part III), and legal proceedings (Part IV) for the control of fisheries in Uganda. The Fish Act has provisions for the management and control of fisheries activities that are undertaken in wetlands in Uganda.

The National Environment (Standards for Discharge of Effluents into Water and on Land) Regulations, (1999): The issue of discharge of effluents from various activities in the catchment is important and should be adequately managed for the protection of water resources and other related natural resources. These regulations inform the stakeholders on effluent discharge compliance requirements and will protect the environment from pollution. *The National Environment (Waste Management) Regulations, 1999.* The regulations apply to all categories of wastes and provides for management best practices.

Wetland User Guidelines

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

1.6 Wetland Governance in Uganda

Wetland management is essential because of its role as a promoter of conservation and wise use of wetlands. The Ministry of Water and Environment through the Wetlands Management Department is mandated to protect and conserve wetlands on the behalf of Ugandans. The other key partners in the management of wetlands in Uganda include the National Environmental Management Authority, Ministry of Lands, Housing and Urban Development, District Land Boards and Area Land Committees, District Wetland/ Environment Officers and Lower Local Government Councils (Table 1).

Furthermore, as a signatory to the Ramsar convention, Uganda also has a lean structure as provided for under the convention. This includes the Administrative Authority, the National Focal point, the Communication Education Participation and Awareness focal persons for both Government and the NGOs (currently Nature Uganda) and lastly the representative of the Scientific and technical panel review. These are responsible for the operationalisation of the Ramsar Convention in Uganda.

Table 1: Mandates of key players in Wetland Management

Entity	Roles and responsibilities
Wetlands Management Department	a. Maintaining an up-to-date inventory for wetlands b. Promoting the wise use of wetlands c. Developing wetland policy, guidelines, standards and legislation; d. Sensitisation of the public on the importance of wetlands; e. Restoration and protection of wetlands. f. Technical backstopping and capacity building of local governments g. Monitoring and supervision h. Compliance monitoring and enforcement i. Reviewing environment and Social Impact Assessments (ESIAs) and Environment Audits (EAs) for projects in or around wetlands;
National Environment Management Authority	a. Review and approve all ESIAs countrywide, including projects in wetlands; b. 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; c. Conduct periodic inspection and monitoring of wetlands and enforce compliance to the wetland legislation; d. 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	a. Issue all land titles countrywide and ensure none are issued in wetlands; b. Cancel titles erroneously issued in wetlands; c. Develop countrywide base maps indicating land available for titling, and that which is not, such as wetlands.

Entity	Roles and responsibilities
District Local Governments	1. Conduct due diligence on applications for titles within the Local Government to ensure titles are not issued in known wetlands. 2. Assist District and Local Environment Committees to conserve wetlands within their locality and enforce legal compliance. 3. Ensure activities in the catchment area of wetlands do not affect the water level of the wetland. 4. Authorise research activities in a protected wetland. 5. Formulate by-laws, guidelines and directives for management of wetlands. 6. 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

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Cycads in The River Mpanga Gorge in the L.George ramsar site in Kitagwenda district

2. Chapter Two: Wetland Characteristics and Values

2.1 Introduction

This chapter describes the unique wetland soils including peatlands and wetland hydrology. Uganda's peatlands coverage places it as the second in the Nile basin after South Sudan. The chapter also characterises the diverse wetland vegetation species and fauna that inhabits either seasonal or permanent wetlands. The chapter provides the contribution of wetlands regarding the supply of ironic and diverse ecosystem services to communities' survival and biodiversity.

2.2 Physical and chemical characteristics

2.2.1 Wetland Soils

Wetland soils are hydric soils, which are defined as "soils that are formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part". Generally, wetland soils can be classified into three broad categories: (i) Soils permanently inundated with water above the soil surface; (ii) Saturated soils with the water table at or just below the soil surface and (iii) Soils where the water table depth is always below the surface. These soils can also be characterised by acidification, level of organic matter, nutrient content, cation exchange capacity, soil texture and levels of trace elements. The wetland soils differ from terrestrial soils in that they are anaerobic. The absence of oxygen produces characteristics, especially differences in soil color and texture that are uniquely different from aerobic, terrestrial soils. In anaerobic soils, a shift in microbial metabolism occurs, from one of aerobic, oxygen-driven metabolism to one driven by other energy-producing compounds. The soils that dominate Uganda's wetlands are classified as Gleysols, Petric Plinthosols, Vertisols, Gleyic Arenosols, Luvisols and Histosols, while Calcisols are the least (Figure 1).

Wetland soils are unique, with patterns and processes characteristic of both upland (oxidized) soils and aquatic (reduced) sediments that vary spatially and temporally. Periodic to continuous inundation and saturation drives a number of aerobic and anaerobic microbial processes that provide critical ecosystem functions and services, including water quality improvement through denitrification and cycling of carbon and greenhouse gases, Carbon dioxide and Methane. Because of their often-high plant productivity and slow rate of decomposition, wetland soils are an important global sink for carbon. The variable physical (texture, bulk density) and chemical (pH, redox potential) properties of wetland soils affect the ability of wetlands to perform these ecosystem services and act as carbon and nutrient sinks. The fringes of valley bottom wetlands in Uganda are majorly composed of high clay, organic matter and bulk density content (1-1.37g/cm3), while riparian zones have high variations of soil moisture (41.8±8.5%) (Gabiri et al, 2020). This is attributed to topography especially very steep hills with V or U-shaped valleys and high rainfall amounts received that sustain soil saturation (Schepp et al., 2022). Further, the properties of wetland soils are influenced by high above-ground biomass content (Odeke, 2019).

Depending on their locality, wetland soils are either contaminated or not. Scientific studies in Uganda (Dalahmeh et al., 2020; Namaalwa et al., 2020) reveal that urban wetlands are highly contaminated with heavy metals (i.e., lead, zinc, cadmium) due to pollution from point and non-point sources. Pollutants originate from wastes from multiple industrial sources and poorly managed agricultural

fields. For example, nitrates end up in wetlands due to interflow and surface runoff. These affect aquatic ecosystems because of their persistence and lethal toxicity levels beyond the carrying capacities of fatigued wetlands. As result, the wastes increase toxicity levels of wetland soils by altering their properties and deforming the structure. They also lead to loss of soil biodiversity and high sediment mobilisation. Besides, pollution, the quality of wetland soils is also undermined by to poor agronomic practices and unsustainable practices (i.e., dumping of murram, burning, over exploitation of resources, solid waste disposal etc). Wetland soils are drained which leads to reduction of organic matter and soil pH, but more impacted is the soil structure.

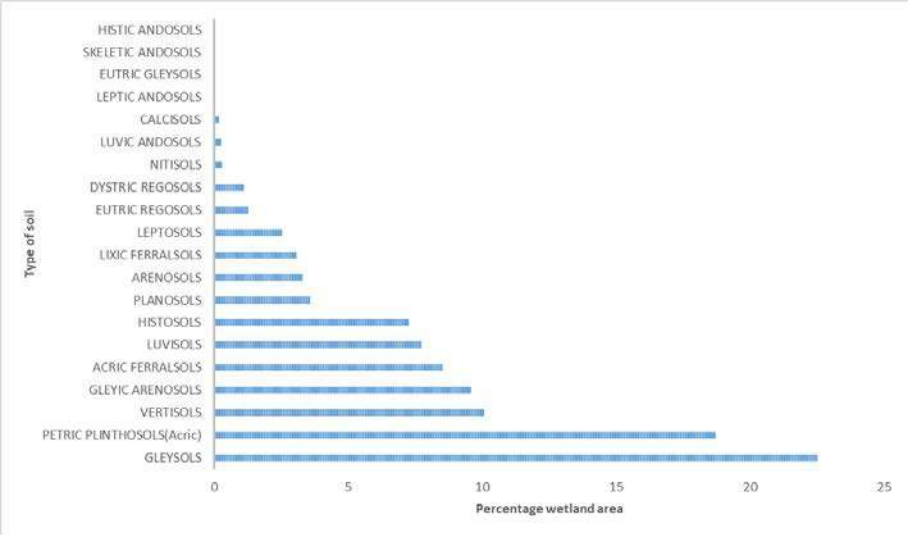


Figure 1: Soil classification in Uganda's wetlands

2.2.2 Peatlands

Peatlands are areas of land, habitats, supported by a naturally accumulated layer of peat. Peat soils are formed from carbon rich, dead and decaying plant material under waterlogged conditions. The ecosystems are characterized by the unique ability to accumulate and store dead organic matter from Sphagnum and many other non-moss species, as peat, under conditions of almost permanent water saturation. Peatlands are adapted to the extreme conditions of high water and low oxygen content, of toxic elements and low availability of plant nutrients.

Plate 2: Peatland in Lake Nakivali basin

Peatlands offer living spaces for millions of people and support livelihoods of many communities. They are also important ecosystems for a wide range of wildlife habitats supporting important biological diversity and species at risk, freshwater quality and hydrological integrity, carbon storage and sequestration, and geochemical and palaeo archives. In addition, they are inextricably linked to social, economic and cultural values important to human communities worldwide. Their total carbon pool exceeds that of the world's forests and equals that of the atmosphere. Peatlands are used by many stakeholders for agriculture, forestry, fuel production, industry, pollution control, recreation,

tourism, nature conservation and scientific research, while also supplying for the needs and life support of local communities and many indigenous peoples.

Uganda's peatlands coverage places it as the second in the Nile basin after South Sudan. Uganda has a total peatland area of 6,878 Sq.km with the largest areas located in extensive valleys that end in Lake Kyoga, and around Lake Victoria. The peatland coverage represents a carbon content of 0.075 kg/m^3 and have a carbon stock estimation of 192 Mtons (Figure 2). As a consequence, any human influence on peatlands, or their surrounding landscape, can affect their form and function. This necessitates an integrated environmental impact assessment approach prior to approval of any development affecting peatlands

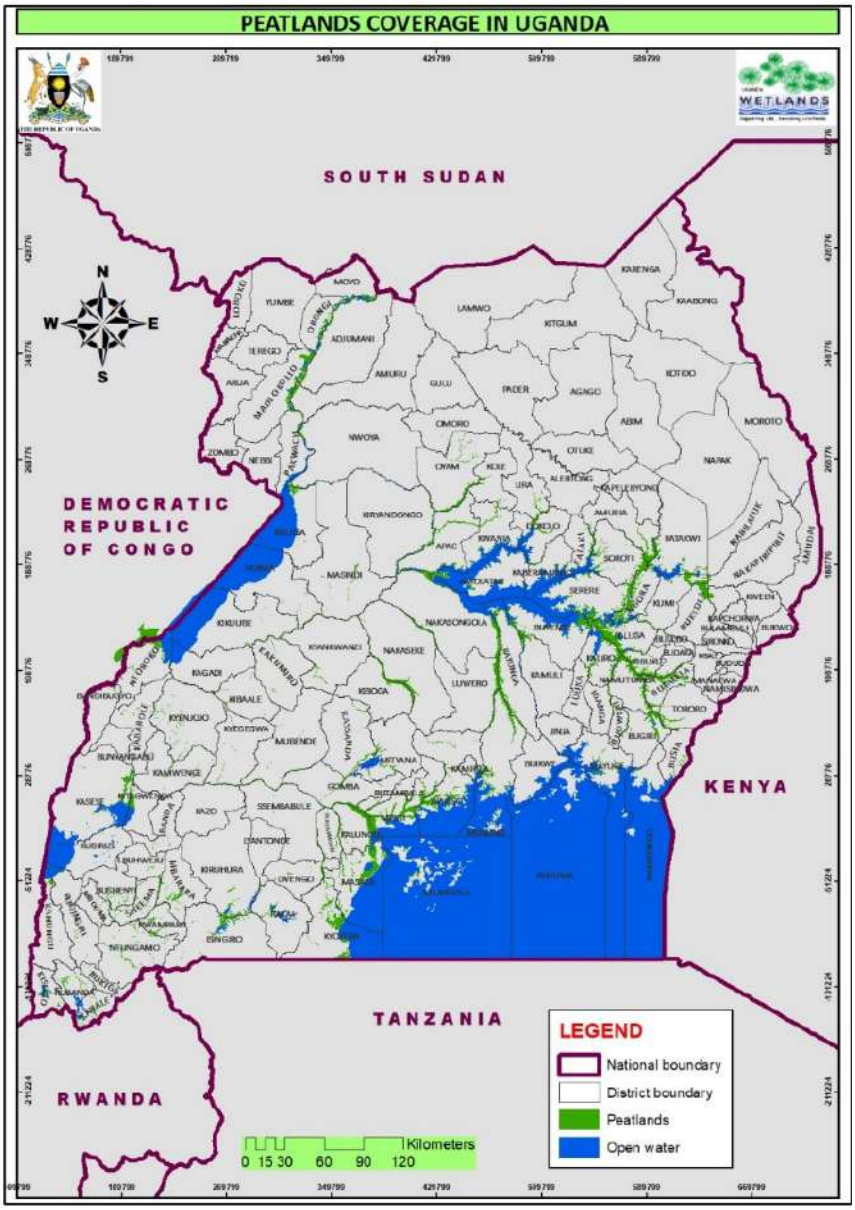


Figure 2: Peatland hotspots in Uganda

2.2.3 Wetland Hydrology

Water budget in wetlands is highly influenced by channel flow (99.7%), direct precipitation and ground discharge with 0.2% and <0.1%, respectively (Kayendeke & French, 2019), but also lateral flow (Gabiri et al., 2019). Water in wetlands is sustained by wetland and rainfall characteristics, such as hydro period, morphology, vegetation, and depth of wetland bed. In intact wetlands, they have a slower rainfall–runoff response, smaller peak runoff discharges, lower rainfall-runoff ratios and significantly smaller suspended sediment concentrations (Ryken et al., 2015). However, wetland hydrological dynamics are largely influenced by natural and anthropogenic factors. Changes in climate, have caused delayed or early onset of rainfall patterns, and more threatening, prolonged droughts. The man-made illegal disturbing activities to discharge in wetlands, include burning, establishment of drainage channels, over extraction of water and intensive farming activities. The peak of these disturbances is responsible for increment in reclamation, cracking of soil structure, loss of aquatic life, and increased emission of methane. This is harmful to the supply of wetland ecosystem services and biodiversity survival at large.

The quality of water in wetlands also differs from one wetland to another. In Papayo wetland system in Eastern Uganda (Pallisa District), turbidity, colour, total phosphorus, nitrogen, suspended solids and chemical oxygen demand were the most affected water quality properties by wetland degradation especially from rice cultivation and tree planting (IUCN, 2020). Nutrients (N and P) enter wetlands mainly through stream flow and runoff from surrounding adjacent areas (Kansiime et al., 2007). The water in most wetlands has a neutral pH which ranges from 6.5-7.0, although the water from the underground springs is slightly acidic (MWE, 2020). In return, the deterioration of water quality in wetlands trigger a high burden of diseases, including water-borne disease in the communities adjacent to the wetland and loss of biodiversity (Dalahmeh et al., 2020). Restoration is the only sustainable option to mitigate wetland water quality deterioration challenges currently faced in the country.

Plate 3: Opened drainage channel in Kanoni wetland system, Buhweju District

Case Studies: Wetland Streamflow Analysis in Eastern and Western Uganda

In Eastern Uganda, the wetlands that receive high discharge (340.54 m^3/s and above) are Namakale (181 m^3/s) and Lemwa-Namatala (87m^3/s) followed by Nakwansi (74 m^3/s), Limoto (63 m^3/s) and Namakole (40 m^3/s). Discharge is projected to increase in these particular wetlands between 5- and 100-year return periods, though intense peaks will be experienced in the 5–10-year return periods.

Peak flows (m3/s) into the wetland basins at various return periods for Eastern Uganda

Return Period, T (years)	Lemwa Namatala flow (m^3/s)	Limoto flow (m^3/s)	Limoto-Lemwa flow (m^3/s)	Bukedea flow (m^3/s)	Namakole flow (m^3/s)
5	87.72	63.01	14.56	14.16	40.80
10	106.52	17.68	17.20	49.54	106.52
25	130.27	93.58	21.63	21.03	60.59
50	147.90	106.24	24.55	23.88	68.79
100	165.39	118.80	27.45	26.70	76.92
Return Period	**Ngora flow (m^3/s)**	**Nakwasi flow (m^3/s)**	**Tororo flow (m^3/s)**	**Namakale flow (m^3/s)**	**Balimuka flow (m^3/s)**
5	7.26	74.52	2.20	181.04	39.76
10	8.81	90.80	2.68	227.77	50.02
25	10.78	111.37	3.28	286.82	62.99

Plate 4: Contaminated water due to gold mining ore washing Ngoro wetland

Plate 5: A hydrological monitoring station along

2.3 Biological Characteristics

2.3.1 Wetland Vegetation

Wetland plants are defined as those species normally found growing in wetlands of all kinds, either in or on the water, or where soils are flooded or saturated long enough for anaerobic conditions to develop in the root zone. Wetland plants are often the most conspicuous component of wetland ecosystems. They are also referred to as *hydrophytes*, *macrophytes*, and *aquatic plants*. Wetland plants are, with a few exceptions, angiosperms, or flowering plants. Peatlands are inhabited by a number of moss species (Bryophyta).

Wetland water regime variation is a key component in the development and survival of wetland plants in Uganda. Seasonal wetlands are dominated by grasslands, thickets and shrubs (common in eastern and northern parts of Uganda), while the permanent wetlands host water loving plants such as papyrus, marshes, palms and phragmites (common in Central and Western Uganda). Other factors include levels of wetland encroachment, invasive species, topography and climate change impacts. The survival of wetlands has existed over years in intact wetlands and low in degraded wetland ecosystems especially in Eastern Uganda. The wetland plants are threatened by illegal activities such as burning, wetland cultivation, brick making, sand mining and over extraction of water among others. Wetland plant regeneration and colonisation have happened after rains and flooding in wetlands. Water levels and hydroperiod influence the distribution and succession of wetland plants. However, the wetland plants have adopted to these conditions by elongating stems, and developing shallow root systems.

Plants in wetlands are vital in sustaining food chains, habitats for taxonomic groups, such as bacteria, epiphyton (algae that grows on the surface of plants), and macroinvertebrates, fish, and birds. There are also a source of raw materials, food and medicine to local communities. Apparently, the wetland plants that are highly threatened are those found in Ramsar sites, urban wetlands and Uganda's cattle corridor. The wetland vegetation species found in Uganda's wetlands can be categorised as trees, shrubs, herbs grass, sedges and water weeds. These are provided in Table 2 below.

No	Category	Common vegetation species
1	Trees	*Acacia drepanolobium, Sclerocarya birrea (Etoboco in Ateso), Crateva adansoni, Balanites aegyplica, Acacia sieberiana, Acacia nilotica, Acacia polyacantha, Eucalyptus sp., Pinus sp., Ficus sp. Vernonia amygdalena, Tamarindus indica, Albizia coriaria, Milicia excelsa, Ficus mucuso, Mangifera indica*
2	Shrubs	*Mimosa pigra, Harissonia abyssinica, Flueggea viriosa, Caparis tomentosa, Cadaba farinose, Acacia drepanolobium, Portulaca sp., Lantana camara*
3	Herbs	*Solanum incanum, Cissus sp., Senseveria sp., Scadoxus multiflorus, Hibiscus vitifolius, Sesamum calycinum, Cyphostema nodiglandolosum, Hoslumdia opposite, Asparagus flagellaris, Conyza floribunda, Leonotis nepetifolia, Acanthospernum hispidium, Aspilia sp., Soda cordifolia, Borreria pusilla, Satureia pseudosinensis, Bidens Pilosa, Tagetes minuta, Senna occidentale, Cynoglossum amplifolium, Cirsium vulgare*
4	Grasses	*Cynodon dactylon, Sporobolus pyramidalis, Hyperthelia desoluta, Agave sisalaca, Miscanthus violaceum, Vossia cuspidate, Typha latifolia, Digitaria scalarum, Digitaria velutin, Leersia hexandra, Eragrostis ciliaris, Eragrostis exasperata, Imperata cylindrica, Dactyloctenium aegyptica.*
5	Water weed	*Limnophyton obtusifolium, Nymphaea caerulea.*
6	Sedges	*Cyperus papyrus*
7	Food crops	*Oryza sativa, Eluesine coracana, Sorghum bicolor*

Table 2: Wetland vegetation types in Uganda

Plate 6: Typha in Buhweju district

Plate 7: Floating Papyrus on River Nile Adjumani District

2.3.2 Wetland Fauna

Wetlands are habitats for endangered and threatened animal species. The availability of wetland fauna in Uganda is dependent of water regime, vegetation diversity and abundance and encroachment. The abundance and diversity of wetland fauna is slightly high in Ramsar Sites, though threatened. The major threats include wetland cultivation, infrastructural development, invasive species, urbanisation, pollution, poor waste disposal, burning and drainage. Wetland fauna in Uganda is classified as: amphibians, reptiles, birds, insects, mammals and fish. These are examined below:

Amphibians

Over 100 amphibian species are now documented or predicted for Uganda (WCS, 2016; Amphibiaweb, 2022), while over 200 reptilian species are predicted for or have been recorded (WCS, 2016; Reptile Database of the World, 2022). These are common inhabitants of the littoral and ecotone zones of lacustrine ecosystems. The commonest species are: *Afrixalus quadrivittatus* (Four-lined Spiny Reed Frog), *Hyperolius kivuensis* (Kuvu Reed Frog), *Hyperolius viridiflavus* (Common Reed Frog), *Hoplobatrachus occipitalis* (Crowned Bullfrog), *Phrynobatrachus natalensis* (Natal Dwarf Puddle Frog), *Ptychadena nilotica* (Nile Grass Frog) and *Sclerophrys regularis* (African Common Toad). Others include *Hyperolius balfouri* (Balfouri's Reerd Frog), *Leptopelis bocagii* (Bocage's Tree Frog), *Amnirana albolabris* (Forest White-lipped Frog), *Amietia nuttii* (Nutti's River Frog) and *Xenopus victorianus* (Victoria Clawed Frog). Nearly almost of the amphibian species recorded in Uganda are of Least Concern (LC) globally and nationally according to the IUCN Red list (IUCN, 2022; WCS, 2016).

Reptiles

Reptile species that are common in Uganda's wetlands include *Acanthocercus ugandaensis* (Uganda Blue-headed Tree Agama), *Trachylepis maculilabris* (Speckle-lipped Skink), *Trachylepis striata* (Striped Skink) and *Naja subflava* (Forest Cobra); while others are *Varanus niloticus* (Nile Monitor Lizard), *Boaedon fulginosus* (Brown House Snake), *Crotaphopeltis degeni* (Yellow-flanked Snake), *Natriciteres olivacea* (Olive Marsh Snake) and *Philothamnus battersbyi* (Battersby's Green Snake), and tortoise. Majority of reptiles in wetlands are recorded as both globally and nationally of Least Concern (LC) (IUCN, 2022; WCS, 2016).

Birds

Uganda's wetlands host both local and migrant birds. The country hosts 998 bird species (Landbirds 858, Migratory 236, Breeding Endemic 1, Seabirds 9, and Waterbirds 140). Of these 33 are globally threatened birds, 4 are critically endangered, 13 endangered, 16 vulnerable, 21 near threatened and 944 with least concern (BirdLife International, 2022). The number of Important Bird and Biodiversity Areas (IBA) are 34, which total to 1,899,721 hectares. The Endemic Bird Areas are only 6 (Figure 3).

Plate 8: Crested Cranes in Sheema District

The most predominant bird species that are nearly threatened include *Balearica regulorum* (Grey Crested crane), *Laniarius mufumbiri* (Papyrus gonolek), *Ardea melanocephala* (Black-headed Heron) and *Microcarbo africanus* (Long-tailed Cormorants) while the vulnerable bird species are the *Bubulcus ibis* (Cattle egret). Since 1990s, the birds that have reduced in number are White-winged Terns, Grey-headed Gulls and Grey Crowned Crane, while the species that have maintained or increase in number include Pied Kingfishers, Shoebill and Egyptian Geese (Figure 4Figure 5Figure 6Figure 7Figure 8-Figure 9).

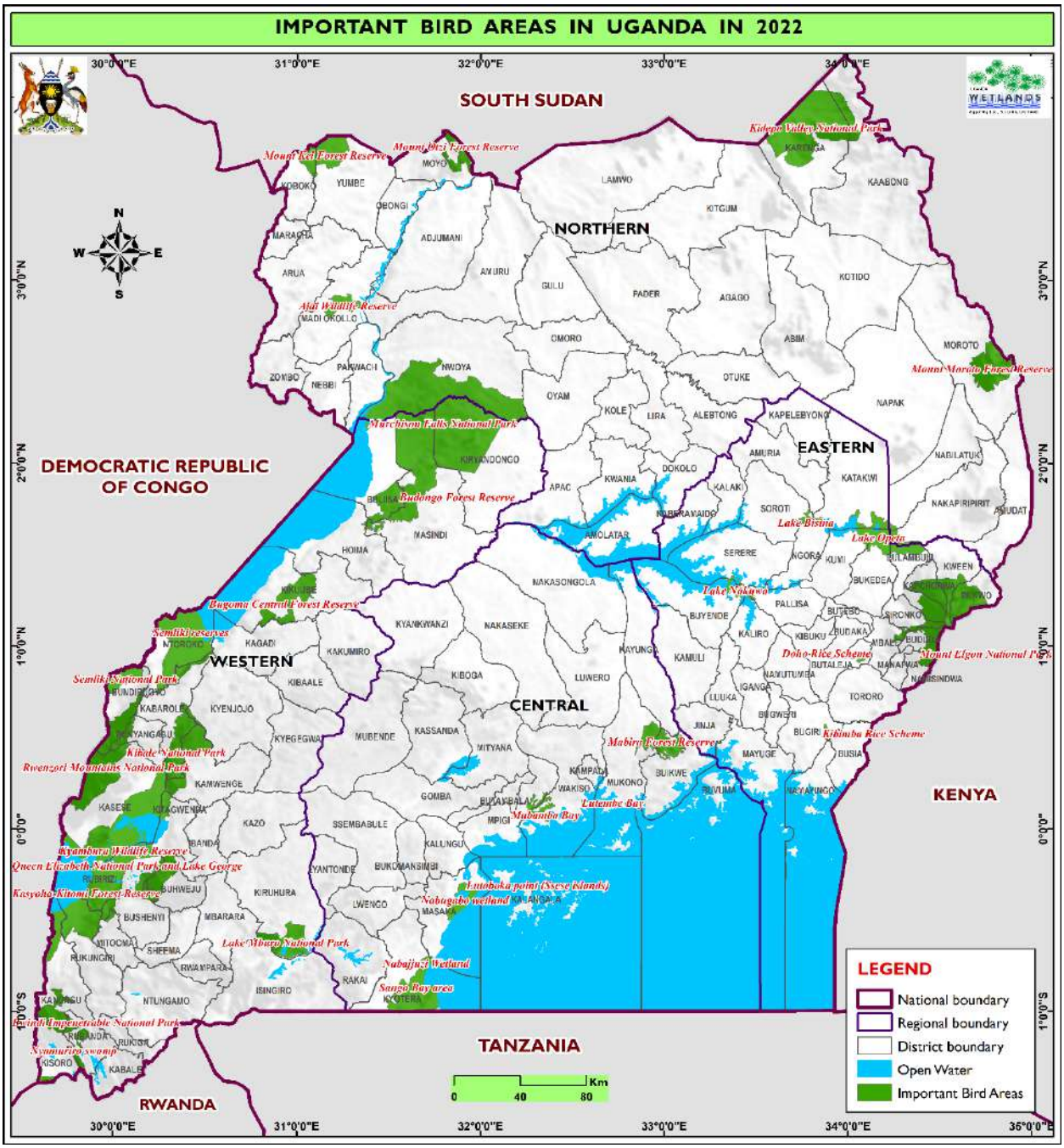


Figure 3: Important Bird Areas in Uganda

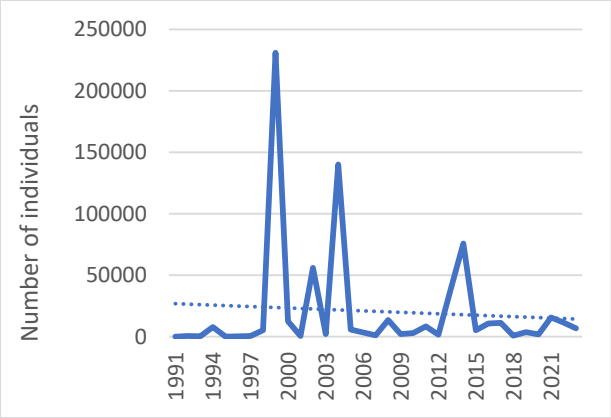


Figure 4:. Numbers of White-winged Terns in IBAs over time

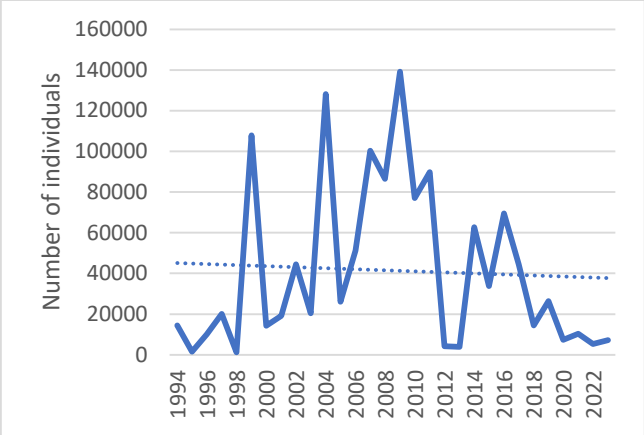


Figure 5: Numbers of Grey-headed Gulls in IBAs over time

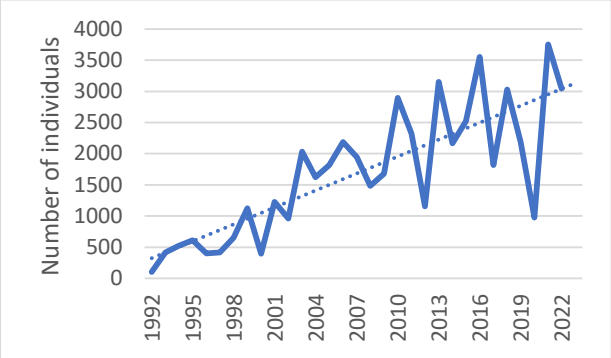


Figure 6: Numbers of Pied Kingfishers in IBAs across years

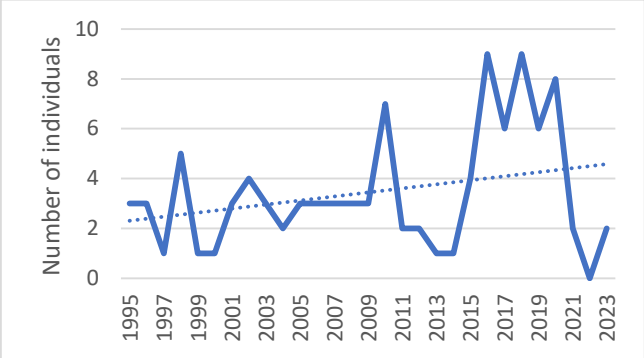


Figure 7: Numbers of Shoebill records in IBAs over time

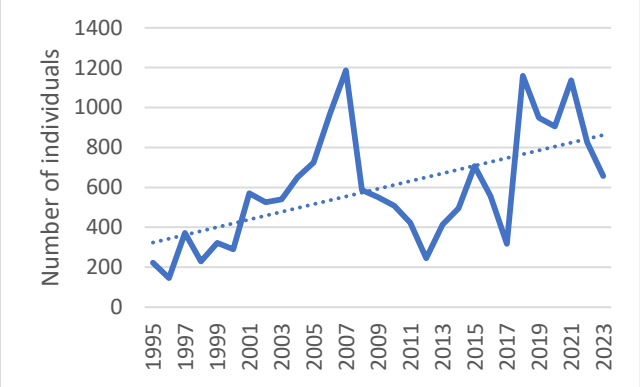


Figure 8: Numbers of Egyptian Geese in IBAs over years

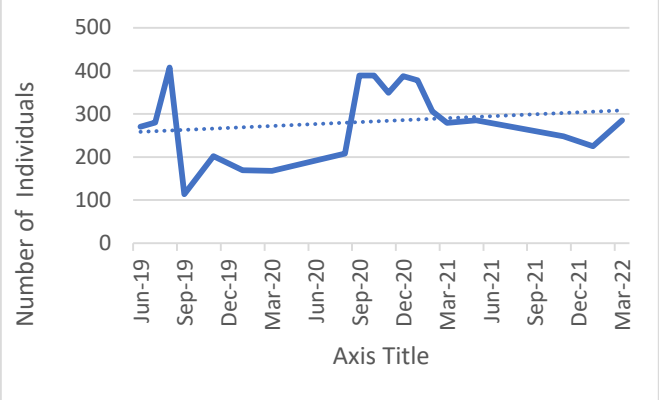


Figure 9: Numbers of Grey Crowned Crane recorded along 20km transect in Kabale and Rubanda

Insects

The most common insects include Crickets, Wasps, Dragon flies, Bees, and butterflies. In Uganda's wetlands, majority of dragon and butter flies are recorded as both globally and nationally being of least concern according to IUCN Red List. For the dragon flies, one of the globally vulnerable species is the *Agriocnemis paleaforma* species. The critical threats to the survival of insects include continuing decline in area, extent and/or quality of habitats, severely fragmented populations, continuing decline of mature individuals. Wetlands also are inhabited by invertebrates like snails, and earthworms.

Mammals

The small mammals found in Uganda's wetlands (Rodentia) include *Aethomys hindei, Grammomys dolichurus, Lophuromys sikapusi, Mus minutoides, Mus-triton and Praomys jacksoni*. The large mammals found in Semagimbi wetland for example are displayed in Table 3. Majority of small mamals (rodents and shrews) are not listed globally by IUCN (2022) not at country level (WCS 2016) as threatened species. However, the larger mammal species found in Uganda's wetlands that are listed include

1. The Spot necked otter *Hydrictis maculicollis* is listed as Near threatened and Endangered at the country level
2. The Uganda Mangabey *Lophocebus ugandae* is listed globally as Near threatened (WCS 2016) and as Vulnerable at the Country level

Table 3: Large mammals found in Semagimbi wetland (Source: MWE, 2022)

Order	Family	English name
Artiodactyla	Bovidae	Bushbuck *Tragelaphus scriptus*
Carnivora	Canidae	Side-Striped Jackal *Lupulella adusta*
	Felidae	Serval cat *Leptailurus serval*
	Herpestidae	Marsh mongoose *Atilax paludinosus* Large grey mongoose *Herpestes ichneumon* Slender mongoose *Herpestes sanguineus* Banded mongooses *Mungos mungo*
	Mustelidae	Spot necked otter *Hydrictis maculicollis*
Primates	Cercopithecidae	Red-tailed monkey *Cercopithecus Ascanius* Ugandan Mangabey *Lophocebus ugandae* Vervet Monkeys *Chlorocebus pyerythrus*

Fish

The most common fish species harvested in Uganda's wetlands include Tilapia, Mudfish, Lungfish, Oreochromis Niloticus (Nile Tilapia). The harvested fish offers potential for livelihood and nutritional value to households.

2.4 Wetland Values and Livelihood Support

2.4.1 Wetland Values

Wetland values are exceedingly dependent on size and ecosystem properties. The values are either direct or indirect, such as water regulation, food provisioning and biodiversity support among others. These values are critical for the survival of life and economies. For instance, wetland plants and sedimentation of organic nitrogen play a key role in the removal of nitrogen (Kayima & Mayo, 2020). Wetlands are also a large store of water ($7.0 \pm 1.3\ m^3$), carbon (0.5 ± 0.04 M t) and water vapour ($40 \pm 180\ k\ m^3\ y^{-1}$), but also sink carbon (Langan et al., 2019). Nalule (2023) observed that in Mende and Mabamba-Bay wetlands in Wakiso District, the main direct use-values include sand mining (73.8%), crop cultivation (71.2%) and domestic water (60.3%). While the indirect uses included water purification (66.6%) and climate regulation (63.1%). The non-use wetland values include wildlife habitat and biodiversity conservation. However, harnessing wetland values by households is largely dependent on parameters, such as distance to wetlands, age of household and residence period. Therefore, to enhance wetland values, the suggested interventions include increased wetland restoration, increased wetland awareness campaigns and provision of alternative livelihoods.

Plate 9: Kabwoya-Kyakatwanga-Nyamarwa water supply system in Nyamambukabiri wetland in Kibaale district

2.4.2 Wetland Livelihood Support

Uganda's wetlands are a source of livelihood support. They support or sustain periperical agricultural activities (fish farming, crop cultivation and livestock grazing), and provide marketable raw materials (papyrus and sand/clay). These activities are dependent on the potential of the wetland to regulate water, but also intensities of encroachment. The households' likelihood to actively engage in wetland resource exploitation and willingness to pay for its conservation is influenced by wetland land size and ownership, education level and household size (Mwakubo & Obare, 2009).

