



Wetland Monograph for the Semliki Delta (Democratic Republic of Congo - Uganda) wetland landscape

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Wetlands are among the most biodiverse ecosystems on Earth. Up to 40% of the world's species live and breed in wetlands. More than one billion people depend on them for a living and directly or indirectly, wetlands provide almost all of the world's consumption of freshwater. In addition, wetlands represent just three percent of total land area, but sequester 30 percent of all soil carbon. Maintaining and restoring damaged wetlands is necessary to ensure soil carbon is not released into the atmosphere. On equal areas, wetlands store between 10 and 50 times more carbon than tropical forests.

Yet these wetlands are disappearing three times faster than forests according to the Global Outlook Report, 2018 by RAMSAR and UNFCCC. In addition, more than 25% of all wetlands plants and animals are at risk of extinction. Approximately 35% of the world's wetlands were lost between 1970-2015 and the loss rate is accelerating, driven by population increase, urbanization, and changes to land and water use and to agriculture while the ones left are under threat from water drainage, pollution, unsustainable use, invasive species, disrupted flows from dams and sediment dumping from deforestation and soil erosion.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) comprised of over 550 scientists from more than 100 countries in its latest report warns that human destruction of nature is rapidly eroding the world's capacity to provide food, water and security to billions of people with the risks posed by biodiversity loss on the same scale as those of climate change. Although the focus of media and society and is on poaching particularly of rhinos, elephants and other exotic animals, far larger threats to nature are from habitat loss, invasive species, chemicals and climate change. The report adds that "Biodiversity and the ecosystem services it supports are not only the foundation for our life on Earth, but critical to the livelihoods and well-being of people everywhere." Exploitation including conversion of forests and wetlands to agriculture and urban development has devastated ecosystem services on which climate, economy and well-being depend.

The Nile Basin Initiative (NBI), created by member states of the Nile Basin 'to promote sustainable socio-economic development through the equitable utilization of, and benefit from, the common Nile Basin water resources' in 2013 established a Wetland Management Strategy to reverse degradation and sustain critical ecosystem services, including biodiversity.

In this connection, the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) has initiated an action research project to increase the knowledge base and strengthen capacity to integrate green infrastructure in river basin planning in three transboundary wetlands: *Semliki Delta* (DRC-Uganda), *Sango Bay-Minziro* (Tanzania-Uganda) and *Sio-Siteko* (Kenya-Uganda). The project, implemented by Wetlands International in partnership with Acacia Water and Nature Uganda, is expected to strengthen national policies and institutional capacities for the effective management of wetlands with basin-wide importance; while contributing to biodiversity conservation as well as to ecosystem-based adaptation to climate change and to regional co-operation in the Nile region.

The project consists of three integrated components that build on each other: Wetland Monographs, Wetland Management Plans (WMPs) and Conservation Investment Plans (CIPs). These are complemented by Early Investment Projects to put the plans into practice as quickly as possible. The Wetland Monograph presents a detailed study of the physical context, biodiversity and ecosystems, policies and institutions, socio-economics and livelihoods, and social dimensions of the landscape. In the final chapters it identifies the main challenges the wetland landscape face, and the main conclusions on which to develop successful management plans and investment portfolios.

The wetlands of the Semliki (sometimes written as Semuliki) river delta provide valuable natural resources on which local communities depend and are characterized by an exceptional biodiversity that can be harnessed to provide economic and sustainable livelihoods. Semliki River begins near Ishango, Democratic Republic of the Congo (DRC), at the northern end of Lake Edward, enters Virunga National Park (DRC), runs along the west edge of Semliki National Park (Uganda) forming part of the international border between the DRC and the western Ugandan district of Bundibugyo towards Lake Albert.

More than 300 species of birds, including the *Shoebill Balaeniceps rex*, forest ground-thrush, Sassi's olive greenbul, and nine species of hornbill frequent the park, as do many kinds of Charaxes butterflies. Among the mammals in the park are elephants, buffalo, hippopotami, duikers, and pygmy flying squirrels. *Cynometra alexandri*, a tropical tree species, dominates the tropical forest but is interspersed with other trees and swamp flora.

Snowmelt from the Rwenzori mountains, overgrazing, and land use changes have caused river bank erosion and frequent changes to the course of the river, with Uganda losing up to 10 metres of land per year on its side of the river to erosion, and siltation filling in the southern delta of Lake Albert. Worryingly, the nearby Lake Wamala reduced from 164 km² to 87 km² between 1990 and 2005.

In the same region, by 1990 the Lyamuriro wetland (near Lake Bunyonyi) was intact, performing hydrological and ecological functions. From 2005 to 2009, the whole eco-system has been converted to agricultural cultivation land.

This wetland was one of the Important Bird Areas (IBAs) in Uganda. The conversion happened “instantly” and impacts were highly significant including loss of biodiversity including endemic birds e.g. the Papyrus yellow warbler, change in hydrology and micro-climate in in the area.

The current project is crucial to reduce the likelihood of similar fate befalling the Semliki. The project has received unprecedented support and cooperation from national agencies, ministries and departments of all member states, as well as inputs from technical officers, local authorities, community leadership and other stakeholders.

Special thanks are due to the NELSAP Technical Advisory Committee, the Wetland Management Team, GIZ, the Lake Edward and Albert Fisheries Project (LEAF II) officers from DRC and Uganda who contributed with extremely valuable information, data and support; and finally the Semliki Delta community leaders and stakeholder groups who adopted the project as their own.

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ACRONYMS

amsl	-	above mean sea level
AWMZ	-	Albert Water Management Zone
BMU	-	Beach Management Unit
BMUB	-	Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit
BMUB-ICI	-	BMUB- International Climate Initiative
CAS	-	Catch Assessment Survey
CBD	-	Convention on Biological Diversity
CCI	-	Climate Change Initiative
CFR	-	Central Forest Reserve
CIP	-	Conservation Investment Plan
CMIP	-	Coupled Model Intercomparison Project
CMP	-	Catchment Management Plan
CMS	-	Convention on the Conservation of Migratory Species of Wild Animals
CSO	-	Civil Society Organization
DRC	-	Democratic Republic of Congo
DWD	-	Directorate of Water Development (Uganda)
EAC	-	East African Community
EMCA	-	Environmental Management and Coordination Act
ENSAP	-	Eastern Nile Subsidiary Action Program
ENTRO	-	Eastern Nile Technical Regional Office
ESA	-	European Space Agency
FNR	-	Forest Nature Reserve
GEF	-	Global Environment Facility
GIZ	-	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GIZ-NEL	-	GIZ Nile Equatorial Lakes region project
GPS	-	Global Positioning System
IBA	-	Important Birding Area
IPCC	-	Intergovernmental Panel on Climate Change
ITCZ	-	Inter-Tropical Convergence Zone
IWRM	-	Integrated Water Resources Management
IUCN	-	International Union for Conservation of Nature
km	-	kilometer
LEAB	-	Lakes Edward and Albert Basin
LEAF	-	Lakes Edward and Albert Integrated Fisheries and Water Resources Management Project
LEAIBMP	-	Lakes Edward and Albert Integrated Basin Management Plan
LVEMP	-	Lake Victoria Environmental Management Program
LVFO	-	Lake Victoria Fisheries Organization
m	-	meter
MEA	-	Multilateral Environmental Agreement
mm	-	millimeter
MUIENR	-	Makerere University Institute of Environment and Natural Resources

MWE	-	Ministry of Water and Environment (Uganda)
NaFIRRI	-	National Fisheries Resource Research Institute
NBI	-	Nile Basin Initiative
NELSAP	-	Nile Equatorial Lakes Subsidiary Action Program
NELSAP-CU	-	NELSAP Coordination Unit
NEMA	-	National Environment Management Authority
NFR	-	Nature Forest Reserve
NILE COM	-	Nile Council of Ministers
Nile Eco-VWU	-	Nile Ecosystem Valuation for Wise Use
NILE-SEC	-	Nile Basin Initiative Secretariat
NILE-TAC	-	Nile Technical Advisory Committee
NLC	-	National Lands Commission
NRBC	-	Nile River Basin Commission
NT	-	Near Threatened
NVDI	-	Normalized Difference Vegetation Index
PC	-	Project Coordinator
RAMCEA	-	Ramsar Centre for Eastern Africa
SWL	-	Static Water Level
UWA	-	Uganda Wildlife Authority
VU	-	Vulnerable
WMP	-	Wetland Management Plan
WRA	-	Water Resources Authority
yr	-	year
μS/cm	-	micro Siemens per centimeter

EXECUTIVE SUMMARY

The Nile Equatorial Lakes Subsidiary Action Program (NELSAP) has initiated an action research project to increase the knowledge base and strengthen the capacity to integrate green infrastructure in river basin planning in three transboundary wetlands: Semliki Delta (DRC-Uganda), Sango Bay-Minziro (Tanzania-Uganda) and Sio-Siteko (Kenya-Uganda). This project builds upon existing and previous plans and programs and aims to pave the way and create drivers to improve governance, promote conservation and sustainable livelihoods in the Semliki Delta wetland landscape which directly or indirectly involve the wetlands.

This Wetland Monograph presents a detailed study of the physical context, biodiversity and ecosystems, policies and institutions, socio-economics and livelihoods, and social dimensions of the Semliki Delta wetland landscape. In addition, it identifies challenges the wetland landscape faces and on which to develop successful management plans and investment portfolios.

The Semliki Delta supports considerable biodiversity of flora and fauna with endemic mammals, birds, amphibians, and plants. The delta habitat contains 325 species of bird, more than 19 fish species, 253 species of butterflies and 72 species of dragonflies, amongst others. The tall vegetation along the marshy shores is home to the *Shoebill Balaeniceps rex* and other wetland birds. The Semliki Delta wetland further plays an important role in regulating the hydrological system and storage of potable water as well as supporting livelihoods through the provision of fish, medicinal plants, grazing land and building and craft materials.

The main challenges include encroachment and deforestation, over-exploitation of natural resources, and unclear and changing wetland boundaries. The root causes of these challenges include rapid population growth, weak institutional capacity, low community awareness, and climate change. Climate change is expected to increase the frequency and intensity of floods and droughts, but will also continue the loss of glacier ice in the Rwenzori Mountains, ultimately causing a shift in Semliki River flows. Another future threat is the possibility of oil extraction, which will have environmental and socio-economic impacts.

Water resources are likely to be increasingly strained in the future climatic and socio-economic conditions of the wider Semliki Delta area. Wetlands are an effective sink for carbon, thereby buffering the effects of climate change and supporting climate resiliency. Therefore, the Semliki Delta wetland landscape needs better protection from human-induced and climatic changes to protect the ecosystem and local livelihoods.

In order to develop successful and sustainable management and investment plans, it is crucial to understand the environmental and socio-economic system of the wetland landscape and the main threats it faces. Therefore, the first step and cornerstone of this approach is this Wetland Monograph, which serves as the baseline and reference for the Semliki Delta Wetland Management and Conservation Investment Plans.

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1. INTRODUCTION

1.1 OVERVIEW OF THE WETLAND LANDSCAPE

1.1.1 Geographical location

The Semliki Delta wetland landscape is located in the East African Rift Valley on the southern shore of Lake Albert and encompasses the delta-shaped river mouth of the

River Semliki (sometimes written as Semuliki) cross the boundary of the Democratic Republic of Congo (DRC) and Uganda (Figure 1). The Semliki Delta lies between latitude 1.31 - 0.98 °N and longitude 30.21 - 30.53 °E and has an area of approximately 830 square kilometers.

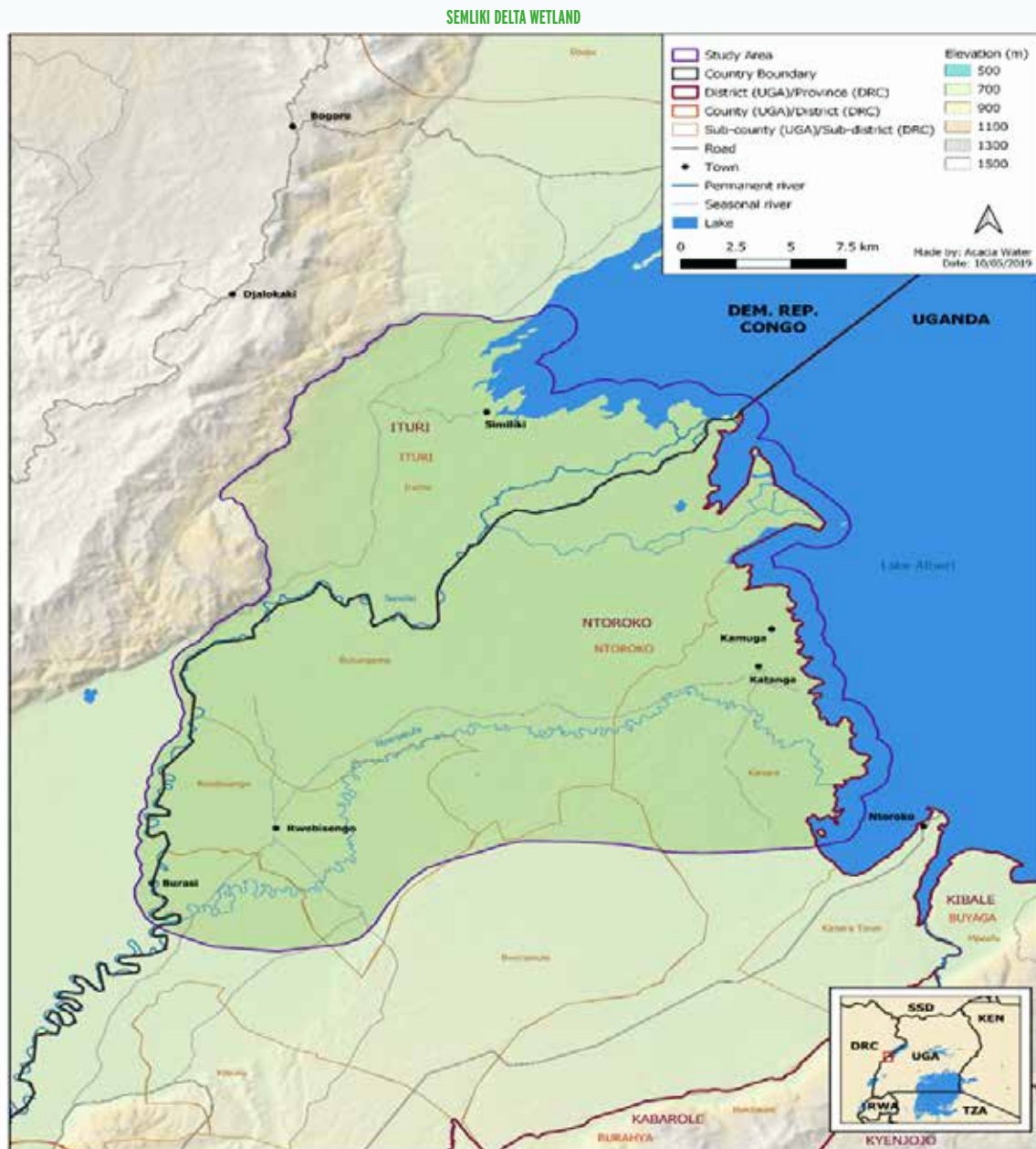


Figure 1: Geographic location and administrative boundaries of the Semliki Delta wetland landscape.

1.1.1 Ecological potential

Wetlands have primary production often 10-50 times higher than rainforests per unit area, contributing to exceptional biodiversity and hosting enormous numbers of wild animals including fish, birds, and aquatic animals. They also produce vast quantities of freshwater, oxygen, store carbon, and process nitrogen, providing fertile soils

for agriculture. Therefore, wetlands are of significant ecological and socio-economic value. The Semliki Delta promote breeding and nursery grounds for many species of fish and is as such extremely important for the fisheries of Lake Albert (Figure 2).

Social economic potential

Besides the ecological value of wetlands, the Semliki Delta

Figure 2: The Semliki Delta wetlands are of high ecological importance, being rich in biodiversity and provide a number of eco-system services for the local population, including the provision of clean water, fish and raw materials.

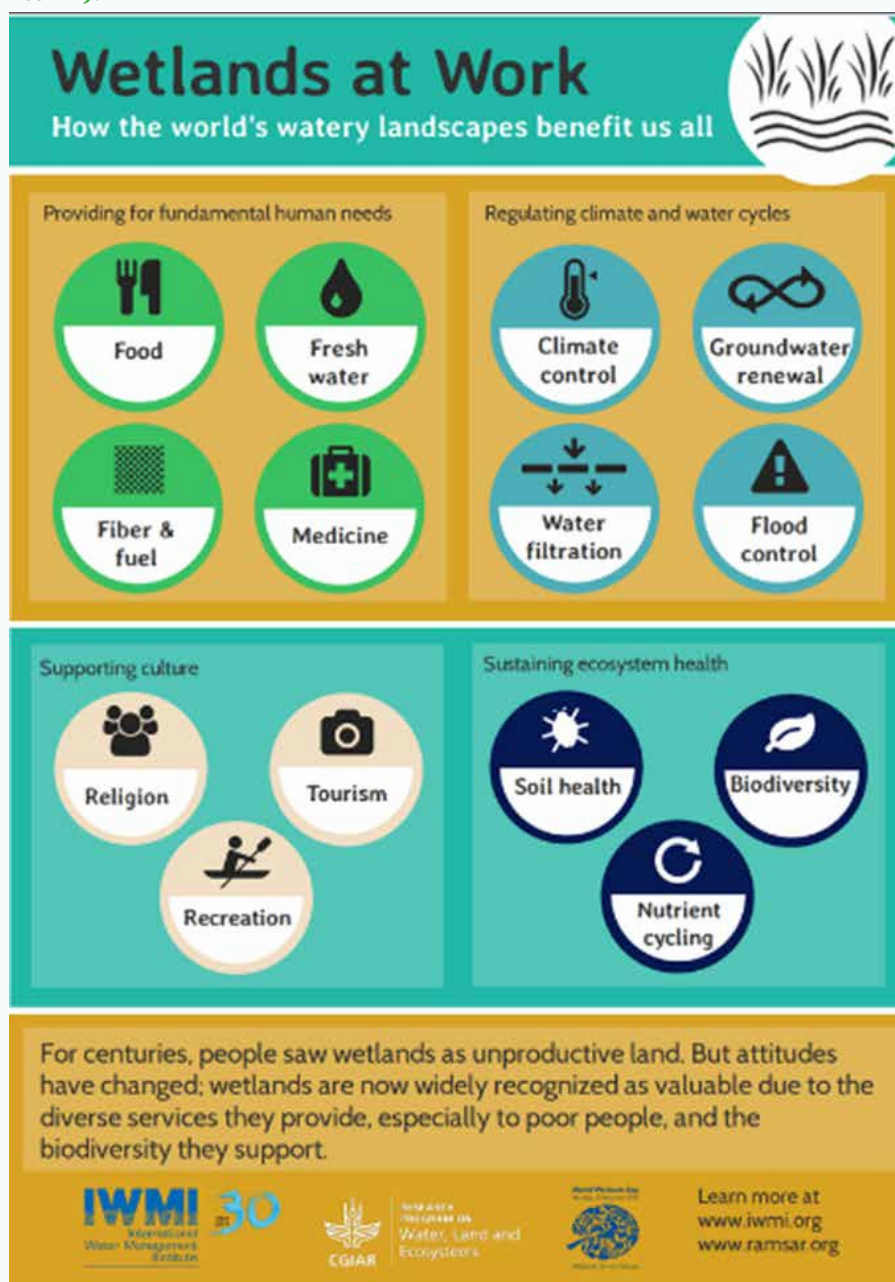


wetland landscape provides important social economic services to thousands of people living in Ituri Province of DRC and Ntoroko District of Uganda. The Semliki Delta's natural resources are harvested to provide food (mainly fish) and materials for construction and crafts, such as reeds and papyrus. In addition, the flat rift valley provides pasture, fodder and grazing grounds for livestock. Other important ecosystem services provided by the Semliki Delta wetlands include water filtration and purification, water buffering, protection against erosion, and cultural services (Figure 3).