Plate 10: Catfish captured from Busia District

The major crops grown in wetlands today include paddy rice, Coco yams, and sugarcanes, while the animals grazed include cattle, goats and sheep. In crop production, more than 80% of harvests are sold as cash crops and the rest is for use. The total cash value of this production comprises nearly 40% of rural household income and is thus a highly significant source of cash income. The wetland habitat services are estimated at UGX 273,000 /ha/year and UGX 84,000 /ha/year. Together, these services contribute UGX 944 billion/year, measured as Gross Value Added equivalent or (GDP equivalent) to the national economy (UNDP, 2018). However, the conversion of natural wetland areas to farmland seriously affects valuable ecosystem services, including global climate regulation.

Much as wetlands offer high potential for agricultural production, majority of these wetlands are tremendously abused by over exploitation and degradation. The vastest areas of wetlands degraded are found in eastern Uganda (Mbale, Pallisa, Kibuku, Iganga, Butaleja, Tororo, Namutumba etc) with intensive rice cultivation. These facts are a result of household adaptation to the changing climate and environment to enhance income and food production. However, in practice, households are faced with many unending challenges, such as land conflicts due to unclear wetland boundaries, customary land tenure system and high population pressure.

Plate 11: Fishing along river Nile in Obongi District

Plate 12: Fish ponds in Kisamura wetland, Kyegegwa district

Plate 13: Art and Craft stools in Mpigi District

Plate 14: Grazing in Muzizi wetland-Kibaale district

Plate 15: Cultivated wetland section in Sheema district

Plate 16: Brick laying in Muzizi wetland along Kibaale-Kagadi highway

3. Chapter Three: Wetland Mapping

3.1 Introduction

This chapter demonstrates the methodology used to map wetlands as of 2022 in Uganda. Sentinel-2B images were downloaded and interpreted to facilitate spectral differentiation of wetland features. Unlike the previous wetland mapping exercises, this assessment used high resolution images, different classification methodology and increased number of validation control points. The methodology is hereby explained below:

3.2 Datasets Used

3.2.1 Data and Sources

The state of wetlands was analysed using satellite images, past wetland shapefiles and location coordinates. Sentinel-2B images were obtained from the European Space Agency and used (*Figure 10*). The ortho-rectified images are freely available for download and usage. There are made up of 13 spectral bands. Sentinel-2 images are widely used globally to map land cover/cover changes. As such, 51 satellite image tiles captured in 2022 (January-February) covering Uganda were downloaded and interpreted. In additional, the past wetland shapefiles (1994, 2008 and 2015) were obtained from the Ministry of Water and Environment to facilitate boundary and wetland class definition. While, the locational coordinates of wetland classes were picked to train the classification process using global positioning systems.

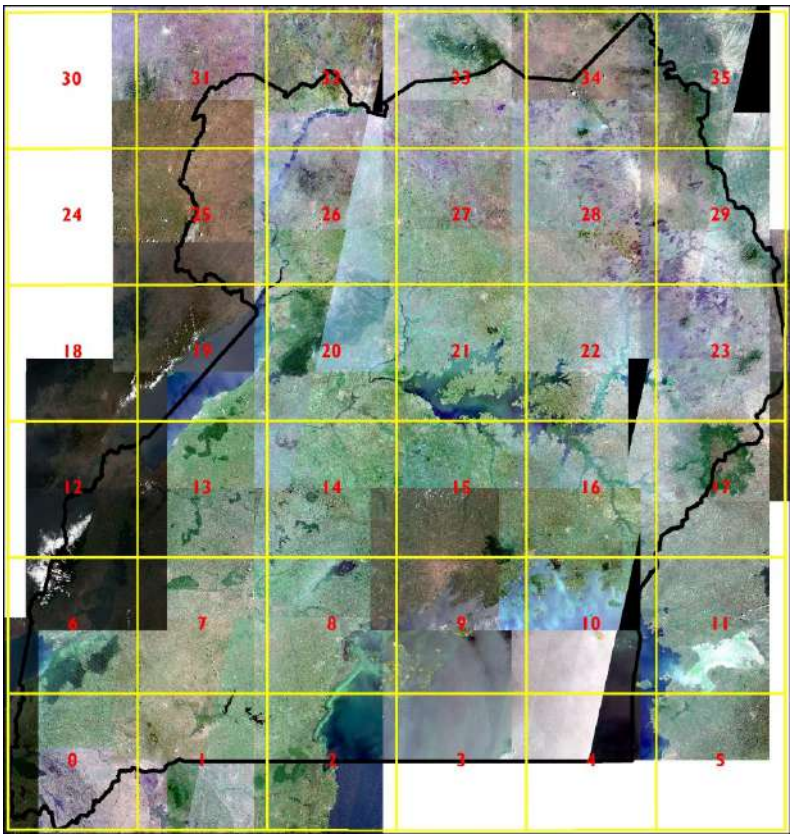


Figure 10: Composites of Sentinel-2 images in Uganda and the grids

3.3 Data Processing and Analysis

3.3.1 Pre-processing

Sentinel-2B images were enhanced, combined into composites (using bands 4,3,2) and stacked. The images were atmospherically corrected (Dark Object Subtraction method) and re-enhanced to facilitate spectral differentiation of features. While the wetland shapefiles, were collated to track wetland boundaries and classes. Prior to analysis, wetland boundaries were delineated using a developed Wetland Analytical Toolbox (WAT) plugin in QGIS environment (Figure 11). The boundaries were segmented depending on hydrological and wetland class indicators, but also in collation with the past wetland shapefiles. Mixed segments were merged to harmonised wetland boundaries (Figure 12).

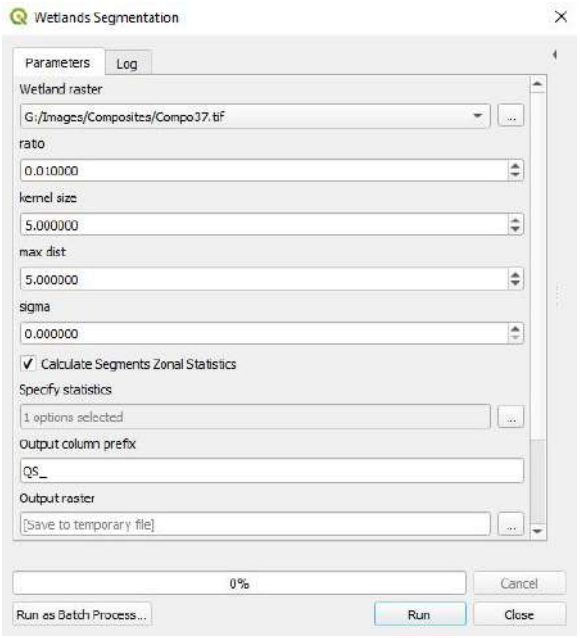


Figure 11: A Wetland Analytical Toolbox before Segmentation

Figure 12: Delineated wetlands around Victoria Nile catchment

3.3.2 Image Analysis

The algorithm used to cluster spectral features within the delineated wetland boundaries was Unsupervised (ISODATA) classification. The clusters in relation with location coordinates were used train wetland classes into 8 types at a scale of 1:20,000. The validated wetland use/cover types include papyrus and floating vegetation, grasslands, woodlands, forested areas, bushlands, small-scale farmlands, commercial farmlands, and built-up areas. Table 4 presents a description of wetland use/cover types in Uganda.

Table 4: Description of the wetland use/cover classes for 2022

No	Wetland classes	Description
1	Papyrus and floating vegetation	These are wetlands with rooted and floating vegetation that can grow up to 5-6m
2	Grasslands	These are wetlands with tall and short grasses. Sometimes include reeds.
3	Woodlands	These are wetlands composed of scattered tall trees, shrubs, palm trees with grasslands underneath
4	Forested areas	These include wetlands characterised by dense tree canopy
5	Bushlands	These wetlands include dense and scattered bushes that are not more than 4meter in height
6	Small-scale farmlands	These include wetlands under cultivation with crops grown purposely for household consumption such as annuals and perennials e.g., Root crops, vegetables, cereals etc
7	Commercial farmlands	These include wetlands under cultivation with crops grown purposely for commercial use such as tea and sugar cane plantations, rice schemes among others
8	Built-up areas	Wetlands converted into settlements, industries, waste treatment plants, roads etc

3.3.3 Post Classification

The classified wetland dataset of 2022 was validated using field wetland locational coordinates, past wetland shapefiles and Google Earth engine images. These images are also open and with high spatial resolution. Wetlands were defined using tone, texture and shape elements on image interpretations. An Error Matrix methodology was deployed to measure the wetland classification accuracy using 1,909 ground truthed control points captured throughout the country (Figure 13). The overall classification accuracy achieved was 80% for the processed 2022 wetland dataset (Table 5).

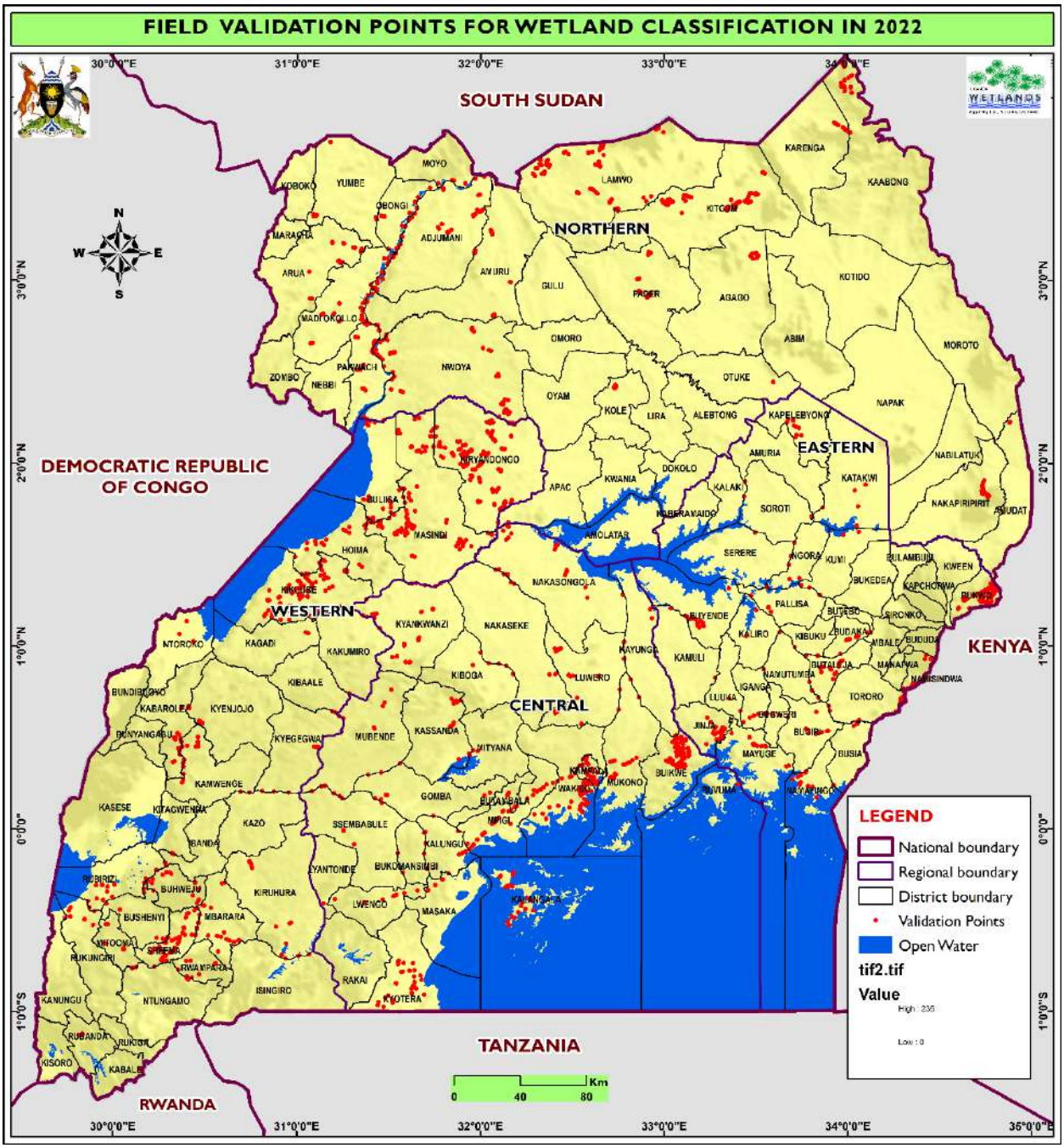


Figure 13: Field validation points for wetland use/cover classification in 2022

Table 5: Error matrix for the classified wetland use/cover types for Uganda in 2022

Wetland Use/Cover Type	Accuracy assessment											
	Papyrus	Grasslands	Woodlands	Open Water	Small-scale Farmlands	Built-up	Bushlands	Forested Areas	Commercial Farmlands	**Total**	Error of Commission	User's Accuracy
Papyrus	237	6	2	0	10	7	0	0	0	**262**	0.10	0.90
Grasslands	8	84	20	0	57	14	18	2	3	**206**	0.59	0.41
Woodlands	4	5	137	3	0	1	10	29	3	**192**	0.29	0.71
Open Water	4	0	0	231	0	0	0	0	0	**235**	0.02	0.98
Small-scale Farmlands	6	7	9	0	247	41	11	0	13	**334**	0.26	0.74
Built-up	0	1	0	0	3	200	0	0	1	**205**	0.02	0.98
Bushlands	11	13	1	0	37	6	53	1	5	**127**	0.58	0.42
Forested Areas	0	0	3	0	0	1	0	155	0	**159**	0.03	0.97
Commercial Farmlands	0	0	0	0	3	0	0	0	183	**186**	0.02	0.98
Total	**270**	**116**	**172**	**234**	**357**	**270**	**92**	**187**	**208**	**1,906**		
Error of Omission	0.12	0.28	0.20	0.01	0.31	0.26	0.42	0.17	0.12			
Producer's Accuracy	0.88	0.72	0.80	0.99	0.69	0.74	0.58	0.83	0.88			
Overall Accuracy	0.80	Kappa Coefficient	0.77									

3.3.4 Change Detection

In this assessment, the wetland datasets of 1994, 2008, 2015 and 2022 were analysed to measure or monitor changes in wetland coverage in the country over time. This is vital in wetland conservation and management.

3.4 Limitations

The delineation of wetland boundaries and classification of satellite images was limited by the following reasons; some of the seasonal wetlands were not visibly clear on the satellite images as well as Google Earth and this hindered their mapping; the satellite images were captured on different days of the year and this hindered comparison of spectral signatures for different wetland use/cover types; some sections of the images especially the mountainous areas had clouds and this hampered the classification process in those areas; the different wetland classification criteria of National Biomass Study and Land Cover Changes mired the transition analysis between the datasets, and the resolution of satellite images hindered the differentiation of some wetland use/cover types especially in seasonal wetlands.

An ophiophagous bird in L.George ramsar site in Kasese district

4. Chapter Four: Status and Trend of Wetland Changes

4.1 Introduction

This chapter presents the status and trend of wetlands in the country. This information is provided at national, regional and district levels, but also by water regime. It also covers the wetland international importance, wetland use/cover types and changes in Uganda including the transboundary ones.

4.2 State and Trend of Wetland Changes

4.2.1 National Spatial Extent of Wetlands

According to the mapping results of 2022, wetlands in Uganda currently cover a total area of 33,762.6 sq.km (13.9% of Uganda's total area). This is an increment of 0.9% from the last mapping exercise of 2015 (31,412.7km^2; 13% of Uganda's surface area) (Figure 15). The increment in wetland coverage is majorly attributed to; restoration of some degraded wetlands and the inclusion of wetlands that were erroneously missed out in the previous mapping initiatives.

As per the 2022 mapping, the biggest coverage of wetlands in Uganda is in the Central region (28.9%), followed by 28.4 % in the Northern region and lastly 27. 1% in the Eastern region (Figure 14). In all the regions, the most dominant wetland use/cover types were papyrus, floating vegetation, grasslands and small-scale farmlands (Table 6). The highest percentage of small-scale farmlands is found in Eastern Uganda (45.3%), followed by Northern Uganda (28.4%) and then Western Uganda (26.9%). Built-up areas in wetlands were mainly found in Central Uganda (0.9%), Western Uganda (0.6%), and then Eastern Uganda (0.5%). Forested wetland areas and commercial farmlands were the least dominant in Northern Uganda.

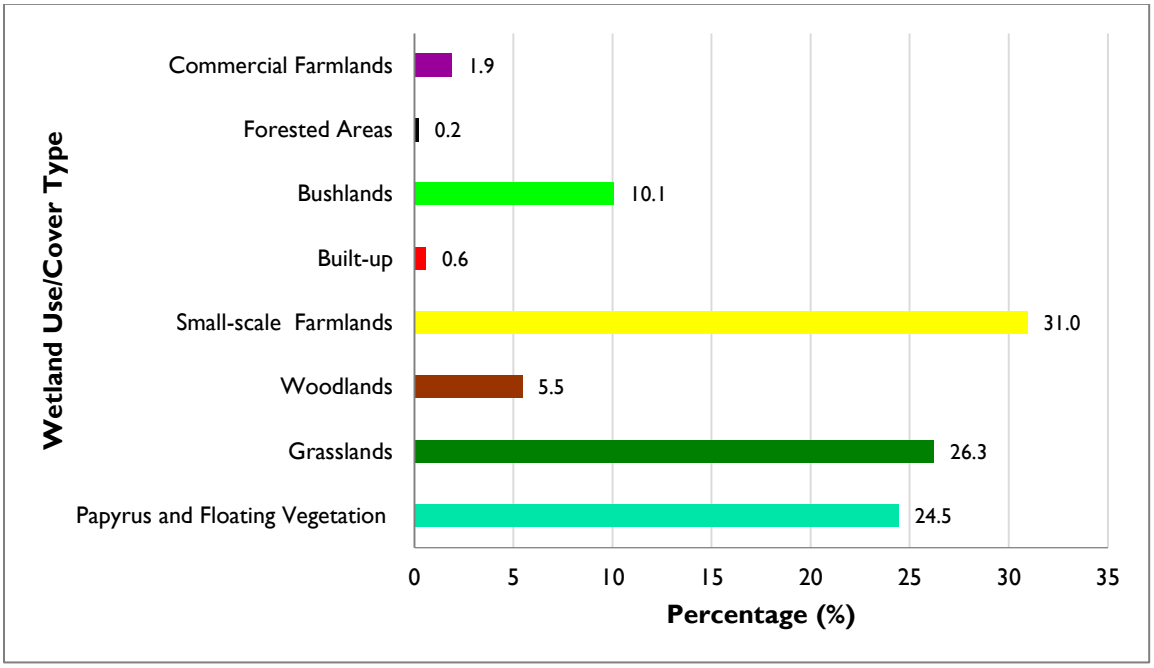


Figure 14: Coverage of wetland use/cover types in Uganda

Table 6: Wetland Use/Cover Types in the different regions of Uganda

Wetland Use/Cover Type	Region								Total	
	Central		Eastern		Northern		Western			
	Area (Sq.km)	%	Area (Sq.km)	%	Area (Sq.km)	%	Area (Sq.km)	%	Area (Sq.km)	%
Papyrus and floating vegetation	3,017.8	30.9	2,840.4	31.0	1,498.6	15.6	903.0	17.2	8,259.8	24.5
Grasslands	2,541.4	26.0	1,214.4	13.2	3,610.5	37.7	1,499.4	28.6	8,865.8	26.3
Woodlands	485.8	5.0	122.0	1.3	547.3	5.7	689.4	13.2	1,844.5	5.5
Small-scale Farmlands	2,166.5	22.2	4,158.0	45.3	2,721.7	28.4	1,407.9	26.9	10,454.1	31.0
Built-up	89.3	0.9	44.2	0.5	37.3	0.4	33.2	0.6	204.0	0.6
Bushlands	1,296.7	13.3	350.2	3.8	1,143.0	11.9	616.0	11.8	3,405.9	10.1
Forested Areas	22.3	0.2	6.3	0.1	0.6	0.0	52.2	1.0	81.4	0.2
Commercial Farmlands	153.8	1.6	436.1	4.8	20.7	0.2	36.4	0.7	647.0	1.9
National Total	9,773.6	100	9,171.7	100	9,579.6	100	5,237.6	100	33,762.6	100

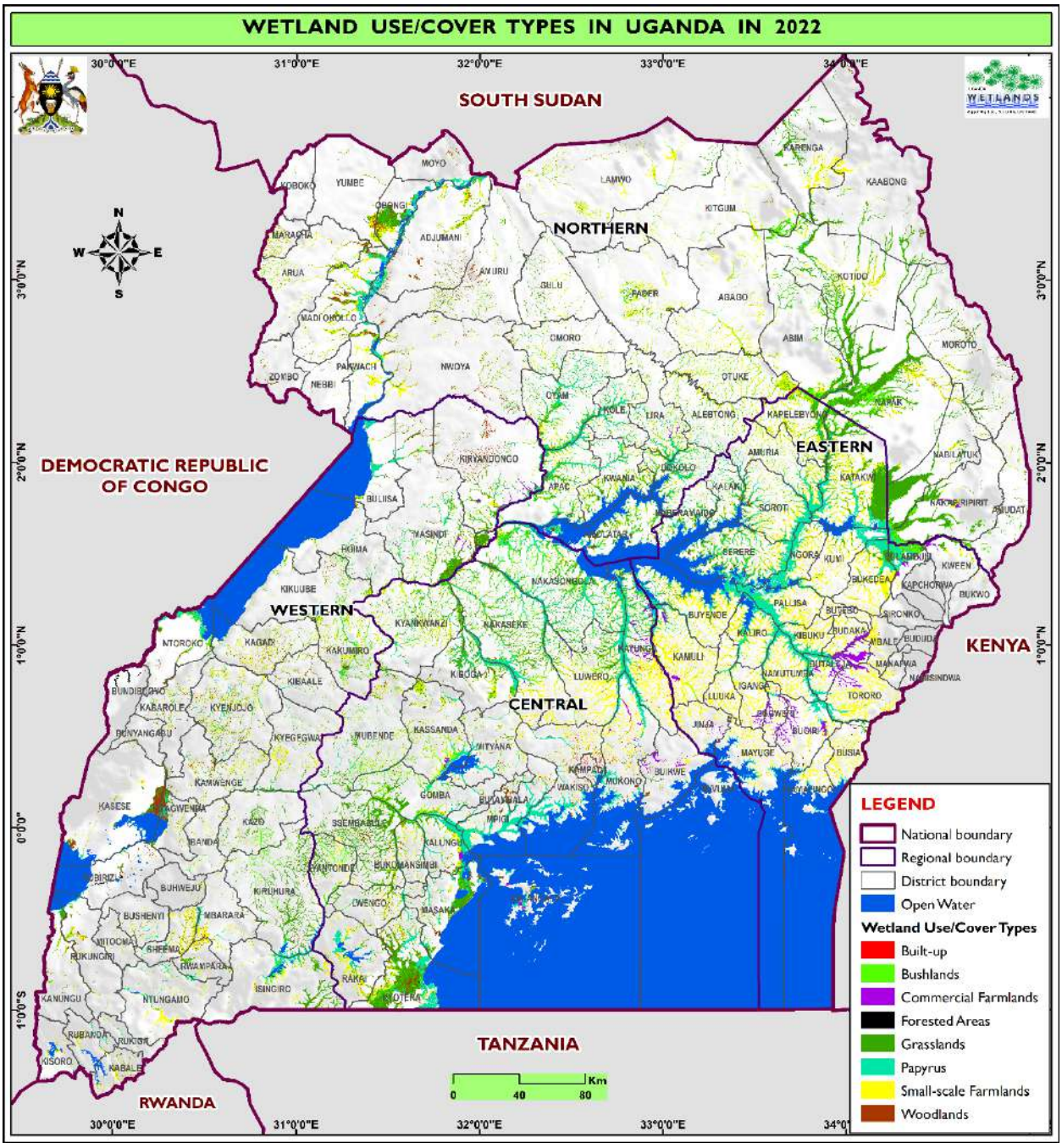


Figure 15: Wetland use/cover types in Uganda, 2022

4.2.2 National Wetland Coverage Trends

The coverage of wetlands in 1994 was 37,559.4km^2 (15.6% of Uganda's surface area) and 31,412.7km^2 (13% of Uganda's surface area) in 2015. In 2022, however, the coverage of wetlands is 33,762.6 sq.km (13.9% of Uganda's surface area).

Between 1994 and 2015, Uganda lost 6,146.6 sq.km of wetlands (2.5% of Uganda's surface area) which is (1.6% of Uganda's surface area). The decrease in wetlands coverage was due to increasing encroachment by small-scale and large-scale farmlands and built-up areas. Between 2015 and 2022, the coverage of wetlands increased by 2,349.9 sq.km (0.9% of Uganda's surface area) due to intensification of wetland restoration interventions, and increase in lake water levels (lake inundation) (Figure 16).

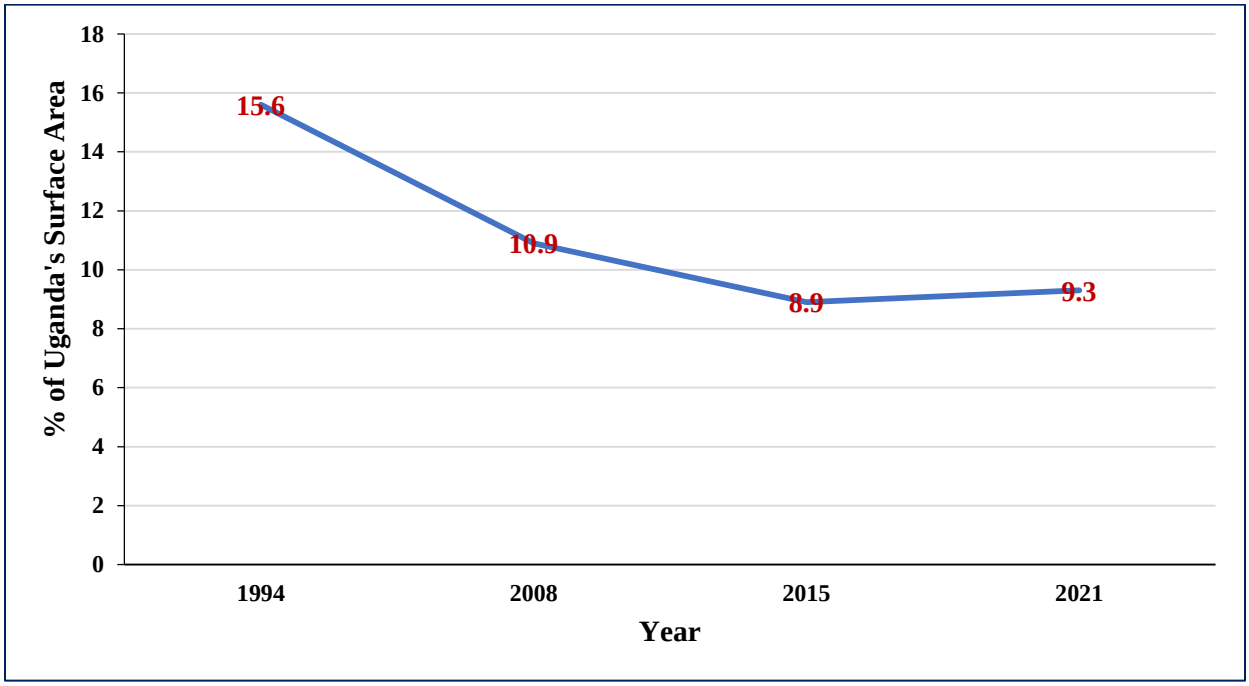


Figure 16: Coverage of intact wetlands in Uganda in 1994, 2008, 2015, and 2022

In 1994, most of the wetlands in the country were dominated by grasslands (57%) (Figure 17). The least dominant wetland classes by then were floating vegetation, farmlands, bushes, palms and thickets. In 2022, most of the wetlands in the country were dominated by small-scale farmlands (Figure 18). The least dominant wetland classes were built-up and forested areas. Despite the difference in the nomenclature of wetlands, the most significant changes were observed in grasslands, woodlands, and farmlands. Between 1994 and 2022, grasslands and woodlands decreased by 31% and 12% respectively whereas the farmlands increased by 28%. Noteworthy, farmland in 1994 covered both subsistence (small-scale) and commercial classes while the papyrus class was merged with floating vegetation in 2022.

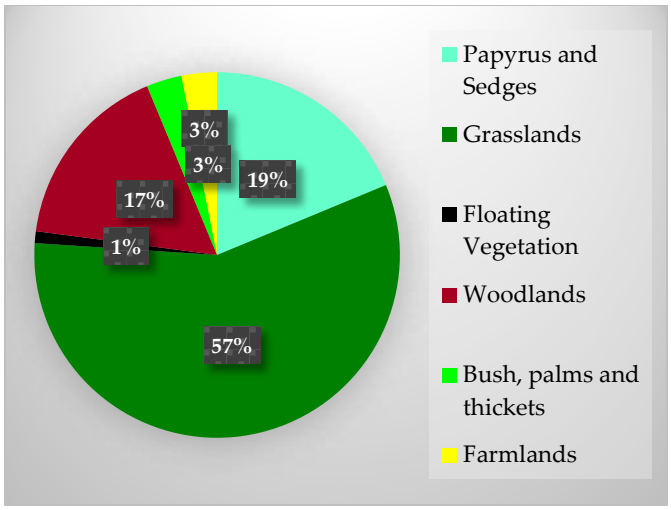


Figure 17: Wetland use/cover types in 1994

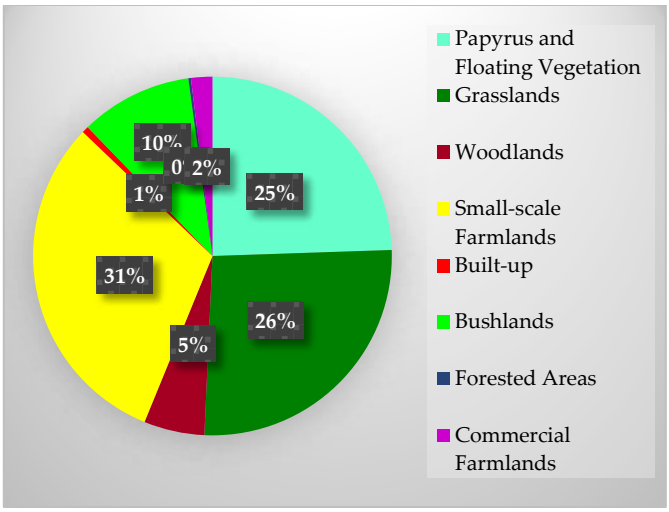


Figure 18: Wetland use/cover types in 2022

In 2015, the Central region had the biggest coverage of wetlands with 8,940km^2 (28.5%) whereas the Western region had the least wetlands coverage with 5,693.8km^2 (18.1%) (Figure 21). The 2022 mapping shows that the biggest and least coverage of wetlands is still found in Central and Western regions respectively. Comparison of wetlands in 2022 and 1994 shows a decline in the wetland's coverage in all the regions with the highest being in the Western region followed by the Eastern region (Figure 19 and Table 7). This is mainly due to the high rate of population growth in Uganda that has exerted pressure on wetland resources, increasing farmlands and settlements within wetlands (NSER, 2018). Conversely, degraded wetlands were mainly found in Eastern Uganda.

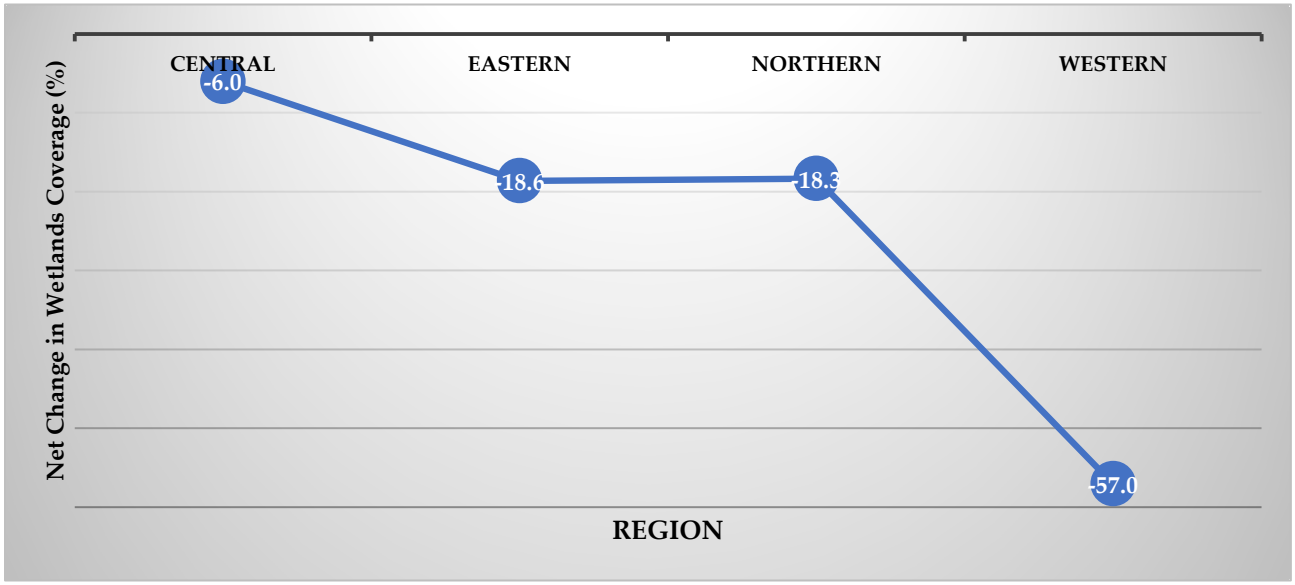


Figure 19: Percentage change in wetlands coverage by region between 1994 and 2022

Table 7: Regional coverage of wetlands in 1994, 2015, and 2022

YEAR	1994	2015	2022	Net Change (1994 – 2015)		Net Change (1994 – 2022)	
REGION	Area (Sq.km)			Area (Sq.km)	%	Area (Sq.km)	%
Central	10,002.2	8,940.0	9,773.6	-1,062.20	-17.3	-228.6	-6.0
Eastern	9,878.6	8,562.7	9,171.7	-1,315.90	-21.4	-706.9	-18.6
Northern	10,275.5	8,216.2	9,579.6	-2,059.30	-33.5	-695.9	-18.3
Western	7,403.1	5,693.8	5,237.6	-1,709.30	-27.8	-2,165.5	-57.0
Total	37,559.4	31,412.7	33,762.6	-6,146.70	100	-3,796.8	100