In recent years, encroachment and unsustainable use of wetlands resources have become serious issues. The wetlands are being cleared to provide agricultural land to support the growing population. Deforestation, overfishing and other overuse of the natural resources are

also major threats to a landscape that is already vulnerable to climate change. Together, these threats not only have environmental consequences as habitats are destroyed and natural flooding regimes are disturbed, but also put the continuation and sustainability of the ecosystem services the wetlands provide at risk. Due to the transboundary nature of the wetlands, a transboundary approach is necessary to ensure the wetlands are sustainably managed, now and in the future.

Figure 3: Overview of ecosystem services of wetland landscapes (source: IWMI).



1.2 DIGESTION OF PREVIOUS PLANS AND PROGRAMS

Despite its immense importance for humans and the environment, and the constant threat of the fragile balance being lost limited attention and resources have been dedicated to Semliki Wetlands. Few surveys and studies were conducted in the past, and then especially focusing on the more easy accessible areas upstream and not on the delta itself. More recently, Bundibugyo/Ntoroko District on the Ugandan side has increasingly putting emphasis on the need to protect this important landscape, and the Ugandan Government commissioned the development of a Semliki River Catchment Management Plan, albeit not transboundary. Also attention for the

Semliki Wildlife Reserve has been rising, amongst other because external pressures on biodiversity are increasing. With an eye on current and future economic developments the international community supported the development of the Albertine Graben Sensitivity Atlas and the Lakes Edward and Albert Fisheries and water resources management Project (LEAF) Programs.

Bundibugyo (Ntoroko) District Development Plan 2015 -2019

The District Development Plan (DDPII) 2015/16 - 2019/20 for Bundibugyo (Ntoroko was part of this plan before becoming an independent district) is the second in a series of six five-year plans aimed at achieving the Uganda Vision 2040 and the District

Vision: “A healthy, productive, poverty free and resilient population to climate and disaster related risks by 2040” with a purpose of serving the community through coordinated delivery of services that focuses on national and local priorities and contributes to the improvement in quality of life in the District. It is now under review and the version 2020 - 2027 will be out soon. The district mission is: “to serve the community through coordinated delivery of services that focuses on national and local priorities and contributes to the improvement in quality of life in the District” and the overall goal of this Plan is to improve the quality of life of the people of Bundibugyo District, while protecting the environmental values of the area and ensuring sustainable exploitation of natural resources. The District acknowledges the national priorities like Prosperity for all, UPE and USE and Wealth Creation which has re-oriented its priorities to the NDP II (now under review to NDP III).

Semliki Catchment Management Plan - 2017

Status of the Catchment Management Plan (CMP): Finalized

Status of Catchment Management Committees (CMC): Present

The Semliki CMP is an integrated catchment plan that identifies issues that need urgent consideration, proposes mitigation strategies and identifies appropriate stakeholders and their roles. The CMP has a timeframe of 25 years (2017 to 2040) in which to achieve the objectives of integrated water and other resources management. A log frame for executing the CMP components, means of verification, stakeholder responsibilities and approximate costs are included. The plan has inbuilt mechanisms for monitoring and evaluating its implementation. This plan is an adjustable blueprint upon which other programs within in the catchment can be based.

The Semliki catchment management plan is delineated into two sub-catchments: 1) Mubuku/ Nyamwamba and 2) Lamia lower Semliki and identifies and proposes suggestions of the possible interventions using the integrated water resources management approach specific to two sub-catchments. In addition each of the two sub catchments is categorized into upper and lower sections. The plan takes into consideration the natural resources in the basin, their economic and tourism potential and identifies conservation threats from catchment wide processes. The proposed integrated approach to conservation will promote sustainable livelihoods, create new socio-economic opportunities, harness existing ones

and safeguard the conservation of the key natural resources. The plan proposes management strategies that take into account the natural ecological linkages, conservation objectives and needs in designated areas and highlights targeted research to guide natural resource management and overall conservation of the basin while ensuring sustainable livelihoods. The management structure for the CMP is Catchment Management Committee-CMC with a chairman for all the districts covered in the plan. For Semliki, the secretary of the committee is the DNRO Ntoroko. The CMC consists of 2 Female and 26 Male (MWE 2019).

In the financial year 2017/2018, catchment management intervention that took place within Semliki CMP was the training of WRUGs in River Bank Stabilization and Restoration of Degraded Watersheds in Karusandara that is Mubuku-Nyamwamba sub-catchment. The Albert Water Management Zone (AWMZ) has carried out riverbank stabilization along River Mubuku that is found in Mubuku Town Council, this involved community sensitization meetings, group formation, demarcation of river banks, and planting the demarcated area with bamboo and other environmentally friendly trees (MWE 2019).

Semliki Wildlife Reserve Sensitivity Atlas

The Environmental Sensitivity Atlas for Semliki Wildlife Reserve (SWR) was prepared to provide a tool for identifying the most sensitive areas at risk in the reserve, establish protection priorities, and identify timely and appropriate responses and clean-up strategies. Despite the growing importance of Semliki Wildlife Reserve, it is faced with pressure of development projects that have been proposed in and around it, including petroleum development, mining, hydropower production, road construction, transmission lines installations, and development of water gravity schemes, among others. These projects have potential to result in negative impacts that will compromise the integrity of the reserve. This Atlas is meant to be used as a guiding tool for decision making by all stakeholders on the placement of different development projects within the reserve.

The sensitivity analysis is based on information on various animal species specifying their distribution, breeding areas, and seasons and their critical habitats among others. It also considers physical, biological, and socio-economic aspects and determines the most sensitive areas in the reserve.

Albertine Graben sensitivity atlas

This was developed especially with the insight of the potential threats foreseen from the Oil & Gas

exploration activities in the area, which is rich in both Oil & gas and Biodiversity with the Semliki delta having four potential oil wells identified for exploration by 2010 (EA3 A to D). The overall objective of the Sensitivity Atlas was to “*display, identify and provide the ability to analyse the relative environmental sensitivities to oil spill and oil development within the exploration areas in the Albertine Graben region of western Uganda*”. The specific objectives as derived from the overall objective were; 1) to identify and protect: fragile land cover types; designated protected areas; endemic and threatened species; areas of high biodiversity; cultural, religious and historical sites; economic activities that could be negatively impacted by oil activities and; location and size of water courses; and 2) identify and preserve areas currently covered by vegetation but, which areas are susceptible to erosion; identify and locate permeable soils or areas with high ground water and shallow aquifers that could easily be contaminated by oil development activities; and also; identify fault lines and advise against major construction of major infrastructure such as, pipelines on fault lines in order to guide decision making.

LEAF II project - Lakes Edward and Albert Fisheries and Water Resources Management

The multinational Lakes Edward and Albert Integrated Fisheries and Water Resources Management (LEAF II)

Project is implemented nationally by Uganda and Democratic Republic of Congo on one hand through financing from the African Development Bank/Fund, and regionally by the Nile Basin Initiative (NBI)/ Nile Equatorial Lakes Subsidiary Action Program (NELSAP) on the other hand through financing from the Global Environment Facility (ADF Group, 2015). The Project’s objectives are poverty reduction and sustainable livelihoods of the basin community through (i) creation of institutional and legal framework (ii) promotion and enforcing sustainable fishing procedures and (iii) reversal of catchment degradation and promotion of sustainable use of fisheries and water resources.

The transboundary LEAF II project includes three components of: (i) Fisheries Resources Development and Management, (ii) Integrated Water Resources Management, and (iii) Project Management and Coordination. The project is being executed in the communities within the catchment area of on Lakes Edward and Albert, which are an integral part of the Nile Basin. The objectives and activities which emphasize alternative livelihoods with

linkages to environmental conservation and river bank restoration/protection. The Albertine basin Integrated fisheries and Lakes management plan development is in initial development stages of development. The programme will develop five Catchment Management Plans for the main Semliki River sub-catchments.

The sector goal of the LEAF II Project is poverty reduction and sustainable livelihoods for local fishing communities through effective control and management of Lakes Edward and Albert (LEA) Basin water and fisheries resources and the protection of its environment. Uganda government – Albert Water Management Zone (AWMZ) - MoWE has zonal offices and the one for AWMZ is located in Nyabukara, Fort Portal.

Previous studies include:

1) the Thematic Sub-Plans Report (2018), a LEAIBMP study which aimed at developing an Integrated and Sustainable development and management of the water, fisheries and allied natural resources of Lakes Edward and Albert Basin (LEAB);

2) the Situation Analysis Report (LEAIBMP) conducted by NELSAP in 2018, a report that gives a critical view of topical areas relevant to the development of a wetland management plan like Watershed and Wetland Management, Water Resource Management Planning, Basin-wide water balance and International and Transboundary cooperative arrangements, institutions, and agencies in place relating to governance of natural resources. The study also conducted stakeholder identification and mapping which will also be very useful in the current planning process;

3) the Fisheries Management and Development Processes in Lakes Edward and Albert, a study on developing a Fisheries Management Plan within the Framework of the Integrated Lakes Management Plan as reported by the African Union Interafrican Bureau for Animal Resources (AU-IBAR 2016);

4) the Lakes Edward and Albert Fisheries (LEAF) Pilot Project, which was executed between 2004-2006 in name of the Nile Basin Initiative Secretariat (NBI-Sec) with the objective to develop a sustainable plan for the joint management of the water and fisheries resources of Lakes Edward and Albert (NBI-Sec 2003).

During the Financial Year 2018 / 2019, harmonization of fisheries legislation and regulation was completed and a Bilateral Agreement between Uganda and DRC on the Fisheries Management and Development

was signed. The development of the Lakes Edward and Albert Integrated Basin Management Plan was completed inclusive of the Institutional and Financing Arrangements. Also activities were undertaken to enhance water quality and quantity monitoring and to improve access to water and sanitation within the lake's basin (MWE 2019 and NELSAP 2019).

TEEB study for Semliki Delta

Currently, The Economics of Ecosystems and Biodiversity (TEEB) study is being undertaken for Semliki Delta (NBI 2019b). This TEEB study is coordinated by the Nile Basin Initiative (NBI) and has the goal of raising awareness about the importance of wetland ecosystem services to regional, national, sectoral and local-level development processes. It seeks to build the economic case for wetland conservation and wise use, with a specific focus on generating evidence on the economic value of wetlands as 'green' water infrastructure. By doing so, it intends to bring wetland ecosystem values to the attention of river basin planners and managers, and thereby promote better-informed, more effective, inclusive, equitable and sustainable conservation and development decision-making in the Nile River Basin. To this end, NBI seek to conduct a TEEB study for the Semliki Delta wetland landscape which will help in supporting basin planning and investment agenda into the conservation and sustainable use of the wetland for sustainable provision of the ecosystem services for the local economies of Ituri Province in DRC and Ntoroko District in Uganda, and reduction in biodiversity loss. A presentation about the TEEB study in progress was attended during the NBI workshop in Nairobi on November 23rd 2019, and a draft version of the TEEB study (NBI 2019b, December 2019) was consulted for harmonization with this Monograph; see chapter 3.2 on Ecosystem Services.

1.3 MONOGRAPH PURPOSE AND DEVELOPMENT APPROACH

Recognizing the importance of wetlands locally as well as within the larger Nile Basin and the scale of the challenges the wetlands face, the Nile Basin Initiative launched a project to pave the way and create drivers to improve governance, promote conservation and sustainable livelihoods in the Semliki landscape, as well as two other transboundary wetlands. This project builds upon other plans and programs that have been active in the area, which directly or indirectly involve the wetlands.

This project comprises of four integrated components that build on each other:

1. **Wetland Monograph:** Establish the physical context, biodiversity and ecosystems, policies and institutions, socio-economics and livelihoods, and social dimensions where key development aspects that inform wetland management planning will also be addressed;
2. **Wetland Management Plan:** Builds on the monograph and incorporates existing utilization, social and cultural values; stakeholders involved and power mapping; existing and potential impacts or threats; to develop a strategy to reverse degradation, enhance conservation and promote livelihoods consistent with wetland protection and restoration.
3. **Conservation Investment Plans (CIPs):** Many environmental management plans often have excellent situation analysis including causes and threats to ecosystems from human, environmental or climate issues, but fail to clarify the economic value or propose sources of funding. CIPs expound on the economic benefits and detail the financial outlays economic benefits that can be derived from implementation of management actions; presented as investment packages to attract public, finance and private institutions.
4. **Early Investment Projects:** In the last 30 years, many environmental studies have been taking place within the Nile Basin, mobilizing stakeholders and communities. To ensure there is sustained interest and demonstrate potential of the CIP portfolios, this project with local stakeholders and communities is preparing readily implementable priority actions that promote ecosystem conservation through sustainable livelihoods.

In order to develop successful and sustainable management and investment plans, it is crucial to understand the environmental and socio-economic system of the wetland landscape and the main threats it faces. Therefore, the first step and cornerstone of this approach is the Wetland Monograph, which serves as the baseline and reference for the Semliki Wetland Management and Conservation Investment plans.

This monograph presents an overview of the landscape within which the wetland system is located. The study was largely based on consultations with technical officers, community representatives, local administrative and political leadership and other social actors including civil society were held

in January, April and July 2019 with the aim of coming to a common and detailed understanding of the different dimensions of the wetlands system. The data collected during these consultations was supplemented with exhaustive studies of existing literature, openly available global datasets, and field visits.

1.4 OUTLINE OF THE MONOGRAPH

This monograph presents a comprehensive overview of the Semliki Delta wetland landscape.

Chapter 1 gives an introduction and overview of the landscape within which the wetland system is located. A description of the physical landscape, including topography, geology and soils, the hydrology and water resources, and the land use and land cover, as well as the current climate and expected climate change and how these influence the wetland, as well as the land use and cover, is described in Chapter 2. Chapter 3 focuses on the biological diversity and

the ecosystem services the wetlands provide. The institutional context, main actors, policies and legislation are described in Chapter 4 at global, regional, national and local levels. This chapter also cover the protected areas and natural resources management. The socio-economic and livelihood system is presented in Chapter 5, describing the main livelihoods such as pastoralism and crop production, forestry, fisheries, trade and eco-tourism. Chapter 6 provides an overview of the social dimension of the wetland landscape, focusing on human demography, social organizations, WASH and public health. An overview of the main challenges the wetland landscape faces are presented in Chapter 7. Finally, the most important conclusions of the monograph are presented in Chapter 8.

The monograph is supplemented by maps, obtained from a variety of regional, NGO and government institutions, which were updated with more recent remote sensing data, and photos and observations taken on the ground during the field missions.

2.1 LOCATION AND DELINEATION OF THE WETLAND LANDSCAPE

The Semliki Delta wetland landscape is located in the East African Rift Valley on the southern shore of Lake Albert. The Semliki Delta lies across the boundary of the Democratic Republic of Congo (Ituri Province) and Uganda (Ntoroko District). Fort Portal lies approximately 40 kilometers south of the project area. The Virunga and Semliki National Parks are located to the southwest. See Figure 1 and for more detail the *Administrative Boundary Map in Appendix A*.

The western boundary of the Semliki Delta wetland landscape is defined by the bottom of an escarpment and the Semliki River. In the north and west, the project area is bounded by Lake Albert. In the south, the boundary includes the influence area of the Nyanjakufa branch of the Semliki River. Note that the project area extends one kilometer into Lake Albert to account for seasonal changes in the shoreline and more long-term effects of erosion and sedimentation. In previous plans and programs (see chapter 1.2), the focus was on a more regional scale, focusing on the Semliki river catchment or on the Lake Edward and Lake Albert region as a whole. The focus of this monograph is on the final stretch of River Semliki alone, characterized by the wetland landscape around the river delta.

The total study area, including the wetlands and their area of influence, covers approximately 830 square kilometres and is located between latitude 1.31 and 0.98 °N / longitude 30.21 and 30.53 °E.

2.2 TOPOGRAPHY, GEOLOGY AND SOIL

2.2.1 Topography and geomorphology

The Semliki Delta wetland landscape is located in the Albertine Rift and the delta area is very flat with an altitude between 620 to 630 meter above mean sea level (m amsl), making it the lowest point in Uganda. The escarpment bordering the west side of the Semliki Delta rises up to more than 1,700 m amsl and this raised mountain block (or: Horst) is located in the DRC. On the east side of Semliki Delta, the low-lying Albertine Rift valley floor (or: Graben) continues for another 20 km eastwards at an altitude of around 650 m amsl before rising up to 1,300 m amsl at the eastern escarpment, located in Uganda. See Figure 1 and for more detail *the Elevation Map in Appendix A*.

The Semliki river is 140 km long in Uganda and the

DRC and flows between Lake Edward (913 m amsl) and Lake Albert (619 m amsl). Semliki's headwaters drain the western and northern part of the Rwenzori Mountains, that dominate the topography of Semliki river basin. The mountain range is about 120 kilometres long and 65 kilometres wide and comprises six massifs separated by deep gorges. There are six peaks in excess of 4,600 m amsl, the highest point being Mount Stanley (5,109 m amsl).

The main channel of Semliki river meanders in the flat Albertine Rift valley floor, with a river bed of ca. 100 m wide, but is 200 m wide at the intake point at Lake Edward. The upper reaches of river Semliki's tributaries flow in narrow V-shaped valleys bordered by steep slopes and with a steep gradient. The main stem river has a much lower gradient, and in the lower section Semliki river meanders heavily. Alterations to the watershed (like overgrazing) have caused river bank erosion and frequent changes to the course of the meandering lower reaches of the river, forming oxbow lakes in some places. Over its last reach, the river branches into a delta-shaped wedge of which the side branches (like River Nyanjakufa) or distributaries only fill up for several months a year during high flow. Silt from the Semliki is gradually filling in the southern end of Lake Albert.

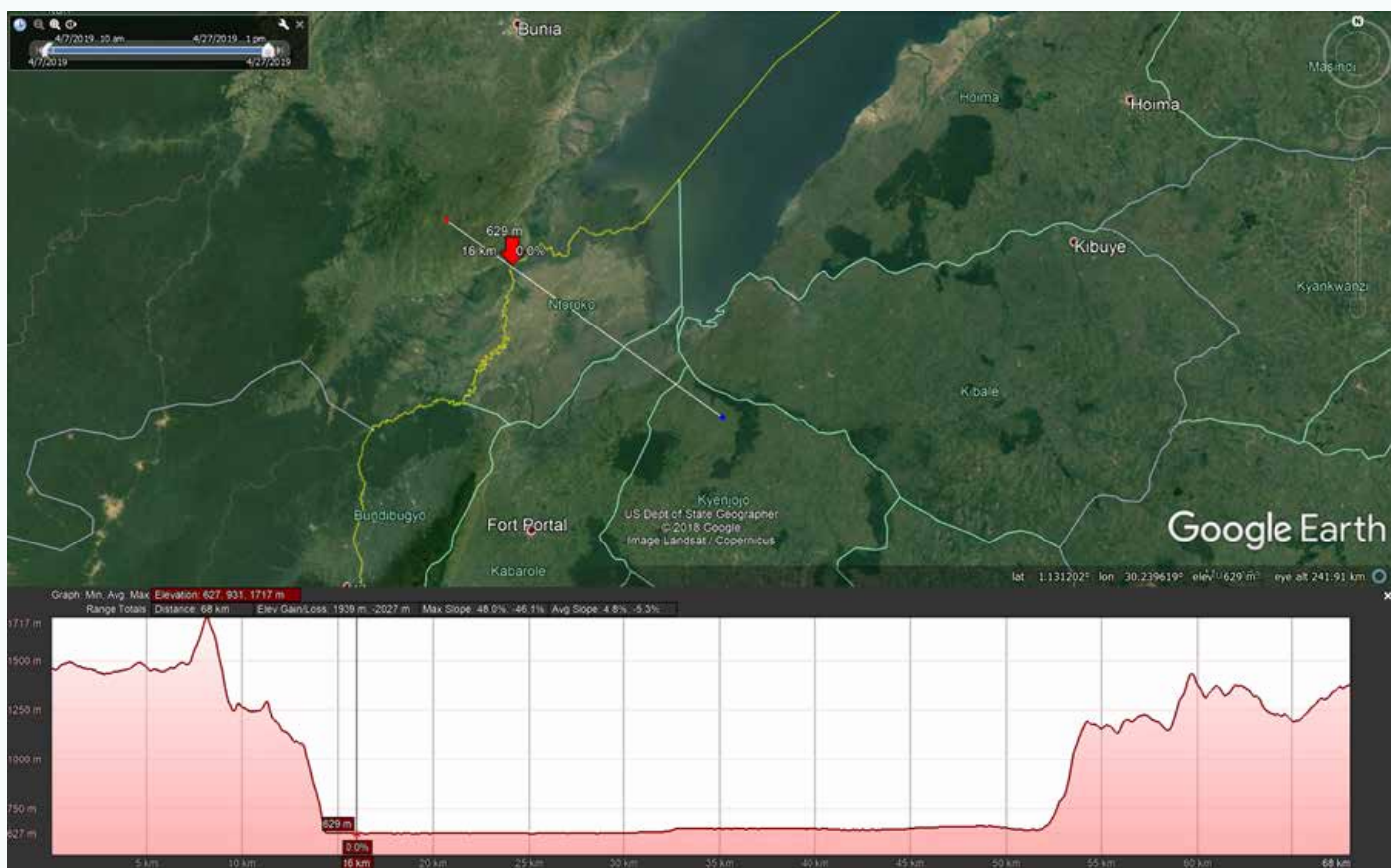


FIGURE 4: SEMLIKI DELTA LOCATED WITHIN THE ALBERTINE RIFT VALLEY FLOOR

2.2.2 Geology and soils

The geology of Semliki Delta is characterized by thick layers of consolidated and unconsolidated rift valley sediments, covered by fluvial-deltaic and lacustrine sediments, consisting of silts and sands where gypsum and clays have been deposited along bedding planes and along vertical fractures (see the *Geological Map in Appendix A*).