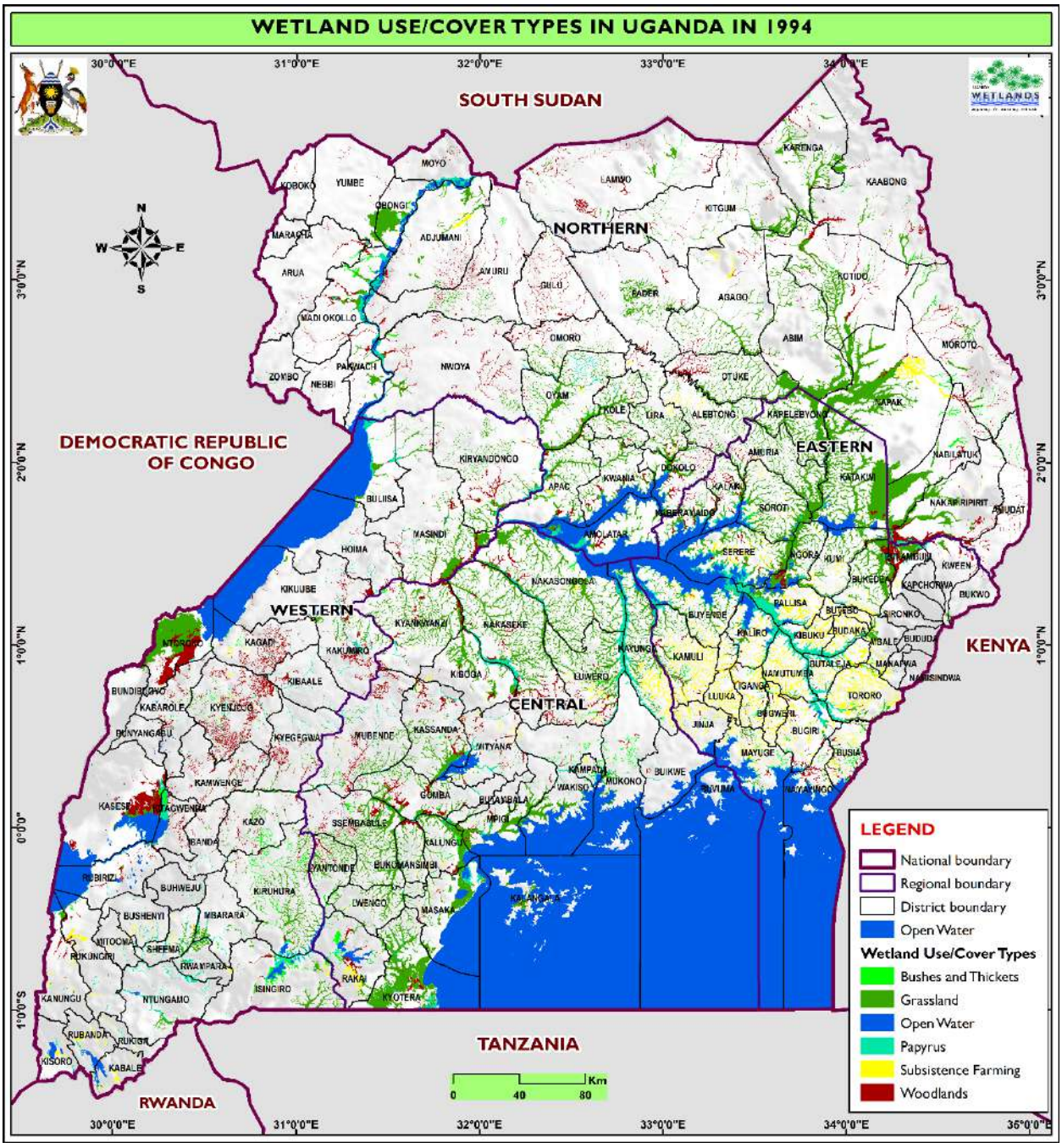


Figure 20: Wetland use/cover types in Uganda, 1994

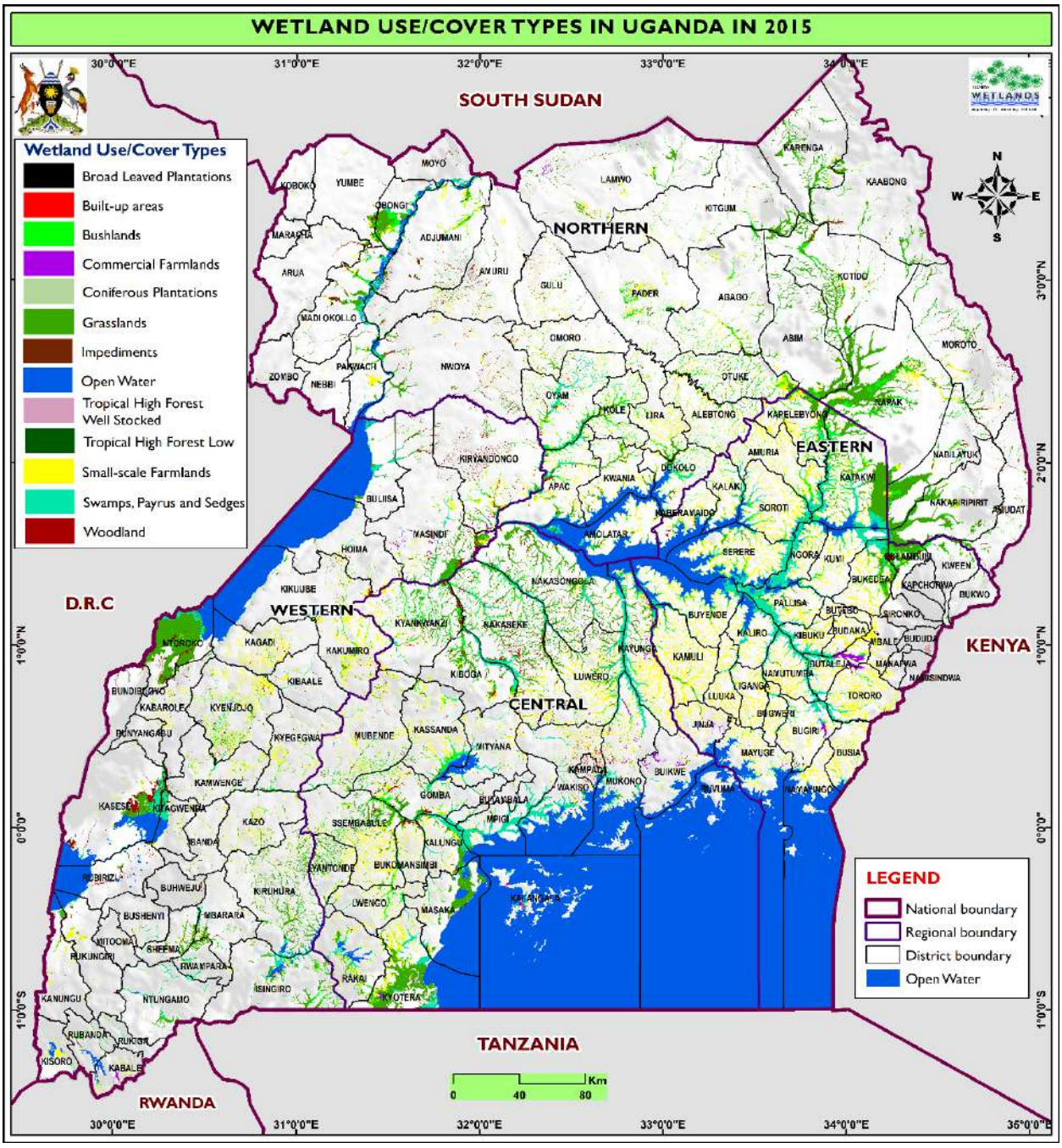


Figure 21: Wetland use/cover types in Uganda, 2015

4.2.3 Reasons for the increment in wetland coverage from 13% in 2015 to 13.9 in 2022

The 2022 wetland mapping exercise conducted in the country revealed that there is a 0.9% increase in the coverage of wetlands from 13% in 2015 to 13.9% in 2022. This wetland increment is brought about by the intensification of wetland restoration intervention programs and increase in lake water levels (lake inundation). These factors are hereby presented in detail as follows:

a. Intensification of wetland restoration interventions in the country

The recovery of wetland areas is also explained by an increment in the restoration activities in the country (Figure 22). The activities undertaken include sensitisation of wetland users on wise-use principles, demarcation, and erecting of live markers or concrete pillars among others. eviction of encroachers responsible for the gain in wetland area. This is also in line with the Wetland Department wetland restoration trend and projections for the next 10 years (Table 8).

2018/19 Baseline	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30
21,526	21,876	22,176	22,476	22,776	23,076	23,376	23,676	23,976	24,276	24,576
8.9%	9.08%	9.20%	9.32%	9.45%	9.57%	9.70%	9.82%	9.95%	10.07%	10.2%

Table 8: Projections in wetland restoration for the next 10 years

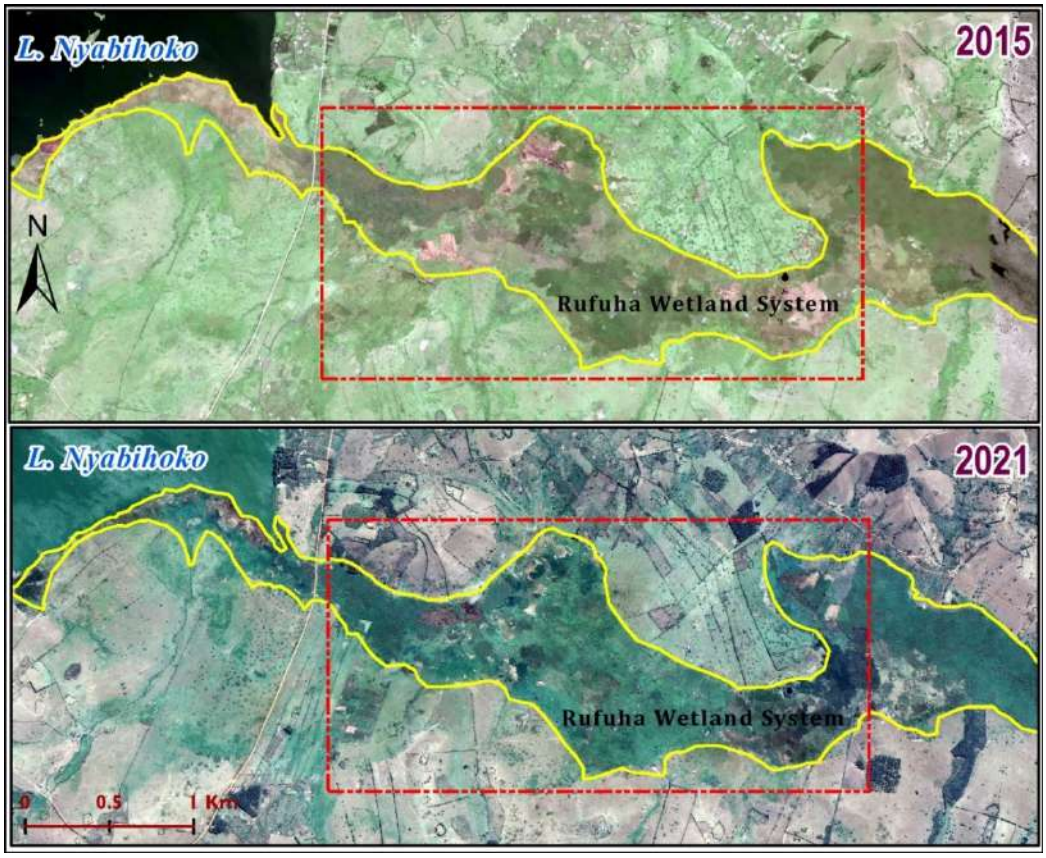


Figure 22: A section of a restored Rufuha wetland in Ntungamo district, South Western Uganda

b. Increases in lake water levels in the country

The gain in wetland acreage was attributed to an increment in the water levels of open water bodies especially in the lakes and rivers (Mehdi et al., 2021). The increase in water levels reclaimed land that had been previously diverted to other land use types such as, farming, settlement etc. For example, the water levels of Lake Victoria rose to 13.48 metres, the highest since 1964 (MWE, 2020). The rise in water levels was due to the degradation of wetlands and forests that act as reservoirs of surplus flow and changes in rainfall patterns that caused El-nino rains (Obubu et al., 2021; Natugonza et al., 2021). The resulting lake inundation caused the displacement of thousands of people and the destruction of property. For the wetlands, these increases in water coverage for a long-time caused rejuvenation and colonisation of wetland vegetation in the lake buffer areas and beyond, and hence an increase in the coverage of lacustrine/riverine wetlands of Uganda (Figure 23 and 18).

Plate 17: Flooding in Wanseko-Bulliisa District

Plate 18: Sir Samuel Baker resort flooded in the Murchison delta

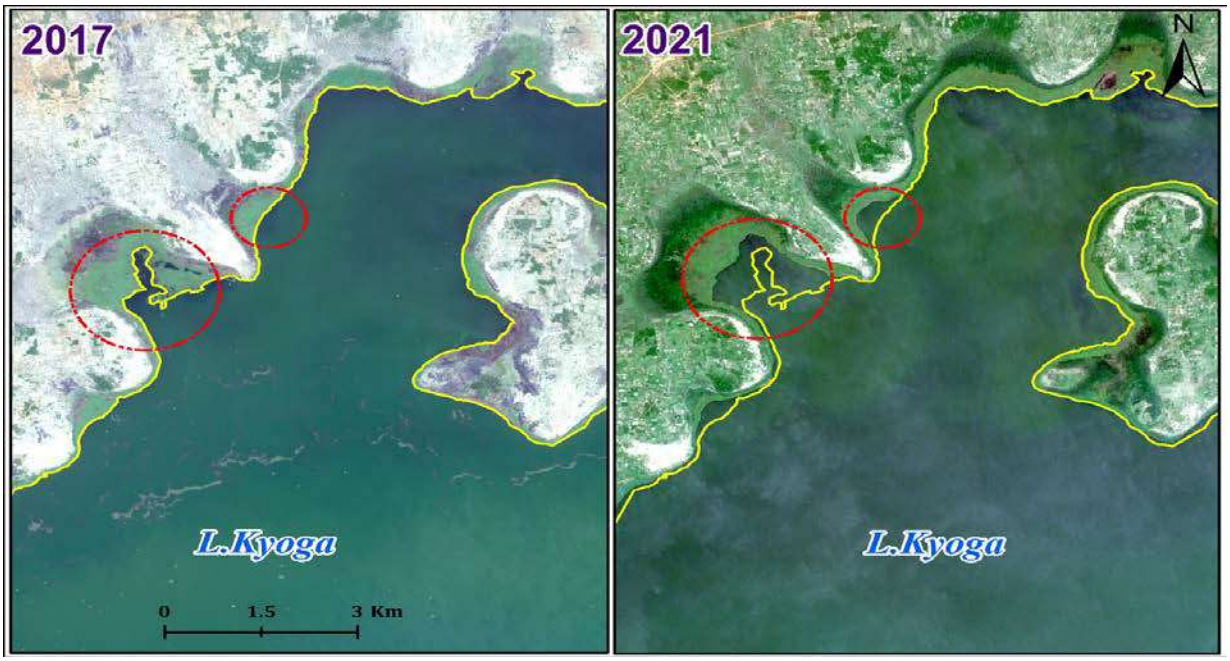


Figure 23: Changes in lake coverage of Lake Kyoga between 2015 and 2021

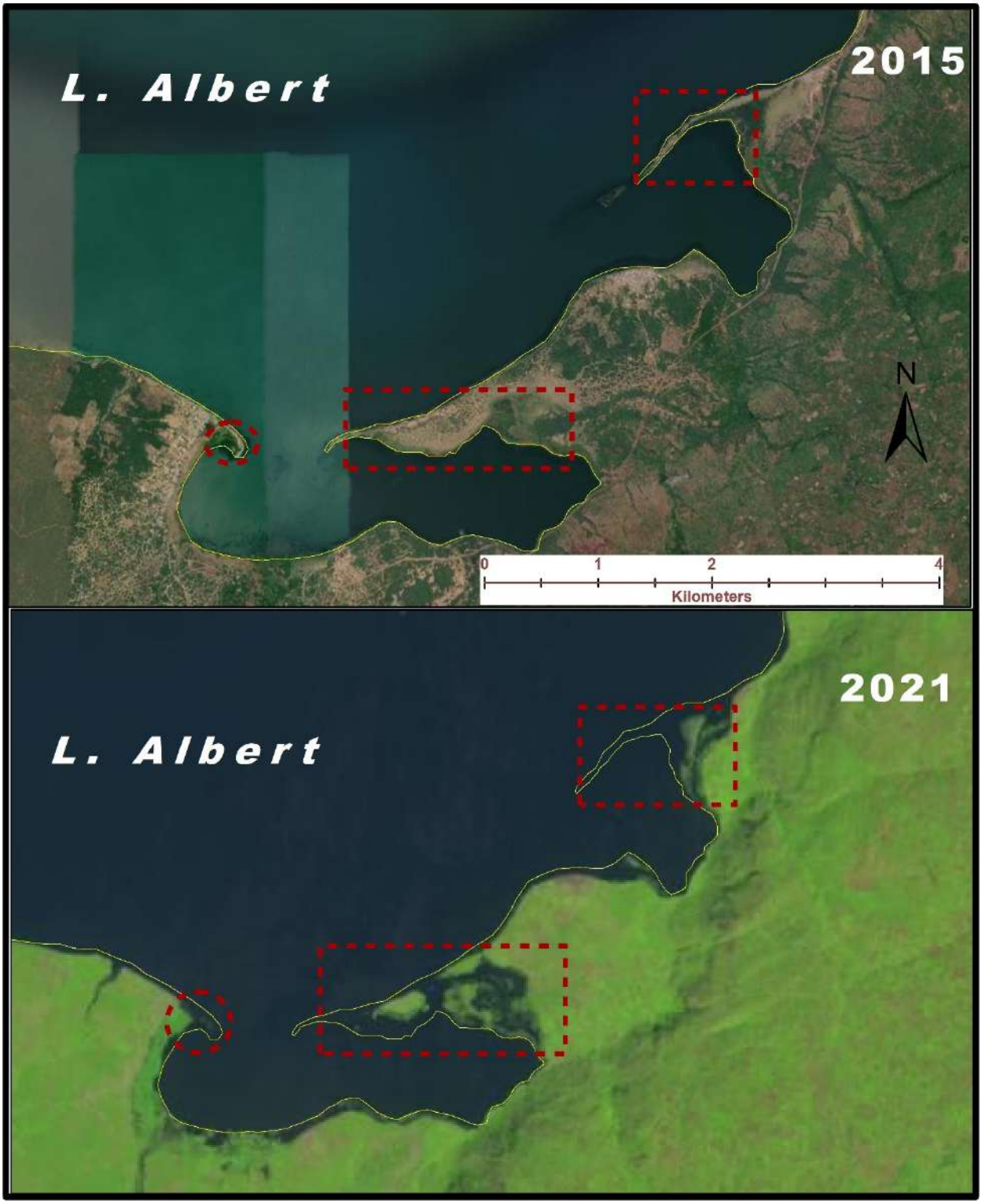


Figure 24: Changes in lake coverage of Lake Albert between 2015 and 2021

4.2.4 Regional Status of Wetland Degradation

The intact wetlands of Uganda cover a total area of 22,457.4 sq.km (9.3% of Uganda's surface area) whereas the degraded wetlands cover a total area of 11,305.1 sq.km (4.7% of Uganda's surface area) with the highest coverage of wetlands in Uganda. The Central region has the most intact wetlands compared to the other regions. Most (41%) of the degraded wetlands are located in the Eastern region (Figure 25). The least coverage of both intact and degraded wetlands is in the western region of Uganda (Table 9).

Region	Degraded		Intact		Total	
	Area (Sq.km)	%	Area (Sq.km)	%	Area (Sq.km)	%
Central	2,409.7	21.3	7,363.9	32.8	9,773.6	28.9
Eastern	4,638.3	41.0	4,533.4	20.2	9,171.7	27.2
Northern	2,779.7	24.6	6,800.0	30.3	9,579.6	28.4
Western	1,477.5	13.1	3,760.1	16.7	5,237.6	15.5
National Total	**11,305.1**	**100**	**22,457.4**	**100**	**33,762.6**	**100**

Table 9: Status of wetlands in the different regions of Uganda

The degradation of wetlands is attributed to the cultivation of crops within wetlands. For example, the growing of paddy rice in the Butaleja district led to the degradation of Doho wetlands (Oonyu, 2011). Also, rice farming and pollution by wastewater led to the degradation of Namatala Wetland in Mbale, Eastern Uganda. Other common crops that are grown in Uganda's wetlands include yams, maize, watermelon, and bananas. Other drivers of wetland degradation in Uganda include infrastructural development such as that of Lubigi wetland (Kayima et al., 2018); over-harvesting of wetland resources; dumping of murram soil; sand miningLwera wetland (Kawala, 2021) and brick making etc.

Plate 19: Rice gardens, burnt wild palm trees and eucalyptus in Kisamura wetland in Kyegegwa district

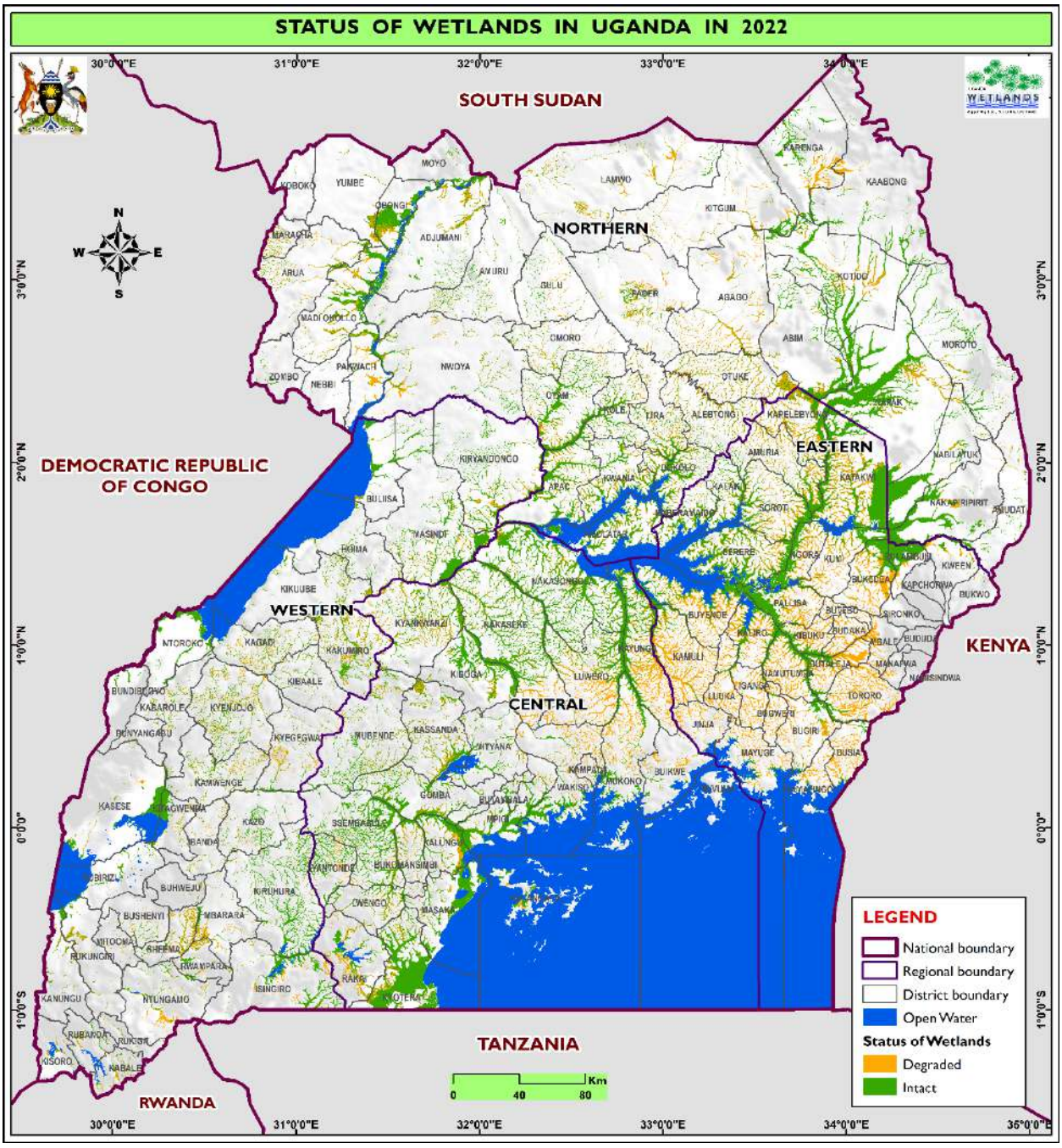


Figure 25: Status of wetlands in Uganda in 2022

4.2.5 District level status and trends of wetland coverage

Wetland management in Uganda is devolved to local governments (Local Governments Act, 1997). It is therefore important to provide wetland information to local governments (districts) to effectively manage wetlands in their jurisdiction. The inventory of wetlands is conducted at the district level and the districts are required to produce the district inventory reports. In this section, the districts with the highest coverage of wetlands, those with the highest coverage of intact and degraded wetlands are provided. Table 10 shows the districts with the highest wetlands coverage (including intact and degraded) in Uganda include Katakwi, Kayunga, Kotido, Kyotera, Luwero, Nakaseke, Nakasongola, Napak, Serere, and Ssembabule. The coverage of wetlands in other districts can be found in the appendix.

Table 10: Districts with the biggest coverage of wetlands in Uganda in 2022

REGION	DISTRICT	Degraded		Intact		Total
		Area (sq.km)	%	Area (sq.km)	%	Area (sq.km)
EASTERN	Katakwi	299.8	27.5	792.0	72.5	1,091.8
CENTRAL	Kayunga	316.4	45.6	377.6	54.4	694.0
NORTHERN	Kotido	119.5	20.0	476.5	80.0	595.9
CENTRAL	Kyotera	97.9	10.7	813.2	89.3	911.0
CENTRAL	Luwero	298.6	46.3	346.7	53.7	645.3
CENTRAL	Nakaseke	197.7	21.8	708.4	78.2	906.0
CENTRAL	Nakasongola	124.1	11.6	943.5	88.4	1,067.6
NORTHERN	Napak	125.4	12.1	913.2	87.9	1,038.6
EASTERN	Serere	161.6	25.5	471.6	74.5	633.2
CENTRAL	Ssembabule	54.8	8.9	559.4	91.1	614.2

The districts with the largest percentage of intact wetlands are Ntoroko (98.7%), Bundibugyo (97.2%), Kiruhura (93.7%), Moyo (92.3%), and Nabilatuk (92.2%) (Table 11). The coverage of intact wetlands in other districts can be found in the appendix.

Table 11: Districts with the biggest coverage of intact wetlands in 2022

REGION	DISTRICT	Degraded		Intact		Total
		Area (sq.km)	%	Area (sq.km)	%	Area (sq.km)
WESTERN	BULIISA	9.6	8.6	102.1	91.4	111.7
WESTERN	BUNDIBUGYO	0.6	2.8	22.3	97.2	23.0
WESTERN	KIRUHURA	31.8	6.3	470.7	93.7	502.6
CENTRAL	MASAKA	35.1	9.7	328.3	90.3	363.4
NORTHERN	MOYO	3.9	7.7	46.9	92.3	50.8
CENTRAL	MPIGI	28.5	8.6	303.5	91.4	332.0
NORTHERN	NABILATUK	30.3	7.8	356.2	92.2	386.5
NORTHERN	NAKAPIRIPIRIT	35.3	8.8	364.6	91.2	399.9
WESTERN	NTOROKO	2.3	1.3	177.2	98.7	179.5
CENTRAL	SSEMBABULE	54.8	8.9	559.4	91.1	614.2

The districts with the biggest portion of degraded wetlands in Uganda include Sironko (99.8%), Manafwa (99.7%), Mbale (99.6%), Butebo (97.2%), and Kapchorwa (95.9%) (Table 12 and Figure 26). The coverage of degraded wetlands in other districts can be found in the appendix.

Table 12: Districts with the biggest coverage of degraded wetlands in 2022

REGION	DISTRICT	Degraded		Intact		Total
		Area (sq.km)	%	Area (sq.km)	%	Area (sq.km)
EASTERN	BUDAKA	115.7	88.7	14.7	11.3	130.4
EASTERN	BUGWERI	91.9	90.5	9.6	9.5	101.5
EASTERN	BUTEBO	50.0	97.2	1.5	2.8	51.5
EASTERN	JINJA	96.6	93.8	6.4	6.2	103.0
EASTERN	KAPCHORWA	0.1	95.9	0.0	4.1	0.1
EASTERN	LUUKA	142.9	86.8	21.7	13.2	164.7
EASTERN	MANAFWA	20.5	99.7	0.1	0.3	20.6
EASTERN	MBALE	98.6	99.6	0.4	0.4	99.0
EASTERN	SIRONKO	6.4	99.8	0.01	0.2	6.4
EASTERN	TORORO	303.7	85.7	50.5	14.3	354.3

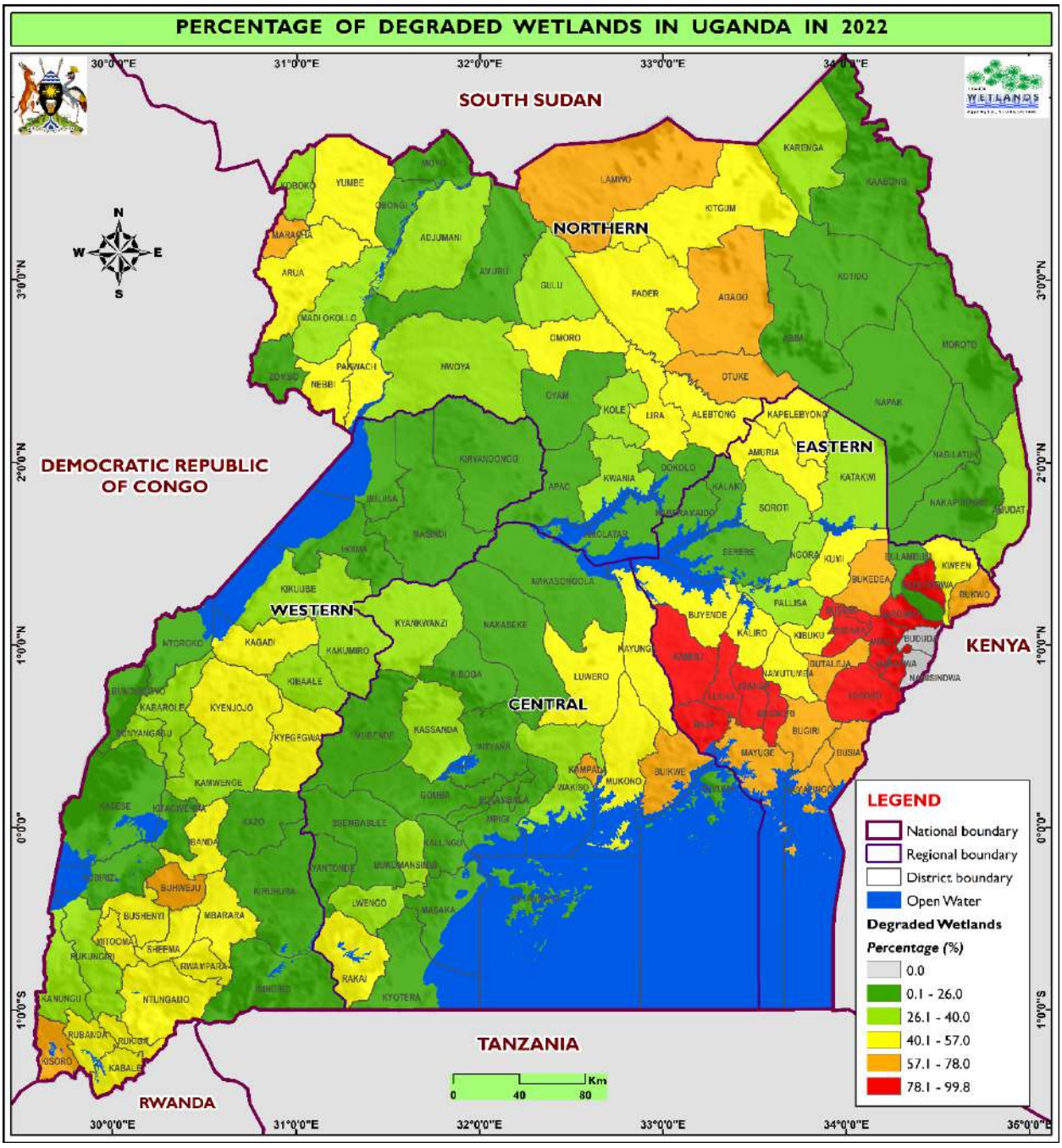


Figure 26: Percentage of degraded wetlands in Uganda by district

Between 2015 and 2022, the districts that lost the biggest acreage of wetlands include Napak, Ntoroko, Ssembabule, Buliisa, and Serere as shown in Table 13. The loss can be attributed to the degradation of wetlands and corrections of errors in the previous mapping exercises.

Table 13: Districts with the biggest loss of wetlands acreage between 1994 and 2022

District	1994		2022		Net Change (1994-2022)
	Area (Sq.km)	%	Area (Sq.km)	%	Area (Sq.km)
BULIISA	776.1	2.1	111.7	0.3	-664.4
KASESE	439.7	1.2	195.5	0.6	-244.1
KATAKWI	1325.7	3.5	1,091.8	3.2	-233.8
NAPAK	1153.1	3.1	8.5	0.0	-1144.5
NTOROKO	914.5	2.4	135.7	0.4	-778.8
OBONGI	356.2	0.9	127.3	0.4	-228.9
OYAM	509.0	1.4	220.7	0.7	-288.2
RAKAI	283.9	0.8	44.2	0.1	-239.7
SERERE	714.5	1.9	155.7	0.5	-558.8
SSEMBABULE	789.3	2.1	74.2	0.2	-715.1

4.2.6 Wetland Status and Degradation by Drainage Basins

A drainage basin refers to an area of land drained by a major river and its tributaries (Hoorn et al., 2017). Uganda has 8 drainage basins and these include Lake Kyoga, Lake Victoria, Lake Edward, Lake Albert, Victoria Nile, Albert Nile, Aswa, and Kidepo. All the wetlands in Uganda are part of a network that drains into the 8 drainage basins. The 2022 mapping showed that Lake Kyoga has the biggest coverage of wetlands (43.1%) whereas Kidepo has the least coverage of wetlands (0.5%). The highest coverage of papyrus, woodlands, built-up, bushlands and commercial farmlands is found in Lake Kyoga and Lake Victoria basins. The biggest percentage of forested wetlands (33.7%) are found in the Lake Albert basin as shown in Table 14 below.

Table 14: Wetland use/cover types in the different drainage basins of Uganda

Basin	Wetland Use/Cover Type (Area in Sq.km)								
	Papyrus	Grasslands	Woodlands	Small-scale Farmlands	Built-up	Bushlands	Forested Areas	Commercial farmlands	Total
Albert Nile	363.2	422.5	301.3	583.5	15.4	173.0	0.0	3.1	1,862.1
Aswa	174.8	488.6	30.1	1,390.8	3.9	369.6	0.0	0.2	2,458.0
Kidepo	0.1	163.1	5.9	8.4	0.1	6.4	0.0	0.0	184.0
Lake Albert	270.2	224.6	209.5	362.0	7.7	243.5	27.5	0.89	1,345.8
Lake Edward	165.8	392.7	260.1	348.9	7.0	109.0	20.7	0.6	1,304.7
Lake Kyoga	3,879.9	3,661.0	282.2	5,047.9	75.4	1,024.6	6.1	546.2	14,523.3
Lake Victoria	1,811.5	1,962.2	414.1	1,408.8	59.5	781.0	11.2	42.9	6,491.0
Victoria Nile	1,593.6	1,501.5	326.7	1,265.9	34.9	697.9	16.0	53.1	5,489.5
Total	8,259.0	8,816.2	1,829.8	10,416.3	203.7	3,405.0	81.4	647.0	33,658.4

The biggest coverage of intact and degraded wetlands is found in Lake Kyoga basin (Table 15). Other drainage basins that exhibited high levels of degradation included Lake Victoria (13.4%), Aswa (12.4%), and Victoria Nile (12%). This degradation is due to the establishment of commercial

farmlands such as tea estates, sugarcane plantations; subsistence farmlands; and factories in wetlands. However, the biggest class contributing to degradation in wetlands is small-scale farming.

Table 15: Status of wetlands in the different drainage basins of Uganda

Basin	Degraded		Intact		Total	
	Area (Sq.km)	%	Area (Sq.km)	%	Area (Sq.km)	%
Albert Nile	602.0	5.3	1,260.1	5.6	1,862.1	5.5
Aswa	1,394.8	12.4	1,063.1	4.7	2,457.9	7.3
Kidepo	8.4	0.1	175.6	0.8	184.0	0.5
Lake Albert	370.6	3.3	975.2	4.4	1,345.8	4.0
Lake Edward	356.5	3.2	948.2	4.2	1,304.7	3.9
Lake Kyoga	5,669.6	50.3	8,853.8	39.5	14,523.3	43.1
Lake Victoria	1,511.1	13.4	4,979.9	22.2	6,491.0	19.3
Victoria Nile	1,353.9	12.0	4,135.6	18.5	5,489.5	16.3
Total	11,266.9	100	22,391.5	100	33,658.4	100

Plate 20: Rice growing in Butaleja District

Lake Kyoga and Kidepo drainage basins had the biggest and least wetlands coverage in 1994, 2015 and 2022 respectively as shown in Table 16. The highest loss in wetlands coverage between 1994 and 2015, was experienced in the Lake Kyoga drainage basin with a loss of 1,749.1km^2 (28.5%) while the least loss was observed in the Lake Edward drainage basin with an area loss of 202.7km^2 (3.3%). During the same period, the Kidepo drainage basin exhibited an increase in wetlands coverage of 5.8km^2 (0.1%). Generally, between 1994 and 2022, the wetlands in Aswa, Lake Albert, Lake Edward, Lake Kyoga, Lake Victoria, and Victoria Nile decreased whereas the wetlands in Kidepo and Albert Nile increased. The largest decrease in wetlands coverage between this period was observed in the Lake Albert drainage basin (40.5%) (Figure 27). The wetlands in the Kidepo basin have increased and this is due to the strict management regime by the authorities of the national park. The decrease in wetlands coverage is due to the establishment of commercial and subsistence farmlands, built-up areas, and factories in wetlands. Particularly for the Lake Albert basin, this decline is due to the correction of errors observed in the previous mapping exercises especially around Ntoroko-Semliki wetland systems.