The Semliki Delta is located in the Albertine Rift Valley, which is the western branch of the East African Rift, a geological fault system of East Africa and southwest Asia, extending 4,830 km from northern Syria to central Mozambique. The Albertine Rift Valley and the surrounding mountains are the result of tectonic movements that are gradually splitting the Somali Plate away from the rest of the African continent (crustal stretching). The mountains surrounding the rift, like the Rwenzori Mountains, formed about three million years ago in the late Pliocene epoch and are the result of an uplifted block of crystalline rocks including gneiss, amphibolite, granite and quartzite. This uplift divided the paleolake Obweruka and created three of the present-day African Great Lakes: Lake Albert, Lake Edward, and Lake George. These lakes were formed by intensive rifting in the geological past, which created depressions that were later filled with water.

The Semliki Delta is located on the valley floor of the Albertine Graben with a distinct escarpment on each side (Figure 4). The Albertine Graben is produced from parallel normal faults, where the displacement of the hanging wall (on which Semliki Delta is located) is downward, while that of the two footwalls (horst) is upward, creating two escarpments and producing a rift valley. The total displacement along these normal faults has been several kilometres. The graben has been filled up with sedimentary deposits of several kilometres thick, consolidated sediments from Pleistocene age covered by unconsolidated Quaternary sediments (see the *Geological Map in Appendix A*). The structural styles and faulting generally trend in NE-SW or NNE-SSW. The faulting comprised in the graben is highly segmented, separated by relay ramps and accommodation zones. Because of the segmented faulting, the sequence from metamorphic basement rocks to consolidated sedimentary rock to unconsolidated sediments can be seen on the edge of the graben along the road from Fort Portal to Bundibugyo (Figure 5).



FIGURE 5: OUTCROPS OF BANDED GNEISS (PHOTO LEFT) AT THE HIGH PART OF THE ESCARPMENT AND OF CONSOLIDATED SEDIMENTARY ROCK (RIGHT) AT THE LOWER PART OF THE ESCARPMENT, AS SEEN ALONG THE ROAD FROM FORT PORTAL TO BUNDIRUGYO. LEFT PHOTO LEFT TAKEN AT LAT: 0°43'25.54"N / LON: 30°11'23.56"E / ALTITUDE 1561 M; RIGHT PHOTO TAKEN AT LAT: 0°55'08.14"N / LON: 30°14'38.24"E / ALTITUDE: 769 M.

The stratigraphy of the Semliki river basin has been characterized by generations of sedimentary cover, erosion, volcanic activity and rift faulting. Hence, the geology of the Semliki river basin is very heterogeneous and includes consolidated and unconsolidated rift valley sediments, gneisses and argillites, as well as volcanic rocks alongside cones and craters around the Lake Edward and George region. The Semliki river has built up a considerable alluvial plain, and the stratigraphy at Semliki Delta dominantly comprises fluvial-deltaic and lacustrine deposits, consisting of silts and sands. Gypsum and clays have been deposited along bedding planes and along vertical fractures.

The Rwenzori region is the most seismically active region in Uganda and also one of the most seismically active zones in the East Africa Rift System and is bounded by steep active normal faults. Most famously, the 1966 Toro earthquake struck with a magnitude of 6.8 causing 157 deaths and extensive damage including landslides.

The Rift Valley sediments in the Semliki Delta wetland landscape are characterized by phaeozem (PH) soils along the main course of River Semliki and solonchak (SC) soils further away from the river at the eastern and southern part of the study area ([Soil Map in Appendix A](#)).

Solonchak is a pale or grey soil type found in poorly drained conditions (Figure 6) that are saline due to high content of sodium and of magnesium. Solonchaks are formed from saline parent material under conditions of high evaporation, encountered typically on the rift valley floor (a closed basin)

with a warm to hot climate and a well-defined dry season. Solonchaks are defined by high soluble salt accumulation within 30 cm of the land surface and by the absence of distinct subsurface layering, except possibly for accumulations of gypsum, sodium, or calcium carbonate or layers showing the effects of waterlogging. Owing to their high soluble salt accumulations, these soils are only suitable for extensive grazing or would require extensive irrigation and drainage if they are to be used for agriculture. The presence of Solonchak soil type in parts of Semliki Delta is an indication that locally deposits of gypsum or calcium carbonates are present in the subsoil. This explains the highly mineralized groundwater that has been observed in parts of Kanara subcounty, which gives rise to corrosion and borehole breakdown.

A phaeozem is a dark soil with a high base status (high in base-forming cations, with relative high pH) that are typically found in grassland plains (Figure 6). Phaeozems are characterized by a humus-rich surface layer covered with abundant grass vegetation. They are highly arable soils and are used for growing wheat, soybeans, and pasture for cattle, as seen along River Semliki. Phaeozems have a high content of available calcium ions bound to soil particles, resulting in a very permeable, well-aggregated structure. Semliki Delta's humid climatic conditions (with an average of around 900 mm of rainfall per year), results in the absence of calcium carbonate or salt accumulation in (shallow) subsurface layers.



FIGURE 6: SPARSELY VEGETATED FLAT RIFT VALLEY FLOOR WITH GREY SALT MARCH SOILS (SOLONCHAK SOIL TYPE) NEAR LAKE ALBERT (PHOTO LEFT), AND COWS GRAZING IN THE GRASSLAND PLAINS WITH BORASSUS PALMS ALONG RIVER SEMLIKI WITH TYPICAL DARK PHAEZOM SOILS (PHOTO RIGHT). LEFT PHOTO TAKEN AT LAT: 1°07'39.32" N / LON: 30°28'26.11" E / ALTITUDE 620 M; RIGHT PHOTO TAKEN AT LAT: 1°01'48.42" N / LON: 30°13'42.68" E / ALTITUDE 623 M.

Borehole drilling reports (Mazzi, 2018 and GIC, 2018) and geophysical survey reports (Scan, 2018) provided by the District Water Officer of Ntoroko District give some insight in the type of alluvium present in the upper 60 m of Semliki Delta. A borehole in Nyakasenyi village of Butungama subcounty of 40 m depth shows black sandy clay in the upper 13.4 m, followed by fine to coarse sands to 22.6 m and sandy clay with gravel particles to 41.0 m depth. Two vertical electric soundings (VES) performed in Kamurabara village and Nyakasenyi village of Butungama subcounty show very low apparent resistivities (<10 Ohm.m) at depths below survey depths (ab/2) of 40 m, indicating the presence of clay layers and/or saline groundwater.

Wetland soil fertility and agriculture

The wetland soils found along River Semliki and its side branches (phaezom soils) are characterized by a relatively high soil fertility and high soil moisture and therefore is used more and more for agriculture. This is in contrast to the overall low soil fertility of the brackish solonchak soils (Soil Map in Appendix A). The use of wetlands for agricultural purposes has been known for decades. This is because of their fertile soil, which comes as a result of the regular sediment deposition when flood events take place. Wetland soils also have a high water holding capacity due to high organic compounds and high moist conditions due to high groundwater table and/or nearby presence of surface water. Wetland soils support vegetation which are adapted to the wet conditions. Carbon is the major nutrient cycled within wetlands. Most nutrients, such as sulphur, phosphorus, carbon, and nitrogen are found within the soil of wetlands. Anaerobic and aerobic respiration in the soil influences the nutrient cycling of carbon, hydrogen, oxygen, and nitrogen,

and the solubility of phosphorus thus contributing to the chemical variations in its water. The use of wetland area for agricultural purposes is one of the main drivers of wetland encroachment taking place in Semliki Delta. This is enhanced by unsustainable land use management, which forces farmers to leave their plots after a few years.

2.3 HYDROLOGY AND WATER RESOURCES

2.3.1 Meteorology

The Semliki Delta is located on the Albertine Rift valley floor which receives an average of about 900 mm per year of precipitation based on the Hazards group InfraRed Precipitation with Station data (CHIRPS) dataset (Funk et al. 2015). This is significantly less than the amount of precipitation that the high parts of the rift valley receive. Based on data from the Moderate Resolution Imaging Spectroradiometer (Mu et al. 2011) averaged over 2001 – 2018, evaporation varies considerably within the study area. Evaporation rates in the grasslands in the south are between 350 and 500 mm per year, compared to 600 – 1000 mm per year in the north where there is more forest cover. The rainfall has a seasonal pattern with a first rainy season between March and May and a second rainy season between August and December. During periods of heavy rainfall, the flat plains of the rift valley floor inundate quickly due to poor drainage (Figure 7). At places with natural vegetation, the water infiltration relatively quickly, but areas with many cattle and human presence remain inundated for longer periods of time due to soil compaction, as was observed on 14 April 2019 in Rwebisengo town (Figure 7).



FIGURE 7: TOTAL ANNUAL RAINFALL IN THE RIFT VALLEY FLOOR IS LOW, BUT HEAVY RAINS OCCUR REGULARLY, INUNDATING THE POORLY DRAINED FLAT PLAINS ALONG RIVER SEMLIKI (PHOTO LEFT). RWEBISENGO TOWN REMAINS INUNDATED UP TO SEVERAL HOURS AFTER HEAVY RAINFALL (PHOTO RIGHT). LEFT PHOTO TAKEN AT LAT: 0°59'20.20"N / LON: 30°17'09.34"E / ALTITUDE 635 M; RIGHT PHOTO TAKEN AT LAT: 1°02'58.49"N / LON: 30°16'21.26"E / ALTITUDE 628 M.

2.3.2 Surface water

River Semliki

River Semliki (sometimes written as Semuliki) drains Lakes George & Edward found in the rift valley and the high rainfall area of the Rwenzori Mountains on the Uganda/DRC border and the Nyamulagira mountains in the DRC. The Semliki river is the largest river in the Albert Water Management Zone (AWMZ), and along its 140 km course in the Albertine Rift Valley a series of tributaries join it before draining into Lake Albert. It has major wetland systems associated with its river delta in Lake Albert. The Edward-George basin receives significant runoff from the Virungas, Rwenzori and western rift escarpment. The outflow forms the Semliki River which is fed by additional runoff from both rift flanks before entering Lake Albert. Over its last reach, the river branches into a delta-shaped wedge of which the side branches (like Nyanjakufa river) only fill up for several months a year during high flow. Discharge at the Semliki delta represents ca 10% of the total inflow into Lake Albert (Hurst, 1952; Shahin, 1985).

Water levels were recorded at the gauging station in River Semliki (Surface Water Station 85205 of AWMZ) on a daily basis (Figure 8). However, the gauging station in River Semliki is not operational anymore since 2012. This was confirmed by the AWMZ who says the LEAF II project intends to reinstall the gauging station but this has not (yet) happened.

Discharge data is available for the period 1950 – 2011, with a multi-year gap between 1979 and 2006. In the earlier period, there is strong seasonality and interannual variability, with annual low flows varying

between 50 and 150 m³/s and annual high flows between 200 and nearly 500 m³/s. After this gap period, the discharge measurements are significantly lower (factor 3) than in the earlier period. Though it is possible that the flow characteristics changed over this period, it is most likely that relocation of the measurement scale and improper adaptation of the rating curve contribute to the seemingly drastic change in discharge.

However, not only the values of the flow regime are different between the earlier and later periods of record. Generally, the seasonal pattern of discharge matches the seasonal pattern of rainfall, with a first rainy season between March and May and a second rainy season between August and December. However, the seasonal pattern of discharge varies between the two periods of record, as the discharge peak in May observed in in 1950 – 1978 is no longer visible in the latter period of 2007 - 2011 (Figure 9). Also, the discharge peak of the second rainy season is earlier in the latter period compared to the earlier period.

In the community and district level meeting in Ntoroko District (Wetlands International 2019b) it was mentioned that “flooding of the Semliki river usually happens in the dry season and this extra water can be harnessed for use.” This does not correspond to the monthly average discharge of River Semliki (Figure 9) which shows the highest discharge (and thus the highest change of flooding) during the rainy season.

FIGURE 8: DAILY DISCHARGE OF RIVER SEMLIKI, BASED ON DAILY WATER LEVEL MEASUREMENTS AT GAUGING STATION #85205 IN THE PERIOD 1950-2011.

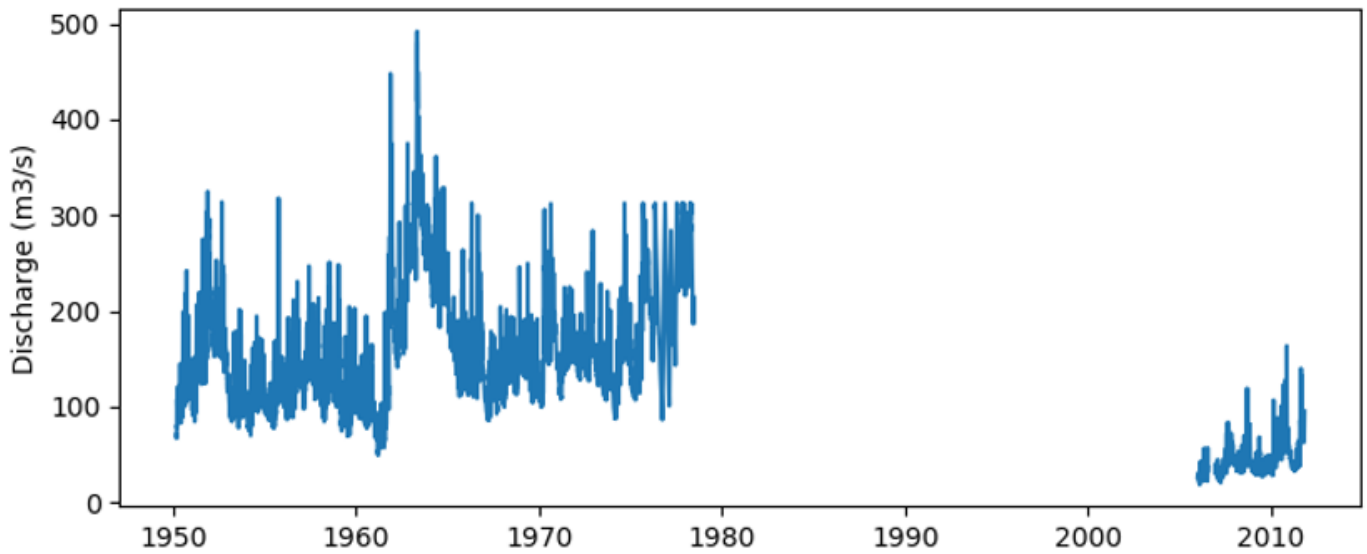
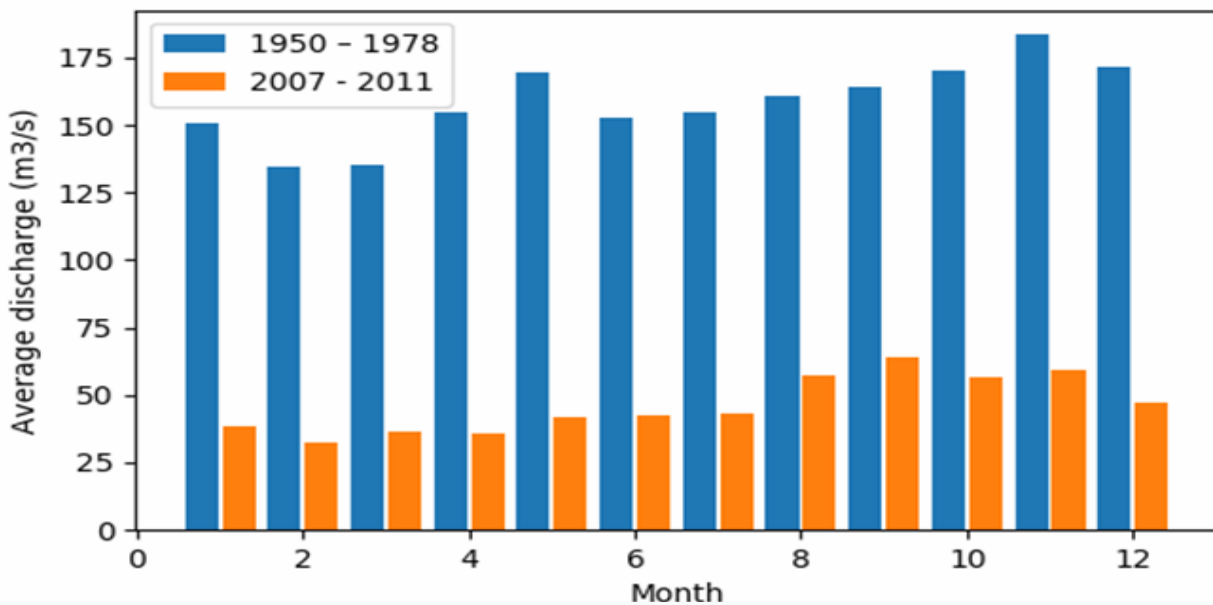


FIGURE 9: SEASONAL PATTERN OF DISCHARGE OF RIVER SEMLIKI, PRESENTED AS MONTHLY AVERAGES OVER THE YEARS 1950 - 1978 AND 2007 - 2011.



The River Semliki is geopolitically important because it defines the border between Uganda and the DRC. The river has enormous erosive power which is realized when it emerges from the forested Semliki National Park onto the Semliki flats in Rwebisengo subcounty, Bundibugyo District. The river is in its old stage, and has characteristic meanders and forms oxbow lakes in some places, which is a very natural process. However, overgrazing, land degradation and other alterations to the watershed due to human and livestock activities have increased river bank erosion in recent decades. This has resulted in frequent changes to the course of the meandering lower reaches of the river (Figure 10). In some places, Uganda is

losing up to 10 metres of land per year on its side of the river to erosion, and silt from the Semliki is gradually filling in the southern end of Lake Albert. In other places, it is the DRC that is losing territory as the changing river course alters the apparent location of the border.