Table 16: Wetland coverage and change by drainage basin in 1994 and 2015

YEAR	1994	2015	2022	Net Change (1994 - 2015)		Net Change (1994-2022)	
Drainage basin	Area (Sq.km)			Area (Sq.km)	%	Area (Sq.km)	%
Albert Nile	1,716.1	1,409.2	1,862.1	-306.9	-5.0	146.0	3.7
Aswa	3,049.5	2,337.8	2,457.9	-711.7	-11.6	-591.6	-15.2
Kidepo	174.2	180.0	184.0	5.8	0.1	9.8	0.3
Lake Albert	2,924.5	1,909.7	1,345.8	-1,014.8	-16.5	-1,578.7	-40.5
Lake Edward	1,673.7	1,471.0	1,304.7	-202.7	-3.3	-369.0	-9.5
Lake Kyoga	14,835.9	13,086.8	14,523.3	-1,749.1	-28.5	-312.6	-8.0
Lake Victoria	7,146.1	5,967.2	6,491.0	-1,178.9	-19.2	-655.1	-16.8
Victoria Nile	6,039.5	5,051.1	5,489.5	-988.4	-16.1	-550.0	-14.1
Total	37,559.5	31,412.8	33,658.4	-6,146.7	100	-3,901.1	100

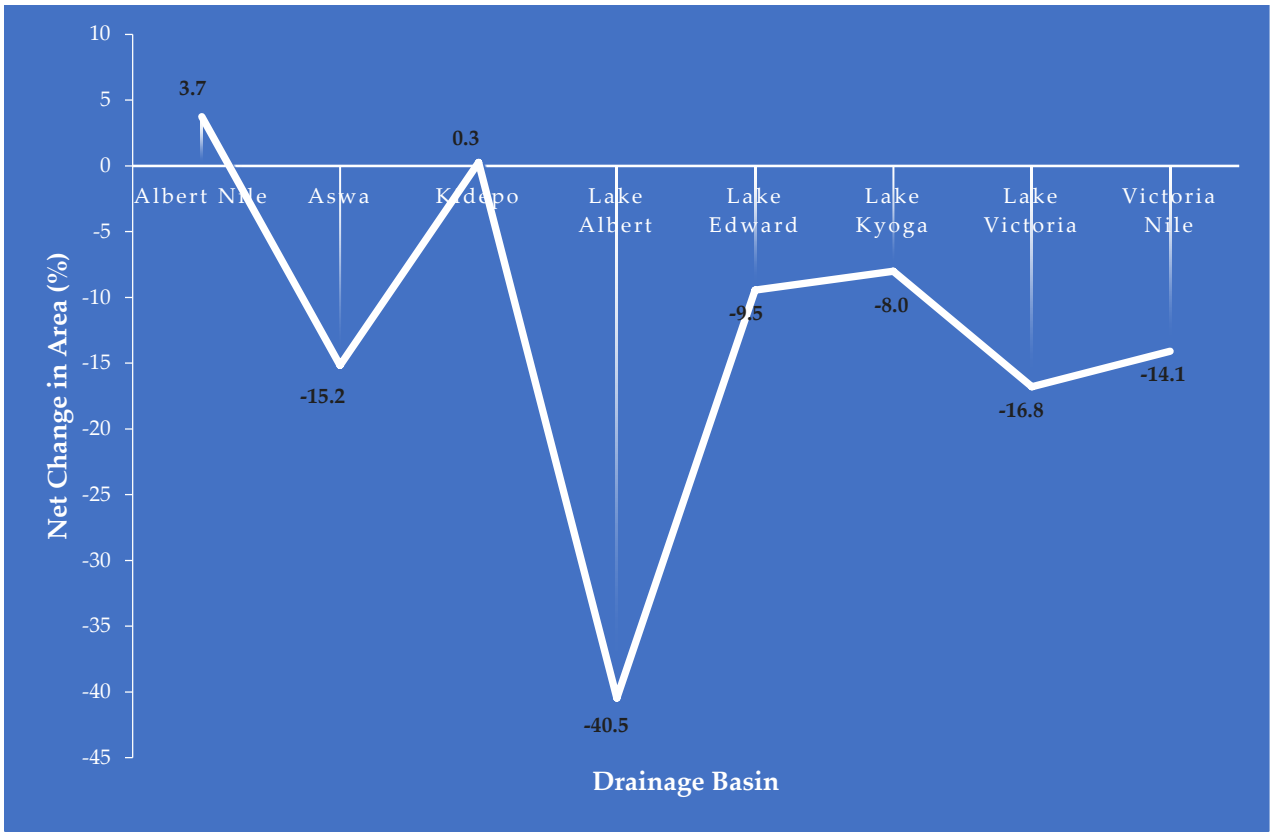
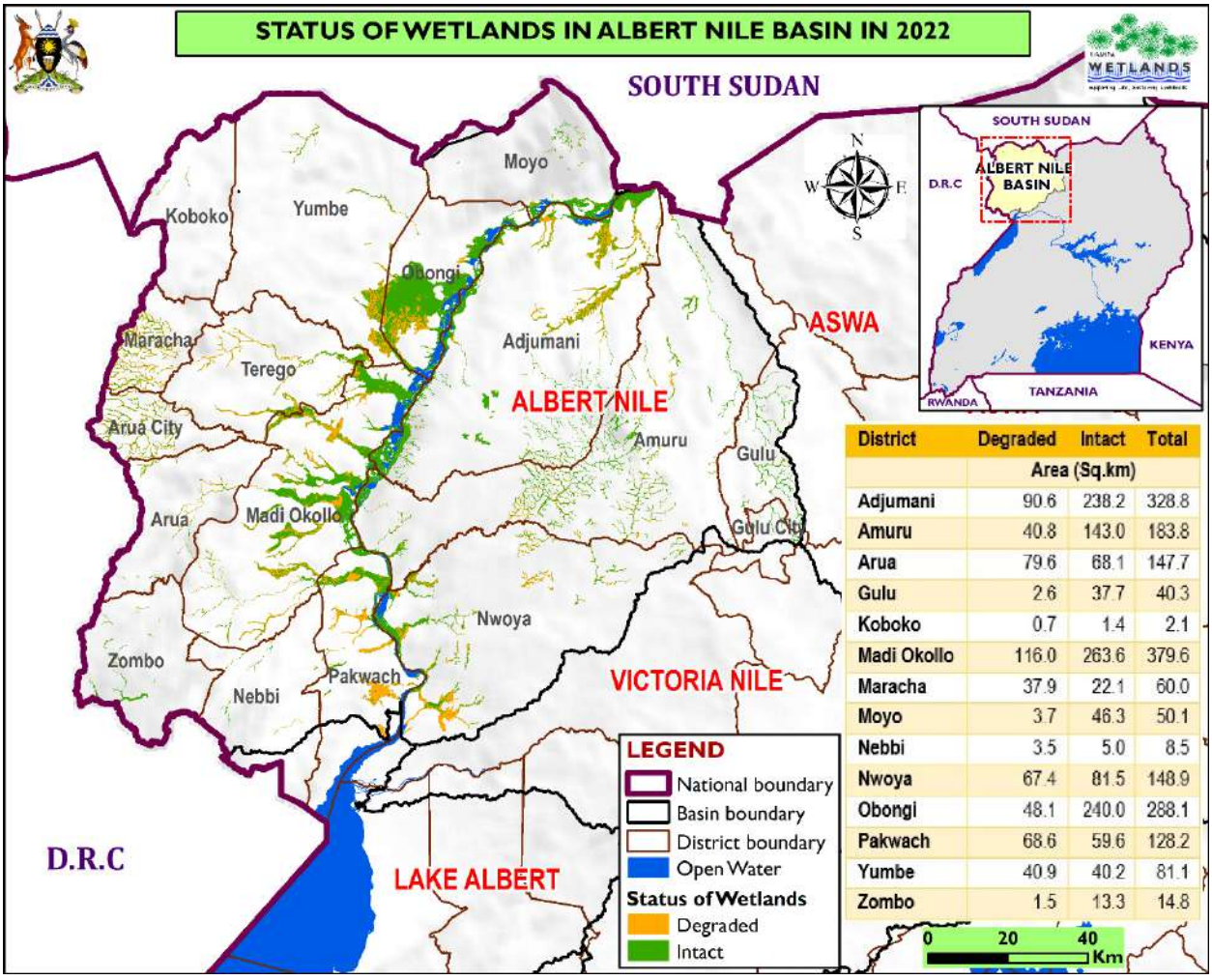


Figure 27: Net Change in wetlands coverage in the different drainage basins between 1994 and 2022

The status of wetlands in the different drainage basins is briefly described below.

Albert Nile Drainage Basin

In the Albert Nile drainage basin, the intact wetlands span a total area of 1,862.1 sq.km (67.7%) and the degraded wetlands cover a total area of 602 sq.km (32.3%). The districts with the biggest coverage of intact wetlands include Madi Okollo, Obongi, Adjumani, Amuru, and Nwoya. The districts with the biggest percentage of degraded wetlands in this basin are Maracha (63.2%), Arua (53.9%), Pakwach (53.5%), Yumbe (50.4%), and Nwoya (45.3%). The status of wetlands in other districts of Albert Nile basin is shown in Figure 28.

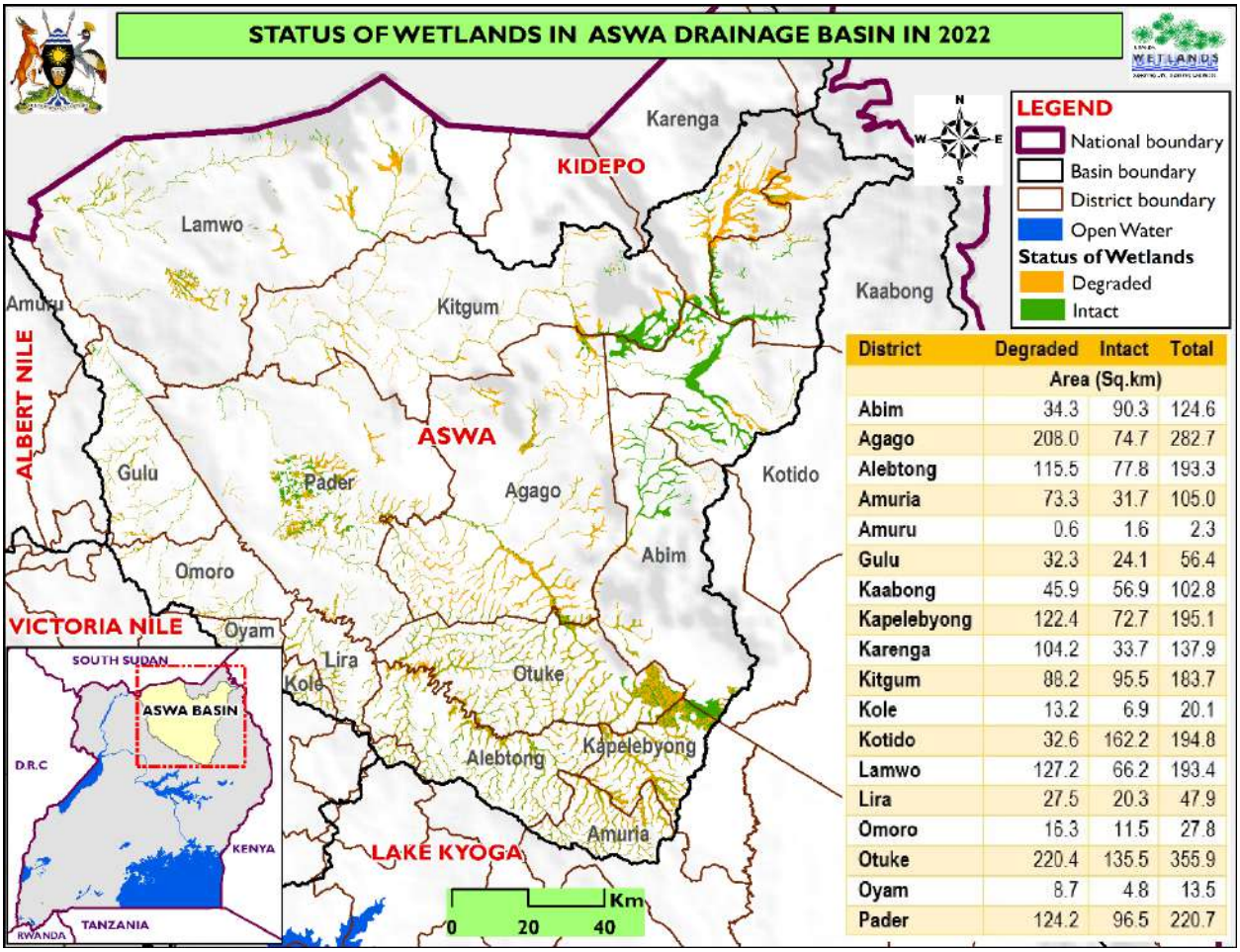


District	Degraded	Intact	Total
	Area (Sq.km)		
Adjumani	90.6	238.2	328.8
Amuru	40.8	143.0	183.8
Arua	79.6	68.1	147.7
Gulu	2.6	37.7	40.3
Koboko	0.7	1.4	2.1
Madi Okollo	116.0	263.6	379.6
Maracha	37.9	22.1	60.0
Moyo	3.7	46.3	50.1
Nebbi	3.5	5.0	8.5
Nwoya	67.4	81.5	148.9
Obongi	48.1	240.0	288.1
Pakwach	68.6	59.6	128.2
Yumbe	40.9	40.2	81.1
Zombo	1.5	13.3	14.8

Figure 28: Status of wetlands in Albert Nile drainage basin

Aswa Drainage Basin

In Aswa, the intact wetlands cover a total area of 1,063.1 sq.km (43.3%) whereas the degraded wetlands cover a total area of 1,394.8 sq.km (56.7%). The districts with the biggest coverage of intact wetlands in the Aswa basin include Kotido, Otuke, Pader, Kitgum, and Abim. The districts with the biggest percentage of degraded wetlands in this basin are Karenga (75.6%), Agago (73.6%), Amuria (69.8%), Lamwo (65.7%), and Kole (65.6%). The status of wetlands in other districts of the Aswa drainage basin is shown in Figure 29.



District	Degraded	Intact	Total
	Area (Sq.km)		
Abim	34.3	90.3	124.6
Agago	208.0	74.7	282.7
Alebtong	115.5	77.8	193.3
Amuria	73.3	31.7	105.0
Amuru	0.6	1.6	2.3
Gulu	32.3	24.1	56.4
Kaabong	45.9	56.9	102.8
Kapelebyong	122.4	72.7	195.1
Karenga	104.2	33.7	137.9
Kitgum	88.2	95.5	183.7
Kole	13.2	6.9	20.1
Kotido	32.6	162.2	194.8
Lamwo	127.2	66.2	193.4
Lira	27.5	20.3	47.9
Omoro	16.3	11.5	27.8
Otuke	220.4	135.5	355.9
Oyam	8.7	4.8	13.5
Pader	124.2	96.5	220.7

Figure 29: Status of wetlands in Aswa drainage basin

Kidepo Drainage Basin

In the Kidepo basin, the intact wetlands cover an area of 175.6sq.km (95.4%) whereas the degraded wetlands cover a total area of 8.4sq.km (4.6%). Most of the wetlands in this basin are located in Karenga and Kitgum districts (Figure 30). The low level of degradation in this drainage basin can be attributed to a strict management regime by the authorities of the Kidepo national park, under Uganda Wildlife Authority.

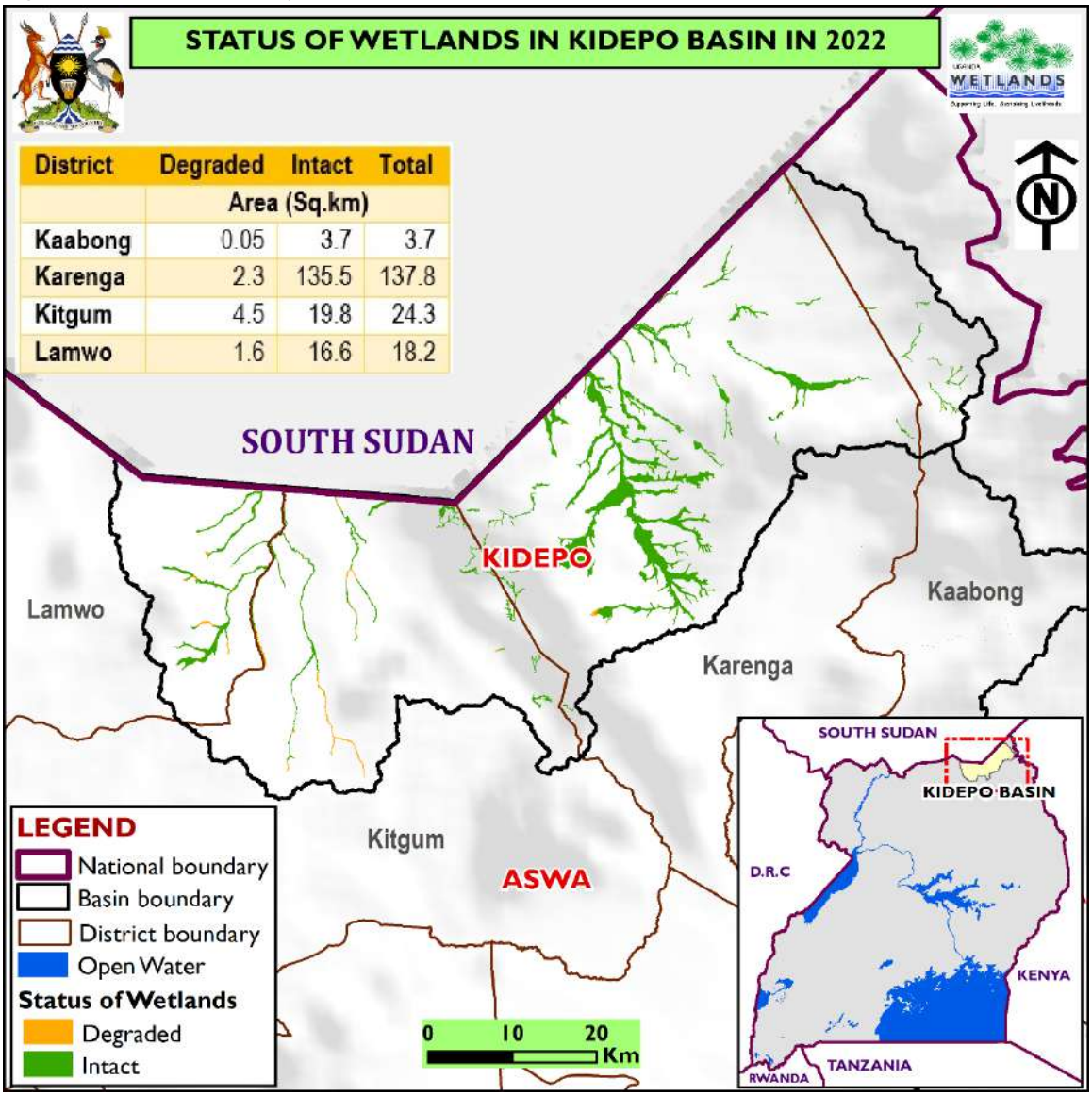
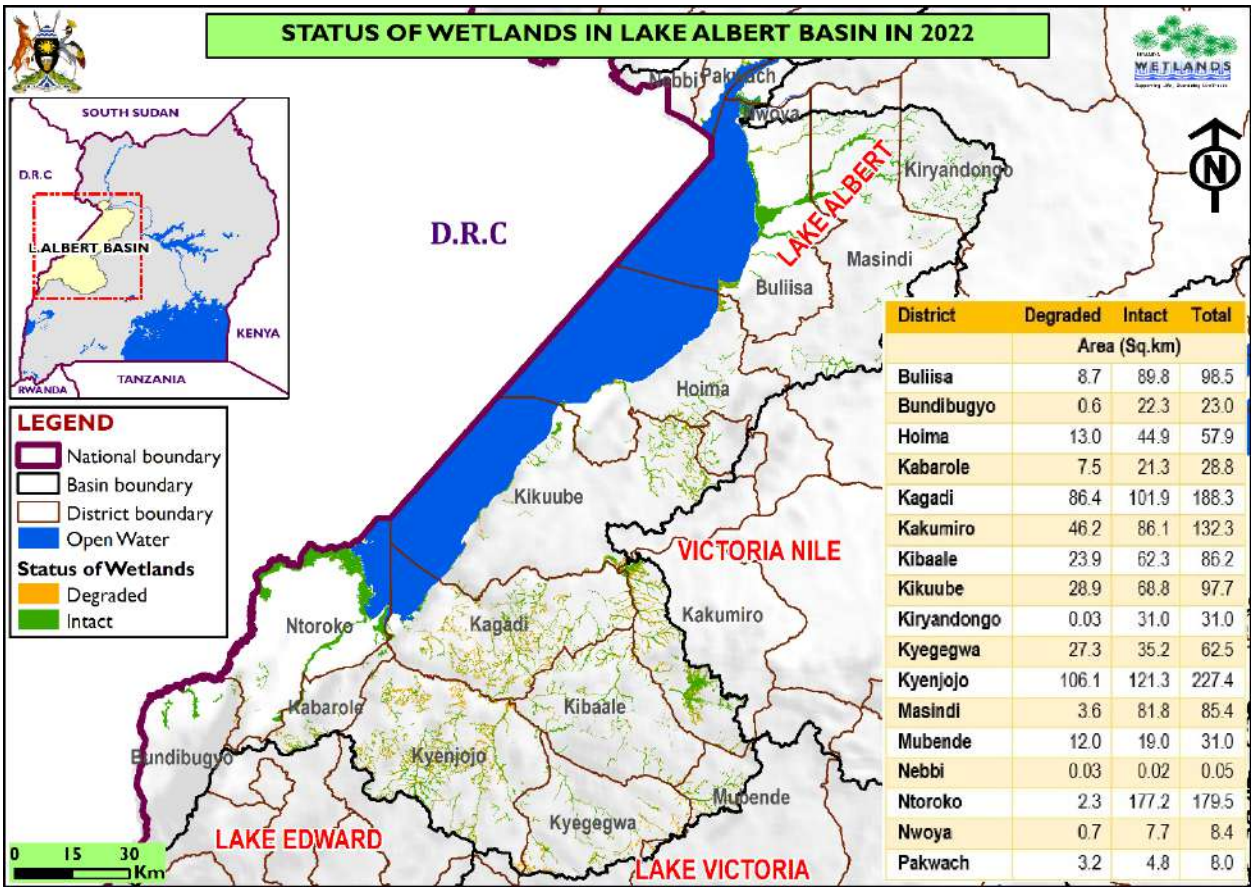


Figure 30: Status of wetlands in Kidepo drainage basin in 2022

Lake Albert Drainage Basin

The intact wetlands in the Lake Albert drainage basin cover a total area of 975.2 sq.km (72.5%) whereas the degraded wetlands in this basin span a total area of 370.6 sq.km (27.5%). The districts with the biggest acreage of intact wetlands in this basin include Ntoroko, Kyenjojo, Kagadi, Buliisa, and Kakumiro. The districts with the biggest percentage of degraded wetlands are Nebbi (57.1%), Kyenjojo (46.7%), Kagadi (45.9%), Kyegegwa (43.7%), and Pakwach (40.6%). The status of wetlands in other districts of the Lake Albert drainage basin is shown in Figure 31.

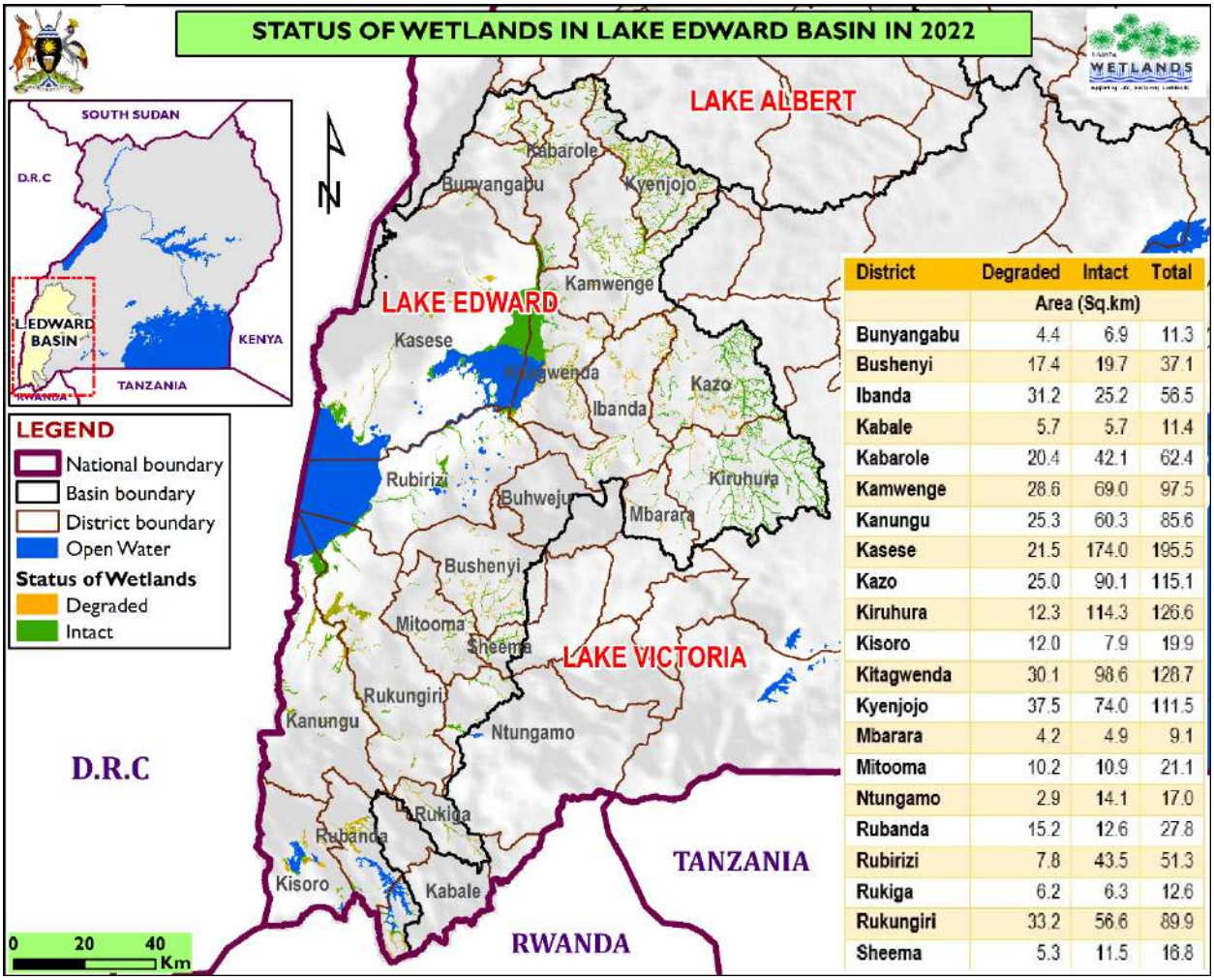


District	Degraded	Intact	Total
	Area (Sq.km)		
Buliisa	8.7	89.8	98.5
Bundibugyo	0.6	22.3	23.0
Hoima	13.0	44.9	57.9
Kabarole	7.5	21.3	28.8
Kagadi	86.4	101.9	188.3
Kakumiro	46.2	86.1	132.3
Kibaale	23.9	62.3	86.2
Kikuube	28.9	68.8	97.7
Kiryandongo	0.03	31.0	31.0
Kyegegwa	27.3	35.2	62.5
Kyenjojo	106.1	121.3	227.4
Masindi	3.6	81.8	85.4
Mubende	12.0	19.0	31.0
Nebbi	0.03	0.02	0.05
Ntoroko	2.3	177.2	179.5
Nwoya	0.7	7.7	8.4
Pakwach	3.2	4.8	8.0

Figure 31: Status of wetlands in Lake Albert drainage basin in 2022

Lake Edward Drainage Basin

The intact wetlands in the Lake Edward drainage basin cover a total area of 948.2 sq.km (72.7%) whereas the degraded wetlands in this basin cover a total area of 356.5 sq.km (27.3%). The districts with the biggest coverage of intact wetlands in this basin include Kasese, Kiruhura, Kitagwenda, Kazo, and Kyenjojo. The districts with the biggest percentage of degraded wetlands in this basin are Kisoro (60.3%), Ibanda (55.3%), Rubanda (54.7%), Kabale (50.1%), and Rukiga (49.8%). The status of wetlands in other districts of the Lake Edward basin is shown in Figure 32below.

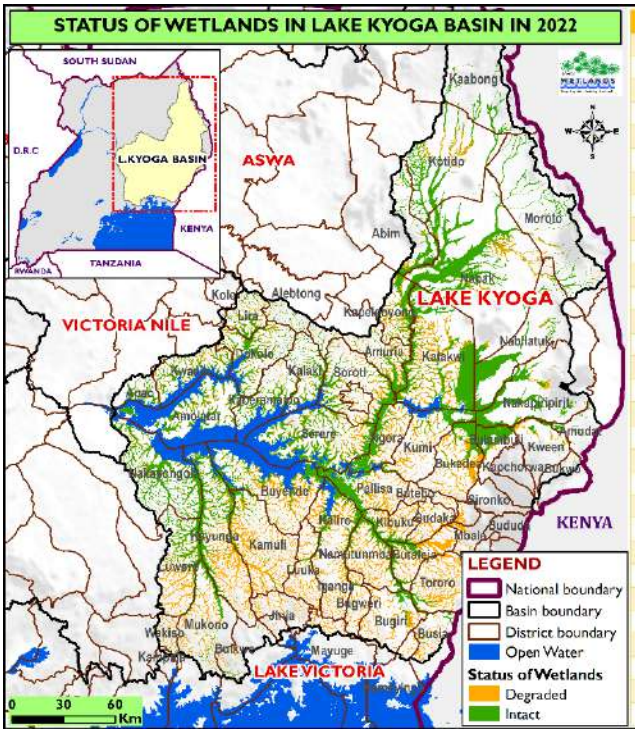


District	Degraded	Intact	Total
	Area (Sq.km)		
Bunyangabu	4.4	6.9	11.3
Bushenyi	17.4	19.7	37.1
Ibanda	31.2	25.2	56.5
Kabale	5.7	5.7	11.4
Kabarole	20.4	42.1	62.4
Kamwenge	28.6	69.0	97.5
Kanungu	25.3	60.3	85.6
Kasese	21.5	174.0	195.5
Kazo	25.0	90.1	115.1
Kiruhura	12.3	114.3	126.6
Kisoro	12.0	7.9	19.9
Kitagwenda	30.1	98.6	128.7
Kyenjojo	37.5	74.0	111.5
Mbarara	4.2	4.9	9.1
Mitooma	10.2	10.9	21.1
Ntungamo	2.9	14.1	17.0
Rubanda	15.2	12.6	27.8
Rubirizi	7.8	43.5	51.3
Rukiga	6.2	6.3	12.6
Rukungiri	33.2	56.6	89.9
Sheema	5.3	11.5	16.8

Figure 32: Status of wetlands in Lake Edward basin in 2022

Lake Kyoga Drainage Basin

In the Lake Kyoga drainage basin, the intact wetlands cover a total area of 8,853.8 sq.km (61%) whereas the degraded wetlands span a total area of 5,669.6 sq.km (39%). The districts with the biggest coverage of intact wetlands in this basin include Napak, Katakwi, Nakasongola, Serere, and Kayunga. The biggest percentage of degraded wetlands in this basin is found in Sironko (99.8%), Manafwa (99.7%), Mbale (99.6%), Mayuge (98.2%), and Butebo (97.2%). The status of wetlands in other districts of the Lake Kyoga basin is shown in Figure 33.

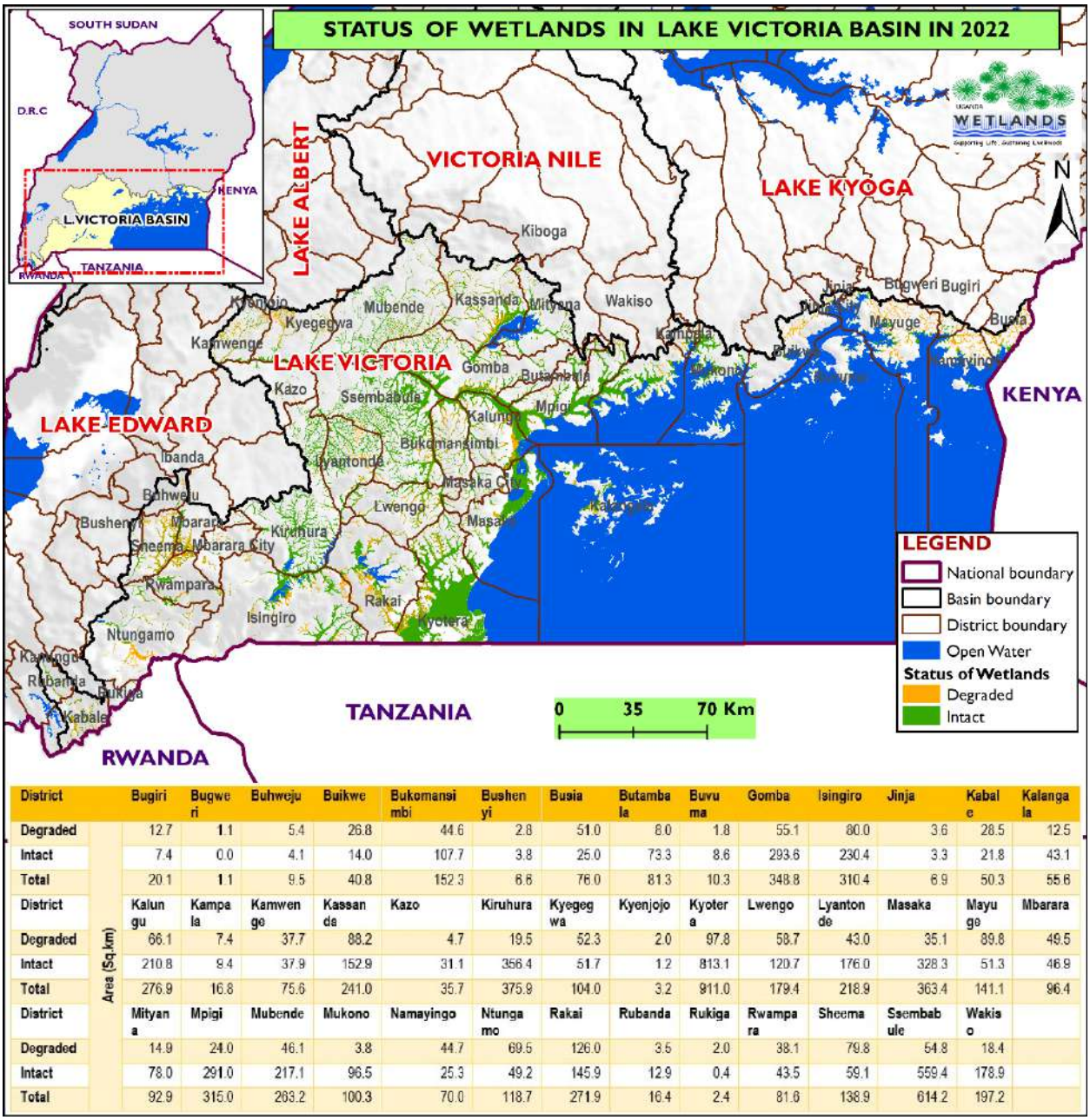


District	Degraded	Intact	Total	District	Degraded	Intact	Total
	Area (Sq.km)				Area (Sq.km)		
Abim	24.8	175.0	199.8	Kayunga	316.4	377.6	694.0
Alebtong	13.7	31.0	44.7	Kibuku	113.7	92.5	206.2
Amolatar	59.2	241.4	300.6	Kole	0.3	1.4	1.7
Amudat	3.1	34.7	37.8	Kotido	86.9	314.3	401.2
Amuria	103.2	192.9	296.1	Kumi	135.1	150.1	285.2
Apac	12.3	70.3	82.6	Kwania	76.3	140.3	216.5
Budaka	115.7	14.7	130.4	Kween	45.0	47.1	92.1
Bugiri	147.5	60.0	207.5	Lira	57.1	93.7	150.7
Bugweri	90.8	9.6	100.4	Luuka	142.9	21.7	164.7
Buikwe	27.5	15.5	43.0	Luwero	185.2	241.9	427.1
Bukedea	244.2	169.0	413.3	Manafwa	20.5	0.1	20.6
Bukwo	3.7	2.0	5.7	Mayuge	44.0	0.8	44.8
Bulambuli	24.9	201.3	226.2	Mbale	98.6	0.4	99.0
Busia	76.8	23.2	100.0	Moroto	23.1	189.1	212.2
Butaleja	186.4	106.6	293.0	Mukono	156.1	137.8	293.9
Butebo	50.0	1.5	51.5	Nabilatuk	25.5	351.5	376.9
Buyende	264.8	252.0	516.8	Nakapiripirit	28.1	359.4	387.4
Dokolo	81.4	246.8	328.2	Nakasongola	75.5	478.3	553.8
Iganga	133.6	25.3	158.9	Namayingo	18.3	1.0	19.3
Jinja	93.0	3.0	96.0	Namutumba	174.2	143.0	317.2
Kaabong	2.2	113.5	115.7	Napak	125.4	913.2	1,038.6
Kaberamaido	41.3	150.8	192.1	Ngora	99.9	222.4	322.3
Kalaki	37.8	135.2	172.9	Pallisa	140.7	241.1	381.7
Kaliro	171.2	165.7	336.9	Serere	161.6	471.6	633.2
Kampala	3.5	0.5	4.0	Sironko	6.4	0.01	6.4
Kamuli	386.8	103.3	490.1	Soroti	165.0	276.1	441.1
Kapchorwa	0.1	0.0	0.1	Tororo	303.7	50.5	354.3
Kapelebyong	98.4	190.4	288.8	Wakiso	46.2	10.3	56.4
Katakwi	299.8	792.0	1,091.8				

Figure 33: Status of wetlands in the different catchments of Lake Kyoga drainage basin

Lake Victoria Drainage Basin

The intact wetlands in the Lake Victoria drainage basin cover a total area of 4,979.9 sq.km (76.7%) whereas the degraded wetlands in this basin cover a total area of 1,511.1 sq.km (23.3%). The districts with the biggest coverage of intact wetlands in this basin are Kyotera, Ssembabule, Kiruhura, Masaka, and Gomba. The districts with the biggest percentage of degraded wetlands in this basin are Bugweri (100%), Rukiga (83%), Busia (67.1%), Buikwe (65.6%), and Namayingo (63.9%). The status of wetlands in other districts of the Lake Victoria drainage basin is shown in Figure 34.