The problem with this is the loss of infrastructure, border disputes and clashes over land ownership. For instance, there are reports of Ugandans crossing the river to cultivate what used to be ‘their land’ and which now lies in the DRC, and in Rukoro village, Rwebisengo subcounty a telecommunications relay mast which 9 years before was located at a distance

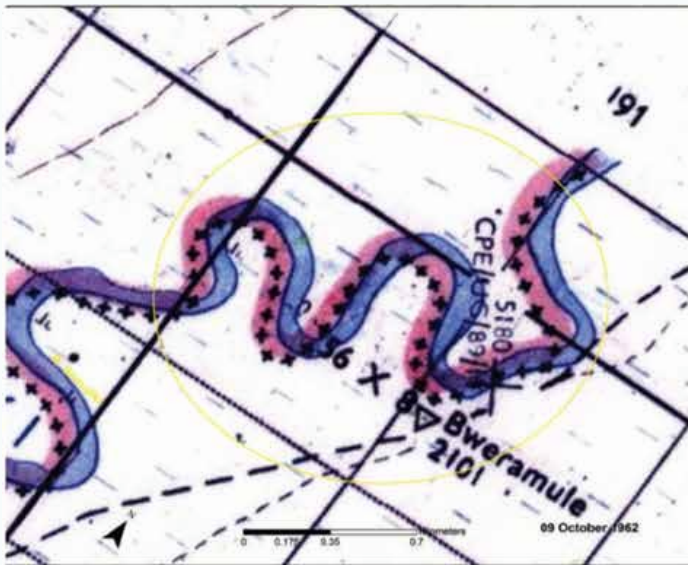


FIGURE 10: IMAGES SHOWING THE CHANGING RIVER COURSE ALTERING THE APPARENT LOCATION OF THE BORDER OF THE RIVER SEMLIKI AT BWERAMULE, NTOROKO DISTRICT, BETWEEN 1962 AND 2016. SOURCE: UGANDA WETLANDS ATLAS - VOLUME TWO, GOVERNMENT OF UGANDA (2016)

of 3 km from the river had been washed away by July 2014 (Uganda Wetlands Atlas – Volume Two, Government of Uganda, 2016).

High population density and exploration for oil has led to significant investment and urban development, for instance in Rwebisengo town which is only 1.5 km from the river bank. The accompanying demand for firewood, building poles and other forest resources have led to a loss of tree cover and shortage of tree resources with great degradation in the catchment. Along cattle watering points rampant, random and intensive cattle trampling on the fragile river banks has resulted in erosion and destabilized riverbanks (Figure 11).

The potential impacts of the complete loss of the Rwenzori glaciers, expected to occur within the next few decades (Taylor et al., 2006), on river discharge is unclear. Discharge data collected at 4,000 m elevation from the Mubuku River suggests that glacial melt may contribute significantly to dry season flow (Kaser & Osmaston, 2002), thereby decreasing the amplitude of seasonal changes in high elevation river discharge. However, the water inputs from glacial melt to Rwenzori rivers likely becomes insignificant relative to precipitation at lower elevations (see also [Explainer 1](#)).



FIGURE 11: RIVER SEMLIKI AS SEEN ON THE LANDING SITE NEAR BURASI (DRC) AND RWEBISENGO (UGA), WHERE CROSS-BORDER TRANSPORTATION IS PROVIDED BY SMALL BOATS (PHOTO LEFT) AND SEVERE RIVER BANK EROSION WAS OBSERVED ON THE EASTERN RIVER BANK (PHOTO RIGHT). BOTH PHOTOS TAKEN ON APRIL 15TH 2019 AT LAT: 1°01'47.98"N / LON: 30°13'42.29"E / ALTITUDE 640 M.



FIGURE 12: RIVER NYANJAKUFA IS A SEASONAL RIVER WHERE NO FLOW WAS OBSERVED ONLY STAGNANT WATER (PHOTO LEFT) BUT THE FIVE BIG CULVERTS UNDERNEATH THE ROAD (PHOTO RIGHT) SUGGEST HIGH FLOW WHEN THIS SIDE-BRANCH OF RIVER SEMLIKI IS ACTIVE DURING HIGH WATER LEVELS. BOTH PHOTOS TAKEN ON APRIL 15TH 2019 AT LAT: 1°01'23.73"N / LON: 30°17'30.70"E / ALTITUDE 635 M.

River Nyanjakufa

Over its last reach, Semliki river branches into a delta-shaped wedge with several side branches, of which Nyanjakufa river is the most noticeable one. The Nyanjakufa is a seasonal river discharging water only during high flow of Semliki River, reported to be around three months per year. The bridge crossing the river has 5 culverts of 1.5 m diameter each (Figure 12), and high water marks up to 2.5 - 3.0 m above the (dry) river bed, clearly indicating the big volume of water flowing through this riverbed seasonally.

Lake Albert

Lake Albert is the northernmost of the chain of lakes in the Albertine Rift, the western branch of the East African Rift. The lake is around 160 km long and 30

km wide and has a maximum depth of 51 m. It has a surface area of 5,400 km² with a surface elevation of 619 m amsl. The Semliki River drains into Lake Albert in the southern, whilst Lake Albert connects the Kyoga Nile with the White Nile in the most northern point of the lake.

The main inflow to Lake Albert is the Victoria Nile (73%) but other rivers feeding the lake from the Uganda side include the Semliki (11%), Muzizi, Nkusi, Wambabya and Waki. Most of the water into the lake is through river flow, which contributes about 45,160 m³/year followed by rainfall (5,198 m³/year) and the loss is mainly through the river outflow (36,875 m³/year) followed by evaporation (13,093m³/year). Rainfall around the lake ranges from 600 mm in the rift floor to 2000 mm in the mountains. The

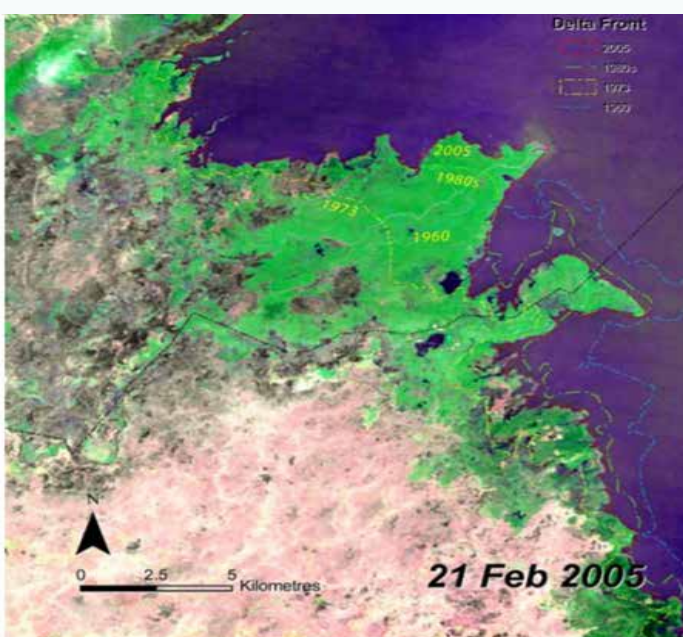
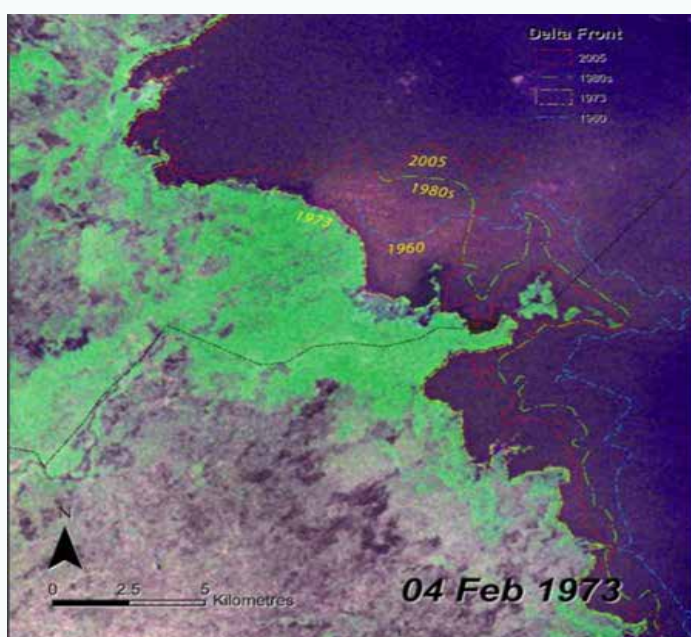


FIGURE 13: EXPANSION AND SHIFTING OF THE SHORELINE AT SEMLIKI DELTA DUE TO INCREASED SILTATION OF LAKE ALBERT. SOURCE: NEMA 2009

monomictic lake mixes from top to bottom during one mixing period each year, in August, and is stratified in March (LEAF II, 2018).

The river inflows with their nutrients, silt and organic matter are associated with extensive development of aquatic macrophytes that promote breeding and nursery grounds for many species of fish. Silt from the Semliki is gradually filling in the southern end of Lake Albert, the expansion and shifting of the Semliki Delta shoreline due to increased siltation of Lake Albert can be seen on satellite imagery (Figure 13).

2.3.3 Ground water

The Semliki Delta consists of tens to hundreds of meters of alluvial unconsolidated deposits, underlain by hundreds to thousands of meters of consolidated sedimentary rocks. The alluvial infills and lacustrine deposits produce an almost continuous aquifer, whereas the yield depends on the transmissivity of the sediments. Fluvial beds within the lacustrine deposits present the best yields.

Rainfall both on the escarpment and valley bottom recharges the aquifer in the rainy season. It is in turn discharged to River Semliki. In the dry season, the aquifers in the valley bottom are recharged by the Semliki and its drainage system. The flat terrain dictates that the hydraulic gradient within the valley bottom is gentle and consequently groundwater flow is low, even during the rainy season.

During the field mission of April 2019, the groundwater table was measured in three open wells at a depth of 2.5 to 3.3 m below ground level. This shallow groundwater table was also observed in a deep borehole in Butungama subcounty where a Static Water Level (SWL) of 3.5 m prior to test pumping was recorded (Geo-Koy, 2018). With a discharge of 5 m³/hr the drawdown was only 5.5 m, showing good aquifer properties at the screen depth between 14.5 and 37.7 m (GIC, 2018). In Kibuuku village, located south of Semliki Delta and a bit more upstream, SWL's was reported of 7.3 and 7.6 m bgl (Geo-Koy, 2018). This suggests that groundwater is flowing generally northwards.

Boreholes in Ntoroko District are generally drilled up to depths of 40 m to maximum 60 m (GIC, 2018), hence not much is known about the deeper groundwater. Sands with gravel particles are generally found at depths ranging between 15 m to 40 m and 30 m to 60 m, with water strikes observed during drilling at 15 m, 24 m and 40 m depth. Estimated yields during drilling range between 10 and 12 m³/hr, while test pumping has been performed with yields between 5 and 6 m³/hr.

Based on the limited available information of the Ntoroko District Water Officer, current borehole siting and drilling programs focus solely on groundwater in the upper 60 meter. Based on the hydrogeology of the area, deeper groundwater in granulated and fractured aquifers is expected up to several hundreds of meters depth, but this has not been explored so far.

According to anecdotal evidence, groundwater levels in Semliki Delta are going down in recent years (Local and District level meeting; Wetlands International 2019b). A “drought for 7 years” resulting in “we do no longer find water when digging wells” has been reported, as well as a “reduction in wetland water level due to unsustainable abstraction of water for various uses especially domestic and agricultural/livestock use.”

Unfortunately, no measurements of groundwater level are available to confirm these observations. Changes in land use and overgrazing, as a result of population pressure and mismanagement are the likely cause for a local fall in groundwater tables, as removal of vegetation and compaction of soils reduces the infiltration capacity and hence the recharge of groundwater. Community members also fear that “oil exploration activities in Lake Albert have caused lowering of the water table” but this claim is unfunded.

The Sector Performance Report 2019 of the Ministry of Water and Environment of Uganda refers to a ‘research paper’ in which “*Groundwater and surface water level observations for Rwebisengo monitoring station and River Semuliki that is approximately 100 m away from the monitoring station were analyzed*” (MWE 2019). Unfortunately, this research paper (Guma et al., 2019) is not included in the references and can also not be found online. According to the SPR 2019, the time series analysis of the groundwater, rainfall and surface water level observations from April 2009 to November 2011 reflect an interconnected hydrological system in which river stage and groundwater level co-vary in response to bimodal rainfall (MWE 2019).

2.3.4 Water quality

The quality of surface water and groundwater can be affected by natural conditions such as geology as well as human activity. River Semliki and ultimately Lake Albert are the final recipient of human and municipal wastes and eroded soils from natural and human-initiated processes within the Semliki river basin, and hence are vulnerable to contamination. The general water quality within Semliki Delta is

overall good, especially the groundwater resources which are less vulnerable to contamination than surface water. However, the presence of gypsious soils and calcium carbonates gives rises to highly mineralized groundwater in some areas in Ntoroko District, especially in and around Kanara subcounty, making the water hard and unsuitable for drinking or irrigation. Also some boreholes and protected wells in Rwebisengo Town Council show signs of highly mineralized groundwater.

During the field visit in April 2019, field measurements of water quality were performed at various rivers, streams, lakes, springs and boreholes throughout the Semliki Delta wetland landscape (Table 1). These measurements represent the hydrochemical characteristics at a specific site and moment in time, but give insight in spatial variations as well as the variation between different water types. The main water quality issues are discussed in more detail in the paragraphs below.

TABLE 1: FIELD MEASUREMENTS OF WATER QUALITY MEASURED AT VARIOUS TYPES OF SURFACE WATER AND GROUNDWATER IN SEMLIKI DELTA

Type	Name	Latitude (UTM)	Longitude (UTM)	Date	EC ($\mu\text{S}/\text{cm}$)	T ($^{\circ}\text{C}$)	NO_3 (mg/l)	Turbidity (NTU)
Open well	Butungama subcounty	0203302	0123186	15/04/2019	874	24,5	<5	<5
Borehole (handpump)	Butungama subcounty	0201360	0121474	15/04/2019	1525	27,5	<5	<5
River (perennial)	River Semliki	0191521	0113980	15/04/2019	677	26,6	<5	225
Protected well (handpump)	Rwebisengo subcounty	0192258	0113718	15/04/2019	1371	27,2	<5	<5
Protected well (handpump)	Rwebisengo subcounty	0195701	0115419	15/04/2019	2490	28,1	<5	<5
Borehole (handpump)	Butungama Primary School	0198716	0119765	15/04/2019	1385	29,6	<5	<5
Lake	Lake Albert	0220183	0128337	16/04/2019	600	30,1	<5	<5
Open well	Kanara subcounty	0218010	0123676	16/04/2019	2720	31,6	10	<5
Protected well (handpump)	Kanara subcounty	0217634	0121725	16/04/2019	323	33,0	5	<5

EC = Electrical Conductivity; T = Temperature; NO_3 = nitrate; NTU = Nephelometric Turbidity Units

Assessments carried out under LEAF 1 indicate that the lakes have low levels of pollution with a number of localised hotspots. However, this number of hotspots is growing as well as the intensity of pollution. The groundwater in Semliki Delta is mainly influenced by different types of soil and rock, and highly mineralized groundwater is encountered in several boreholes in the area. The Albert Water Management Zone is operational but not yet at full strength in terms of staff or the available financial resources to carry out its responsibilities. This means that pollution and water quality monitoring are not yet being carried out as required, but that there is reason to believe that it will be improved in the near future. On the DRC side there is no regular monitoring of pollution or water quality and the institutional responsibility for carrying this out is not clear (LEAIBMP, 2016).

High sediment load (with turbidity as indicative proxy) in surface water

Increased agricultural land use leads to accelerated erosion and deposition of fine sediment in surface water. Monitoring of suspended sediment yields has proven challenging due to the spatial and temporal variability of sediment loading. The simplest way of taking a sample of suspended sediment is to

dip a bucket or other container into the stream, preferably at a point where it will be well mixed, such as downstream from a weir or rock bar. The sediment contained in a measured volume of water is filtered, dried and weighed. This gives a measure of the concentration of sediment (only at one moment in time) and when combined with the rate of flow gives the rate of sediment discharge. However, these measurements need to be repeated multiple times, as reliable sediment yield calculations depend on accurate monitoring of these highly episodic sediment loading events. Also, estimating soil loss from measurements of sediment movement in streams and rivers faces several problems. Taking the measurements is time consuming and expensive; the accuracy of the measurements is likely to be poor; and even if there are good data on the movement in a stream it is not known where the soil came from and when (FAO, 1993). Turbidity measurements are often used to assess the amount of suspended solids in water (Alberto et al., 2016), and turbidity is considered to be a reasonably accurate proxy for suspended sediment data (Ruegner et al., 2013). Turbidity is a measure of the cloudiness of water and is related to the presence of suspended particles and organisms in water. For this monograph study it was used as indicative proxy for sediment load.

The Semliki river has a high turbidity, indicated by measurements of turbidity as proxy, which was measured at 225 NTU on 15 April 2019, on the landing site near Burasi (DRC) and Rwebisengo (UGA), Lat: 1°01'47.98"N / Lon: 30°13'42.29"E. Once this water flows into Lake Albert, the sediment load settles down due to the reduction in flow velocity. The turbidity (as indicative proxy for sediment load) in Lake Albert is therefore much lower, and was measured to be <5 NTU on 16 April 2019, Lat: 1° 9'35.91"N / Lon: 30°29'8.35"E. The expansion and shifting of the shoreline at Semliki Delta (Figure 13) is due to increased siltation of Lake Albert as a result of the deposition of the sediment load of River Semliki.

The siltation of River Semliki is due to unsustainable land use practices that enhance river bank, lakeshore and wetland degradation and soil erosion. The high sediment load is not a result of climate change but a result of human activity such as deforestation, overgrazing, poor farming and fishing methods, encroachment of the river banks and livestock watering. The soil erosion results in lower agricultural yields locally and causing siltation downstream. The increased sedimentation in Semliki Delta and Lake Albert reduces water quality and affects the vegetation by suffocating the native species and allowing invasive species to take root. Accumulation of sediments in wetlands from upland erosion decreases wetland volume and can have a very negative impact on the role that lacustrine wetland play as fish spawning areas such as Semliki Delta.

High sediment load makes the water also less suitable for drinking. At the community and district level meeting (Wetlands International 2019b) community members raised the issue of siltation of the river indicating that they used to drink water direct from River Semliki but now that is "impossible because the water turned brown." Suspended particles in water indeed affect the appreciation of water due to clarity, photosynthesis, and poor oxygen environment rendering water unsuitable. It also increase the health risk as some suspended materials contain functional groups capable of forming complex compounds with metals making them available for poisoning. Such material promotes the growth of bacteria and fouling that give rise to unpleasant taste and odour of the water and thus ideally requires removal.

Faecal contamination

Open defecation, overflowing latrines and failing home septic systems can allow coliforms in the effluent to flow into the water table, aquifers, drainage ditches and nearby surface waters, contaminating the water. Due to poor sanitary facilities (as described in more

detail in chapter 6.3.2), the population in Semliki Delta is very susceptible to faecal contamination. Because of inadequate sanitation and low latrine coverage in Semliki Delta, open defecation is a common practice where sanitation infrastructure and services are not available, which is especially the case in the landing sites along the Lake Albert shoreline. Human excreta are the main input to pit latrines, and they harbour a large number of microbes that can cause infections and waterborne diseases like cholera and diarrhea.

Because of high concentrations of nitrogen in human excreta, its adverse impacts to human health, and its use as an indicator of faecal contamination, nitrate has been the most widely investigated chemical contaminant derived from pit latrines. In addition, consumption of high concentrations of nitrate in drinking water is known to cause methemoglobinemia (blue baby disease). During the field mission in April 2019, nitrate (as NO_3^-) was measured at several water points using test strips as indicator for faecal contamination. Measurements show that at most water points, including Semliki River and Lake Albert, nitrate concentration was found to be < 5 mg/l. At one open well (out of two open wells tested) and one protected well (out of five protected wells and boreholes tested) slightly elevated levels of nitrate were measured, of respectively 10 mg/l and 5 mg/l. These concentrations are above/equal to the Uganda National Standards for nitrate in potable water (5 mg/l) but below the WHO standard of 50 mg/l (WHO, 2011). It is likely that the groundwater in these wells is contaminated due to nearby pit latrines or due to nearby open defecation by humans or animals (for example Figure 38). Frequently, groundwater nitrate concentrations near latrines are above local background levels. However, nitrate may be derived from numerous potential sources in urban and rural environments, including latrines, plant debris, animal manure, garbage repositories, livestock pens, soil, and fertilizers and nitrate can be formed and lost through natural soil processes.