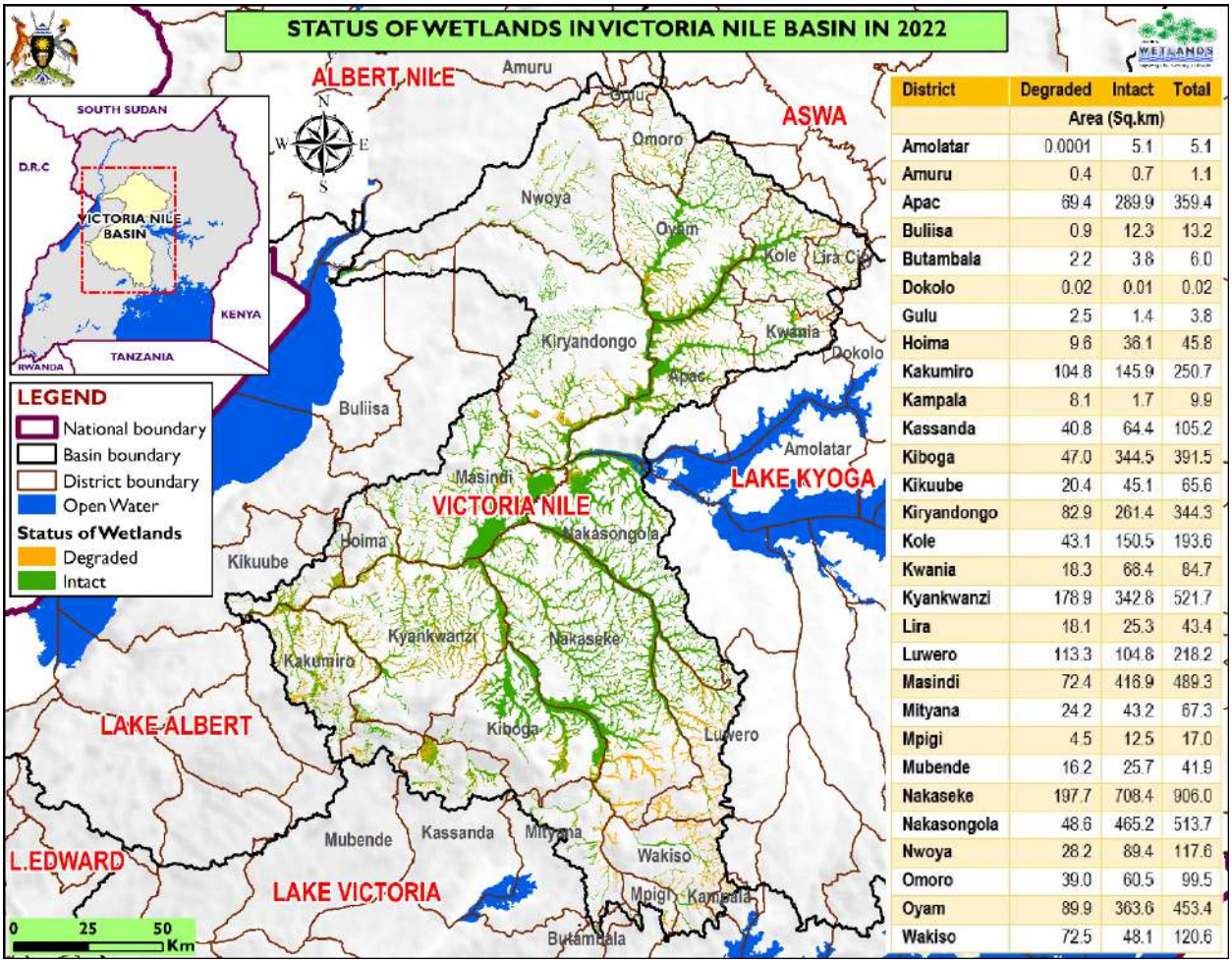


District		Bugiri	Bugweri	Buhweju	Buikwe	Bukomansimbi	Bushenyi	Busia	Butamba la	Buvuma	Gomba	Isingiro	Jinja	Kabale	Kalanga la
Degraded	Area (Sq.km)	12.7	1.1	5.4	26.8	44.6	2.8	51.0	8.0	1.8	55.1	80.0	3.6	28.5	12.5
Intact		7.4	0.0	4.1	14.0	107.7	3.8	25.0	73.3	8.6	293.6	230.4	3.3	21.8	43.1
Total		20.1	1.1	9.5	40.8	152.3	6.6	76.0	81.3	10.3	348.8	310.4	6.9	50.3	55.6
District		Kalungu	Kampala	Kamwenge	Kassanda	Kazo	Kiruhura	Kyegegwa	Kyenjojo	Kyotera	Lwengo	Lyantonde	Masaka	Mayuge	Mbarara
Degraded		66.1	7.4	37.7	88.2	4.7	19.5	52.3	2.0	97.8	58.7	43.0	35.1	89.8	49.5
Intact		210.8	9.4	37.9	152.9	31.1	356.4	51.7	1.2	813.1	120.7	176.0	328.3	51.3	46.9
Total		276.9	16.8	75.6	241.0	35.7	375.9	104.0	3.2	911.0	179.4	218.9	363.4	141.1	96.4
District		Mityana	Mpigi	Mubende	Mukono	Namayingo	Ntungamo	Rakai	Rubanda	Rukiga	Rwampara	Sheema	Ssembabule	Wakiso	
Degraded		14.9	24.0	46.1	3.8	44.7	69.5	126.0	3.5	2.0	38.1	79.8	54.8	18.4	
Intact		78.0	291.0	217.1	96.5	25.3	49.2	145.9	12.9	0.4	43.5	59.1	559.4	178.9	
Total		92.9	315.0	263.2	100.3	70.0	118.7	271.9	16.4	2.4	81.6	138.9	614.2	197.2	

Figure 34: Status of wetlands in Lake Victoria drainage basin

Victoria Nile Drainage Basin

In the Victoria Nile drainage basin, the intact wetlands span a total area of 4,135.6 sq.km (75.3%) whilst the degraded wetlands cover a total area of 1,353.9 sq.km (24.7%). The biggest acreage of intact wetlands is found in Nakaseke, Nakasongola, Masindi, Oyam, and Kiboga. The districts with the biggest percentage of degraded wetlands in this basin are Kampala (82.5%), Dokolo (70%), Gulu (64.3%), Wakiso (60.2%), and Luwero (52%). The status of wetlands in other districts of the Victoria Nile basin is shown in Figure 35 below.



District	Degraded	Intact	Total
	Area (Sq.km)		
Amolatar	0.0001	5.1	5.1
Amuru	0.4	0.7	1.1
Apac	69.4	289.9	359.4
Buliisa	0.9	12.3	13.2
Butambala	2.2	3.8	6.0
Dokolo	0.02	0.01	0.02
Gulu	2.5	1.4	3.8
Hoima	9.6	36.1	45.8
Kakumiro	104.8	145.9	250.7
Kampala	8.1	1.7	9.9
Kassanda	40.8	64.4	105.2
Kiboga	47.0	344.5	391.5
Kikuube	20.4	45.1	65.6
Kiryandongo	82.9	261.4	344.3
Kole	43.1	150.5	193.6
Kwania	18.3	66.4	84.7
Kyankwanzi	178.9	342.8	521.7
Lira	18.1	25.3	43.4
Luwero	113.3	104.8	218.2
Masindi	72.4	416.9	489.3
Mityana	24.2	43.2	67.3
Mpigi	4.5	12.5	17.0
Mubende	16.2	25.7	41.9
Nakaseke	197.7	708.4	906.0
Nakasongola	48.6	465.2	513.7
Nwoya	28.2	89.4	117.6
Omoro	39.0	60.5	99.5
Oyam	89.9	363.6	453.4
Wakiso	72.5	48.1	120.6

Figure 35: Status of wetlands in Victoria Nile drainage basin in 2022

4.2.7 Wetland Status by Water Regime

The wetlands in Uganda are classified by water regimes into two types i.e., permanent and seasonal. The regimes are characterised by flooding or ponding duration. The status of wetlands by water regime is described below at the national, regional, and basin levels.

National and Regional level

Table 17 shows that the permanent and seasonal wetlands in Uganda cover a total area of 10,185.7sq.km (30.2%) and 23,576.9 sq.km (69.8%) respectively. The biggest coverage of permanent wetlands in Uganda is found in the Central region whereas the biggest acreage of seasonal wetlands is located in the Northern region (Figure 36).

Table 17: Wetlands by water regime in the different regions of Uganda

Region	Permanent		Seasonal		Total	
	Area (Sq.km)	%	Area (Sq.km)	%	Area (Sq.km)	%
Central	3,525.8	34.6	6,247.8	26.5	9,773.6	28.9
Eastern	2,968.8	29.1	6,203.0	26.3	9,171.7	27.2
Northern	2,046.5	20.1	7,533.2	32.0	9,579.6	28.4
Western	1,644.6	16.1	3,593.0	15.2	5,237.6	15.5
National Total	10,185.7	100	23,576.9	100	33,762.6	100

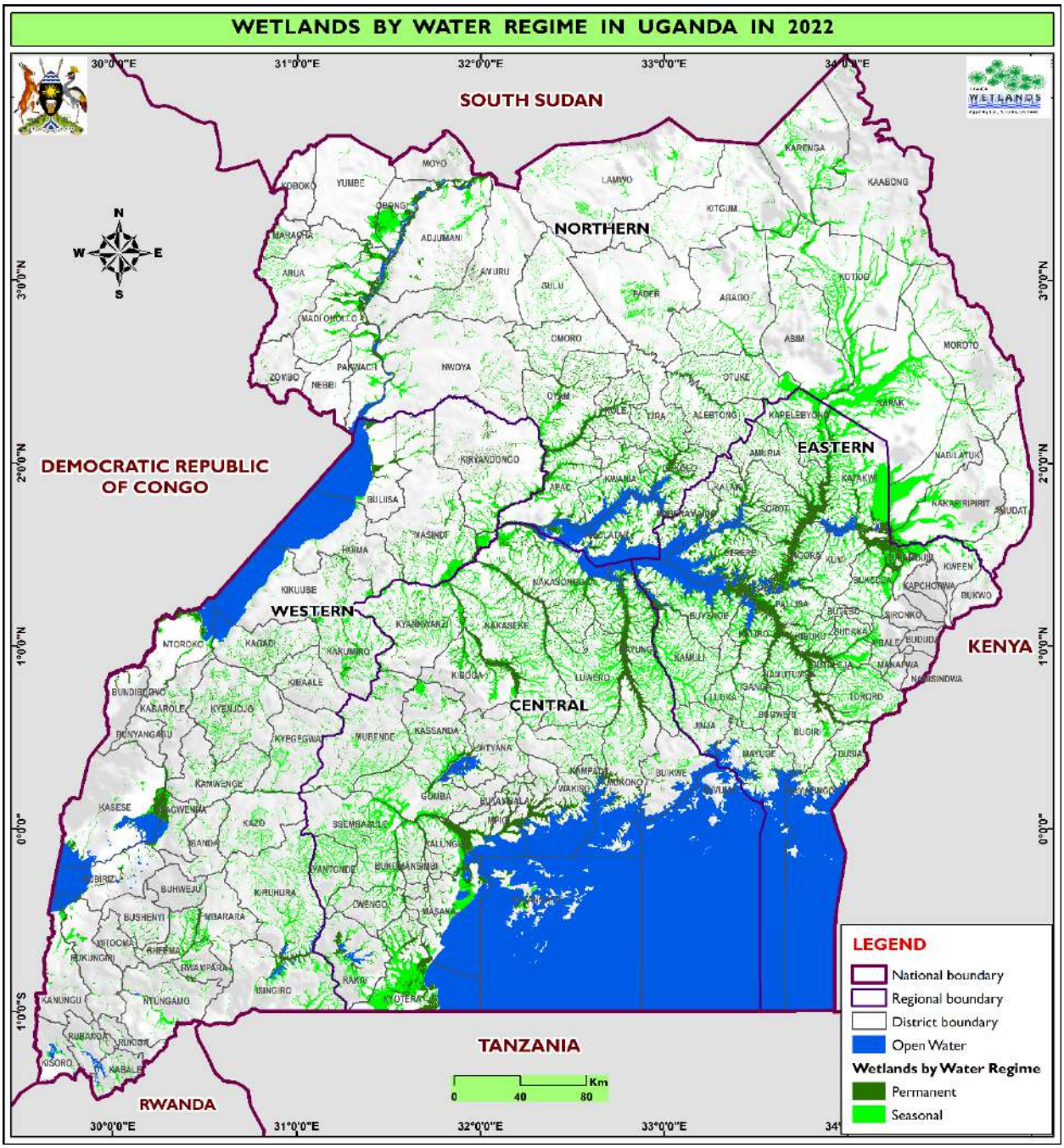


Figure 36: Wetlands by water regime in the different regions of Uganda in 2022

Drainage Basin level

This assessment shows that most of the permanent wetlands are found in Lake Kyoga (48%) and Lake Victoria (28.5%) basins. Still, most of the seasonal wetlands are located in Lake Kyoga (44.1%), Lake Victoria (18.1%), and Victoria Nile (15.1%) basins as shown in Table 18 and Figure 37 below.

Table 18: Seasonality of wetlands in the different drainage basins

Basin	Seasonal		Permanent		Total	
	Area (Sq.km)	%	Area (Sq.km)	%	Area (Sq.km)	%
Albert Nile	1,197.6	5.1	664.5	11.7	1,862.1	11.7
Aswa	2,253.1	9.6	204.9	3.4	2,458.0	3.4
Kidepo	178.0	0.8	6.0	0.3	184.0	0.3
Lake Albert	838.7	3.6	507.1	2.6	1,345.8	2.6
Lake Edward	858.1	3.7	446.5	1.7	1,304.7	1.7
Lake Kyoga	10,355.1	44.1	4,168.2	48.0	14,523.3	48.0
Lake Victoria	4,254.3	18.1	2,236.7	28.5	6,491.0	28.5
Victoria Nile	3,553.3	15.1	1,936.2	3.8	5,489.5	3.8
Total	23,488.2	100	10,170.3	100	33,658.4	100

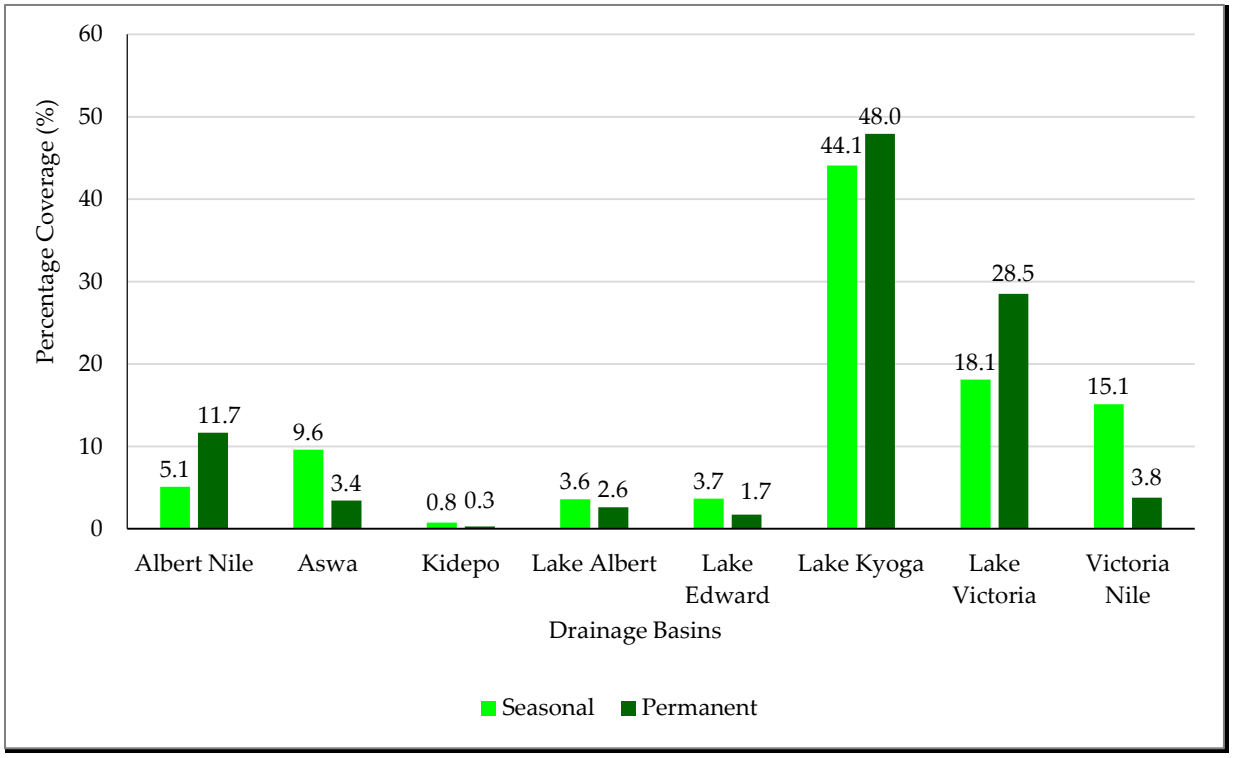


Figure 37: Coverage of wetlands by water regime in the different drainage basins in 2022

Ramsar Sites

Uganda has 12 Ramsar sites that are listed as Wetlands of International Importance by the Ramsar Convention. These sites are also recognized by BirdLife International as Important Bird Areas (IBAs) as well as providing a vital habitat for other threatened plants and animals. These sites are very critical in assisting the government in the implementation of important international agreements such as the Convention on Biological Diversity (CBD) and the Ramsar Convention. They also contribute to the development and implementation of national biodiversity conservation strategies, and in particular, assist national organizations and partners to identify and conserve areas of high biodiversity value; and inform decision-makers about the importance of these sites so that policies and zonation for wetland use is formulated or modified accordingly.

The wetlands in Uganda's Ramsar sites cover a total area of 6,128.3 Sq.km (18.2% of wetlands in the country and 2.5% of Uganda's surface area). Ramsar sites that have the biggest acreage of wetlands include Lake Nakuwa Wetland System (25.6%), Lake Opeta Wetland System (17%), and Sango Bay-Musambwa Island-Kagera (SAMUKA) Wetland System (15.3%). The dominant wetland use/cover types in the Ramsar sites include papyrus (43.2%), small-scale farmlands (23.3%), and grasslands (19.6%) (Table 19). However, over half of all Wetlands of international importance are negatively impacted by agriculture (Convention on Wetlands, 2021).

Table 19: Wetland use/cover types in the different Ramsar Sites in 2022

Ramsar Site	Wetland Use/Cover Types (Area in Sq.km)								
	Papyrus	Grasslands	Woodlands	Small-scale Farmlands	Built-up	Bushlands	Forested Areas	Commercial Farmlands	Total
Lake Bisina	412.3	70.3	0.0	265.5	4.2	6.7	0.0	0.0	759.0
Lake George	55.0	67.2	135.5	24.0	1.0	1.3	2.4	0.04	286.6
Lake Mburo	113.4	93.1	10.2	67.9	3.3	75.6	0.0	0.0	363.5
Lake Opeta	375.1	265.7	0.0	234.5	0.6	128.4	0.0	37.1	1,041.4
Lutembe Bay	11.0	0.1	0.1	1.6	0.6	0.1	0.001	0.003	13.4
Mabamba Bay	178.0	0.6	0.6	1.2	0.2	0.5	0.002	0.00001	181.0
Murchison falls	36.3	2.9	3.1	1.5	0.01	1.7	0.0	0.0	45.5
Nabbajuzi	84.3	30.4	12.1	47.6	0.8	24.6	0.0004	0.0	199.8
Lake Nabugabo	349.4	170.0	43.9	91.9	2.7	65.0	0.2	10.5	733.6
Lake Nakuwa	829.5	69.4	21.9	597.7	8.4	40.7	0.0	0.0	1,567.5
Rwenzori mountains	0.0	0.02	0.1	0.04	0.0	0.0	0.4	0.0	0.5
Sango Bay	203.3	433.6	94.2	94.2	4.2	102.8	4.2	0.0	

									936.6
Total	2,647.5	1,203.2	321.8	1,427.6	26.0	447.4	7.2	47.7	6,128.3

Note: The total area reported is only for wetlands in the Ramsar Sites and not the entire site

Plate 21: Buffalos in the Murchison delta Ramsar site

In terms of status, the intact wetlands in Ramsar sites cover a total area of 4,627.1 sq.km (75.5%) whereas the degraded wetlands span a total area of 1,501.2 sq.km (24.5%). The biggest coverage of intact wetlands is located in Mabamba Wetland System (99.2%), Murchison Falls-Albert Delta Wetland System (96.8%), Rwenzori Mountains Ramsar Site (92.5%), Lake George Wetland System (91.2%), and Sango Bay-Musambwa Island-Kagera Wetland System (89.5%). The most degraded wetlands are found in Lake Nakuwa Wetland System (38.7%), Lake Bisina Wetland System (35.5%), Lake Opeta Wetland System (26.1%), Nabajjuzi Wetland System (24.2%), and Lake Mburo-Nakivali Wetland System (19.6%) (Table 20).

Table 20: Status of wetlands in Ramsar sites in 2022

Ramsar Site	Degraded		Intact		Total
	Area (Sq.km)	%	Area (Sq.km)	%	Area (Sq.km)
Lake Bisina Wetland System	269.7	35.5	489.3	64.5	759.0

Lake George Wetland System	25.1	8.8	261.5	91.2	286.6
Lake Mburo-Nakivali Wetland System	71.2	19.6	292.3	80.4	363.5
Lake Nabugabo Wetland System	105.1	14.3	628.5	85.7	733.6
Lake Nakuwa Wetland System	606.1	38.7	961.5	61.3	1,567.5
Lake Opeta Wetland System	272.2	26.1	769.2	73.9	1,041.4
Lutembe Bay Wetland System	2.1	15.9	11.2	84.1	13.4
Mabamba Bay Wetland System	1.4	0.8	179.6	99.2	181.0
Murchison Falls-Albert Delta System	1.5	3.2	44.0	96.8	45.5
Nabbajuzi Wetland System	48.4	24.2	151.4	75.8	199.8
Rwenzori Mountains Ramsar Site	0.0	7.5	0.5	92.5	0.5
Sango Bay-Musambwa Island-Kagera	98.4	10.5	838.2	89.5	936.6
Total	1,501.2		4,627.1		6,128.3

Note: The total area reported is only for wetlands in the Ramsar Sites and not the entire site

Plate 22: Crested cranes in Sango Bay Musambwa Kagera (SAMUKA) Ramsar site

The trend analysis between 1995 and 2022 showed that the coverage of intact wetlands in Uganda's Ramsar Sites has been reducing. The wetland systems that have experienced the biggest reduction of their intact wetlands between 1995 and 2022 include Lake Bisina (-34.2%), Lake Opeta (-25.7%), Lake Nakuwa (-21.6%), and Lake Mburo-Nakivali (-17.4%) as shown in Figure 38 below.

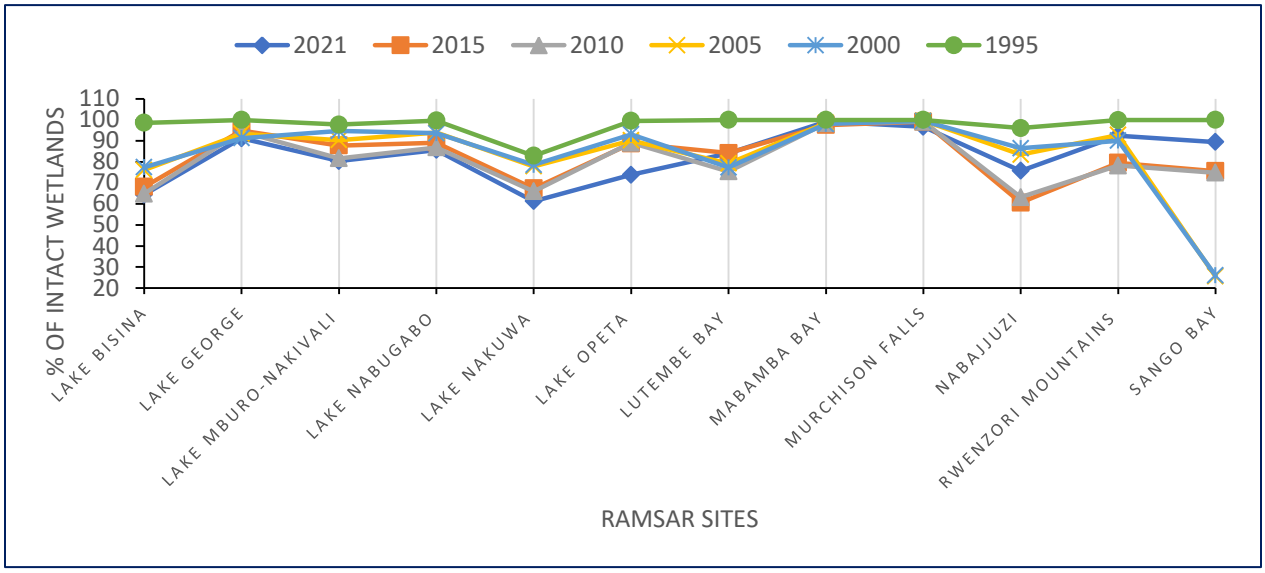


Figure 38: Percentage of intact wetlands in Ramsar sites in 1995, 2000, 2005, 2010, 201, and 2022

Figure 39 shows the trend of the degraded wetlands in Ramsar Sites to be continuously increasing between 1995 and 2022. The wetland systems that have experienced a significant increase in degraded wetlands between 1995 and 2022 include Lake Bisina (34.2%), Lake Opeta (25.7%), Lake Nakuwa (21.6%), Nabajjuzi (20.3%), and Lake Mburo-Nakivali (17.4%). Interestingly, the coverage of degraded wetlands in Rwenzori mountains was higher in 2000 (74.1%) and 2005 (74.5%) but this significantly reduced to 25.1% in 2010 after the designation of the Ramsar Site in 2008.

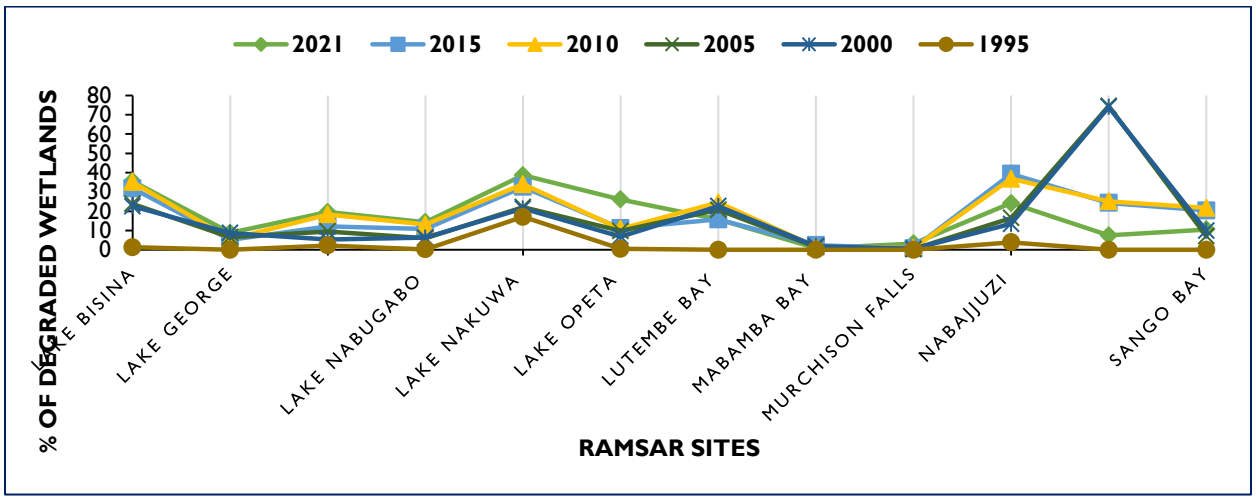


Figure 39: Percentage of degraded wetlands in Ramsar Sites in 1995, 2000, 2005, 2010, 2015, and 2022

Table 21 highlights the Ramsar criteria, the threatened species, their values and threats within the Uganda's Ramsar sites

Table 21: Ramsar Criteria, Values, Threatened Species, and Threats in Uganda's Ramsar Sites

Name	Ramsar Criteria for their designation	Threatened/Vulnerable Species	Social and Cultural Values	Threats
Lake Bisina Wetland System	• Has a Unique macrophyte system • Supports rare and endangered species • Supports species that maintain the biological diversity • Supports species at a critical stage in their life cycles • Supports species of indigenous Cichlid fishes • An important spawning ground	*Balaeniceps rex, Casmerodius albus, Ephippiorhynchus senegalensis, Buphagus africanus, Crocodylus niloticus, Tragelaphus spekii, Pelomys hopkinsi, Oreochromis esculentus*	• Source of fish • Cultivation is carried out in wetland areas • Source of water for livestock and domestic use • Source of food during prolonged drought • Supports inter-district transport connections	• Over fishing • Use of poor fishing methods • Hunting of Sitatunga • Poor farming methods • Low environmental awareness • Habitat degradation due to grazing
Lake George	• Supports species at a critical stage in their life cycles • Supports species of indigenous Cichlid fishes • An important spawning ground	*Balaeniceps rex, Ephippiorhynchus senegalensis, Chloropeta gracilirostris*	• An important tourist destination • Source of fish	• Pollution from copper and cobalt pyrites • Uncontrolled charcoal burning to the east of Lake George • Use of pesticides and agrochemicals in horticulture farms • Poor management practices in the water catchment area of the wetland
Lake Mburo-Nakivali Wetland System	• Supports threatened and vulnerable species • Supports species important for maintaining the biological diversity • Provides refugia to wetland bird species during adverse conditions • An important spawning ground	*Chloropeta gracilirostris, Balaeniceps rex, Torgos tracheliotos*	• Cattle keeping • Source of water for domestic and livestock use • Payrus is harvested and used in the production of mats • Supports fishing activities	• Hunting and habitat destruction through cultivation and settlement. • Over fishing. • Poor fishing methods • The animosity created between local communities and the park. • Crop raiding by wildlife
Lake Nabugabo wetland system	• Has an unusual evolutionary history, water quality, and are satellites to Lake Victoria. • Has rare and endangered species of fish. • Supports species important for maintaining the biological diversity • Destination for migratory bird species both to the south and	*Hirrundo atrocaerulea, Balaeniceps rex, Gallinago media, Circus macrourus, Laniarius mufumbiri*	• Source of fish for subsistence and commercial use • Livestock grazing especially during the dry season • Sources of water and handcraft materials • Crop cultivation and diary farming	• The wastewater effluent from tourism facilities • Continuing fishing pressure • Continued burning of the grassland on the sand bar • Water pollution from cattle grazing and watering • Residential development in the immediate lake shore region • Continuing deforestation in the nearby lake catchment

Name	Ramsar Criteria for their designation	Threatened/Vulnerable Species	Social and Cultural Values	Threats
	• Palaearctic's • Holds species of indigenous Cichlid fishes			
Lake Nakuwa Wetland System	• Forms an unusual extensive and pristine wetland in Uganda • Supports endangered and rare endemic species • Supports species important for maintaining the biological diversity • Supports species at a critical stage in their life cycles • Supports indigenous Cichlid fishes • Important source of food for fishes • Spawning ground, nursery and / or migration path on which fish stocks depend.	*Chloropeta gracilirostris, Balaeniceps rex, Euplectes hartlaubi, Tragelaphus spekii, Ploceus spekeoides, Laniarius mufumbiri, Bradypterus carpalis, Serinus koliensis, Balearica regulorum, Cinnyris erythrocerca*	• Source of water for domestic and livestock use • Source of food (rhizomes) during prolonged droughts • Source of raw materials for crafts • Provides fish to communities • Offers employment opportunities to people	• Illegal hunting of wildlife especially Sitatunga • Over exploitation of wetland resources • Collection of ornamental fish for export • Degradation of the fish habitat • Spread of the Nile Perch and water hyacinth • Reclamation of land for agriculture • Over grazing and cultivation • Bush burning.
Lake Opeta Wetland System	• Forms an unusual extensive important wetland marsh in Uganda • Supports vulnerable, endangered, or critically endangered species or threatened ecological communities • Supports species important for maintaining the biological diversity • Supports species at a critical stage in their life cycles • Supports indigenous Cichlid fishes • Important source of food for fishes • Spawning ground, nursery and / or migration path on	*Balaeniceps rex, Panthera leo, Tragelaphus spekii, Xerus erythropus, Paraxerus palliates, Tatera valida, Ploceus spekeoides, Laniarius mufumbiri*	• The lake and the surrounding swamps are used for grazing and watering cattle in the dry season • The lake serves as a source of fish protein to communities • Cultivation is also done in the wetland catchment areas	• Illegal wildlife hunting in the area • Over stocking of cattle • Grazing in the wetlands during dry seasons • Low environmental awareness.

Name	Ramsar Criteria for their designation	Threatened/Vulnerable Species	Social and Cultural Values	Threats
	which fish stocks depend.			
Lutembe Bay Wetland System	• Supports rare, vulnerable, endangered, or threatened species • Supports species important for maintaining the biological diversity • Provides refuge to migrant birds during adverse conditions • Regularly supports 20,000 or more water birds • An important spawning ground, nursery on which fish stocks depend.	*Balaeniceps rex, Laniarius mufumbiri, Laniarius mufumbiri, Tragelaphus spekii, Lutra maculicollis, Aonyx capensis*	• Source of raw materials for local crafts, building materials, water for livestock and domestic use, and fish for food. • Provides employment opportunities to people • The catchments and wetlands provide agricultural land throughout the year especially during dry spells • The bays provide landing sites for fishermen fishing within Lake Victoria	• Over harvesting of wetland resources • Crop cultivation on the edges of the wetland • The Water hyacinth, *Eichhornia crassipes*, is affecting the ecology in the area • The introduced species of fish Nile Tilapia in Lake Victoria has led to the extinction of several Haplochromine species • The nutrient load from Kampala City • Development of housing estates and industries around the wetland • Sand mining, open pits, and brick making.
Mabamba Bay Wetland System	• Supports vulnerable, endangered, or threatened species • Acts as a refuge for several bird and fish species • Regularly supports 20,000 or more water birds	*Hirundo atrocaerulea, Balaeniceps rex, Chloropeta gracilirostris, Tragelaphus spekei, Laniarius mufumbiri, Circus macrourus, Gelochelidon nilotica, Chlidonias hybridus, Chlidonias leucopterus*	• The Bay has about 6 landing sites, all having lucrative fisheries activities • Source of raw materials for local crafts, building materials, water for livestock and domestic use, and fish for food. • Provides employment opportunities to people • The forested part of the Bay provides wood and non-wood products	• The use of agrochemicals in the surrounding flower farms will have an impact on the ecology of the area • Hunting of the Sitatungas • The dry season incursion into the swamp by fishermen, some of whom build huts in the swamp and stay there. • The breeding of the Shoebill by local people and they sometimes collect the young birds for raising with an intent to sell • The proliferation of the water Hyacinth, *Eichhornia crassipes*
Murchison Falls – Albert Delta Wetland System	• Supports rare, vulnerable, and endangered species • Supports species important for maintaining the biological diversity • An important spawning ground, nursery on which fish stocks depend • Support a number of indigenous fish species that are representative of the global biological diversity	*Balaeniceps rex, Torgos tracheliotus, Falco naumanni, Loxodonta Africana, Crocodylus niloticus, Laniarius mufumbiri*	• The local people poach the wildlife game for meat • Provides fish protein to local communities • Agricultural activities are done in the catchments • Grazing of goats and cattle • Source of water for livestock and domestic use • Supports tourism and recreation activities	• Poaching of wildlife • Human-wildlife conflicts majorly between the fishermen and Nile crocodiles

Name	Ramsar Criteria for their designation	Threatened/Vulnerable Species	Social and Cultural Values	Threats
Nabajjuzi Wetland System	• Supports globally vulnerable and threatened birds • Supports species important for maintaining the biological diversity • An important spawning ground, nursery on which fish stocks depend	*Balaeniceps rex, Laniarius mufumbiri, Chloropeta gracilirostris, Balearica regulorum, Tragelaphus spekei*	• Provides plant materials for thatching, medicine and crafts, water, fish, and game meat • Supplies water to Masaka City and nearby communities • The wetland is a source of Mudfish (Mmale) *Clarias* and Lungfish (Mamba) *Protopterus* • Cultivation is done at the fringes of the wetland • The harvested papyrus is used for handcraft production especially carpets, mats and baskets • Community eco-tourism is also done especially bird-watching based on the wetland, water birds and the Sitatunga	• Hunting of Sitatungas • Growing commercialization of wetland resources • Rapidly growing urban centres in the areas adjacent to the wetland • Rampant cultivation on the edges of the wetland • Water pollution from the tannery
Rwenzori Mountains Ramsar Site	• Contains important wetland bogs in Uganda with a unique macrophtye ecosystem • Supports vulnerable, endangered, or critically endangered species or threatened ecological communities • Supports species important for maintaining the biological diversity • Supports species of indigenous *Clarias spp* fishes	*Ruwenzorisorex suncoides, Hybomys lunaris, Dasymys montanus, Loxodonta africana, Cercopithecus lhoesti, Rhinolophus ruwenzorii, Nectarinia rockefelleri, Cryptospiza shelleyi*	• The history, culture and beliefs of the Bakonzo tribe are closely woven around the Rwenzori Mountains. These include the “kingdom”, circumcision rites and rituals to remove curses (dry spells, disease outbreak etc).	• Population pressure that has resulted into increased demand for agricultural land
Sango Bay-Musambwa Islands-Kagera Wetland System (SAMUKA)	• It represents a unique natural wetland type found in the transition of two vegetation zones • Supports rare, vulnerable, endangered, or critically endangered species or threatened ecological communities • Supports species	*Loxodonta africana, Tragelaphus spekii, Hirundo atrocaerulea, Balaeniceps rex, Laniarius mufumbiri*	• Source of fish proteins to local communities • Provides employment opportunities • Provides herbs and raw materials for crafts • The area has a long history of cultural attachment to Musambwa islands, where women are not allowed to stay overnight • The floodplains are used for cattle grazing	• Over fishing • Expansion of farming activities near the wetland • Hunting of Sitatungas and hippopotamus • Bush burning • Over exploitation of wetland resources • Over grazing especially during the dry spell

Name	Ramsar Criteria for their designation	Threatened/Vulnerable Species	Social and Cultural Values	Threats
	important for maintaining the biological diversity • It regularly supports 20,000 or more water birds • An important spawning ground, nursery on which fish stocks depend		especially during the dry spells • The site has Archaeological and Religious importance	

Source: Ramsar Information Sheets

Plate 23: A wild palm tree in L.George Ramsar site-Kitagwenda district

5. Chapter Five: Drivers and Impacts of Wetland Degradation

5.1 Introduction

This chapter presents the drivers of wetland degradation in Uganda. Knowledge of the drivers is essential for designing proper interventions that will ensure positive impacts while minimizing the negative impacts. In this report, a driver is defined as any factor that causes a change in the aspect of an ecosystem. Direct drivers refer to natural or human-induced causes of biophysical changes at a local to regional scale, whereas 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). Drivers can result in positive and negative effects, however; this report was tailored to the drivers which impose negative impacts on the morphology and functioning of wetland ecosystems in Uganda. The drivers are further classified as physical/structural, extraction and introduction drivers. Physical drivers relate to changes in the ecological morphology of wetlands and their immediate environment. Extractions from the wetland ecosystems include removal of water, species and soils while introduction drivers involve the addition of nutrients, chemicals, pollutants and solid wastes. Institutional drivers are a result of gaps in coordination by the responsible government agencies in the management of wetlands. These are explicitly discussed in the following subsection.

5.2 Drivers of Wetland Degradation

5.2.1 Social Drivers

Rapid population growth and pressure: The increasing population growth rate is a major factor driving the encroachment of wetlands for settlement, agriculture and for other resources. The current statistics indicate that the population of Uganda is growing at a rate of 3.1 percent per annum increasing from 34.4 million in 2014 to 42.8 million in 2021 (UBOS, 2021) (Figure 40). With this rapid growth in human populations, wetlands in Uganda are suffering from serious degradation or loss triggered by wetland pollution, wetland reclamation and land use changes. In Addition, settling refugees in settlements close to wetlands is also a factor that impacts surrounding wetlands because they increase the burden through the access of the ecosystems for thatch grass, firewood and poles for construction purposes (Barasa et al., 2020). As per UBOS (2021) population projections, the districts with the most degraded wetlands above 90% coverage are populated as Mbale (604,100), Sironko (279,700), Bugweri (196,300), Manafwa (179,000) and Butebo (122,800).

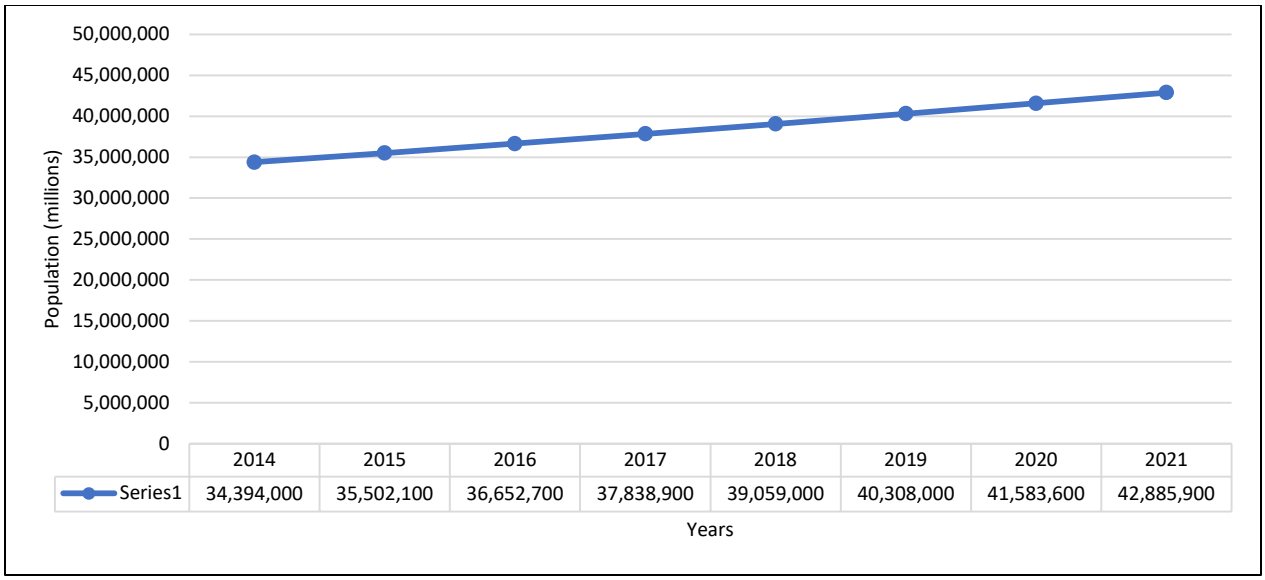


Figure 40: Population growth between 2015 and 2021 (UBOS, 2021)

High poverty rates: As per UBOS (2021), about 8.3 million households live in poverty. In Uganda, wetland degradation is positively linked with poverty in a spiral web compared to access to clean water, access to toilets, and access to electricity and the use of charcoal and firewood (Aggrey et al., 2010). Wetlands in the rural communities have been heavily converted from their pristine nature to cultivation sites as breadbaskets for the poor, increasing their loss across the country. Highly impacted rural wetlands are situated within the poorer communities mostly in the north of Lake Kyoga in Lira, Amuria, Dokolo, and Amolatar districts (Figure 41).

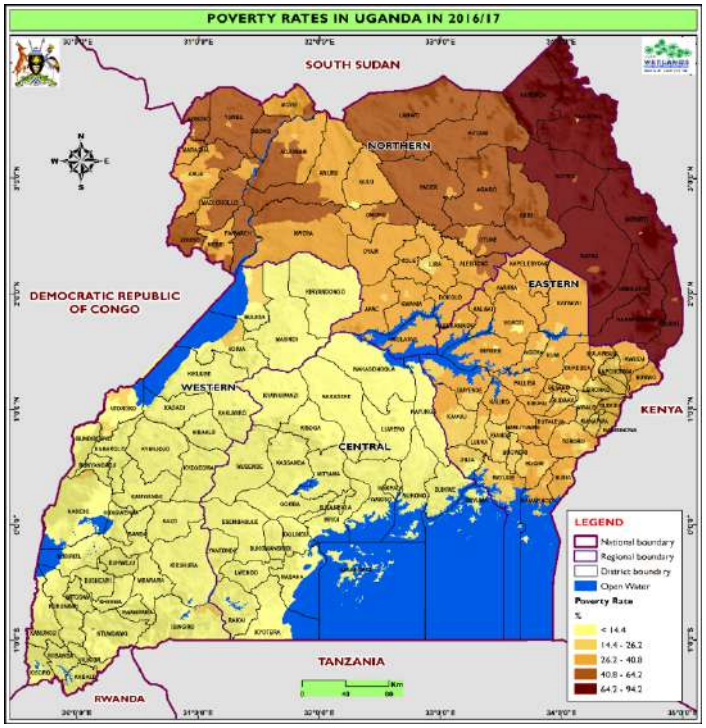


Figure 41: Poverty status in Uganda

Limited awareness and attitudes. One of the misconceptions is that rice and sugar-growing are yielding more funds than other activities. Communities are running away from traditional cash crops such as cotton and groundnuts. Overall, the literacy rates for Uganda have seen a vast improvement since the establishment of Universal Primary Education in 1996. However, the rates are still low in most of the sub -Saharan countries (Schnell, 2021).

5.2.2 Physical and Structural Drivers

Urbanisation, Industrialisation and Infrastructural developments: Urban centres in Uganda are largely characterised by a high development index in terms of infrastructure, urbanisation, industry, commerce and trade. Wetlands are always seen as strategic points for infrastructural and industrial development owing to their location and tenure status (Wasswa et al., 2019). An increase in infrastructural development that is corresponding to the level of rapid urbanization and population pressure (Akiyode et al., 2017). For example, in Nsooba-Lubigi wetland system, the built-up environment constitutes infrastructure development, residential development, the establishment of commercial facilities such as hotels, guest houses, shops and institutions such as schools which account for 73.1% of the current wetland use (Karabo, 2017). Some of the infrastructure projects installed in wetlands include the National Water and Sewerage Corporation treatment plant in Lubigi wetland, Kampala-Entebbe Express Highway, Katosi water treatment plant among others. Consequently, wetland areas end up split into patches and plots, reducing their potential to overcome natural hazards like floods.

Plate 24: Clay work factory in Sheema District

Plate 25: Entebbe express highway

Box 1: Wetlands and Urbanisation

WETLANDS AND URBANISATION

It is expected that, by 2050, the global population will increase to around 9.8 billion most of whom will live in cities [United Nations, 2018]. The effects will include draining, contaminating and destroying wetlands through construction for housing, agriculture and industry [McInnes and Everard, 2017].

Both urbanization and development of cities have presented wetlands with many challenges, such as direct habitat loss due increasing population that has resulted in increased demand for land. Urban wetlands possess a variety of ecological functions that cannot be replaced by other urban ecosystems. Urban wetlands are natural Green-Blue Infrastructure (GBI) in cities that host a wide range of biodiversity [Ye et al., 2018]. In addition, the interaction with these valuable ecosystems in cities improves citizens' physical and mental health [Yun et al., 2021]. Urban wetlands also offer a wide range of socio-cultural services, such as creating space for recreation and leisure for the city inhabitants [Alikhani et al., 2021].

However, based on the 2020/22 mapping, wetlands in the urban areas (Kampala, Mbarara, Masaka, Lira, Gulu and Fort Portal) have been heavily degraded. This implies that the wetlands' ability to perform ecological functions in the cities is greatly compromised. As a result, the intensity of flooding, outbreak of water borne diseases, increased pollution has been registered in the urban settings.

Wetland agricultural expansion and intensification: Land-use change is the biggest driver of degradation to inland wetlands since 1970 (Convention on Wetlands, 2021). Agriculture compromises wetlands capacity to offer other critical ecosystem functions. In Uganda, agriculture has intensified in most wetlands which have significantly affected their yearly availability of water and thus, most of the small-scale farmers have drained these wetlands to convert them into cultivation sites. This has created a challenge among wetland scientists, for instance, there is a growing confusion on how to interpret the wetland ecosystem as a functioning unit within the complex human and often dynamic natural resources, to evaluate their tolerance to various uses and advise on optimum management strategies to maintain functional integrity (Mwakubo and Obare, 2009). In South Western Uganda, wetlands have been reclaimed for vegetable growing, fishing and starting cattle farms while in Eastern Uganda, rice and sugarcane growing have caused reclamation of a big chunk of the wetlands. These have resulted in the loss of wetlands to other wetland uses.

Plate 26: Cattle rearing in Bushenyi District

Plate 27: Rice growing in Butaleja District

5.2.3 Extraction Drivers

Over extraction of sand and clay mining activities: Sand and clay mining in wetlands are one of the leading activities in these fragile ecosystems across the country. Much as these activities provide benefits to the community that lead to poverty eradication and economic growth through the sale of bricks, sand and clay. However, it involves a series of negative impacts on the environment and the wetland. For instance, the activity extraction of clay soil leaves huge gaping holes filled with dirty stagnant water. The holes that are dug in the process of extracting clay lower the water table of that particular area, consequently drying up the uplands/surrounding catchments, which cause a significant reduction of water in the wetland thus, affecting the water levels in the long run at a regional scale. The stagnant water resulting in ponds act as breeding grounds for mosquitos that cause malaria to the surrounding communities (Opio, 2008).

Plate 28: Brick making in Mitooma District

Plate 29: Sand mining in Sheema District

Overharvesting of wetland resources: Wetland resources have been subjected to overexploitation and intensive resource use. Wetlands in most cases are concurrently used for two or more purposes involving overharvesting of vegetation such as papyrus (Cyperus Papyrus), wood and grass for mulching, thatch and craft materials; water collection and livestock rearing (Namulema, 2015). The papyrus wetland class provides income in three ways i.e., it may be sold by harvesters to artisans such as thatch and mat makers; they may be used to produce rough low-cost mats for sale and the harvesters may use the papyrus to produce fine higher-cost mats. Different stakeholders compete

for resource harvesting, especially around municipalities. The overexploitation threatens wetland ecological integrity, leading to deterioration and degradation (Kabumbuli and Kiwazi, 2009). Removal of biomass may have an impact on the standing biomass which could affect primary productivity, a fundamental biological process supporting trophic levels (Taita et al., 2012).

Plate 30: Papryus harvesting in Ntungamo District

Plate 31: Wild palm tree logs Kigooba wetland in Kyenjojo district

Extraction of Water for production: The Ministry of Water and Environment in partnership with the Ministry of Agriculture, Animal Industry and Fisheries are enhancing access to sustainable irrigation for smallholder farmers through the utilization of water resources for crop production, livestock, aquaculture and rural industries. Construction of medium to small scale irrigation schemes, earth dams, valley tanks and bulk water schemes is ongoing in the water management zones of the country with the target of increasing water for production. Some of the water for production technologies are constructed within and near the wetland systems, however, this negatively alters the ecosystem hydrological functioning as well as its biodiversity integrity. Irrigation schemes or water diversions for irrigation have undoubtedly caused adverse effects on wetland ecosystems.

5.2.4 Introduction of Exotic Species and Pollutants

Pollutants (point and non-point): Due to the increasing agricultural activities in the wetlands, small-scale farmers apply pesticides on their crops to control pests and diseases. These pesticides degrade the water quality of the wetland including affecting the biota of the ecosystem. Of the households that use wetlands for farming in Eastern Uganda, 47% use agrochemicals in their gardens in the wetlands while 53% do not use agrochemicals. In Western Uganda, about 60% of households use agrochemicals in their gardens in the wetlands. Additionally, the increasing industrial parks and other factories in Uganda have increased the degradation of the wetlands through the disposal of untreated wastes/industrial effluents leading to pollution as the water quality is significantly reduced for instance in the Namanve stream in Kampala Industrial Park (Wanasolo et al., 2018).

Plate 32: Alcohol brewing in Ngoro wetland in Rubirizi district

Indiscriminate waste disposal: Solid waste management is one of the major environmental problems facing wetlands in urban areas in the country. Solid waste is predominantly biodegradable (78%) with generation rate of 0.55 (0.3–0.66) kg/capita/day and collection coverage of 43.7% (Okot-Okumu & Nyenje, 2011). The indiscriminate disposal and accumulation of waste is attributed to inadequate solid waste collection vessels and the delays in the collection of waste by the garbage trucks. In many urban areas, garbage is collected at one point as people wait for the garbage truck to pick it (Ssemugabo et al., 2021). The vulnerable sites are wetland areas. About 39% of solid waste is disposed to the bushes and wetlands (Otai, 2020). In the process, waste is sometimes burnt to avoid spreading by the wind which causes loss of vegetation but also releases gases in the atmosphere. Therefore, there is an urgent need to provide for the safe disposal of the solid waste generated by rural and urban residents and businesses.

Plate 33: Waste dumping in wetland Buwama sub county, Mpigi district

Introduction of exotic tree species such as blue gum trees (Eucalyptus spp.): There is an increasing rate of Eucalyptus trees planted in the wetlands especially in the central and western regions around the small and big wetlands. The privately-owned wetlands are being converted into Eucalyptus plantations. The introduction of exotic tree species in wetlands has been reported to drain water resources thus degrading the wetland ecological functions and goods. Although there is limited evidence regarding the impacts of *Eucalyptus* on water, it has been claimed that these fast-growing trees absorb more water from the soil than any other tree species. Figure 42 shows an example of eucalyptus tree plantations along the wetland fringes in the Sheema district.

Plate 34: Eucalyptus tree plantation in Bushenyi district

Figure 42: Eucalyptus tree plantations in Kandecho-luhobero wetland Sheema District

5.2.5 Institutional Drivers

Political influence coupled with impunity of the masses: Political interference towards the matters related to protection and conservation of wetlands in Uganda have rendered the wetland management agencies ineffective (Barakagira and de Wit, 2019). For example, some political leaders shield and protect those members within the community who are regarded as electorates from being evicted from the reclaimed wetlands (Kahangirwe & Vanclay, 2021). Thus, officials see it as unnecessary to confront such people who are believed to be 'well politically connected' and involved in the degradation of wetlands, leading to further destruction of the wetlands.

Uncoordinated activities and conflicting interests between different government entities responsible for natural resource management: This has increased wetland degradation especially in the central region of the country. Some of the members of the local community possess valid land titles that have been issued by the officials from the Ministry of Lands and Urban Development, covering some parts of the wetlands. Yet the same piece of land might have been designated as a wetland by the officials from the Ministry of Water and Environment. Secondly, the promotion of rice growing in wetlands by MAAIF complicates wetland conservation initiatives already underway. Such confusion is happening in many parts of the eastern and central regions (near the Capital City), where the value of land is believed to be high. These circumstances have rendered the wetlands management institutions ineffective and have promoted the disappearance of wetlands in the region. Lastly due to policy conflicts, the natural resources management cascades in the local government structure with clear roles, however, these are non-functional grass-root government structures.

Lack of specific judges to expedite cases concerning wetland encroachers: This is also one of the drivers behind the ineffectiveness of the wetland management agencies from protecting and conserving the wetlands in Uganda. Whereas wetland encroachers are always arrested and taken to the Court of Law for prosecution, most times the offenders are let off because some judges seem not to be very conversant with environment-related cases (Barakagira and de Wit, 2019). Furthermore, some of the wetland related cases take an unnecessarily long time before they are resolved and yet wetland degradation often occurs all the time thus this has increased the disappearance of wetlands across the country.

Wetland ownership and tenure: The officially recognised land tenure regimes are the freehold, leasehold, Mailo, and customary regimes (Dieterle, 2021). If the tenure is owned communally, it's only in wetlands that people think they can operate with minimal limitation. The ecosystems are thought of as the last remaining place for farming and the only option to compensate for the loss of agricultural land (van Soest, 2020). Unclear wetland ownership to members of the local community has contributed to the degradation of wetlands across the country. The existing different land tenure systems including the customary, freehold, mailo, and leasehold which operate under different objectives, and are in most cases implemented in the same area, have also exacerbated wetland degradation. For instance, in Kabale district, South-western Uganda, people who own the land immediately adjacent to the wetlands assume ownership of the wetlands (Maclean et al., 2003). Insecure and non-uniform land tenure systems as reported by USAID (2011) are known to threaten sustainable natural resource management and biodiversity conservation (Figure 43).

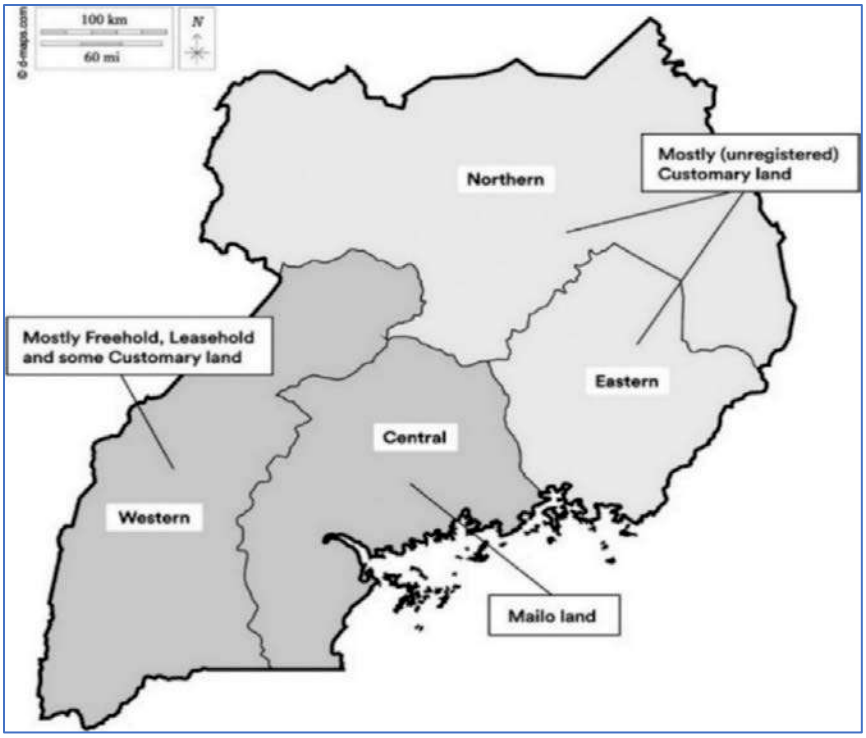


Figure 43: Land tenure regimes in Uganda (Dieterle, 2021)

5.2.6 Unsustainable Practices and Climate Change

Wetland burning: Seasonal wetlands are prone to burning especially at the peak of dry periods. This is perceived by the households to eradicate ticks and facilitate hunting. Burning also occurs at the opening of fresh land for cultivation. For example, in Arua city, wetland burning during the dry season is a common practice by the hunters and livestock grazers. This has led to the removal of vegetation and exposure of soils to erosion agents. This has been observed in Ala, Enyau, Ora, Nyagak and Uyu wetlands. Wetlands in the Eastern and Northern Uganda that are prone to fires include Mpologoma, Manafwa, Limoto, Malaba, Opeta, Awoja, Bisina, Namatala-Doho, Achwa wetlands. Fires expose wetlands to erosion and siltation which significantly affects the wetland natural vegetation and fauna abundance and distribution as well as the regulatory and functioning ecosystem services; such as regulation of floods, microclimate modification and water infiltration.

Plate 35: Peat burning in Bushenyi district

Plate 36: Burning in Sheema district

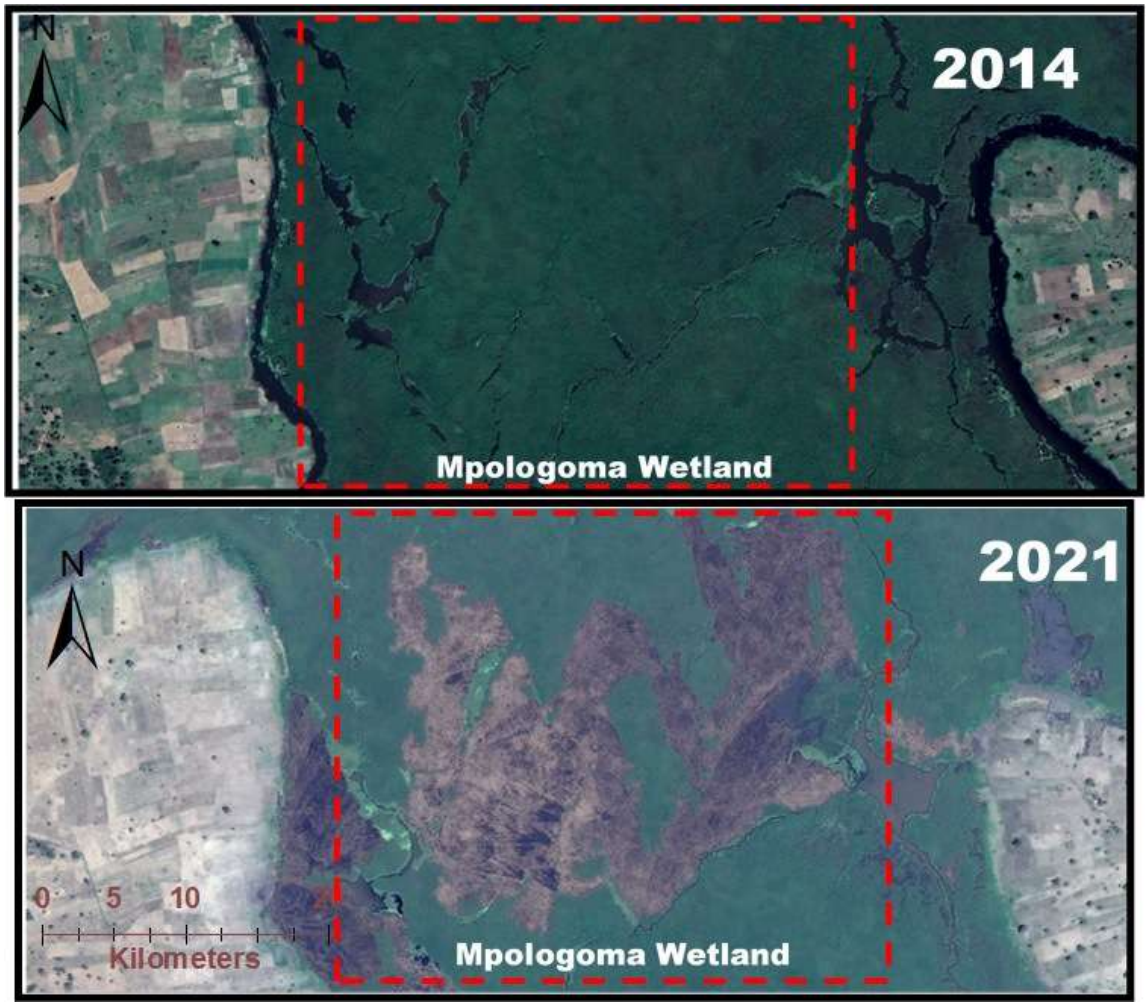


Figure 44: Wetland burning (of papyrus) in Mpologoma (2014 and 2021)

Prolonged drought: Climate intensifies the occurrence and intensity of extreme heat and droughts. Climate variability has led to negative impacts on wetland resources onto which communities derive their livelihood. Wetland uses, flora and fauna are directly affected by the changes in temperature. In addition, climate impacts wetland soils which impact small scale farming activities (Baker et al., 2019).

Plate 37: Paddy rice cultivation in Papayo wetland system Pallisa District

5.3 Impacts of Wetland Degradation

As a result of wetland degradation from the drivers, several impacts on the ecosystem services and functioning of the wetlands have been experienced. These impacts are related to biodiversity, hydrology, land, air and provisioning services. Detailed demonstration of forms of wetland degradation experienced in the country are hereby presented below:

5.3.1 Biodiversity Impacts

Loss of wetland biodiversity (fauna and flora): The growth of water weeds and shrubs in the wetlands mainly located in the Lake Kyoga and Lake Victoria basin has to a large extent contributed to fish extinction. Besides, the increasing industrial developments in and around these wetlands and thus pollutants have on the other hand led to the migration of fish and other aquatic life due to poor water conditions for their existence including changes in water pH limiting survival of fish consequently reduction in their population. The burning of wetlands has led to the destruction of bird species habitats and thus resulted in migration. While sand mining in Lwera wetland influences plant species diversity and leads to the loss of ecologically and socio-economically valuable wetland plant species (Kawala, 2021).

Implications;

- *Decreased economic opportunities from eco-tourism. Similarly, income earned by tour operators from tourism activities associated with the wetland ecosystems has also declined.*
- *Loss of house hold incomes for communities that are dependent on wetlands for*

Plate 38: Threatened papyrus yellow wabler Kyegegwa district Plate 39: Loss of wetland flora in Kamwenge District

5.3.2 Land-Based Impacts

Open pits from mining activities: Sand has been used in the construction of roads, dams, houses for thousands of years. However, the increasing population and economic developments impose an ever-rising demand for sand across the country and thus, increasing the degradation of wetlands most of all the unsustainable mining methods used in which sand is excavated and open pits are covered after mining. These open pits act as habitats and breeding sites for disease-carrying vectors such as mosquitoes; invasive aquatic plants such as water hyacinth (Koehnken et al., 2018; Kusemererwa, 2019). The open pits from sand mining negatively impact the adjoining groundwater

system and also destroys aquatic and riparian habitat through large changes in the stream morphology. The lowering of the water table caused by sand mining-related incision affects the establishment of pioneer forests on previously cleared riparian habitats linked to the natural vegetation on the landforms.

Plate 40: Gold mining in Kanoni wetland, Buhweju district

Soil surface degradation: The most visible soil surface degradation in the already cleared wetlands especially in North Eastern Uganda with wetlands characterized by Vertisols and Glyesols is soil cracking. As a result of clearing wetlands for cultivation and grazing through fire burning, the soils are exposed to the hit and sun energy consequently increasing soil evaporation and drying of the wetland soils due to loss of water and thus, leading to large crack formation in these soils which are vertical. Resultantly, the below-ground biodiversity is negatively affected as well as migration of surface biodiversity within these wetlands. Box 3 displays practices that degrade wetland soils.

Plate 41: Wetland burnt by cobalt floth in Kasese district

Plate 42: Wetland cultivation in Kamwenge district

Box 2: Practices that degrade wetland soils

How wetland soils are degraded in Uganda

a) Over cultivation
b) Wetland burning
c) Dumping of wastes in wetlands (industrial effluents)
d) Dumping of Murrum
e) Reclamation – drainage channels (exposes the soil to weather related factors)
f) Waste discharge particularly in urban areas
g) Brick making
h) Sand mining
i) Compaction by the cattle through grazing
j) Poor agronomic and farming practices
k) Irregular trenching that drains the adjacent land

5.3.3 Hydrological Impacts

Water level reduction: With an increase in wetland degradation, the wetland role of water storage and release of water during the dry spell has been reduced and this is evident in the wetlands across all the major drainage basins across the country. During the rainy seasons, wetlands cannot hold water for long anymore and flooding is normally experienced at lower catchments of several drainage basins for instance in Lake Kyoga basin, floods have been experienced in the Buyende district-the lower part of the Kyoga basin and in the Awoja wetland where most of the wetlands in the upper catchments of the basin have been destroyed. As floods occur, sedimentation increases in these water resources thus, affecting their water levels. Consequently, a decline in water levels is observed pronounced during the long dry spell, evident along river Agu wetland system in Ngora district, and River Malaba according to the key informant stakeholders interviewed.

Plate 43: Dumping of murram in a wetland in Wakiso district

Plate 44: Wetland soil dumping in Mukono District

Figure 45: Wetland murram dumping, Bwaise Kampala

Reduced water flow and soil moisture content: During wetland cultivation especially in the dry seasons for small wetlands in central Uganda, the mainstream networks are always blocked by farmers at several positions along with the channel network, diverting water into the agricultural plots mainly at the riparian zone and valley bottom positions. Furthermore, the main channel is partly modified and shifted by farmers from its original flow path for irrigation and drainage (Gabiri et al., 2018). Consequently, this results in in-stream water level fluctuations at different parts of the main channel. These activities have significant impacts on soil moisture and groundwater table variability thus, hydrological regimes at the riparian zone and valley bottom positions.

Plate 45: Water diversion channels in Buhweju district

Plate 46: Water flow disruption in Mende wetland Wakiso district

Implications;

- Drying up of water sources, flash floods and reduced water levels in some areas.
- Reduction in soil moisture content and eventually cracking of soils making less conducive for production.

Increased sewage and wastewater treatment costs: The increasing wetland degradation especially across the major towns of the country has led to higher operational costs of treating sewage and wastewater by the National Water and Sewerage Corporation (NWSC) before it enters the main river/lake system. McConville et al. (2019) reported that the overall sewage regime operating budget is estimated to be 94% of the total NWSC sanitation operating budget. This is because the fundamental ecosystem functioning of the wetlands in filtering the wastewater is degraded. Wetlands along the Lake Victoria shoreline which are supposed to filter the water before it enters the Lake are being destroyed due to increased human activities. This has increased pollution into the Lake and according to the NWSC, it has pushed the cost of treating water by about 100 percent. Accordingly, the cooperation used to spend an average of 500 million shillings (about 135,135 U.S. dollars) a month to treat water, but the figure has now shot up to close to 1 billion shillings (270,270 dollars) per month.

Plate 47: Water pumping and treatment station in Sheema District

Frequent and intense cases of flooding: As a result of wetland degradation, their soaking/spongy characteristics which holds water during the rainy season and releases it during the dry spell has drastically declined in most of the catchment areas across the country. Therefore, with the increasing changes in rainfall across the country, the areas around the Lake basins have experienced heavy rains resulting in increases in water levels due to high runoff off. In addition, wetlands at the lake shores have also been converted into cultivation sites for sugarcane and rice mainly in Eastern Uganda (especially wetlands in Amuria, Kaplepyong, Katakwi, Sironko, Mayuge, Bugiri and Kwen), settlements and trees cut for fuel which would control the rate and speed of runoff around the shores. Thus, water with high pressure created by the waves drains into people's houses especially those that are around the shores. According to the key informants in the Kagulu sub-county, Buyende district in the lower Lake Kyoga, over 50 households have been displaced by floods due to the rising Lake water levels.