It is a common and good practice to measure and monitor all (new) potable water sources (like boreholes and protected springs) for indicators of faecal contaminants such as *E.coli* and total coliforms. Unfortunately, no bacteriological analysis of potable water sources could be obtained from the local District Water Officers.

Pesticides and fertilisers

The use of pesticides and fertilizers is expected to increase. While the utilisation of pesticides and fertilisers is generally quite limited, the quantities which are being washed into the Semliki river and

lake Albert system is increasing as a result of rapidly reducing levels of soil moisture retention in the upland areas.

Domestic waste

Contamination of surface water with domestic waste takes place in fishing villages and landing sites on the lake Albert shore as well as urban settlements on or close to water courses (Semliki river) which have inadequate or non-existent waste/garbage disposal systems. The proper handling and disposal of domestic waste with rural areas is not adequately developed. Domestic waste is usually dumped without much thought to pollution implications. A survey in rural parts of the Lake Albert catchment Uganda indicated only 30 to 40% of garbage is collected and considerable amount of garbage is burnt. About 40% of the garbage remains uncollected and, therefore contribute to the pollution of the lake. The burning of garbage can lead to acidification of rain, and can expose the population to inhalation of potentially toxic gaseous and particulate emissions. Most wastes have a very high biological oxygen demand (BOD) that depletes oxygen from the lake causing anaerobic conditions. This causes most aerobic organisms to migrate or die. It can also causes eutrophication of water bodies, leading to algal blooms and invasion of the water body by aquatic weeds. Wastes introduce disease-causing pathogens into the lakes, infecting aquatic organisms such as fish and snails, which are later transmitted to men. (LEAIBMP, 2018)

Mining activities

Mining activities can pose significant pollution risks for water resources, even mining activities that have already ceased can continue to present significant problems. Mining activities did and do take place around the Rwenzori Mountains, and as such potentially influence the water resources of the Lakes Edward and Albert Basin (LEAB). Copper (and cobalt) mining in the Kasese area stopped with the closure of the Kilembe mines in 1980 but it is reported that discharges into the Nyamwanda River, which is a source of drinking water, contain heavy metals such as copper, cobalt, iron and lead (LEAIBM, 2018). Mercury is another dangerous pollutant used in artisanal gold mining. Artisanal mining is carried out in Buhweju and Ibanda District within the LEAB. In

and around Semliki Delta, no mining activities were found or reported to take place.

Highly mineralized groundwater

Salt lakes and hot springs are common in the Albertine Rift Valley, and in some areas groundwater has been found to be brackish and hard, which is thought to be of volcanic origin, and occurs as zones and spots. The presence of Solonchak soil type (as explained in chapter 2.2.2; see also the [Soil Map in Appendix A](#)) in parts of Semliki Delta is an indication that deposits of gypsum or calcium carbonates are present locally in the subsoil. Dissolution of gypsum rocks or gypsious soils and/or calcium carbonates gives rises to the highly mineralized groundwater.

It has been observed that some areas in Ntoroko District have hard water, especially in and around Kanara subcounty. Also some boreholes and protected wells in Rwebisengo Town Council show signs of highly mineralized groundwater. Water with too much dissolved minerals is not suitable for drinking; the Uganda National Standard for potable water for Total Dissolved Solids is 1500 mg/l and for Electric Conductivity is 2500 $\mu\text{S}/\text{cm}$. When borehole water is found to be salty, often communities don't find it palatable and it is common therefore for them to abandon safe borehole water for the lake water. Another problem with salty groundwater is that it gives rise to corrosion and borehole breakdown, as was observed at various boreholes in Kanara subcounty and Rwebisengo Town Council.

In Katanga town, Kanara subcounty, two boreholes (DWD 35080 and unknown) and two protected wells (DWD 59965 and unknown) are located next to each other which all four are non-functional due to mechanical breakdown (corrosion) as a result of the groundwater being too salty. One protected open well was working until recently but broke down a year ago. Before breakdown it was used for drinking even though the water tasted salty. An unprotected open well nearby has an EC of 2720 $\mu\text{S}/\text{cm}$. In Rwebisengo town a protected well that was still working but reported to be not in use anymore had water with an EC of 2490 $\mu\text{S}/\text{cm}$ and showed signs of heavy corrosion (Figure 14). In Butungama subcounty, groundwater with EC's of 874 $\mu\text{S}/\text{cm}$ (open well) and 1525 $\mu\text{S}/\text{cm}$ (borehole) was measured.

FIGURE 14: ABANDONED BUT STILL FUNCTIONAL PROTECTED WELL IN RWEBISENGO TOWN COUNCIL WITH CLEAR SIGNS OF CORROSION DUE TO THE HIGH SALT CONTENT OF THE WATER, LAT: 1°02'34.92"N / LON: 30°15'57.32"E.



The District Water Officer of Ntoroko District did provide one analysis certificate of water quality analysis of a borehole in Butangama subcounty (Sample nr K0766/16/C, coordinates unknown). This borehole also shows highly mineralized water with an EC of 6970 $\mu\text{S}/\text{cm}$, and a high alkalinity (total as CaCO_3) of 1680 mg/L (National Standard 500 mg/l) and sulphate (as SO_4) of 577 mg/L (National Standard 200 mg/l), as well as high turbidity of 24.5 NTU (National Standard 10.0 NTU), Total Dissolved Solids of 3585 mg/l (National Standard 1500 mg/l) and Total Suspended Solids of 17 mg/l (National Standard 0 mg/l). The fact that bicarbonates and sulphates are very high, but chloride is relatively low (372.5 mg/l, against 500 mg/l National Standard) suggests that this highly mineralized water is the result of dissolution of gypsum and/or calcium carbonates.

The Electrical Conductivity (EC) in Semliki river was measured to be 677 $\mu\text{S}/\text{cm}$ and in Lake Albert around 600 $\mu\text{S}/\text{cm}$ (up to 750 $\mu\text{S}/\text{cm}$ in the shallow mud along the shoreline). This is lower than the locally present brackish and hard groundwater, but significantly higher than other major lakes and rivers in the area, for example Lake Victoria (around 100 $\mu\text{S}/\text{cm}$) or Kagera River (around 140 $\mu\text{S}/\text{cm}$), due to inflow of highly mineralized groundwater.

Hot spots for water contamination

- Pit latrines
- Fishing villages and landing sites on the lake shore as well as urban settlements on or close to water courses which have inadequate or non-existent sanitation infrastructure and inadequate or non-existent waste/garbage disposal systems
- Mining areas
- Areas with high erosion risks
- Use of fertilizers and pesticides/insecticides in agricultural areas
- Point source pollution, both at commercial and community levels (local gin brewing, palm oil extraction and fermentation)
- Potential pollution of both surface and groundwater by oil exploration and production activities

As part of the Integrated Water Resources Management component of the LEAF II project, the basin water resource monitoring and assessment was strengthened in 2019 through a) 6 Hydro-meteorological monitoring stations constructed and equipped (2 in Uganda, 4 in DRC), b) Water quality laboratory constructed and equipped in Uganda, c) Two mobile water quality laboratories (Figure 15) procured and equipped (one per country), and d) Water Resources Database and Information System developed (NELSAP 2019).



FIGURE 15: LEAF II SUPPLIED TWO MODERN MOBILE WATER QUALITY LABORATORY VEHICLES TO DRC AND UGANDA TO SUPPORT WATER QUALITY MANAGEMENT.

2.3.5 Hydrological functions of the wetland system

The Semliki Delta wetland landscape plays an important role in the hydrology of the catchment and in the ecosystem. Here, we focus on the hydrological aspects of wetlands. The importance of wetlands as nurseries and habitat for a wide variety of wildlife, birds and aquatic organisms is discussed in Chapter 3.

In a wetland, water moves more slowly and is stored for a longer period of time. The large storage capacity allows peak flows, for example resulting from extreme precipitation events, to be stored, thereby reducing flooding. The stored water is then released slowly over a long period of time, making more water available in the dry season.

Water storage in wetland areas improves water quality, as well. Organisms have the opportunity to extract nutrients from the water. In addition, sediments in the surface water have the opportunity to settle, reducing the sediment load of water downstream from the wetland. This is especially vital for the fish in Lake Albert. The water purification service of the wetlands is important for the survival of fish and other aquatic organisms in downstream areas.

2.4 CLIMATE AND CLIMATE CHANGE

The current and expected effects of climate change differ locally, nationally and regionally. The impacts of climate change effects on livelihoods, food and water security, ecosystems, infrastructure etc. differ per country and region as well as community and individual, with gender a particularly important vulnerability factor.

Wetlands play a key role in buffering the effects of climate change, thereby supporting climate adaptation and resiliency. Indeed, vegetated and healthy wetlands are among the most effective sinks for carbon on the planet, but when disturbed or warmed, they release the three major heat-trapping greenhouse gases carbon dioxide, methane, and nitrous oxide. Protecting wetlands from human disturbance therefore helps to limit the increase in greenhouse gases in the atmosphere. The role of wetlands in carbon sequestration in the Nile Equatorial Lake region, including the wetland system of Semliki Delta, has been studied by the Nile Basin Peatlands Carbon Sequestration Study (Elsehawi et al., 2019).

Wetlands strongly dependent on the water cycle, so the current trends and future changes within the whole catchment area of River Semliki determine what the effects of climate change are on the water

resources, food security and wetlands services in the Semliki Delta study area. The streamflow of River Semliki is mainly determined by rain and snowmelt in the Rwenzori Mountain range. Hence, this paragraph assesses the climate and climate change within River Semliki basin.

2.4.1 Current climate

The Semliki river basin is located within a relatively humid equatorial climate zone, where the topography, prevailing winds and water bodies cause large differences in rainfall patterns. Average annual rainfall ranges from 900 mm in the low and flat Semliki Delta up to as high as 2600 mm in the upland zones of the Rwenzori mountain's bogs and bamboo forests, generally falling in two seasons (March to May and October to December). In the Rwenzori Mountains the second rainy season starts earlier, from August to December, and the dry periods are only moderately dry due to moisture advection and fog capture at higher altitudes. For some altitudes and temperatures, precipitation over the mountains will fall as snow. Average daily temperature is around 28 °C, but varies with altitude, with significantly higher temperatures in the low-lying rift valley of the Semliki Delta compared to the surrounding high sides of the rift escarpment.

Sea surface temperatures in the distant tropical Pacific, Indian and, to a lesser extent, Atlantic Oceans determine the movement of the Inter-Tropical Convergence Zone (ITCZ) who strongly influences annual rainfall amounts and timing in the area. Apart from the seasonal control on precipitation exerted by movement of the ITCZ, there is a strong orographic effect on local precipitation. In the Rwenzori Mountains precipitation increases with rising elevation from 1150 mm/yr at 1250 m amsl to a maximum annual precipitation of 2600 mm/yr recorded at 3300 m amsl in the Heath-moss forest zone. Above this, precipitation decreases to 2000 mm/yr in the Afroalpine zone at 4000 m amsl. Year to year variations in annual rainfall can be considerable, and the onset of seasons can shift by 15 to 30 days (earlier or later) and the length of the rainy season can also change by 20 to 40 days from year to year (Climate Change Profile Uganda, 2018).

2.4.2 Current trends

In comparison of records over two 30-year periods, from 1951 to 1980 and from 1981 to 2010 the data overall indicate no clear changes in annual rainfall in Uganda and direct surroundings. Analyses identified a statistically significant increase in temperature at

a rate of 0.5 °C per decade over the past 30 years, with an increase in the average number of both hot days and hot nights per year (Climate Service Center Germany, 2015).

2.4.3 Climate change

Global projections of climate change focus on expected changes in precipitation and temperature. Projections are available for several scenarios of through the Coupled Model Intercomparison Project (CMIP) version 5 (Taylor et al. 2012). These data provide an overview of the impacts of the different climate change scenarios. When the data is subsequently used in water resources planning or drought analysis, the data must be downscaled and bias-corrected (NBI 2019).

Precipitation

Within the region, models predict potentially large changes in precipitation (Semazzi 2005). For example, in northern Uganda rainfall is expected to increase, while precipitation is expected to decrease in southern Kenya (Figure 16). Based on these projections, precipitation will increase slightly in the Semliki Delta area, and will increase more significantly in the upstream part of the Semliki basin. A closer look at climate projections from CMIP-5 (Taylor et al. 2012) for the Semliki study area shows that for most of the year precipitation is not expected to change significantly by 2050. However, precipitation is expected to increase by 5-8% in October through December and decrease by 17% in March. However, the variability between models, and therefore the uncertainty in the climate projections, is high. Some models predict significant decreases in precipitation, especially in October, while others predict increases. For example, the precipitation in April may decrease by 30%, or may increase by 60%, depending on the model.

Warming and extreme events

The temperature is projected to increase by about 1.5°C by 2050 (Figure 17) based on the results of the CMIP-5 experiment (Taylor et al. 2012), though some models predict temperature increases of more than 2.0°C. These projections are in line with the already observed warming trend. The temperature increase is expected to be highest in June and July, and relatively low in October to February. Due to this warming, there is a potential for an increase in the frequency and intensity of extreme events (e.g. heavy rainstorms, flooding, droughts). The percentage of rainfall coming in the form of heavy precipitation events is anticipated to further increase, due to

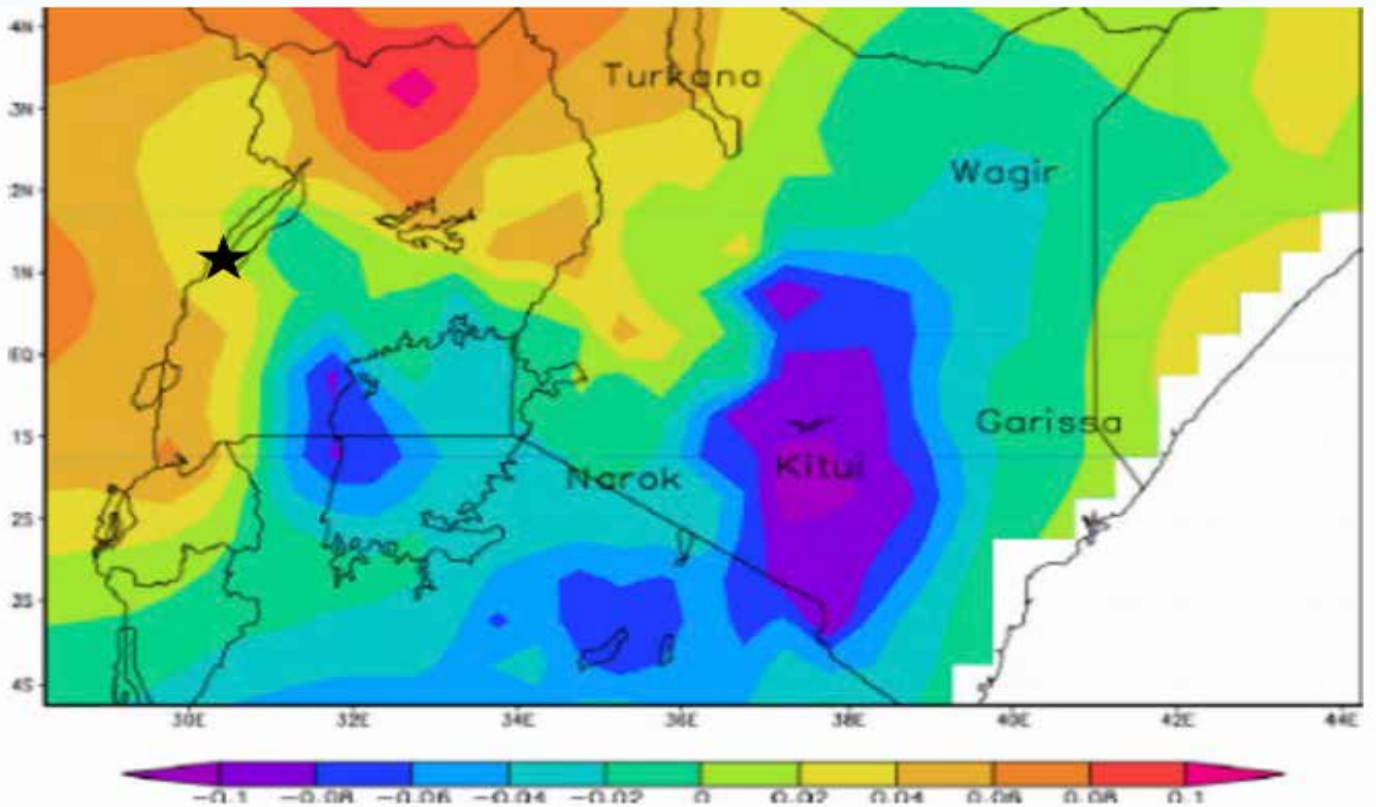
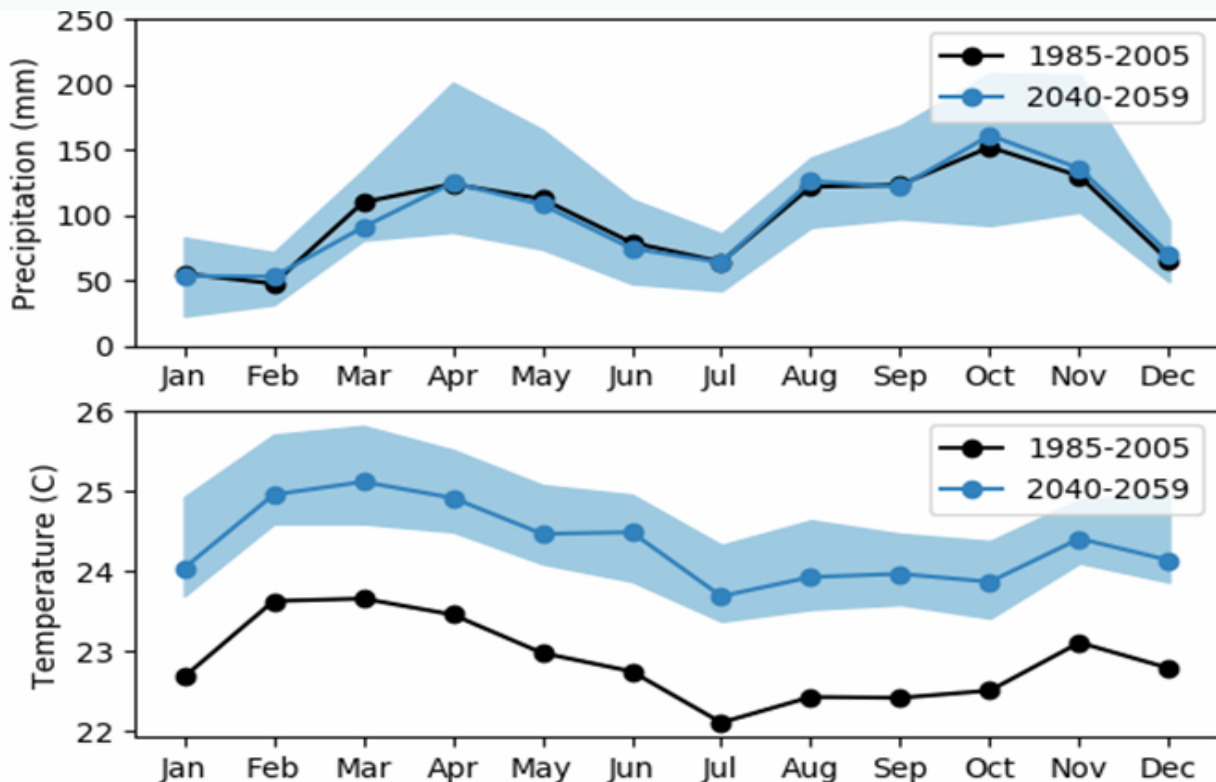


FIGURE 16: DIFFERENCES IN ANNUAL RAINFALL CHANGES (BLUE IS DECREASE, RED IS INCREASE) DUE TO CLIMATE CHANGE ACROSS UGANDA, WITH THE LOCATION OF SEMLIKI DELTA INDICATED WITH A BLACK STAR

continued warming, which would escalate the risk of disasters such as floods and landslides. An increase in the frequency and intensity of droughts and floods in recent years was reported by local community

members of Semliki Delta (Wetlands International 2019b) and in the upstream part of Semliki river basin landslides have occurred.

FIGURE 17: HISTORICAL MONTHLY PRECIPITATION AND MONTHLY AVERAGE TEMPERATURE FOR THE PERIOD 1985 - 2005 AND FOR THE RCP4.5 CLIMATE SCENARIO CONSIDERING THE PERIOD 2040-2059. THE BLUE LINE SHOWS THE MODEL ENSEMBLE MEDIAN, THE SHADED AREA SHOWS THE 10TH - 90TH PERCENTILES OF THE MODEL ENSEMBLE (N=35).



2.4.4 Effects of climate change

Water resources

Water resources are likely to be increasingly strained in the future climate of Semliki river basin. While it is projected that the total rainfall will slightly increase, warmer temperatures will accelerate evapotranspiration, reducing the benefits of increased rainfall. With more frequent and severe droughts, the Semliki river basin will likely experience negative impacts on water supply, biodiversity and (potential for) hydroelectric power generation. A shift in rainfall patterns will decrease the recharge of rainwater into the soil, which will have a negative impact on groundwater resources and water tables in wells. Recent years have shown that climate change has

disrupted rainfall patterns, resulting in more intense rains and then drier spells. Continued warming will also increase the melting rate of the glaciers atop the Rwenzori Mountains, which are likely to disappear completely within the next decades (Tayler et al., 2006). The Intergovernmental Panel on Climate Change (IPCC) has highlighted glacier retreat and Great Lakes warming as directly observed changes in the region related to anthropogenic climate change. Climate change and the related effects on snowmelt and continued loss in glacier ice, imply a change in the observed streamflow, together with a shift of peak discharge (IPCC, 2014b). However, the glacial recession does not change significantly the total amount of water flow of River Semliki (Explainer 1).

Explainer 1 – Climate change in the Rwenzori Mountains

Environmentalists have expressed a lot of concern over the high melting rate of the glaciers atop the Rwenzori Mountains. Research indicates that the ice caps on the Rwenzori Mountains have shrunk significantly in the last century. In 1906, the Rwenzori had 43 named glaciers distributed over six mountains with a total area of 7.5 km², about half the total glacier area in Africa. By 2005, less than half of these were still present, on only three peaks, Mt Stanley, Baker and Speke, with an area <1 km². The percentage of ice loss on Mt. Baker is 96% followed by Mt Speke 91% while Mt Stanley has the lowest percentage of ice loss at 69%. According to the Global Outlook for Ice and Snow 2007, if they continue to recede as they have since 1906, some experts warn that they will be gone in the next few years. The Rwenzori glaciers are clearly disappearing fast and by now (2019) may actually be not much more than accumulated blocks of ice slowly atrophying.

Recent scientific studies, such as those by Richard Taylor of University College London, have attributed the continued melting of glaciers on the Rwenzori Mountains over the years, and now even at an accelerated rate, to global climate change. The frequency of hot days has increased significantly while that of cold days is decreasing, which attributes the glacial recession to higher air temperatures and less snow accumulation.

Unlike the shrinkage of the glaciers on Kilimanjaro in Tanzania, which is widely thought to be caused by a lack of rainfall (note the expected decrease in annual rainfall in Kilimanjaro region in figure 4), most of the Rwenzori glacier melt is attributed to increased air temperature rather than lack of rainfall (Taylor et al, 2006). The glacial retreat on Kilimanjaro has a big regional impact on the water resources, but this is not the case for Rwenzori. The annual rainfall on Rwenzori is many times that on Kilimanjaro and even seems to be slightly increasing rather than decreasing. The glacial discharge from Rwenzori is trivial compared with the heavy rainfall exceeding 2000 mm per year in upland Heath-moss and Montane Forest that collects in the Rwenzori mountain's bogs and bamboo forests. Spot measurements of meltwater discharges indicate that icefields contribute considerably less than 2% of the river discharge at the base of the Rwenzori Mountains during both dry and wet seasons (Taylor et al, 2009). Consequently, the decline in the area covered by glaciers in the Rwenzori Mountains has had a minimal impact on the flow of Semliki river, which is partly fed by snowmelt of Rwenzori. This is contrary to popular believe that the disappearance of the ice cover will mean reduced water flow in the receiving streams which feed into Semliki River, as stated in f.e. 'Uganda: Atlas of Our Changing Environment' (NEMA, 2009).

However, a shift toward fewer but heavier rainfalls in the Rwenzori Mountains which is expected to have occurred in response to the observed rise in air temperatures, enhances the seasonality in river flow and gives rise to more frequent and intense floods. These changes in the river flow draining the Rwenzori Mountains are expected to become more prominent as warming continues in the 21st century.

With its exceptionally steep topography, wet climate, and active faulting, landslides and flash floods are occurring regularly in the Rwenzori Mountains. Rainfall is also the main trigger for landslides and flashfloods and the increased intensity of rainfall due to climate change is expected to trigger more landslides and flashfloods in the Rwenzori Mountains in the future. This might cause increased eroding of Semliki river banks and increased silting of Lake Albert at the Semliki Delta. Longer droughts and more frequent and intense floods brought about by warming impair crop production, hydroelectric power generation and transport via bridges. Climate change adaptation strategies need to consider this shift toward more variable rainfall and river flow in the design of infrastructure such as bridges and reservoirs for hydroelectric power generation and irrigation.



The glaciers on top of Rwenzori in 1925 (left) and in 2005 (right)

Food security

If temperatures rise and the frequency and intensity of extreme droughts and floods increase, it can reduce crop yields and cause a loss in livestock, which will have important implications for food security in Semliki Delta. The expected increase in rain during the dry season (Jan-Feb & April – August) could have a significant impact on both livestock and agriculture. An overall decrease in the predictability of rainfall intensity and of the onset of the rainy season increases the chance of crop failure, especially on perennial crops and post-harvest activities such as drying and storage. The potential increase in the frequency of extreme events like droughts and flooding can have a devastating effect on the pasture lands available for livestock along Semliki river.

Wetlands

Climate change may affect the health of the wetland and forest ecosystems of Semliki, which provide critical ecosystem (and economic) services for the surrounding communities. Wetlands strongly dependent on the water cycle and for this reason are extremely vulnerable to the effects of climate change. Some of the main consequences that can be predicted from climate change for wetlands are modifications in hydrological regimes, in particular decreased surface water and ground water levels, which can cause intense droughts. Therefore, climate change will likely cause the loss of, or reduction in, the total wetland area of Semliki Delta and will challenge the adaptability, composition and distribution of species, as wetland networks are key corridors and stepping stones allowing species to move to cooler areas and thus adapt to rising temperatures. This loss of biodiversity will probably have consequences for the human population that depend on them. In addition, droughts impair the ability of freshwater wetlands to deliver other ecosystem services, including improving water quality, water supply, flood control, and storm protection, with severe negative ecological and socioeconomic impacts.

2.4.5 Climate vulnerability

Uganda ranks 155 of 181 countries in the ND-GAIN index for climate vulnerability and DRC ranks 165 of 181 countries (Gain Index, 2016). Uganda is the

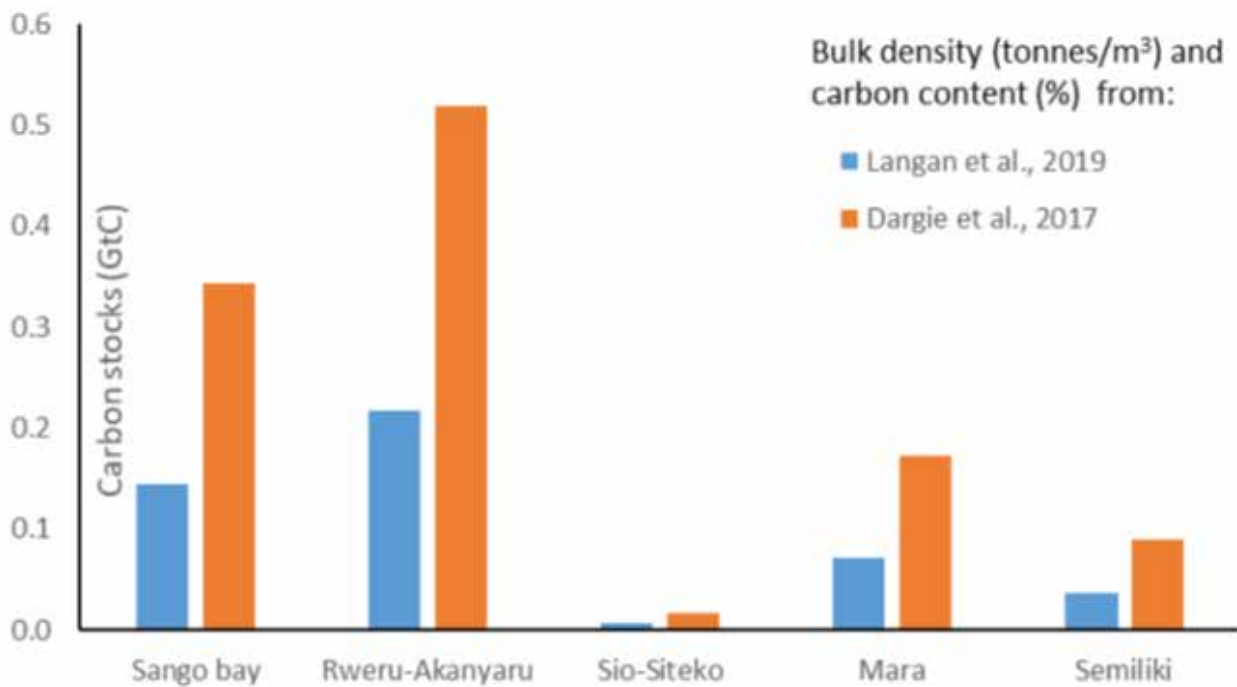
14th most vulnerable country and the 48th least ready country – meaning that it is very vulnerable to, yet unready to address climate change effects. **Vulnerability** measures the country's exposure, sensitivity, and ability to cope with the negative effects of climate change by considering vulnerability in six life-supporting sectors: food, water, ecosystem service, health, human habitat and infrastructure. **Readiness** measures a country's ability to leverage investments and convert them to adaptation actions by considering the country's economic, governance and social readiness.

Due to a high Multidimensional Poverty Index (74% of the population in DRC and 55% in Uganda is in multidimensional poverty; UNDP 2019b), low rural incomes, lack of income diversity and heavy dependence on rainfed-agriculture, the Semliki river basin and its people are very vulnerable to climate change. Rapid population growth and the expansion of farming and pastoralism under an unpredictable and warmer climate regime could decrease the resilience of the ecosystem and dramatically increase the number of at-risk people in the next 20 years.

2.4.6 Carbon storage in Semliki Delta peatlands

The oxygen-free environment in wetland ecosystems prevents the decay of vegetation and organic matter, causing the formation of peat which effectively traps carbon. Tropical peatlands are known to be the most space-efficient terrestrial carbon stock pool, with their carbon stock per hectare 10-15 times higher than a tropical rain forest on mineral soil. The Nile Equatorial Lakes region is estimated to contain over 12,000 km² of peatlands holding 2.5-6 billion tonnes of organic carbon. Figure 18 shows the estimated total amount of carbon in Semliki peatlands: around 0.05-0.1 billion tonnes. Although being smaller than some of the other peatlands, this number is still significant. Meanwhile, Semliki peatlands is highlighted as undergoing slight degradation. So while some areas are experiencing more severe degradation, the current trend of degradation of the Semliki peatlands is cause for concern (Elsehawi et al. 2019).

FIGURE 18: CARBON STOCKS (IN GIGATONNES OF CARBON) OF SOME OF THE TRANSBOUNDARY WETLANDS IN THE NILE BASIN (ELSEHAWI ET AL. 2019).



Globally, the draining of peatlands emit about 2 giga tonnes of CO₂, which amounts to ~5 % of the global CO₂ emissions. In DRC and Uganda, CO₂ emissions from drained peatlands equal more than 50 % of national fossil fuel and cement emissions, indicating the importance of peatlands for national climate policies in these countries. Preventing further drainage (i.e. keep peatlands wet) and rewetting already drained peatlands (i.e. make drained peatlands wet again) would lead to avoidance and

reduction of further emissions. Unsustainable use of peatlands can turn peatlands from a carbon sink to a huge carbon source (Elsehawi et al. 2019).

2.5 LAND USE AND LAND COVER

The most important land cover types in the Semliki Delta project area are trees and grassland. These are interspersed with croplands and shrubs (Figure 19). Overall, tree cover is more common on the DRC



FIGURE 19: GRAZING IS THE MOST IMPORTANT LAND USE TYPE IN THE SEMLIKI DELTA AREA

TABLE 2. OVERVIEW OF RELATIVE COVERAGE OF DIFFERENT LAND COVER TYPES IN THE SEMLIKI STUDY AREA, BASED ON THE 20-M RESOLUTION DATASET FOR AFRICA PRODUCED BY THE CCI LAND COVER PROGRAMME.

Land cover	Coverage (%)
Trees*	34.4
Shrubs	3.6
Grassland	42.9
Cropland	9.5
Aquatic/regularly flooded	0.9
Built up	0.0
Water	8.7

*this might include also dense papyrus and reed vegetation; see Explainer 2

side of the project area, while cropland, grassland and shrubs are more common on the Ugandan side. Built up area is limited, mainly concentrated around the village of Rwebisengo in the south. Other small villages are scattered near the shores of the lake and rivers in the project area. The larger town of Ntoroko is located just outside the study area.

A land cover map developed by the Climate Change Initiative (CCI) Land cover programme based on Sentinel satellite imagery (ESA CCI Land cover 2017) is shown in the [Land Cover Map in Appendix](#)

A and a summary of the data is presented in Table 2. It should be noted that part of the area classified as ‘trees’ includes papyrus swamps & reeds (with some tree cover), which is explained in more detail in Explainer 2.

Different types of wetland are found within the delta ([Appendix A – Wetland Map](#)), covering a total of 273 km² (Table 3). In the northern part of the project area, the wetlands are dominated by tree cover near the river and its tributaries. In between the tributaries, the wetlands are covered by shrubs and woody vegetation. Most of this area is seasonally flooded, though the wetlands at the edge of Lake Albert are more likely to be permanently flooded. Along the Nyanjakufa River, the southern tributary of River Semliki, the wetlands are covered by grasses and herbaceous vegetation (Figure 20). This area is also seasonally flooded and may be affected by river flooding as well as high groundwater levels. An overview of the coverage of different wetland types based on the AFcover dataset is found in Table 3. The similarities and differences between the land cover and wetlands data sets are explained in Explainer 2



FIGURE 20: IMPRESSION OF THE SEASONALLY FLOODED HERBACEOUS WETLANDS, COVERED BY GRASSES, REEDS AND PAPYRUS SPECIES.

TABLE 3: OVERVIEW OF THE AREAL COVERAGE OF DIFFERENT WETLAND TYPES IN THE SEMLIKI DELTA STUDY AREA.

Wetland type	Area (km ²)
Tree cover, permanently flooded	3
Tree cover, temporarily flooded	114
Shrubs and woody vegetation, permanently flooded	33
Shrubs and woody vegetation, temporarily flooded	8
Grass with sparse trees, temporarily flooded	111
Grass and papyrus swamps, permanently flooded	4
Total	273

Land use in the project area varies with the land cover. In the savanna landscape of grasslands and cropland, grazing is the most important land use (Figure 19). Over 80% of the local population is dependent on cattle keeping. In contrast, agriculture is small-scale and limited to subsistence farming. Transportation is present, though there is some transport by boat over the Semliki River between Uganda and DRC. Most of the roads in the project area are murrum or gravel roads, though the main road from Fort Portal to Bundibugyo has been tarmacked.

Part of the forested area is protected under the Rwengara Community Wildlife Management Area. This is located just south of one of the main tributaries of the Semliki River and stretches along the shore of Lake Albert. Though officially prohibited in the protected area, fishing is practiced and is even an important activity. Another larger protected area, the Toro-Semliki Wildlife Reserve, is located just south of the project area.

Wetland encroachment and wetland degradation

The pressure on land and resources is increasing due to population growth. Forests are cleared to provide firewood more land for grazing and agriculture. The

grazing land in turn is threatened by poor agricultural practices, such as overgrazing, which contribute to declining soil fertility. Wetland encroachment is taking place in Semliki Delta, with more and more informal settlements originating along the river banks at the river mouth, that are only accessible by boat (Figure 21). At these settlements, natural vegetation is being replaced by cultivated land used for construction of houses and for agriculture. Land cover and use changes related to encroachment and deforestation are not visible in the 300-m CCI land cover dataset looking at the period 1995 to 2015 (ESA CCI Land cover 2019). However, the informal settlements are visible on Google Earth imagery. The imagery shows that at least six new settlements have been founded within the wetland area since 2003, and other existing settlements have expanded since that date. The settlements vary in size, containing between about 15 to over 100 structures.

Quantifying land cover change

In the ESA CCI 3000m dataset, observed land cover changes between 1995 and 2015 in the project area are negligible. In reality, land cover change including wetland encroachment and deforestation has taken

Explainer 2 – Land cover and wetland datasets

An increasing number of global and regional datasets related to land cover and vegetation type are becoming available. The products are developed by different organizations, are based on different information (for example using different satellites), and have different spatial and temporal characteristics and accuracies. As a result, while datasets tend to agree on general patterns, there may be significant discrepancies at small scales.

Several land cover datasets are available, most derived largely from remote sensing data. The ESA CCI 20m **classified** dataset used in this study has an unprecedentedly high resolution but is only available for one year (2016). An alternative dataset is the ESA CCI dataset with a 300m resolution, which is available annually for a period of almost 15 years. The latter dataset is more suited to studying land cover change. However, in practice the relatively coarse resolution of the dataset compared to the size of the project area has proven problematic. In the dataset, observed land cover changes between 1995 and 2015 in the project area are negligible. In reality, land cover change including wetland encroachment and deforestation has taken place. The most likely reason this is not visible in the land cover dataset is that the land cover changes are scattered and (much) smaller than the 300m resolution of the dataset. The finer level of spatial detail in the 20m and more recent acquisition date are the reasons this dataset was ultimately preferred above the 300m dataset.

There are also discrepancies between the ESA CCI land cover and AFcover wetland datasets used in this study. Wetlands and aquatic vegetation are underrepresented in the land cover dataset compared to the wetland dataset and field visits. This underestimation may be because they are harder to identify from the source imagery, especially where vegetation cover is relatively dense. In the Semliki Delta wetland landscape, wetlands from the AFcover dataset are mainly classified as tree cover or grasslands in the land cover dataset. Overall, there is a good match between AFcover wetland type and the vegetation type in the land cover dataset. Wetlands with tree cover, for instance, are mainly classified as tree cover in the land cover dataset, and the same for grass and sparse tree wetland types being classified as grass. However, the land cover dataset is more pixelated and patchier than the wetland dataset. In addition, some of the grass and sparse tree cover wetlands are classified as cropland in the land cover dataset. This may be misclassification of the vegetation, but may also be evidence of wetland encroachment.

place. The most likely reason this is not visible in the land cover dataset is that the land cover changes are scattered and (much) smaller than the 300m resolution of the dataset. The ESA CCI 20m dataset would be suitable to study land cover change because of its high resolution, but is only available for one year (2016) and hence would require a new classified ESA CCI 20m dataset to become available. Moreover, on satellite images it is hard to distinguish between certain types of crop (like sugar cane) and natural wetland

vegetation (papyrus and reeds). This might keep wetland encroachment underexposed on satellite images; see also the explanatory notes in Explainer 2.