Plate 48: Flooding Butaleja District along Mpologoma River

Implications:

- *Floods have caused significant economic losses in terms of loss of property; homes, businesses as well as human and animal lives.*
- *Decrease in value and increase in insurance costs associated with properties near or in wetlands due to the high risk of frequent and destructive flooding.*

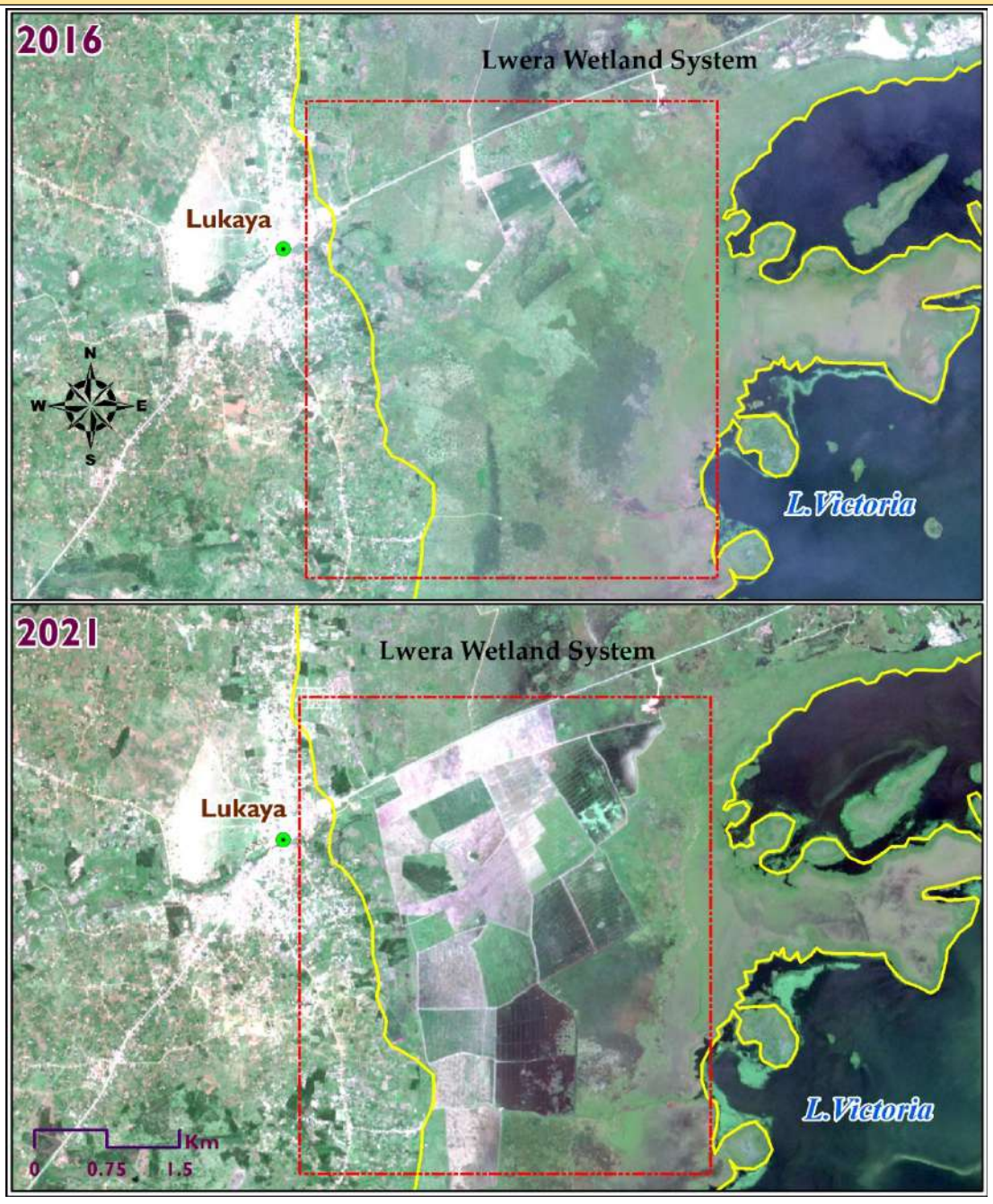


Figure 46: Conversion of wetland to commercial rice growing in Lwera wetland system

Decline in water quality/increased water pollution: In some of the industries and factories, during production, the untreated waster products are released into the wetlands and lakes. This contributes to changing the quality of water, causing eutrophication resulting in algal bloom and suffocation of aquatic species. According to the study conducted by Angiro et al. (2020), to evaluate the effect of industrial effluents on the physicochemical and microbiological quality of water taken from four different sites along the Namanve stream in Kampala Industrial and Business Park (KIBP), Wakiso district. Uganda, one of the premier and the most successful Ugandan industrial complexes that impact the inner Murchison bay of Lake Victoria. Water quality results in the Namanve wetland system indicate that the water quality parameters (PH, Total dissolved solids, Total phosphates, Total nitrogen, Total suspended solids, Biochemical oxygen demand) were above WHO maximum permissible limits except for turbidity, electrical conductivity and Escherichia coli count (Angiro et al., 2020).

Plate 49: Polluted water due to gold ore washing in Ibanda District

Implications;

- *Increased water treatment costs: Increased infrastructure and management costs to provide safe and clean water have impacted negatively on the economy both at household and national levels.*
- *Increased maintenance costs for water drainage channels: Costs associated with seasonal de-silting of constructed drainage water channels have also increased significantly.*
- *High economic burden of sanitation related diseases: There has been an increase in health costs as well as occurrence of illnesses directly attributed to contamination of wetland water sources*

5.3.4 Climate-Related Impacts

Temperature and rainfall variability: The increasing carbon dioxide concentrations in the atmosphere will impinge on the stability of the Earth's climate system, human systems and long-term sustainability of socio-economic systems (IPCC, 2019). Tropical wetland ecosystems are among the most crucial carbon sinks and thus, have attracted significant interest in climate change mitigation efforts, due to high and relatively stable yearly temperatures which enhance carbon storage. Given the increasing food demand from the high population growth (3.2% per annum; UBOS, 2018), coupled with ongoing local and regional climate variability, wetlands are undergoing significant changes from their pristine nature to agricultural lands, thus altering the carbon stocks, consequently increasing their Greenhouse gas emissions. Given that wetlands are highly vulnerable to changes in the quantity and quality of their water supply, climate change coupled with the ongoing land-use alterations will significantly affect the ecological attributes of these wetlands (Table 22). Moreover, the loss of wetlands could exacerbate the impact of climate change since they provide fundamental services that contribute to the mitigation of such impacts (Gabiri et al., 2020).

Table 22: Manifestations of climate risks

Climate risk	Timing
Warmer temperatures	-0.9˚C-1.4˚C by 2050; -1˚C-2.8˚C by 2100
Erratic rainfall	Recorded incidents of erratic rainfall
Stronger dry season	Increasing with more years to come
Increased frequency of El Nino Events	One record of El Nino Event in Uganda in 1997/98.

Source: MWE, 2018

5.3.5 Provisioning Related Impacts

Overharvesting of wetland resources: Wetland resources in Uganda have traditionally been utilized by the people as a source of materials for construction, crafts, furniture, and hunting and fishing areas. Traditionally seasonal wetlands and margins of permanent wetlands have been used for grazing cattle, growing crops and as a source for domestic water. In addition, they are a major habitat for wildlife resources.

In Uganda, the most dominantly harvested wetland resource is papyrus (*Cyperus papyrus*) along the shores of Lake Victoria and occurs as extensive monoculture stands along rivers in eastern Uganda that drain into the Lake Kyoga system. Extensive systems include the Mpologoma, Nabajuzzi, and Namatala wetlands. Papyrus also dominates many wetlands in western Uganda's Bushenyi, Kabale Kisoro, Ntungamo, and Rukungiri districts. Occurrence ranges from littoral vegetation of satellite lakes such as Lake Nabugabo and adjacent lakes to the Rwambeita swamps and valley swamps along the rivers common in western Uganda and extending to Rwanda. In Eastern Uganda, this vegetation has been harvested for thatching, crafts and mulching. For instance, in Namutumba, Pallisa and Iganga districts, communities around Mpologoma, Naigombowa, Lumbuye and Limoto wetlands harvest papyrus for rooting because of its long-life span and due to decline in thatch grass.

Furthermore, other wetland resources such as water availability have been heavily over-utilized during the dry season for crop production especially in Eastern Uganda for rice production and

Southwestern Uganda in Kabale district for Irish potato cultivation. The unsustainable water harvesting from the streams of these wetlands into the small established ridged plots for cultivation as a form of irrigation has affected the water quantity in the streams and thus, downstream catchments.

Plate 50: Sand mining in Masaka District

Plate 51: Grass harvesting in Mpigi district

Case study: The cost of wetland degradation in Lake Nabugabo wetland

Wetland values in the extended Ramsar Site areas will fall to almost half their current levels over the next 24 years: from a baseline value of USD 43.6 million in 2014 to USD 22 million in 2039 (Lucy, 2014) Figure 47). Without additional action to enhance wetland conservation and wise use, it is therefore estimated that ecosystem services worth over USD 260 million will be lost over the next 25 years, to a net present cost of some USD 50 million (Table 23).

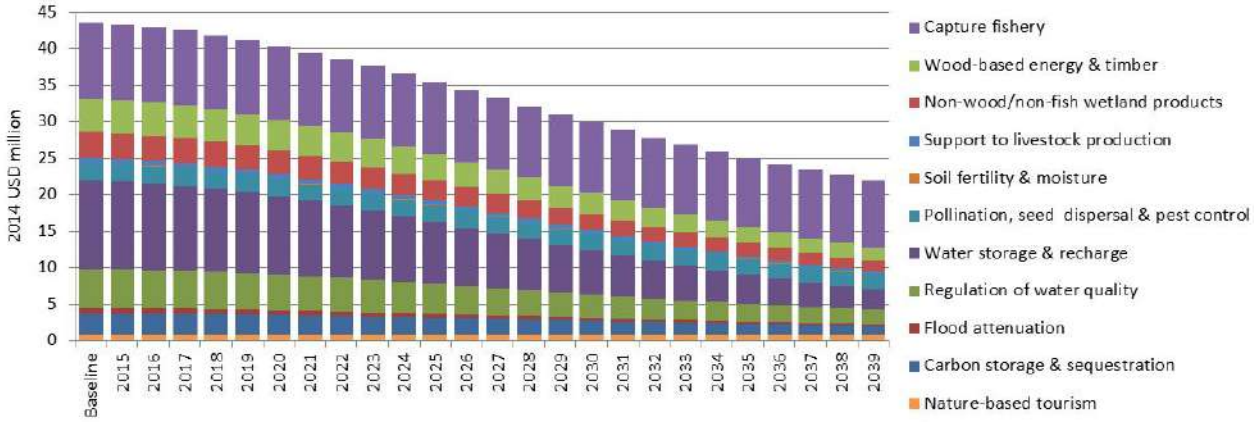


Figure 47: Change in wetland values in extended Ramsar Site under BAU, 2014-39

Table 23: Cost of ecosystem service value loss under BAU, 2014-39

Ecosystem service	Baseline value (USD million)	2039 value (USD million)	Total cost over 25 years (USD million)	Net present cost (USD million)
Capture fishery	10.45	9.24	-15.99	-3.47
Wood-based energy & timber	4.56	1.83	-32.36	-6.16
Non-wood/non-fish wetland products	3.50	1.47	-23.71	-4.49
Support to livestock production	0.73	0.31	-4.88	-0.92
Soil fertility & moisture	0.08	0.04	-0.49	-0.09
Pollination, seed dispersal & pest control	2.32	2.09	-2.97	-0.64
Water storage & recharge	12.09	2.75	-114.47	-22.07
Regulation of water quality	5.38	1.98	-41.59	-8.02
Flood attenuation	0.70	0.26	-5.44	-1.05
Carbon storage & sequestration	3.01	1.26	-20.40	-3.86
Nature-based tourism	0.80	0.80	-	-
Total	43.62	22.03	-262.30	-50.78

An intact wetland section of Muzizi wetland with papyrus in Kyegegwa district

Rubirizi district leaders and the AC-WMD during map reading of Ngoro wetland before restoration

6. Chapter Six: Wetland Conservation and Challenges

6.1 Introduction

To minimise the impacts of wetland degradation in the country, many conservation, management and restoration interventions have been implemented or planned to restore the ecosystems to their previous natural state. The interventions implemented are supported by the government, partners and communities. Some of the interventions implemented are in collaboration. This chapter provides information on the state of interventions undertaken to restore wetlands in the country, but also the challenges faced.

6.2 Implemented Wetland Conservation and Restoration Interventions

Demarcation of critical wetlands: The wetlands that have been identified as highly prone to encroachment or degradation were earmarked for demarcation. The type of demarcations installed is meant to define the boundaries of flexuous wetlands to mitigate human encroachment. The tools used to demarcate wetlands are concrete pillars and live markers such as planting tree seedlings. However, it is important to note that this process is consultative and involves comprehensive engagement with multisectoral and community stakeholders. Depending on the budget for demarcation which is the major hindrance, when the tools are procured, communities spearhead the demarcation process.

With this in mind, in the last five years, 1,728.5 Kms have been demarcated with pillars, beacons and live markers erected. This means that only 345.7 Km are demarcated annually. At this rate, all wetlands will not be demarcated by 2040 unless more resources are provided to demarcate at least 7,129.4 Km per annum. Figure 48 shows the trends of wetlands demarcation. In FY 2020/21 a total of 531km of critical wetlands were demarcated. This was an increase from 450.39km demarcated in FY 2019/20. This increase in the length of wetland demarcated was attributed to the increased funding from GOU and support from the Green Climate Fund. The areas covered are presented in Table 24 below.

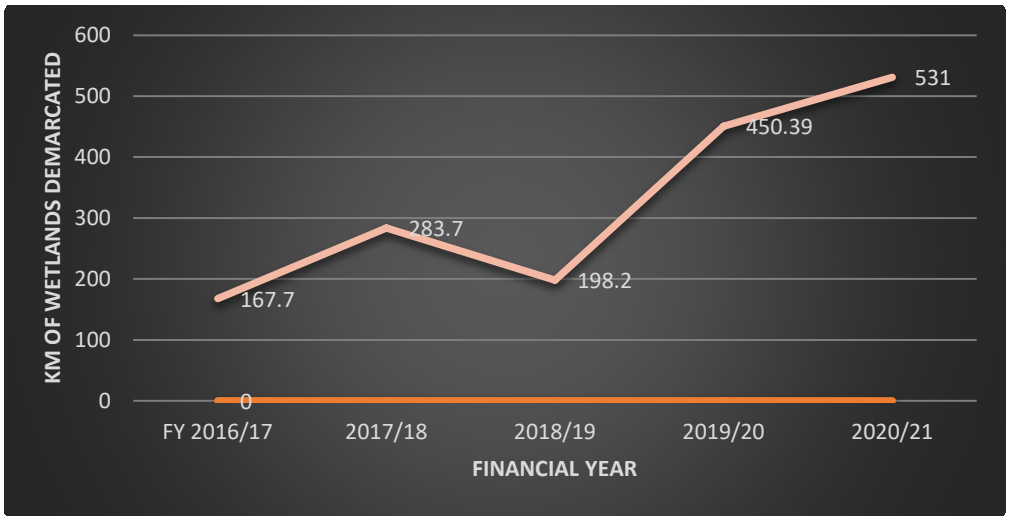


Figure 48: Wetlands Demarcation Trends for the Past 5 Years

Table 24: Demarcated wetlands in FY 2020/21

Wetland Name	Area demarcated (km)	Location
Kyenzogyera-Mushaha, Mpangango	138	Western
Tirinyi-Mpologoma, Ppiyai-Asuret, Papayo, Komorotot, R. Manafa	235	Eastern
Chosan Cholol, Ogwete, Olupe Popong, Zombo, Achorichori, Suruma-Iniangwa, Okole,Tochi	108.4	Northern
Nakayiba	49.5	Central
Total	530.9	

Wetland restoration: During the FY 2020/21, strategic actions were undertaken against the increasing degradation of the Environment and Natural Resources. A total of 10,038.8 ha out of the planned 21,876 critical wetlands were restored across the country. The majority of restoration activities were carried out in South-Western and Eastern Uganda. This was due to the contribution of the GCF project in those two regions. The achievement was less than half of the target because of the COVID-19 pandemic and inadequate funds released during the reporting period. Table 25 shows the restored wetlands in FY 2020/21. In addition, NEMA supported the protection of fragile ecosystems including the restoration and demarcation of wetlands in Kiretwa Peninsula, Lake Nakivale shores in Isingiro district, Ntungamo district, Otuke district, Jinja city/district, Kayunga and Kamuli districts. The implemented activities included community sensitization on ecosystem management, buffer zone demarcation and protection including removal of illegal structures in the buffer zones and tree planting in the buffer zones. Figure 49 shows the trend of wetland restoration for the past 5 years in Uganda.

Table 25: restoration of degraded wetlands in FY 2021/21

Name of wetland	Area restored (ha)	Location
Kyenzogyera – Mushasha	1361	Buhunga, Bitsya and Kalungu sub-counties in Buhweju district
Nyamuhizi -Kigogo	1550	Mitooma Subcounty, Mitooma district
	2663	Ibanda, Kitagwenda, Rukungiri, Kabale, Rubirizi, Mitooma, Buhweju, Kanungu, Lira, Yumbe, Kampala, Wakiso, Masaka, Kyotera, Kayunga, Lwengo, Butambala and Rakai
Mazuba-Mpologoma	1982	Mazuba sub-county Namutumba District
Tirinyi wetland	1528	Tirinyi sub-county Kibuku district
Kapujan	734	Kapujan sub-county in Katakwi,
Tochi	19.3	Amuru
	10	Lira city- Eastern division
Obubua	2	Yumbe district

Arocha	24	
Okole	13	
Lutembe Bay Ramsar	50.4	Wakiso District (Entebbe Municipality)
Lugala	48	Rubaga Division, Kampala City
Mpasha	21	Ibanda
Total	10005.7	

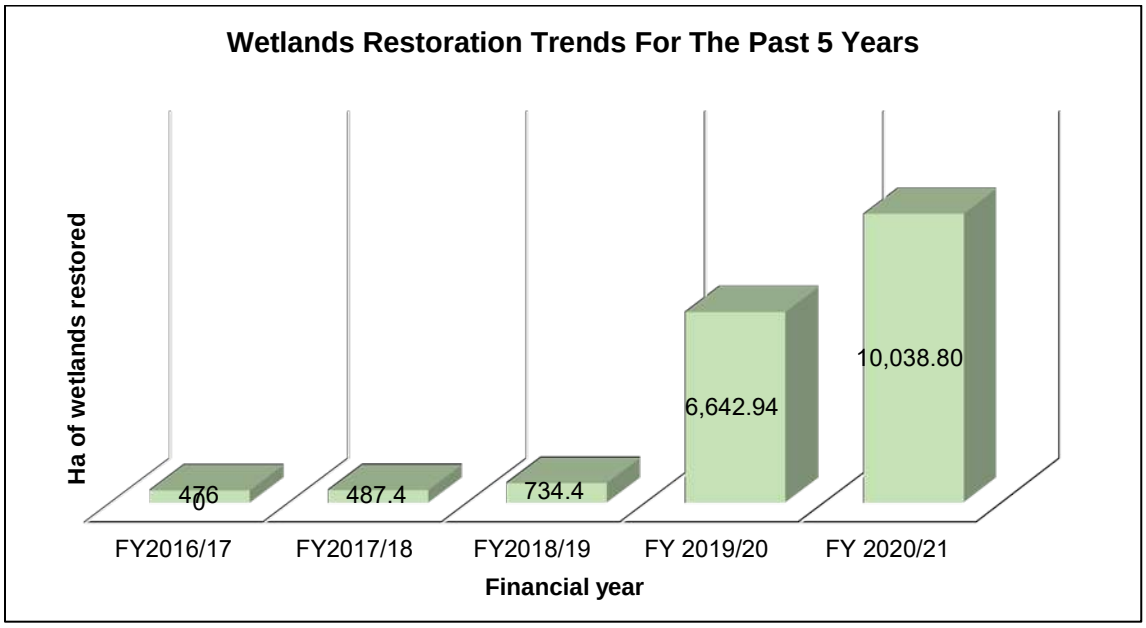


Figure 49: Trend of wetland restoration for the past 5 years in Uganda

Attributes of successful wetland restoration activities

1) Minimal encroachment
2) Reestablishment of vegetation in once degraded lands
3) Improved biodiversity in flora and fauna (monkeys)
4) Improved and increased wetland resources and services eg. Increased fish
5) Increase in water quantity
6) Reduced conflicts

Box 3:

Attributes of successful wetland restoration

Plate 52: Wetland restoration in Mushasha wetland in Buhweju District

Plate 53: Wetland demarcation in Mitooma District

Plate 54: Wetland restoration in Mitooma district

Demarcation of river banks and lakeshores: In the FY 2020/21, the Department of Environment Services (DESSS) carried out inventory and profiling of 15 km river Nile bank, 30 km River Wambabya and 10km Lake Kwania. The objective was to identify the ongoing activities within the likely buffer zones, impact and influence of planned boundary delineation concerning its protection, conservation and restoration.

Compliance monitoring and enforcement. Wetlands are monitored to ensure that the principle of wise use is adhered to. And where this principle is not implemented, enforcement has been introduced to counteract the violators of the policies. In FY 2020/21, the WMD and EPPU implemented compliance as a strategy to control the illegal use of wetlands. However, the observed decline in the number of cases reported to police, the number of suspects taken to courts of law and convicted as compared to the previous years is due to COVID–19 pandemic set lockdown restrictions that limited routine compliance monitoring and enforcement. The Environment Police Protection Unit working with technical officers arrested and prosecuted 29 wetland degraders, impounded 6 motor vehicles and instituted 17 criminal cases against Environmental offenders.

Plate 55: Cutting of eucalyptus trees in Mwongyera wetland in Rubirizi district

Development of Wetland Management Plans. Wetland management plans are developed as a consolidation of information from various stakeholders including different wetland resource users; policymakers and policy implementers; and natural resource management actors, including the private sector. The implementation of these plans is overseen by the WMD and partners. These plans are tools that guide the processes of wetland restoration and can be used to mobilise resources to meet the needs of the ecosystems and adjacent communities.

The area under wetland management plans increased from 6376.5km^2 in 2019/2020 to 6507.34Km^2 in FY 2020/21 (Figure 50). In 2020/21, 7 wetland management plans were planned and developed covering an area of 130.84km$^{2.}$ At the current rate of developing wetland management plans, it will take more than 20 years to cover the total wetland area with management plans. The Wetland Management Plans developed are those in Central Uganda (Nkonka wetland in Buvuma, Kiyanja-Kaku wetland in Lwengo and Namaya wetland in Mpigi and Wakiso) and in Eastern Uganda (Namatala wetland management plan in Tademeri sub-county in Budaka and Agu wetland system in Ngora sub-county, Ngora district). In Northern Uganda (Owei wetland in Amuru district) and Western Uganda (Rufuha wetland in Ntungamo district). The wetland management plans for Lake Nakuwa Ramsar site in Pallisa, Kaliro and Kamuli, covering 3,800 hectares were reviewed.

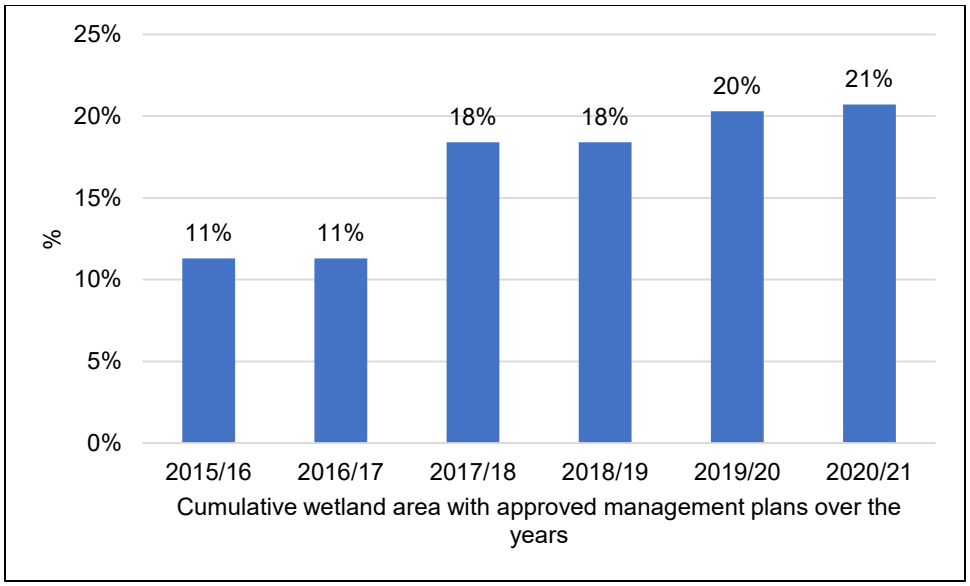


Figure 50: Percentage of cumulative wetland area with approved management plans over the years

Plate 56: Rapid Assessment of Muzizi wetland in Kibaale district

Development of wetland wise use demonstration sites. Wetland wise use is synonymous with sustainable use. Thus, to ensure a win-win situation with the communities adjacent to the wetlands, the Wetlands Management Department has supported interventions geared towards diversifying the livelihoods of these communities. For example, in southwestern Uganda, the department has supported livelihoods through demonstrating the viability of income-generating activities of the communities dependent on wetland resources from wetland function and services. The GCF project has constructed two water retention facilities at Nyaruzinga wetland in Bushenyi district and Kandekye-Ruhorobero wetland in Sheema district with a capacity of 20 and 15 million litres of water respectively. The facilities are aimed at enhancing wetland recovery while supplying clean and safe water for mini-irrigation of the communities' crop adjacent to the wetland covering an area of 40acres. However, the sustainability of these facilities will be dependent on the establishment of inclusive management structures, continued monitoring and budgetary allocation for monitoring purposes. In addition, 20 fishponds were constructed in the districts of Ngora, Pallisa, Sheema,

Bushenyi and Ntungamo. These schemes will support communities to engage in agriculture activities throughout the year and reduce their dependency on rain-fed agriculture.

Plate 57: Mini irrigation scheme in Shuuku town council Sheema District

Gazettement of Wetlands. The Gazettement of wetland systems in Uganda is based on the existing eight drainage basins. Within these systems, wetlands are defined as primary, secondary, tertiary and quaternary depending on their drainage pattern. The process includes identifying wetlands, naming them and describing their state. The department has coded all the wetlands in the eight drainage basins. Coding is assigning a wetland unique identifier for instance number followed by names. Each drainage basin has a code from 01 to 08. Kyoga-04-001-001-001-01. These codes are used to guide the gazettement process.

To strengthen the management of wetlands and also support the legal actions on wetland degraders, the Wetlands Management Department (WMD) in the FY 2020/21 embarked on the process to gazette all wetlands. The process involved delineation of all wetland boundaries, generation of boundary coordinates, production of maps and agreement on the categorization criteria. This was then followed by National consultations for the Gazettement of Wetlands and a draft Gazettement instrument was prepared and submitted by the Ministry of Justice and Constitutional Affairs.

Plate 58: Wetland assessment in Kamwenge District

Conducting reforms in Policy, Planning and Legal Framework: The Wetland Management Department reviewed the National Wetland Policy for the conservation and management of wetland resources. In the FY 2020/21, the Regulatory Impact Assessment was undertaken that guided the development of the Wetlands Bill which is now in its final stages of development. National consultations for the Gazettement of Wetland were conducted, draft Gazettement instrument was prepared and submitted by the Ministry of Justice and Constitutional Affairs.

Public awareness and capacity building: Wetland users and technocrats are frequently retooled to ensure sustainable use of wetlands and implementation of restoration interventions. For the communities, awareness campaigns are conducted through radio and talk shows, the commemoration of World Wetlands Day, music and dance festivals among others. The content frequently passed on to the communities includes but is not limited to understanding the values of wetlands and the cost of degradation. While the technocrats are trained on several actions such as developing wetland management plans, conducting restorations, monitoring and enforcement among others. For these reasons, about 400 wetland resource users were trained by WMD against the planned 800 in FY 2020/21. These were from the districts of Pallisa at papaya, Nyaruzinga in Sheema, Kandekye- Ruhobero, Kabale, Ntungamo, Ngora, and Bukedea. This training enabled participants to improve on their current methods and practices of managing wetland resources.

Cancellation of land titles acquired in wetlands. The government of Uganda ordered the cancellation of illegal land titles acquired in wetlands, and those involved in the illegality were prosecuted. Many encroachers had obtained land titles in wetlands, backfilled them with murram soil and established illegal projects such as settlements, industries, farming activities and putting up social amenities. On cancellation of titles in wetlands, 250 stakeholders comprising of political leaders and technical staff were sensitized in Mukono District Local Government against the planned 400 participants in both Mukono and Kampala Capital city Authority. However, this exercise is expected to scale up sub-counties and villages in FY 2020/22.

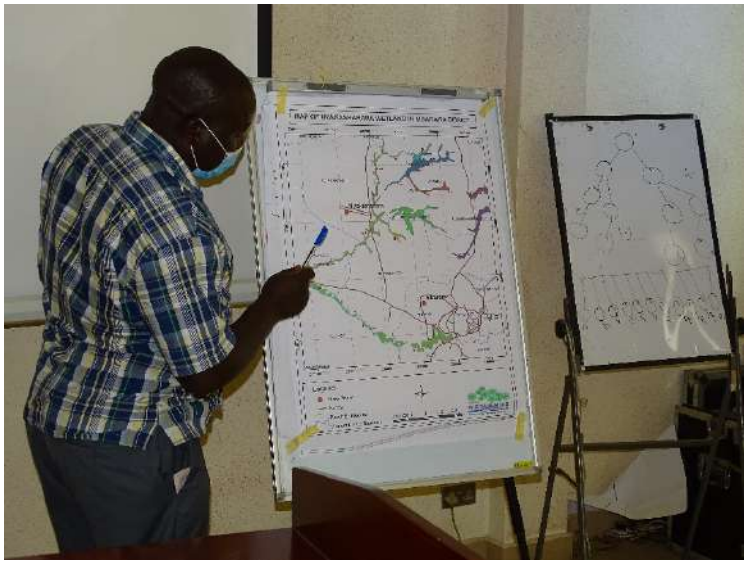


Plate 59: Capacity building of district officers from Western Uganda on wetland inventory

Construction of Soil and Water retention Facilities: The Wetlands Management Department under "Building Resilient Communities, Wetland Ecosystems and Associated Catchments in Uganda Project has constructed Nine soil and water storage and retention facilities against the planned 12 to enhance infiltration in wetland systems in Western Uganda (Rufuha wetland in Ntungamo and Kabanyonyi wetland in Kabale) and Eastern Uganda (Agu Wetland in Ngora, Nyakambu wetland and Papaya wetland in Pallisa). These have increased the water retention capacity of the wetland by reducing the amount of water running through the wetland. The presence of water in the wetland throughout the year and increased vegetation cover has enhanced the capacity of the wetland to withstand drought conditions resulting in the continued provision of ecosystem services and products.

Designation of wetlands as of international importance: The designation of wetlands as Ramsar sites have a significant contribution to the conservation of the ecosystems in Uganda. During the FY 2020/21, the designation of the Lake Wamala Wetland system as a Ramsar Site was conducted. Studies of the various Taxa such as plants, socio-economics and mammals were conducted and the Ramsar Information Sheet partially populated pending finalisation of all the remaining three ecological studies. The designation of wetlands is associated with high compliance monitoring and adequate management and reporting (Kingsford et al., 2021).

6.3 The Challenges Faced in Wetland Conservation and Management

The challenges to the management of wetland in Uganda can be majorly classified under management challenges and policy related challenges.

6.3.1 Management Challenges

The major challenges facing the management of wetland resources in Uganda include

Lack of adequate scientific information to guide decision making, inadequate staffing and low capacity to handle the enormous work countrywide, limited funding, impunity and resistance of encroachers to vacate wetlands and limited awareness on the values of wetlands among others. The delayed and intermittent release of funds for implementing planned management interventions, and

failure to sustain wetland management interventions on ground is also a big hiccup in ensuring sustainable management of wetlands. Others are lack of resources to promote economically viable alternative uses of wetlands and slow uptake of the wetland alternative options which is as a result of mind-sets and limited data.

Wetlands management as per the Local Government act is a decentralised function, but the Local Governments are incapacitated in terms of staffing, capacity and funding for operations. Whereas, there is a conditional grant for ENR, it is so meagre to meet the management demands of such a vast resource.

6.3.2 Policy, Planning and Institutional Challenges

The uncoordinated government efforts to protect and save wetlands are evident through the conflicting institutional mandates, policies and laws with regard to management and use of wetlands. The continued issuance of titles in wetlands, the continued large-scale cultivation of wetlands for food, the continued allocation of wetlands for industrial development, the allocation of wetlands for settlement of refugees also point to conflicting mandates and policy, uncoordinated planning and implementation of the policies plus conflicting land use practices. However, there is also weak enforcement that is coupled with weak fines and sentences by court that are not punitive enough to deter further encroachment and degradation. These practices either individually or in combination continue to undermine all efforts to manage and protect wetlands. The permitting system has over time also been abused leading to non-compliance to the permit conditions.

Plate 60: Wetland user assessment in Rubirizi district.

An overview of L.George Ramsar site in Kitagwenda district

7. Chapter Seven: Conclusion and Recommendations

7.1 Conclusion

The wetland mapping of 2022 categorised wetlands, as papyrus, grasslands, woodlands, forested wetlands, bushlands, small scale farmlands, commercial farmlands and built-up areas. The findings of wetland spatial coverage stood at 13.9% as of 2022, an increment of 0.9 from 2015 wetland data. The generated and validated wetland product had an accuracy of 80%. Uganda has about 9.3% intact wetlands while the degraded wetlands cover a total area of 4.7%. The identified drivers of wetland degradation are characterised as social, physical and structural, extraction, exotic species and institutional drivers. The eastern region has the most degraded wetlands due to the mentioned rampant drivers. As a consequence, the impacts have been felt on biodiversity, land, hydrology, climate and provision services. However, to reverse or mitigate the drivers of wetland degradation, this report stipulates that there is a need to strengthen wetland restoration related activities, the Ugandan government should increase budgetary funds allocated to restoration initiatives, but also enact the wetland specific law. There is also a need to build the capacity of local government officials to collect data on wetlands, but also enforce their wise.

7.2 Recommendations

This report proposes the following policy recommendations:

a. There is also need to harmonise the planning and implementation of all activities in and around wetlands. This should be coupled with strengthening community participation in management of their resources through community policing among others.
b. The need to incentivize conservation of wetlands needs to be explored so that those who conserve their resources are rewarded with incentives. Whereas the current practice is to offer livelihood options to those communities being removed from wetlands, those who conserve should equally be incentivized.
c. There is an urgent need to fast track gazettement of wetlands: Gazettement of wetlands is still ongoing but hampered with facilitation challenges. The funds allocated by the government cannot facilitate this process to be conducted as required. This activity is also affected by the delay to enact the wetland specific law. Therefore, this activity should be prioritised by the government to curb wetland encroachment which is widespread in the country.
d. Increase the staffing levels in the WMD: The Department has inadequate staff members available at the centre, regional and district levels who cannot effectively monitor all the wetlands in the country. The Ugandan government should urgently allocate more resources towards this vote to facilitate the recruitment and deployment processes of new staff members. This will ensure faster implementation of wetland conservation interventions such as demarcation, restoration, gazettement and development of management plans among others.
e. Strengthen research on inland and transboundary wetlands: There is inadequate data on wetland characteristics such as biodiversity, values of ecosystem services and wetlands contribution on climate change adaptation among others. The WMD should invest in infrastructure to facilitate the capture and storage of wetland data and information. This will ease the update of the future state of wetland reports when required. A linkage of this database with national databases is highly recommended. The benefit of this process will involve tracking wetland changes and accurate reporting that is highly needed in decision-making processes.

f. Promote partnership and collaboration with the private sector and academia: Apparently, there is the minimum engagement of the private sector and academia in the management of wetlands in Uganda. The cooperation space is still limited due to limited funding and data on the roles of the particular stakeholders. Therefore, the Department should promote partnership with community organisations, research institutions and private sector stakeholders to influence policies, mobilise resources and increase awareness. Areas of engagement would include participation in wetlands days and national workshops among others.
g. Strengthen capacity building initiatives meant to promote wetland integrity: Much as the structures to manage wetlands are available, the personnel deployed are in dire need of knowledge and skills on wetland conservation and wise use. The personnel need to be retooled on how to conduct wetland inventories, monitor wetland degradation and report on status in their areas of jurisdiction. Therefore, to mitigate wetland degradation, the WMD should be allocated with more financial resources to be able to conduct awareness and capacity building such as the development of wetland learning materials and inclusive participation of communities in World Wetlands days.
h. Fast track the enactment and review of wetland policies: Policies play a critical role in institutional strengthening to carry out their intended objectives/mandates. The government should urgently fast track the enactment of the wetland bill and review the wetland policy. These will strengthen the activities implemented to conserve wetlands since the laws will be more punitive throughout the country. The offenders will be easily aligned to courts of law and sentenced in a short period.

8. References

1. Aaen, E. (2020). Estimation of water access and contaminant risks at the Nyenga foundation in Uganda (Master's thesis, Norwegian University of Life Sciences, Ås).
2. Aazami, M., & Shanazi, K. (2020). Tourism wetlands and rural sustainable livelihood: The case from Iran. Journal of Outdoor Recreation and Tourism, 30, 100284.
3. 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.
4. Akiyode, O. O., Tumushabe, A., & Abdu, Y. A. (2017). Urban Environmental Security in a Continuously Growing City in Sub-Saharan Africa in the Climate Change Era: A Case of Kampala, Uganda. American Journal of Environmental Policy and Management, 3(4), 24-30.
5. Anaba, L. A., Banadda, N., Kiggundu, N., Wanyama, J., Engel, B., & Moriasi, D. (2016). Application of SWAT to assess the effects of land use change in the Murchison Bay catchment in Uganda.
6. Angiro, C., Abila, P.P., Omara, T. (2020). Effects of industrial effluents on the quality of water in Namanve stream, Kampala Industrial and Business Park, Uganda. BMC Res Notes, 13, 220.
7. Ayebare, S., Nangendo, G., & Nampindo, S. (2020). Prioritizing Conservation Sites for Biodiversity Protection in Uganda. In *Terrestrial Ecosystems and Biodiversity* (pp. 119-128). CRC Press.
8. Baker, M., Sarfo, I., Darko, G., & Bi, S. (2019). Loss of wetland resources in Uganda: The case of lake Wamala in Mityana District.
9. Barakagira, A., de Wit, A.H. (2019). The role of wetland management agencies within the local community in the conservation of wetlands in Uganda. Environ. Socio.-econ.stud.,7,59-74
10. Bennell, P. (2021). The political economy of attaining Universal Primary Education in sub-Saharan Africa: The politics of UPE implementation. International Journal of Educational Development, 80, 102317.
11. Bernard, B., Aron, M., Loy, T., Muhamud, N. W., & Benard, S. (2020). The impact of refugee settlements on land use changes and vegetation degradation in West Nile Sub-region, Uganda. *Geocarto International*, 1-19.
12. BirdLife International (2022) Country profile: Uganda. Available from http://www.birdlife.org/datazone/country/uganda. Checked: 2022-01-05
13. Blaschke, T., Burnett, C., & Pekkarinen, A. (2004). Image segmentation methods for object-based analysis and classification. In *Remote sensing image analysis: Including the spatial domain* (pp. 211-236). Springer, Dordrecht.
14. Bosma, C., Glenk, K., & Novo, P. (2017). How do individuals and groups perceive wetland functioning? Fuzzy cognitive mapping of wetland perceptions in Uganda. *Land Use Policy*, *60*, 181-196.
15. Convention on Wetlands. (2021). Global Wetland Outlook: Special Edition 2021. Gland, Switzerland: Secretariat of the Convention on Wetlands.
16. Dalahmeh, S., Björnberg, E., Elenström, A. K., Niwagaba, C. B., & Komakech, A. J. (2020). Pharmaceutical pollution of water resources in Nakivubo wetlands and Lake Victoria, Kampala, Uganda. Science of The Total Environment, 710, 136347.
17. Dieterle, C. (2021). Global governance meets local land tenure: international codes of conduct for responsible land investments in Uganda. *The Journal of Development Studies*, 1-17.