Figure 21: Wetland encroachment along Semliki River, showing two examples of informal settlements of >100 huts (example 1) and >15 huts (example 2) that originated in the period between 2003 and 2013 as can be seen on satellite imagery from Google Earth.

FIGURE 21: WETLAND ENCROACHMENT ALONG SEMLIKI RIVER, SHOWING TWO EXAMPLES OF INFORMAL SETTLEMENTS OF >100 HUTS (EXAMPLE 1) AND >15 HUTS (EXAMPLE 2) THAT ORIGINATED IN THE PERIOD BETWEEN 2003 AND 2013 AS CAN BE SEEN ON SATELLITE IMAGERY FROM GOOGLE EARTH.





3.1 BIODIVERSITY

3.1.1 Bio-geographical significance of Semliki Delta area

Semliki Delta is the last part of the River Semliki where it empties its waters into Lake Albert. It is part of the Albertine Rift Biodiversity hotspot and is shared between Uganda and DRC, making it a transboundary wetland. The delta and the last part of the River Semliki are located in the Semliki Controlled Hunting Area which extends up to River Semliki and Semliki Wildlife Reserve, both forming an Important Bird Area, part of which is a protected area managed by the Uganda Wildlife Authority. Semliki Delta is generally flat lying at the bottom of the Rift Valley (BLI 2019) largely composed of grassland and a swamp of *Miscanthus sp* and *Cyperus papyrus* often interspersed with Water Hyacinth (Figure 22)

The local microclimate is greatly influenced by the surrounding topography, including the Rwenzori mountain ranges, and the mosaic landscape created over time by human activities. The main vegetation

types include lakeshore flats and swamp, riverine forest, and grassland with patches of bush land and woodland. In general, the wetland habitat in the delta is of good quality as compared to other surrounding habitats which have been adversely degraded by extreme human activities.

Semliki Delta is part of the Lake Albert basin which as a whole supports a considerable biodiversity of flora and fauna with endemic mammals, birds, amphibians, and plants. The delta itself is an ecoregion particularly rich in vertebrates and contains more endemic and threatened species than any other part of Africa. As it holds globally threatened species, restricted range species and is an important site for the congregation of birds it qualifies as one of the top Key Biodiversity Area (KBA) in Uganda (Akwetaireho et al. 2010).

3.1.2 Biodiversity assessments of Semliki Delta

Limited in-depth and detailed research has been conducted in Semliki Delta on biodiversity. The following studies and surveys have been used a



FIGURE 22: PART OF SEMLIKI DELTA COVERED WITH WATER HYACINTH (PHOTO TAKEN BY NATURE UGANDA)

starting point for the biodiversity section in this monograph:

- The study from Kityo et al on biodiversity in Semliki (2003)
- The assessment of the biodiversity of Semliki by the Uganda Wildlife Authority (UWA) (N.D.)
- The baseline studies for the RAMSAR application of Semliki Wildlife Reserve (N.D.)
- The IUCN Red list assessment for Semliki (N.D.)
- The studies on biodiversity in the larger Semliki area by Akwetaireho et al. (2010)
- The Environmental Impact Assessment by the Uganda National Roads Authority (UNRA) (2017)

Besides the literature a wide variety of databases was consulted, including but not limited to African Plants Database, The National Biodiversity Data Bank of the Department of Environmental Management, World Conservation Survey by IUCN (2016), AmphibiaWeb (2015), and the reptile Reptile Database by Uetz, P. & Jirí Hošek (eds.) 2015).

For this monograph the available data on biodiversity was collated and compared by researchers specialized in wetland habitats, and then species occurrence was checked against habitat records. The data from previous studies was mainly collected using the Timed Species Counts (Bibby *et al.* 2000) and the sectioned transect method (Nalwanga *et al.* 2012). Taxonomic literature was checked for information on habitats of the species and various published articles for their uses in the local areas.

The IUCN Red List (IUCN, 2019) was checked for the conservation status of the species, whenever possible at global, country, regional and local levels. Species names were updated and harmonized, so that listing species under more than one name was avoided. Brief field visits were conducted to assess the general characteristics and nature of the sites, interview key informants, focus group discussions, and collect anecdotal evidence. Whenever available the conservation status of the species was registered in the IUCN-categories of Extinct (EX), Critically endangered (CR), Endangered (EN), Vulnerable

(VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD), Not Evaluated (NE), Restricted – range (RR) species.

Note that many species are roaming a larger area. Hence for this assessment a slightly larger area, i.e. including the region around the Semliki Delta, was looked at to ensure all species are included that in some way depend on or at least may possibly make use of the Semliki Delta area.

3.1.3 Plants

Most of the shores are too steep to allow for the development of wetlands, except for the delta areas where the Victoria Nile and Semliki enter the lake. Here, papyrus swamps and fringes of hippo grass (*Vossia cuspidata*) can be found (Figure 23). An overview of plant species in the Semliki Delta is developed through a desk literature review and consultation of researchers, who have worked in the respective wetland areas (Namaganda, 2019). Species lists and habitat information were generated and standardized into five habitat categories, namely forest, woodland, bushland, grassland and wetland habitats.

Land cover at the Semliki Delta is largely grassland, with a wetland strip along the lake and river shores. Within the grassland areas, few scattered patches of woodland and bushland can be identified. The inventory revealed 106 unique plant species in the Semliki Delta out of which are 51 herbs (48%), 38 tree species (36%) and 17 shrubs (16%). Grey-haired acacia *Acacia gerrardii* and Sacred barna *Crateva adansonii* are the predominant tree species recorded in all habitat types, buffalograss *Panicum maximum* and *Grewia Grewia similis* respectively, are the most common herbs and shrubs species in the different habitats.

According to the IUCNs red listed species, none of the found plant species are currently threatened, however, Tamarind *Tamarindus indica* is nationally assessed as 'vulnerable'. Activities in the Semliki Delta, including grazing by cattle, bush and charcoal burning, and clearing land for cultivation may lead to habitat loss and subsequently increases the risk of local extinction of plant species.



FIGURE 23: CONTRASTING STEEP SEMLIKI RIVER BANK AND THE DELTA AREA FULL OF HIPPO GRASS *VOSSIA CUSPIDATA* AND WATER HYACINTH (PHOTO TAKEN BY NATURE UGANDA)

3.1.4 BIRDS

Birds are among the best indicators for biodiversity. In part due to the large variation in vegetation types and the presence of large surface water bodies, Semliki Delta host large numbers of bird species. In total 325 bird species have been recorded in the area, most of which are savanna-woodland species or water-associated species found along streams and in swamps.

The tall vegetation along the marshy shores of the lake is home to the Shoebill *Balaeniceps rex* and other wetland birds, such as the Lesser Jacana *Microparra capensis* and African Pygmy Goose *Nettapus auritus*, whilst the papyrus swamp holds the Papyrus Gonolek *Laniarius mufumbiri* and other papyrus specialists. Biome restricted species in the delta include 22 Sudan–Guinea Savanna biome species, such as Red-throated Bee-eater *Merops bulocki* and Purple Starling *Lamprotornis purpureus*; 16 Guinea–Congo Forests biome species as well as four Lake Victoria Basin biome species.

Eco-tourism and bird-watching cruises on Lake Albert – main attractions are Shoebills, African Pygmy Goose, Blue-breasted and Blue-Cheeked Bee-eaters and Blue-headed Coucal – are considered important ecosystem-based livelihoods activities in the area (Nalwanga 2019).

3.1.5 Mammals

A recent desk study documented the status of mammals in the wetland landscapes (Martin, 2019). The records of mammals in Semliki Delta are derived from surveys in the Semliki Wildlife Reserve. Wildlife in this area includes elephants,

hippopotamus, crocodiles, civets, buffalo, leopards, lions, chimpanzees (*Pan troglodytes*) along the riverine forest, various species of antelopes which are very abundant in the area including the bay duiker and the pygmy flying squirrel that occur no-where else in East Africa. However, from this study (Martin 2019) it is not clear which of the mammals that occur in the Semliki Wildlife Reserve are also found in the Semliki Delta. Based on anecdotal information about mammal occurrence (field mission April 2019), buffalo and crocodile are common in in the Semliki Delta wetlands, while elephants, leopards, lions and chimpanzees are most probably restricted to the higher-up located Semliki wildlife reserve.

Martin 2019 showed that the ecosystem of the Semliki Wildlife Reserve is quite rich in mammal fauna at the ordinal, family and species levels. A total of 122 species are listed for the area which list combines both the forested and savanna area species.

Notable among the mammals of conservation concern are:

- 1) The Bongo *Tragelaphus eurycerus*. This large antelope was only recorded for Semliki National Park and Uganda in particular, for the first time in 2018. The species is listed by IUCN as Near Threatened. The only record of this species for Semliki and Uganda comes from camera trapping which is indisputable evidence of its occurrence. At the present time there is no information about its range and population in the Semliki Delta area.
- 2) The Pygmy Antelope *Neotragus batesi*. This forest antelope may occur in at least one other location in Western Uganda and makes this species of interest as a range restricted

species in Uganda. Besides this sighting, there is no recent record of its existence.

- 3) The Water Chevrotain *Hyemoschus aquaticus*, unique for Uganda. It has previously only been reported for Semliki in Uganda in historical data. The species has not been recorded/reported in recent times. The species is listed as Data Deficient (DD) on the national listing for Uganda.
- 4) The Hippopotamus *Hippopotamus amphibious* (VU), Leopard *Panthera pardus* (NT), and Lion *Panthera leo* (VU), of which only few remain after the poaching in the period 1971-1986 and which are probably concentrated in the upstream Semliki Nature Reserve.
- 5) Tree Pangolin *Manis tricupsis* (VU) and the African Spot-necked Otter *Hydriectis maculicollis* (NT) both classified as endangered species in Uganda.

The recent discovery of the Bongo highlights the fact that the mammalian diversity of different habitats maybe far from being completely documented and that more species remain to be discovered.

3.1.6 Amphibians and reptiles

Albeit scarce data is available on the distribution of amphibians and reptiles (together: herpetofauna) in the Semliki Delta wetland system; recordings are for example available for a few locations around Ntoroko Town. Most of the data presented in (Behangana 2019) is in adjacent areas further Southwest in Semliki National Park and Southeast in the Nkusi Delta. A total of 28 amphibian species, belonging to the order anura, 8 families and 12 genera were predicted for the Semliki Delta wetland. Semliki Forest has the highest diversity with 26 species, while Nkusi Delta has 12 species and Ntoroko area had the least diversity with 11 species. Many different species of frogs were recorded. All amphibian species in the area are globally and nationally listed as of Least Concern except the Lake Victoria Toad *Schlerophrys vitattus* (Data Deficient), African Clawed frog *Xenopus ruwenzoriensis* and the Bouchia Clawed frog *Xenopus pygmaeus* (nationally assessed as Endangered).

A total of 15 reptilian species of Semliki Delta are globally and nationally listed as of Least Concern. Exceptions are: The Grass-top Skink *Trachylepis megalura* (globally listed as Not Evaluated, nationally listed as Near Threatened), the Common House Snake *Boaedon cf. fuliginosis* and White-lipped Herald Snake *Crotaphopeltis hotamboia* (both globally listed as Not Evaluated), the Angola Green

Snake *Philothamnus cf. angolensis* and Laurent's Green Tree Snake *Dipsadoboa viridis gracilis* (nationally listed as Data Deficient). The most highly rated reptilian species in the area is the African Soft-shelled Turtle *Trionyx triunguis*, globally listed as Vulnerable and nationally as Critically Threatened. More species reptilian species could occur with more extensive surveys in the Semliki Delta area. The low diversity could be due to the few and far off surveys done so-far.

The Semliki Delta wetland is also home to a large number of crocodiles that attack and kill livestock and sometimes human beings. According to the TEEB study, the frequency and severity of such attacks varies but it is estimated that crocodiles kill three goats or sheep per day and kill or injure two cows a month across the delta (NBI 2019b).

3.1.7 Fish

Due to the inflow of nutrients, silt and organic matter, aquatic macrophytes develop extensively in Semliki Delta that promote breeding and nursery grounds for many species of fish. As such, the Semliki Delta wetland area is extremely important for the fish of Lake Albert, especially as Semliki Delta is much larger than the delta of the Victoria Nile, which is the biggest river inflow (73%) of Lake Albert.

In 2010, more than 19 fish species were found in Lake Albert and Semliki wetland (Table 4) by NaFIRRI while in recent years more than 33 fish species were found in Lake Albert and Albert Nile (NaFIRRI 2014). Few and important fish species were observed at the Kamuga landing site in Semliki Delta, along the Lake Albert shoreline, in a one day visit in April 2019 (see Plate 1-10 in Appendix B2). The diversity of fish species in Lake Albert is generally low compared to Lakes Malawi, Tanganyika and Victoria. Scientists urge that the situation is due to the fact that, the Lake was separated from the upper Nile lakes (Kyoga and Victoria) by the Murchison Falls which acts as a natural barrier to natural upstream movement of fish and very few of its fish species have been able to reach the system above the falls (Greenwood 1981). The absence of these Nilotic fish species from Lake Victoria, and Lake Kyoga, permitted the extraordinary radiation of their endemic Haplochromines (600+ species in Lake Victoria) and a similar radiation has not occurred in Lake Albert. Greenwood (1966) listed only six Haplochromine species from Lake Albert but recent work by NaFIRRI suggest that there may be two un-described species code-named *Neochromis "nigricans"* and *N. "zebra"* held in the NaFIRRI Museum in Jinja, Uganda (NaFIRRI 2014).

Table 4: Fish species targeted in Lake Albert and Semliki wetland

1. <i>Lates Niloticus</i> (Mputa)	11. Malapterurus
2. <i>Neobola</i> (Muziri)	12. <i>Alestes</i> (Angara)
3. Tilapines (Ngege)	13. <i>Brycinus</i>
4. <i>Clarias</i> (Male)	14. <i>Bagrus</i>
5. <i>Protopterus</i> (Mamba) (Ssemutundu/Munama)	15. <i>Mormyrus</i>
6. <i>Synodontis</i> (Nkolongo)	16. <i>Distichodus</i>
7. Haplochromines (Nkejje)	17. <i>Hydrocynus</i> (Ngassia)
8. <i>Labeo</i> (Ningu)	18. <i>Auchenoglanis</i>
9. <i>Barbus</i>	19. <i>Polypterus</i>
10. <i>Schilbe</i>	20. Others

Greenwood (1966; 1981) found about 40-57 fish species which is about one-third (1/3) of the total number recorded from the Nile system as a whole. But the only cichlids were six Haplochromines and three *Tilapia* species, all of which are restricted to sheltered, inshore areas, particularly lagoons. Two of these cichlids are endemic and non-cichlids fish species are also endemic. One of these, the Albert *Lates macrophthalmus* is on IUCN Red List of endangered species (Balirwa 1995).

The Lake is one of the few lakes in Great Lakes region supporting a fishery based on a community of indigenous species. The fishery of two types of Nile Perch, *Lates niloticus* and *L. macrophthalmus*, as well as the alestids *Alestes baremose* and *Hydrocynus forskhallii* and cat fishes such as *Bagrus bajad*, *B. docmak*, *Schilbe spp.* and *Clarias gariepinus*. In the early years of the fishery the moonfishes *Citharinus citharus* and *Distichodus spp.* were the most important species (Worthington, 1929) but in the period up to 1960s, the most important species were

Alestes, *Lates*, *Hydrocynus* and *Tilapias* (Holden, 1963; 1970). The fishery now dominated by two small pelagic fishes, *Neobolabreoi* (52%) and *Brycinus nurse* (34%) with larger species contributing much less (*Lates spp.*- 6%, *Hydrocynus forskalli*-4%, and *Tilapias*-2%) (NaFIRRI 2010). A more extensive overview of fish biodiversity, fishing methods and fishing gear can be found in [Appendix B](#).

3.1.8 Insects

Insects such as butterflies, dragon flies or dung beetles are very useful indicators for the overall biodiversity of an ecosystem. Advantages of surveying these larger insects as a proxy for biodiversity include ease of sampling and a well-defined taxonomy. Butterflies have widely been used as indicators of sustainable forest management, dragonflies have been used as flagship species in freshwater conservation, and dung beetles have been widely used in studying ecosystem functions such as nutrient recycling and parasite suppression (Akite 2019).

According to Akite (2019), a total of 253 species of butterflies and 72 species of dragonflies have been recorded in the Semliki Delta. These include 47 and 21 endangered species of butterflies and dragonflies listed as Vulnerable (VU), Endangered (EN) or Critically Endangered (CR) on the Uganda National Red List (Table 5). Also, several Albertine endemic species have been recorded in this area.

Butterflies

The populations of butterflies are influenced by changes in local climatic conditions and the availability of host plants for larval and adult stages. Changes in the abundance, structure, and diversity of butterfly assemblages have been linked to gradients

TABLE 5: SUMMARY OF THREATENED SPECIES OF BUTTERFLIES AND DRAGONFLIES IN SEMLIKI DELTA (SOURCE: AKITE 2019)

	Status	Semliki Delta	
		IUCN Red List	Uganda National Red List
BUTTERFLIES	CR	0	3
	EN	0	14
	VU	0	30
DRAGONFLIES	CR	0	10
	EN	0	2
	VU	0	9

Critically Endangered (CR), *Endangered (EN)*, *Vulnerable (VU)*

of human-generated disturbances. Butterflies are the second group of insects that pollinate most food crops and, as such, are of great value for agricultural production.

A total of 253 species of butterflies have been recorded in the Semliki Delta. Some of them are included in the Uganda red list for endangered species: Three with the threat status 'critical', 14 with the threat status 'endangered' and 30 with the threat status 'vulnerable' (Akite 2019).

Dragonflies

Utilizing both aquatic and terrestrial habitats, the dragonflies that are predominantly diurnal contribute greatly to the evaluation of environmental quality. The amphibious larvae are critical in regard to water quality and aquatic morphology of streams. The adults are sensitive to habitat structure and are excellent indicators of river disturbances. Dragonflies are among the major biological control agents for mosquitoes and are therefore valuable in counteracting the spread of Malaria.

72 species of dragonflies have been recorded. Of these, ten species are listed with the threat status 'critical', two with the threat status 'endangered' and nine species have the threat status 'vulnerable' (Akite 2019).

3.1.9 Vermin and invasive species

Vermin

Vermin control services are provided in areas where frequent inter-face between vermin and humans is reported. No common vermin are known in Semliki Delta wetland landscape. Based on anecdotal evidence, violent interactions between crocodiles and humans (mainly fishermen) do occur occasionally in River Semliki.

Invasive species

The common water hyacinth (*Pontederia crassipes*) has become an invasive plant species in the northern tip of Lake Albert. The Karuma and Murchison Falls crushed to pieces mobile water hyacinth floating down the Nile. Hence, mainly fragments of the weed from upstream entered Lake Albert where the viable portions sprouted profusely in the shelter environments of the Nile Albert delta and the northern tip of Lake Albert. However, water hyacinth is not known to be common on River Semliki and was also not observed during the April 2019 field mission.

3.2 ECOSYSTEM SERVICES

A wetland is any land area that has the ability to hold surface water and support aquatic flora and fauna. Wetlands in general are not only hotspots of biodiversity, they provide an array of ecosystem services (Figure 24). Ecosystem services provided by wetlands can be divided into provisioning functions (e.g. food, water and raw materials), regulating and supporting services (e.g. regulating climate through carbon capture and storage in wetland sediment and groundwater), habitat services (e.g. supporting aquatic flora and fauna, providing breeding grounds for birds and sustaining ecosystem health by maintenance of genetic diversity) and cultural and amenity services (e.g. green spaces for recreation and outdoor activities).