18. Gabiri, G., Leemhuis, C., Diekkrüger, B., Näschen, K., Steinbach, S., & Thonfeld, F. (2019). Modelling the impact of land use management on water resources in a tropical inland valley catchment of central Uganda, East Africa. *Science of the total environment*, *653*, 1052-1066.
19. Hoorn, C., Bogotá-A, G. R., Romero-Baez, M., Lammertsma, E. I., Flantua, S. G., Dantas, E. L., ... & Chemale Jr, F. (2017). The Amazon at sea: Onset and stages of the Amazon River from a marine record, with special reference to Neogene plant turnover in the drainage basin. *Global and Planetary Change*, *153*, 51-65.
20. IUCN (2020) *Restoration and management of wetland hydrology and associated forests* building resilient communities, wetland ecosystems and associated catchments in Uganda, Papayo wetland system
21. Kabiri, S., Allen, M., Okuonzia, J. T., Akello, B., Ssabaganzi, R., & Mubiru, D. (2020). Detecting level of wetland encroachment for urban agriculture in Uganda using hyper-temporal remote sensing. *AAS open Research*, *3*(18), 18.
22. Kahangirwe, P., & Vanclay, F. (2021). Evaluating the effectiveness of a national environmental and social impact assessment system: lessons from Uganda. Impact Assessment and Project Appraisal, 1-13.
23. Kakuba, S. J., & Kanyamurwa, J. M. (2021). Management of wetlands and livelihood opportunities in Kinawataka wetland, Kampala-Uganda. *Environmental challenges*, *2*, 100021.
24. Kakuba, S. J., & Kanyamurwa, J. M. (2021). Management of wetlands and livelihood opportunities in Kinawataka wetland, Kampala-Uganda. *Environmental challenges*, *2*, 100021.
25. Kambubali, R., Kiwazi, F.W. (2009). Participatory planning, management and alternative livelihoods for poor wetland-dependent communities in Kampala, Uganda. Afr. J. Ecol., 47 (Suppl. 1), 154–160
26. Kansiime, F., Saunders, M. J., & Loiselle, S. A. (2007). Functioning and dynamics of wetland vegetation of Lake Victoria: an overview. Wetlands Ecology and Management, 15(6), 443-451.
27. Karabo, Q. C. (2017). Land use and land cover changes in Nsooba-Lubigi wetland system, Central Uganda.
28. Kawala, S. (2021). *Impacts of sand mining on species diversity of vascular plants in Lwera wetland, central Uganda* (Doctoral dissertation, Makerere University)
29. Kayima, J. K., & Mayo, A. W. (2020). Nitrogen removal buffer capacity of the Lubigi wetland in Uganda. *Physics and Chemistry of the Earth, Parts A/B/C*, *117*, 102883.
30. Kingsford, R. T., Bino, G., Finlayson, C. M., Falster, D., Fitzsimons, J. A., Gawlik, D. E., ... & Thomas, R. F. (2021). Ramsar wetlands of international importance–improving conservation outcomes. Frontiers in Environmental Science, 9, 53.
31. Koehnken, L., and Rintoul, M. (2018). Impacts of Sand Mining on Ecosystem Structure, Process and Biodiversity in Rivers. WWF.
32. Kusemererwa, E. I. (2019). Impacts of sand mining on Komuchwezi wetland: a case study of Katente parish, Kyegegwa district (Doctoral dissertation, Makerere University).
33. 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.
34. 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.

35. Lucy Emerton (2014) Summary of the economic value of biodiversity and ecosystem services in Lake Nabugabo Wetland Complex, Uganda
36. Macfarlane, D., Kotze, D., Ellery, W., Walters, D., Koopman, V., Goodman, P. and Goge, M. 2009. *WET-Health: A technique for rapidly assessing wetland health.* Wetland Management Series. Water Research Commission Report TT 340/09.
37. Maclean I., Tinch R., Hassall M., Boar R. (2003). Towards Optimal Use of Tropical Wetlands: An Economic Valuation of Goods Derived from Papyrus Swamps in Southwest Uganda. *Environmental Change and Management Working Paper ECM03-10*. Centre for Social and Economic Research on the Global Environment, Norwich.
38. Mehdi, B., Dekens, J., & Herrnegger, M. (2021). Climatic impacts on water resources in a tropical catchment in Uganda and adaptation measures proposed by resident stakeholders. Climatic Change, 164(1), 1-22.
39. Mugonola, B., Deckers, J., Poesen, J., Isabirye, M., & Mathijs, E. (2013). Adoption of soil and water conservation technologies in the Rwizi catchment of south western Uganda. *International journal of agricultural sustainability*, *11*(3), 264-281.
40. Musonge, P. S., Boets, P., Lock, K., & Goethals, P. L. (2020). Drivers of benthic macroinvertebrate assemblages in equatorial alpine rivers of the Rwenzoris (Uganda). *Water*, *12*(6), 1668.
41. Mwakubo, S. M., & Obare, G. A. (2009). Vulnerability, livelihood assets and institutional dynamics in the management of wetlands in Lake Victoria watershed basin. *Wetlands Ecology and Management*, *17*(6), 613.
42. MWE (2018). A study on undertaking a detailed design of the small-scale water storage and detention facilities, detailed plan for silt traps drainage, flood control and maximum water recuperation aimed at restoring wetlands
43. Namulema, M.J. (2015). Relevance of wetland economic valuation in Uganda: a case study of the Kiyanja–Kaku wetland in Lwengo, central Uganda
44. Natugonza, V., Musinguzi, L., Kishe, M. A., Rijssel, J. C. V., Seehausen, O., & Ogutu-Ohwayo, R. (2021). The consequences of anthropogenic stressors on cichlid fish communities: revisiting Lakes Victoria, Kyoga, and Nabugabo. In The Behavior, Ecology and Evolution of Cichlid Fishes (pp. 217-246). Springer, Dordrecht.
45. NBS, 2002. National Biomass Study. Technical Report of 1996-2002. Forest Department, Ministry of Water, Lands and Environment.
46. NBS, 2009. National Biomass Study. Technical Report of December 2009. National Forest Authority (NFA), Ministry of Water and Environment.
47. NSER, 2018. National State of the Environment Report, 2018-2019. National Environment Management Authority (NEMA).
48. Obubu, J. P., Mengistou, S., Fetahi, T., Alamirew, T., Odong, R., & Ekwacu, S. (2021). Recent Climate Change in the Lake Kyoga Basin, Uganda: An Analysis Using Short-Term and Long-Term Data with Standardized Precipitation and Anomaly Indexes. *Climate*, *9*(12), 179.
49. Okot-Okumu, J., & Nyenje, R. (2011). Municipal solid waste management under decentralisation in Uganda. *Habitat International*, *35*(4), 537-543.
50. Omute Paul, 2019: A rapid assessment to generate geographic information and selected characteristics on targeted wetlands in 20 project districts to update or bridge existing GIS data gaps. Ministry of Water and Environment. Green Climate Fund. United Nations Development Programme.

51. Otai, J. (2020). Assessing household willingness to pay for solid waste management services in uganda using contingent valuation (Doctoral dissertation, BANGOR UNIVERSITY).
52. Ramsar Convention on Wetlands. (2018). *Global Wetland Outlook: State of the World's Wetlands and their Services to People*. Gland, Switzerland: Ramsar Convention Secretariat
53. Ryken, N., Vanmaercke, M., Wanyama, J., Deckers, J., Isabirye, M., & Poesen, J. (2014, May). The impact of papyrus wetland encroachment on the spatial and temporal variability of stream flow and sediment export in the upper Rwizi catchment, Southwest Uganda. In *EGU General Assembly Conference Abstracts* (p. 10287).
54. Ryken, N., Vanmaercke, M., Wanyama, J., Isabirye, M., Vanonckelen, S., Deckers, J., & Poesen, J. (2015). Impact of papyrus wetland encroachment on spatial and temporal variabilities of stream flow and sediment export from wet tropical catchments. *Science of the Total Environment*, *511*, 756-766.
55. Sanni, T. (2020). The Legal Framework for Sand Mining in Uganda. *Legal Instruments for Sustainable Soil Management in Africa*, 101.
56. Ssemugabo, C., Nalinya, S., Lubega, G. B., Ndejjo, R., & Musoke, D. (2021). Health Risks in Our Environment: Urban Slum Youth'Perspectives Using Photovoice in Kampala, Uganda. *Sustainability*, *13*(1), 248.
57. Taita, T., Ludwig,T., Muasya, A.M. (2012).Effects of harvesting Cyperus papyrus in undisturbed wetland, Lake Naivasha, Kenya. Hydrobiologia, 680, 135–148
58. Turyahabwe, R., Mulabbi, A., Asaba, J., & Olowo, M. (2021). Ecological Responses of Macroinvertebrates to an In-Stream Ecosystem Restoration Technique in a Tropical Stream in Eastern Uganda. *East African Journal of Environment and Natural Resources*, *3*(1), 129-144.
59. Uganda Bureau of Statistics 2021 Statistical Report
60. UNDP (2018). Assessments and cost analysis for wetland restoration under the building resilient communities, wetland ecosystems and associated catchments in Uganda
61. *USAID*. 2011. Environmental Threats and Opportunities Assessment. Report produced for review by the United States Agency for International Development. Kampala, Uganda.
62. van Soest, M. (2020). Wetlands as a last resort. In *The Political Ecology of Malaria* (pp. 170-178). transcript-Verlag.
63. Vesselly, K. B., Opio, A., Mwanjalolo, M., & Kansiime, F. (2020). Seasonal Variability of Water Quality and Nutrient Removal Efficiency of a Restored Wetland. *Environment, Earth and Ecology*, *4*(1), 50-61.
64. 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.
65. Were, D., Kansiime, F., Fetahi, T., & Hein, T. (2020). A natural tropical freshwater wetland is a better climate change mitigation option through soil organic carbon storage compared to a rice paddy wetland. *SN Applied Sciences*, *2*(5), 1-13.
66. Were, D., Kansiime, F., Fetahi, T., & Hein, T. (2021). Carbon Dioxide and Methane Fluxes from a Tropical Freshwater Wetland Under Natural and Rice Paddy Conditions: Implications for Climate Change Mitigation. *Wetlands*, *41*(5), 1-12.
67. William Wanasolo, W., Turyagenda, K.B., 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, 49-56

68. Tweheyo, M., Amanya, B. K., & Turyahabwe, N. (2010). Feeding patterns of sitatunga (Tragelaphus Speki) in the Rushebeya-Kanyabaha wetland, south western Uganda. African Journal of Ecology, 48(4), 1045-1052.
69. Kansiime, F., Kateyo, E., Oryem-Origa, H., & Mucunguzi, P. (2007). Nutrient status and retention in pristine and disturbed wetlands in Uganda: management implications. Wetlands Ecology and Management, 15, 453-467
70. Convention on Wetlands. (2021). Global Wetland Outlook: Special Edition 2021. Gland, Switzerland: Secretariat of the Convention on Wetland
71. IPBES (2019). Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148
72.
73. Odeke, C. (2019). Wetland degradation and carbon sequestration potential–a case of Lubigi wetland, Uganda (Doctoral dissertation, Kyambogo University (un published work)).
74. Schepp, C., Diekkrüger, B., & Becker, M. (2022). Hillslope Hydrology in a Deeply Weathered Saprolite and Associated Nitrate Transport to a Valley Bottom Wetland in Central Uganda. Hydrology, 9(12), 229.
75. Dalahmeh, S., Björnberg, E., Elenström, A. K., Niwagaba, C. B., & Komakech, A. J. (2020). Pharmaceutical pollution of water resources in Nakivubo wetlands and Lake Victoria, Kampala, Uganda. Science of the Total Environment, 710, 136347.
76. Namaalwa, S., Van Dam, A. A., Gettel, G. M., Kaggwa, R. C., Zsuffa, I., & Irvine, K. (2020). The impact of wastewater discharge and agriculture on water quality and nutrient retention of Namatala wetland, Eastern Uganda. Frontiers in Environmental Science, 8, 148.
77. Kayendeke, E. J., & French, H. K. (2019). Characterising the hydrological regime of a tropical papyrus wetland in the Lake Kyoga Basin, Uganda. Agriculture and Ecosystem Resilience in Sub Saharan Africa: Livelihood Pathways Under Changing Climate, 213-236.
78. MWE (2020) Rapid assessment to generate BASELINE WETLAND health for all the wetlands in 20 districts in Eastern and South Western Uganda and obtain georeferenced data on indicators of wetland health (flora, fauna, hydrology, soils
79. IUCN (2022) IUCN Red List of Threatened Species. Version 2021.1. <www.iucnredlist.org>.
80. WCS, 2016. Nationally Threatened Species for Uganda. National Red List for Uganda for the following taxa: Mammals, Birds, Reptiles, Amphibians, Butterflies, Dragonflies and Vascular Plants. Prepared by WCS, the Government of Uganda, the Uganda Wildlife Authority.
81. Kayima, J. K., & Mayo, A. W. (2020). Nitrogen removal buffer capacity of the Lubigi wetland in Uganda. Physics and Chemistry of the Earth, Parts A/B/C, 117, 102883.
82.
83. Nalule, R. (2023). Local perceptions on wetland land use and land cover dynamics: a comparison of Mabamba-bay Ramsar site and Mende wetland, Wakiso district, central Uganda (Doctoral dissertation, Makerere University).
84.
85. Kunan, B. V. (2015). Effects of restoration on soil, plants and water quality in Nakyesanja wetland, Wakiso District, Uganda. Unpublished master's thesis, Makerere University, Kampala, Uganda.

86. 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.

9. Appendix

Status of wetlands in the different districts of Uganda

REGION	DISTRICT	Degraded Area (sq.km)	%	Intact Area (sq.km)	%	Total Area (sq.km)
NORTHERN	ABIM	59.0	18.2	265.2	81.8	324.2
NORTHERN	ADJUMANI	90.6	27.5	238.2	72.5	328.8
NORTHERN	AGAGO	208.0	73.6	74.7	26.4	282.7
NORTHERN	ALEBTONG	129.3	54.3	108.8	45.7	238.0
NORTHERN	AMOLATAR	59.2	19.4	246.5	80.6	305.7
NORTHERN	AMUDAT	24.2	29.2	58.4	70.8	82.6
EASTERN	AMURIA	176.6	44.0	224.6	56.0	401.2
NORTHERN	AMURU	41.8	22.3	145.4	77.7	187.2
NORTHERN	APAC	81.7	18.5	360.2	81.5	442.0
NORTHERN	ARUA	39.2	53.3	34.4	46.7	73.6
EASTERN	BUDAKA	115.7	88.7	14.7	11.3	130.4
EASTERN	BUGIRI	160.2	70.4	67.4	29.6	227.6
EASTERN	BUGWERI	91.9	90.5	9.6	9.5	101.5
WESTERN	BUHWEJU	5.4	57.3	4.1	42.7	9.5
CENTRAL	BUIKWE	54.3	64.8	29.5	35.2	83.7
EASTERN	BUKEDEA	244.2	59.1	169.0	40.9	413.3
CENTRAL	BUKOMANSIMBI	44.6	29.3	107.7	70.7	152.3
EASTERN	BUKWO	3.7	65.5	2.0	34.5	5.7
EASTERN	BULAMBULI	24.9	11.0	201.3	89.0	226.2
WESTERN	BULIISA	9.6	8.6	102.1	91.4	111.7
WESTERN	BUNDIBUGYO	0.6	2.8	22.3	97.2	23.0
WESTERN	BUNYANGABU	4.4	38.7	6.9	61.3	11.3
WESTERN	BUSHENYI	20.2	46.1	23.5	53.9	43.7
EASTERN	BUSIA	127.8	72.6	48.3	27.4	176.0
EASTERN	BUTALEJA	186.4	63.6	106.6	36.4	293.0
CENTRAL	BUTAMBALA	10.2	11.7	77.1	88.3	87.3
EASTERN	BUTEBO	50.0	97.2	1.5	2.8	51.5
CENTRAL	BUVUMA	1.8	17.0	8.6	83.0	10.3
EASTERN	BUYENDE	264.8	51.2	252.0	48.8	516.8

REGION	DISTRICT	Degraded Area (sq.km)	%	Intact Area (sq.km)	%	Total Area (sq.km)
NORTHERN	DOKOLO	81.4	24.8	246.8	75.2	328.2
CENTRAL	GOMBA	55.1	15.8	293.6	84.2	348.8
NORTHERN	GULU	37.4	37.2	63.1	62.8	100.5
WESTERN	HOIMA	22.7	21.9	81.0	78.1	103.7
WESTERN	IBANDA	31.2	55.3	25.2	44.7	56.5
EASTERN	IGANGA	133.6	84.1	25.3	15.9	158.9
WESTERN	ISINGIRO	80.0	25.8	230.4	74.2	310.4
EASTERN	JINJA	96.6	93.8	6.4	6.2	103.0
NORTHERN	KAABONG	48.3	20.4	188.1	79.6	236.3
WESTERN	KABALE	34.2	55.5	27.5	44.5	61.7
WESTERN	KABAROLE	27.9	30.6	63.4	69.4	91.3
EASTERN	KABERAMAIDO	41.3	21.5	150.8	78.5	192.1
WESTERN	KAGADI	86.4	45.9	101.9	54.1	188.3
WESTERN	KAKUMIRO	151.0	39.4	232.0	60.6	383.0
EASTERN	KALAKI	37.8	21.8	135.2	78.2	172.9
CENTRAL	KALANGALA	12.5	22.6	43.1	77.4	55.6
EASTERN	KALIRO	171.2	50.8	165.7	49.2	336.9
CENTRAL	KALUNGU	66.1	23.9	210.8	76.1	276.9
CENTRAL	KAMPALA	19.0	62.1	11.6	37.9	30.6
EASTERN	KAMULI	386.8	78.9	103.3	21.1	490.1
WESTERN	KAMWENGE	66.2	38.3	106.9	61.7	173.1
WESTERN	KANUNGU	25.3	29.5	60.3	70.5	85.6
EASTERN	KAPCHORWA	0.1	95.9	0.003	4.1	0.1
EASTERN	KAPELEBYONG	220.7	45.6	263.1	54.4	483.8
NORTHERN	KARENGA	106.5	38.6	169.2	61.4	275.7
WESTERN	KASESE	21.6	11.0	174.0	89.0	195.5
CENTRAL	KASSANDA	129.0	37.2	217.3	62.8	346.3
EASTERN	KATAKWI	299.8	27.5	792.0	72.5	1091.8
CENTRAL	KAYUNGA	316.4	45.6	377.6	54.4	694.0
WESTERN	KAZO	29.6	19.6	121.2	80.4	150.8
WESTERN	KIBAALE	23.9	27.7	62.3	72.3	86.2
CENTRAL	KIBOGA	47.0	12.0	344.5	88.0	391.5
EASTERN	KIBUKU	113.7	55.1	92.5	44.9	206.2
WESTERN	KIKUUBE	49.3	30.2	113.9	69.8	163.3
WESTERN	KIRUHURA	31.8	6.3	470.7	93.7	502.6
WESTERN	KIRYANDONGO	82.9	22.1	292.4	77.9	375.3
WESTERN	KISORO	12.0	60.3	7.9	39.7	19.9
WESTERN	KITAGWENDA	30.1	23.4	98.6	76.6	128.7

REGION	DISTRICT	Degraded Area (sq.km)	%	Intact Area (sq.km)	%	Total Area (sq.km)
NORTHERN	KITGUM	92.8	44.6	115.2	55.4	208.0
NORTHERN	KOBOKO	0.7	31.7	1.4	68.3	2.1
NORTHERN	KOLE	56.6	26.3	158.8	73.7	215.4
NORTHERN	KOTIDO	119.5	20.0	476.5	80.0	595.9
EASTERN	KUMI	135.1	47.4	150.1	52.6	285.2
NORTHERN	KWANIA	94.6	31.4	206.6	68.6	301.2
EASTERN	KWEEN	45.0	48.9	47.1	51.1	92.1
CENTRAL	KYANKWANZI	178.9	34.3	342.8	65.7	521.7
WESTERN	KYEGEGWA	79.7	47.8	86.9	52.2	166.5
WESTERN	KYENJOJO	145.6	42.6	196.5	57.4	342.1
CENTRAL	KYOTERA	97.9	10.7	813.2	89.3	911.0
NORTHERN	LAMWO	128.8	60.8	83.1	39.2	211.9
NORTHERN	LIRA	102.7	42.4	139.3	57.6	242.0
EASTERN	LUUKA	142.9	86.8	21.7	13.2	164.7
CENTRAL	LUWERO	298.6	46.3	346.7	53.7	645.3
CENTRAL	LWENGO	58.7	32.7	120.7	67.3	179.4
CENTRAL	LYANTONDE	43.0	19.6	176.0	80.4	218.9
NORTHERN	MADI OKOLLO	116.0	30.6	263.6	69.4	379.6
EASTERN	MANAFWA	20.5	99.7	0.1	0.3	20.6
NORTHERN	MARACHA	37.9	63.2	22.1	36.8	60.0
CENTRAL	MASAKA	35.1	9.7	328.3	90.3	363.4
WESTERN	MASINDI	76.0	13.2	498.8	86.8	574.7
EASTERN	MAYUGE	133.9	72.0	52.1	28.0	186.0
EASTERN	MBALE	98.6	99.6	0.4	0.4	99.0
WESTERN	MBARARA	53.7	50.9	51.8	49.1	105.5
WESTERN	MITOOMA	10.2	48.3	10.9	51.7	21.1
CENTRAL	MITYANA	39.1	24.4	121.2	75.6	160.2
NORTHERN	MOROTO	27.6	11.8	205.7	88.2	233.4
NORTHERN	MOYO	3.9	7.7	46.9	92.3	50.8
CENTRAL	MPIGI	28.5	8.6	303.5	91.4	332.0
CENTRAL	MUBENDE	74.3	22.1	261.7	77.9	336.0
CENTRAL	MUKONO	159.9	40.6	234.3	59.4	394.2
NORTHERN	NABILATUK	30.3	7.8	356.2	92.2	386.5
NORTHERN	NAKAPIRIPIRIT	35.3	8.8	364.6	91.2	399.9
CENTRAL	NAKASEKE	197.7	21.8	708.4	78.2	906.0
CENTRAL	NAKASONGOLA	124.1	11.6	943.5	88.4	1067.6
EASTERN	NAMAYINGO	63.0	70.6	26.3	29.4	89.3
EASTERN	NAMUTUMBA	174.2	54.9	143.0	45.1	317.2

REGION	DISTRICT	Degraded Area (sq.km)	%	Intact Area (sq.km)	%	Total Area (sq.km)
NORTHERN	NAPAK	125.4	12.1	913.2	87.9	1038.6
NORTHERN	NEBBI	3.6	41.6	5.0	58.4	8.5
EASTERN	NGORA	99.9	31.0	222.4	69.0	322.3
WESTERN	NTOROKO	2.3	1.3	177.2	98.7	179.5
WESTERN	NTUNGAMO	72.4	53.4	63.3	46.6	135.7
NORTHERN	NWOYA	96.3	35.0	178.6	65.0	275.0
NORTHERN	OBONGI	48.1	16.7	240.0	83.3	288.1
NORTHERN	OMORO	55.3	43.4	72.0	56.6	127.3
NORTHERN	OTUKE	220.4	61.9	135.5	38.1	355.9
NORTHERN	OYAM	98.5	21.1	368.4	78.9	466.9
NORTHERN	PADER	124.2	56.3	96.5	43.7	220.7
NORTHERN	PAKWACH	71.8	52.7	64.4	47.3	136.2
EASTERN	PALLISA	140.7	36.9	241.1	63.1	381.7
CENTRAL	RAKAI	126.0	46.3	145.9	53.7	271.9
WESTERN	RUBANDA	18.7	42.3	25.5	57.7	44.2
WESTERN	RUBIRIZI	7.8	15.2	43.5	84.8	51.3
WESTERN	RUKIGA	8.3	55.1	6.7	44.9	15.0
WESTERN	RUKUNGIRI	33.2	37.0	56.6	63.0	89.9
WESTERN	RWAMPARA	38.1	46.7	43.5	53.3	81.6
EASTERN	SERERE	161.6	25.5	471.6	74.5	633.2
WESTERN	SHEEMA	85.1	54.7	70.6	45.3	155.7
EASTERN	SIRONKO	6.4	99.8	0.01	0.2	6.4
EASTERN	SOROTI	165.0	37.4	276.1	62.6	441.1
CENTRAL	SSEMBABULE	54.8	8.9	559.4	91.1	614.2
NORTHERN	TEREGO	40.4	54.5	33.8	45.5	74.2
EASTERN	TORORO	303.7	85.7	50.5	14.3	354.3
CENTRAL	WAKISO	137.1	36.6	237.2	63.4	374.2
NORTHERN	YUMBE	40.9	50.4	40.2	49.6	81.1
NORTHERN	ZOMBO	1.6	10.7	13.3	89.3	14.9

Wetland Change analysis between 1994 and 2022

District	1994	2015	2021	1994-2015	2015-2022	1994-2022
	Area (Sq.km)					
ABIM	537.2	307.1	324.2	-230.1	17.1	-213.0
ADJUMANI	312.3	294.6	328.8	-17.7	34.1	16.5
AGAGO	353.5	259.5	282.7	-93.9	23.2	-70.8
ALEBTONG	245.2	229.4	238.0	-15.8	8.6	-7.2
AMOLATAR	266.8	244.4	305.7	-22.4	61.3	38.9
AMUDAT	72.7	83.5	82.6	10.9	-0.9	9.9
AMURIA	505.1	370.1	401.2	-135.0	31.0	-104.0
AMURU	198.9	172.6	187.2	-26.4	14.6	-11.8
APAC	432.1	353.1	442.0	-79.0	88.8	9.9
ARUA	41.2	38.2	73.6	-3.0	35.4	32.4
BUDAKA	130.2	113.6	130.4	-16.6	16.8	0.2
BUGIRI	236.1	232.8	227.6	-3.3	-5.2	-8.4
BUGWERI	116.7	104.0	101.5	-12.7	-2.5	-15.2
BUHWEJU	7.4	7.4	9.5	0.0	2.1	2.1
BUIKWE	25.1	73.5	83.7	48.4	10.2	58.6
BUKEDEA	448.4	396.8	413.3	-51.6	16.4	-35.2
BUKOMANSIMBI	216.2	145.5	152.3	-70.7	6.8	-63.9
BUKWO	10.5	13.3	5.7	2.8	-7.6	-4.9
BULAMBULI	203.6	226.4	226.2	22.9	-0.3	22.6
BULIISA	776.1	111.5	111.7	-664.6	0.2	-664.4
BUNDIBUGYO	11.0	28.7	23.0	17.7	-5.7	12.0
BUNYANGABU	7.7	13.2	11.3	5.5	-1.8	3.7
BUSHENYI	34.8	21.4	43.7	-13.4	22.3	8.9
BUSIA	155.0	171.3	176.0	16.4	4.7	21.1
BUTALEJA	284.4	264.7	293.0	-19.7	28.3	8.6
BUTAMBALA	50.6	43.8	87.3	-6.8	43.5	36.7
BUTEBO	44.9	51.1	51.5	6.3	0.4	6.6
BUVUMA	12.4	12.8	10.3	0.4	-2.4	-2.0
BUYENDE	416.9	385.6	516.8	-31.3	131.2	99.9
DOKOLO	284.6	225.4	328.2	-59.2	102.8	43.6
GOMBA	446.6	337.3	348.8	-109.3	11.5	-97.8
GULU	94.6	92.6	100.5	-2.0	7.9	5.9
HOIMA	185.9	74.9	103.7	-111.0	28.7	-82.3
IBANDA	60.0	43.9	56.5	-16.1	12.6	-3.5
IGANGA	167.6	163.3	158.9	-4.2	-4.4	-8.7

District	1994	2015	2021	1994-2015	2015-2022	1994-2022
ISINGIRO	346.3	305.8	310.4	-40.4	4.6	-35.8
JINJA	101.3	108.1	103.0	6.8	-5.2	1.6
KAABONG	212.6	201.6	236.3	-11.0	34.7	23.8
KABALE	35.0	53.6	61.7	18.5	8.1	26.7
KABAROLE	116.6	92.6	91.3	-24.0	-1.3	-25.3
KABERAMAIDO	188.9	179.9	192.1	-8.9	12.2	3.2
KAGADI	218.6	175.6	188.3	-43.0	12.7	-30.4
KAKUMIRO	352.3	321.8	383.0	-30.4	61.2	30.8
KALAKI	256.4	166.5	172.9	-89.9	6.4	-83.5
KALANGALA	47.0	37.9	55.6	-9.1	17.7	8.6
KALIRO	295.1	233.4	336.9	-61.6	103.4	41.8
KALUNGU	341.0	261.7	276.9	-79.3	15.2	-64.1
KAMPALA	33.2	33.3	30.6	0.1	-2.7	-2.6
KAMULI	428.8	424.5	490.1	-4.4	65.6	61.3
KAMWENGE	184.3	137.6	173.1	-46.7	35.6	-11.1
KANUNGU	72.1	72.2	85.6	0.1	13.4	13.5
KAPCHORWA	1.2	0.8	0.1	-0.4	-0.8	-1.2
KAPELEBYONG	564.8	462.8	483.8	-102.0	21.0	-81.0
KARENGA	277.1	262.3	275.7	-14.8	13.4	-1.4
KASESE	439.7	406.9	195.5	-32.8	-211.3	-244.1
KASSANDA	336.1	331.0	346.3	-5.1	15.3	10.2
KATAKWI	1325.7	1075.4	1,091.8	-250.2	16.4	-233.8
KAYUNGA	585.2	587.3	694.0	2.1	106.7	108.8
KAZO	195.0	147.2	150.8	-47.7	3.6	-44.2
KIBAALE	63.7	50.3	86.2	-13.4	35.9	22.5
KIBOGA	332.9	334.0	391.5	1.1	57.5	58.6
KIBUKU	228.3	175.4	206.2	-52.9	30.7	-22.2
KIKUUBE	130.4	108.0	163.3	-22.4	55.2	32.9
KIRUHURA	560.6	479.8	502.6	-80.7	22.7	-58.0
KIRYANDONGO	425.9	347.1	375.3	-78.8	28.2	-50.6
KISORO	25.7	33.1	19.9	7.4	-13.1	-5.8
KITAGWENDA	214.4	119.1	128.7	-95.3	9.6	-85.6
KITGUM	328.3	188.8	208.0	-139.5	19.2	-120.3
KOBOKO	2.0	2.1	2.1	0.1	-0.1	0.1
KOLE	232.6	207.9	215.4	-24.8	7.5	-17.3
KOTIDO	486.7	460.9	595.9	-25.8	135.0	109.2
KUMI	313.6	255.4	285.2	-58.2	29.8	-28.4
KWANIA	214.6	219.6	301.2	5.0	81.6	86.6

District	1994	2015	2021	1994-2015	2015-2022	1994-2022
KWEEN	82.2	97.0	92.1	14.9	-4.9	9.9
KYANKWANZI	718.5	538.4	521.7	-180.1	-16.7	-196.8
KYEGEGWA	205.9	152.1	166.5	-53.9	14.5	-39.4
KYENJOJO	547.3	427.3	342.1	-120.0	-85.1	-205.2
KYOTERA	844.3	831.8	911.0	-12.5	79.2	66.8
LAMWO	207.0	191.9	211.9	-15.1	20.0	5.0
LIRA	242.3	198.9	242.0	-43.3	43.0	-0.3
LUUKA	179.6	158.8	164.7	-20.8	5.9	-15.0
LUWERO	602.4	610.3	645.3	7.9	35.0	42.9
LWENGO	256.9	166.9	179.4	-90.0	12.5	-77.6
LYANTONDE	360.2	199.2	218.9	-161.0	19.7	-141.3
MADI OKOLLO	306.6	236.4	379.6	-70.2	143.2	73.0
MANAFWA	17.3	17.8	20.6	0.4	2.8	3.3
MARACHA	0.0	0.0	60.0	0.0	60.0	60.0
MASAKA	322.8	320.3	363.4	-2.5	43.1	40.6
MASINDI	577.6	493.9	574.7	-83.7	80.8	-2.9
MAYUGE	207.1	195.8	186.0	-11.3	-9.8	-21.2
MBALE	88.4	95.3	99.0	6.8	3.8	10.6
MBARARA	83.6	91.0	105.5	7.4	14.5	21.9
MITOOMA	15.8	9.3	21.1	-6.5	11.8	5.3
MITYANA	162.7	151.7	160.2	-11.1	8.6	-2.5
MOROTO	235.1	203.1	233.4	-32.0	30.3	-1.8
MOYO	112.7	42.8	50.8	-69.8	8.0	-61.9
MPIGI	348.2	302.8	332.0	-45.4	29.2	-16.2
MUBENDE	385.1	304.7	336.0	-80.4	31.3	-49.1
MUKONO	140.1	384.5	394.2	244.4	9.7	254.2
NABILATUK	495.4	375.9	386.5	-119.5	10.6	-108.9
NAKAPIRIPIRIT	487.1	386.6	399.9	-100.5	13.3	-87.2
NAKASEKE	1054.4	929.8	906.0	-124.6	-23.7	-148.4
NAKASONGOLA	1013.8	860.9	1,067.6	-152.9	206.7	53.8
NAMAYINGO	88.9	101.0	89.3	12.1	-11.7	0.4
NAMISINDWA	0.0	2.1	317.2	2.1	315.0	317.2
NAMUTUMBA	278.1	279.2	1,038.6	1.1	759.4	760.5
NAPAK	1153.1	948.8	8.5	-204.3	-940.3	-1144.5
NEBBI	7.4	8.2	322.3	0.8	314.1	314.9
NGORA	382.7	333.8	179.5	-48.9	-154.3	-203.2
NTOROKO	914.5	876.0	135.7	-38.5	-740.3	-778.8
NTUNGAMO	138.9	112.0	275.0	-26.9	163.0	136.1

District	1994	2015	2021	1994-2015	2015-2022	1994-2022
NWOYA	385.2	259.7	288.1	-125.4	28.4	-97.0
OBONGI	356.2	262.4	127.3	-93.9	-135.1	-228.9
OMORO	155.7	113.5	355.9	-42.3	242.5	200.2
OTUKE	564.2	337.4	466.9	-226.8	129.5	-97.2
OYAM	509.0	379.7	220.7	-129.2	-159.0	-288.2
PADER	237.6	203.1	136.2	-34.5	-66.9	-101.4
PAKWACH	142.6	100.7	381.7	-41.9	281.0	239.1
PALLISA	373.8	367.8	271.9	-6.0	-95.8	-101.8
RAKAI	283.9	237.4	44.2	-46.4	-193.3	-239.7
RUBANDA	42.7	44.0	51.3	1.3	7.3	8.6
RUBIRIZI	70.3	48.4	15.0	-21.9	-33.4	-55.3
RUKIGA	12.5	10.0	89.9	-2.6	79.9	77.3
RUKUNGIRI	73.6	71.8	81.6	-1.8	9.7	8.0
RWAMPARA	82.8	76.5	633.2	-6.3	556.7	550.4
SERERE	714.5	555.4	155.7	-159.1	-399.7	-558.8
SHEEMA	172.1	93.3	6.4	-78.8	-86.9	-165.7
SIRONKO	2.3	7.4	441.1	5.0	433.7	438.7
SOROTI	652.3	409.2	614.2	-243.1	205.0	-38.1
SSEMBABULE	789.3	581.3	74.2	-208.0	-507.2	-715.1
TORORO	343.6	338.7	354.3	-4.8	15.5	10.7
WAKISO	329.2	381.1	374.2	51.9	-6.8	45.0
YUMBE	85.4	72.2	81.1	-13.2	8.9	-4.3
ZOMBO	5.0	4.7	14.9	-0.3	10.2	9.9