The benefits to humankind that can be delivered by natural systems are known broadly as ecosystem services. The concept has developed over many years, through the Millennium Ecosystem Assessment (MEA, 2005) and now with a Common International Classification of Ecosystem Services (CICES). A useful analysis of ecosystem services and their value can be found in 'The Economics of Ecosystems and Biodiversity (TEEB)' project, which uses the categories as can be seen in Table 6. Ecosystem services include 'provisioning' services such as food, fibre, genetic materials, etc., which we obtain directly. Arguably, provisioning services can be subdivided in carrier functions (use of wetland space for agriculture, livestock grazing etc.) and production functions (harvesting of natural resources). Then there are 'regulating' services, which are derived from ecosystem processes (nutrient supply/cycling, pollination, natural pest control, etc.) or which regulate essential parts of the ecosystem (temperature and humidity regulation, air or water quality, etc.). The concept of ecosystem services also recognises that there are other values that cannot be expressed in such mechanistic or utilitarian terms yet may be very important for cultural reasons, for amenity or habitat maintenance.

The majority of the around 48,000 people living in the transboundary ecosystem (see chapter 6.1) depend heavily on the ecosystem services provided by the wetland to support their economic well-being and survival. Specific examples of ecosystem services falling under each of the four main types of services described above are shown in Table 6. These examples are based on field surveys undertaken by the project team in 2019 as well as on expert judgement. The assessment involved participatory discussions by wetland stakeholders including government agencies, NGOs and community-based groups,

The Wonder Of Wetlands

A wetland is any land area that has the ability to hold surface water and support aquatic flora and fauna. In urban spaces, wetlands occur in the form of lakes, ponds, marshlands and swamps.

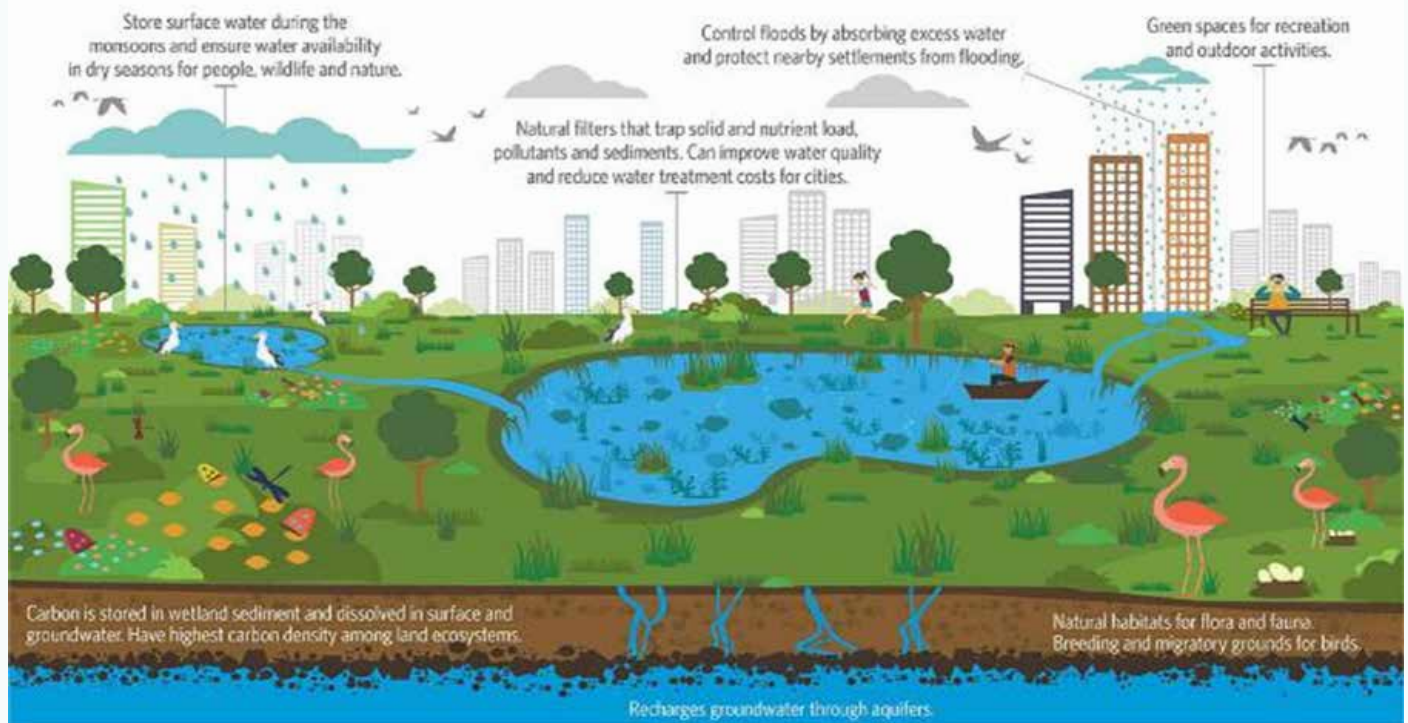


FIGURE 24: OVERVIEW OF WETLAND ECOSYSTEM SERVICES (SOURCE: THE NATURE CONSERVANCY INDIA).

whose perceptions and interests were collected. Note that the importance of the different services can vary between communities within the project area. For example, the Rwebisengo community, located along the west and north western edge of the reserve in the Semliki Flats, are predominantly pastoralists. The Ntoroko community, located at the south-eastern tip of Lake Albert between the estuaries of Wasa and Muzizi rivers at the end of the delta, are predominantly fishers.

Many of the resources in the wetland are related to multiple uses, and there are many interlinkages between the different types of services. For example, grass is used for livestock grazing, but also as building material and mulch for agriculture (Table



FIGURE 25: LOCAL PALM WINE BAR IN RWEBISENGO TOWN (SOURCE: TEEB STUDY SEMLIKI DELTA, NBI 2019B).

6). Animals, such as the crocodile, are a food source, are used for medicinal purposes, and also play a role in eco-tourism potential and research opportunities. Regulating and supporting services are less tangible, but this does not mean they are less important. One specific example is water storage in the wetland during times of high rainfall, which has the double benefit of reducing flood risk but also providing a water store that can be used in the dry season. In Semliki Delta, palm trees cover a wide range of eco-system services as they can be harvested (f.e. palm leaves for religious practises and palm wine as alcoholic beverage; Figure 25), but also filter the air, serve as wind breaks and contribute to erosion control.

Providing habitat to a wide range of species, including animals, birds, insects, microorganisms, and plants is an eco-system service in and of itself, but is also crucial to support many other types of ecosystem services. Some species are harvested, others have other indirect use such as providing a basis for eco-tourism, while other species have no direct use for the local population yet are still play an important role in ensuring a strong ecosystem. These examples show how each eco-system service cannot be evaluated individually, but that each is part of a complex web that must be used sustainably to ensure its conservation for future generations.

Table 6: Classification of ecosystem services (adapted from TEEB, 2010), with specific examples of these services in Semliki Delta wetland landscape

Type of service	Ecosystem service	Examples in Semliki Delta
Provisioning services	1. Food	Fish, (bush)meat, snails, crabs, plants, palm wine
	2. Water	Drinking (domestic and livestock), bathing, cooking, industrial use
	3. Raw materials	Grass (pasture, mulching, building material), reeds and papyrus (crafts, mat making, houses-thatching), sand (construction material), wood (fuel, building material), phragmites (building material), oil, palm leaves (religious practices)
	4. Genetic resources	Gene banks for sustainable food and agricultural products
	5. Medicinal resources	Medicinal plants, herbs and animals (including crocodile) for medicinal use
	6. Ornamental resources	Materials for handicrafts, bird feathers
Regulating (and supporting) services	7. Air quality regulation	Filtration of particles and chemicals
	8. Climate regulation	Wind breaks, rain formation, carbon sequestration (peatlands)
	9. Moderation of extreme events	Flood control, water buffering to mitigate droughts
	10. Regulation of water flows	Natural drainage, water storage, drought prevention
	11. Waste treatment	Water purification and filtration
	12. Erosion prevention	Soil loss avoidance, vegetated buffer strips
	13. Maintenance of soil fertility	Soil formation, nutrient enrichment
	14. Pollination	Providing habitat to pollinators such as bees, birds, bats and butterflies, which are important for fertilization of crops
	15. Natural regulation of pests, weeds and diseases	Natural pest control to better protect livestock and crops
Habitat services	16. Maintenance of life cycles of migratory species	Bio-corridors and stepping stones
	17. Maintenance of genetic diversity	Diverse habitat supporting many species (like fish nurseries, insects, micro-organisms)
Cultural and amenity services	18. Aesthetic information	Natural beauty of Semliki River / Lake Albert and its wetlands can attract tourists and investors
	19. Opportunities for recreation and tourism	Eco-tourism, cultural sites
	20. Inspiration for culture, art and design	Animals with cultural significance
	21. Spiritual experience	Religious practices, shrines and holy places
	22. Information for cognitive development	Research (animals, birds, weather)

TEEB study for Semliki Delta

Currently, The Economics of Ecosystems and Biodiversity (TEEB) study is being undertaken for Semliki Delta (NBI 2019b). The TEEB initiative proposes a structured approach to valuation that helps decision makers recognize the wide range of benefits provided by ecosystems and biodiversity, demonstrates their values in economic terms and where appropriate captures those values in decision making. The study aims at building a knowledge base on trans-boundary wetland biodiversity and ecosystem services economic values to provide the “business case” and economic justification for green infrastructure investment through wetland management and conservation investment planning.

The objectives of the study include:

- 1) Identifying and quantifying the ecosystem services generated by the Semliki Delta trans-boundary Wetland;
- 2) Determining the economic value of the ecosystem services generated by the Semliki Delta trans-boundary wetland;
- 3) Identifying and assessing, using a participatory approach, the priority social, economic and environmental issues in the wetland system;
- 4) Carrying out stakeholder mapping/identification, analysis and engagement to

determine those who enjoy the benefits or suffer the costs of wetland degradation and loss;

- 5) Generating recommendations and a way forward for integration into the Semliki Delta trans-boundary wetland management plan.

Field interviews, meetings and key informant interviews were undertaken on at-least ten respondents per sub-county using a structured questionnaire for the Ugandan side. The respondents were selected using purposive random sampling techniques to improve representation. Key informant discussions substituted for interviews on the DRC side due to insecurity and restricted accessibility.

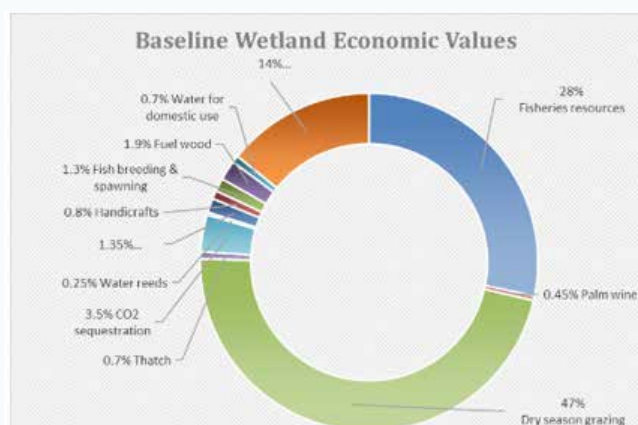
Focus group discussions were also conducted to determine the type, quantity, frequency and price of wetland resources households used in the area (NBI 2019b).

The Market Price Method (market prices of products that are traded in the market are used to estimate the total value of production) was used for valuation of ecosystem services. Table 7 and Figure 26 show the valuation of eight main ecosystem services, according to the draft results of the TEEB study (NBI 2019b). The economic valuation of the Semliki Delta wetland landscape shows that it provide ecosystem services to more than 4,769 households across the border of DRC and Uganda to an estimated value of 91 billion Ugandan shilling (USD 25 million).

TABLE 7: BASELINE ECONOMIC VALUE OF SEMLIKI DELTA WETLAND LANDSCAPE ECOSYSTEM SERVICES (TEEB STUDY SEMLIKI DELTA, NBI 2019B)

Ecosystem service	Total Value for the Delta (50,000ha) in Ugandan shillings
Fisheries Resources	25,590,150,000
Papyrus and other craft materials (total for water reeds, thatch and handicrafts)	1,594,208,000
- Water reeds	229,400,000
- Thatch	635,488,725
- Handicrafts	729,319,275
Medicinal Plants and Food Materials (total for medicinal plants and palm wine)	1,639,327,200
- Medicinal plants	1,228,327,200
- Palm wine	411,000,000
Fuel-wood	1,706,010,000
Dry season grazing (Total Milk Values, Beef, Goats and Sheep)	42,349,787,500
- Milk values	8,373,100,000
- Beef values	30,467,187,500
- Sheep and goats	3,509,500,000
Water Supply for Domestic and Livestock Use	13,534,740,000
- Domestic Supplies	630,990,000
- Livestock Supplies	12,903,750,000
Fish breeding and spawning	1,149,750,000
Carbon sequestration values (excluding avoided CO ₂ emissions)	3,214,920,000
TOTAL	90,778,892,700,00

FIGURE 26: BASELINE ECONOMIC VALUE OF SEMLIKI DELTA WETLAND LANDSCAPE ECOSYSTEM SERVICES (TEEB STUDY SEMLIKI DELTA, NBI 2019B)



According to the TEEB study, the wetland is infested with crocodiles that attack and kill livestock and sometimes human beings. The frequency and severity of such attacks varies but it is estimated that crocodiles kill three goats or sheep per day and kill or injure two cows a month across the delta. The loss attributed to crocodile attacks on livestock is in the range of Ushs 273,750,000 for goats and 40,800,000 for cattle or a total of Ushs 314,550,000 per annum across the delta (NBI 2019b).

5.1 MAIN ACTORS AND INTERACTIONS IN THE WETLAND LANDSCAPE

Due to the transboundary nature of the Semliki Delta wetland landscape, actors at several different institutional levels influence the management of the landscape. The actors range from global and organizations, which are by definition transboundary in nature, to institutions at national and local levels (Figure 27). Each actor has a different level of interest

in the wetland landscape and a different level of power to initiate change. Proper identification of stakeholders and their motivations and interactions is a crucial step in recognizing the avenues of change within a landscape (Figure 28). A brief overview of the different levels and general delineation of the actors involved at each level is provided in this subchapter. A detailed stakeholders analysis is presented in the Semliki Delta Wetland Management Plan.

FIGURE 27: SCHEMATIZATION OF A SELECTION OF RELEVANT ACTORS AT DIFFERENT LEVELS.

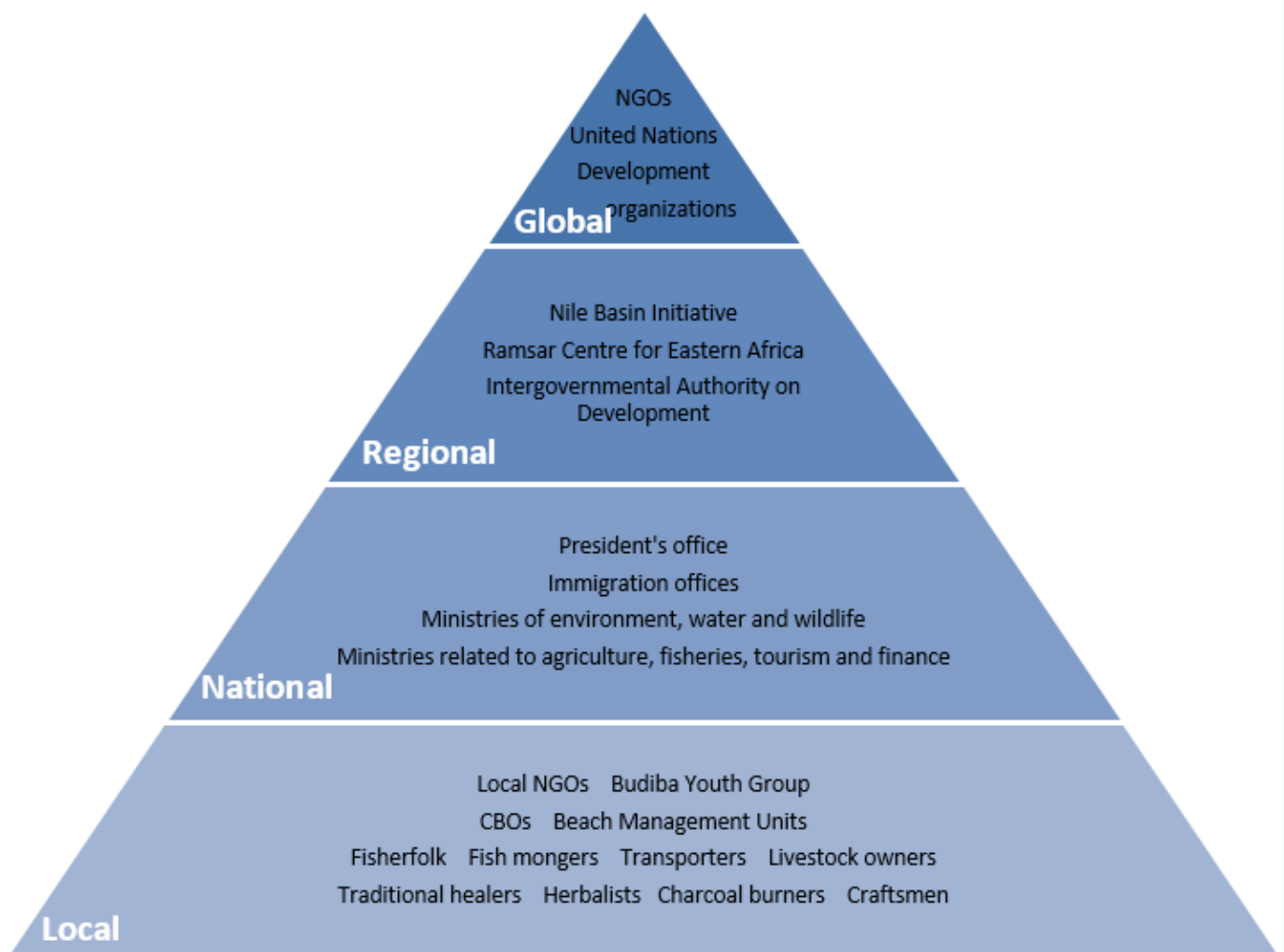


Figure 27: Schematization of a selection of relevant actors at different levels.



FIGURE 28: REPRESENTATIVES FROM A BROAD RANGE OF GOVERNMENT MINISTRIES, NON-GOVERNMENTAL ORGANIZATIONS AND COMMUNITY BASED ORGANIZATIONS SEMLIKI DELTA. PHOTO TAKEN IN FORT PORTAL, UGANDA, BY WETLAND INTERNATIONAL.

4.1.1 Global level

At global level, there are several organizations that can influence the Semliki delta wetland area, either directly or indirectly. Institutions linked to the United Nations, in particular, such as the FAO, are important global-scale actors. International NGO's, for example the World Wide Fund for Nature (WWF), are important funding sources for conservation projects around the world and at different scales. In the same way, development organizations and global financial institutions such as the World Bank have great potential to influence wetland conservation and management through investments and projects.

4.1.2 Regional level

Here, we define the regional scale as larger than national, but smaller than global scale. In this way, the regional scale may be defined by a set of neighbouring countries or may be defined by physical boundaries defining a water basin that lies within more than one country. One actor that is directly related to wetland conservation and promoting wise use of wetland resources is the Ramsar Centre for Eastern

Africa (RAMCEA), which supports East African Community countries. The Intergovernmental Authority on Development (IGAD) has developed regional policy and regulatory frameworks for water resources management to address transboundary water challenges, with eight participating countries in East Africa.

Other regional actors are those related to the sustainable development and/or management of basins. The Semliki Delta drains into Lake Albert. From there, the River Semliki ultimately drains into the River Nile. The Nile Basin Initiative (NBI), and the related Nile Basin Secretariat and Nile Council of Ministers, are important players at this level as they formulate and implement a wide range of activities aimed at cooperatively developing the river basin.

Implementation of relevant transboundary projects take place such as the multinational Lakes Edward and Albert Integrated Fisheries and Water Resources Management (LEAF II) Project, which is implemented nationally by Uganda and Democratic Republic of Congo.

4.1.3 National Level

The national level is the first level that does not naturally adopt a transboundary approach, though many nations participate in transboundary efforts, whether formalized or informal. The national government, including the president's office and various ministries are important actors at this level. Actors directly involved with the conservation and management of the environment and water resources, including the national environmental management authorities, wildlife services, tourism, or, in the case of Uganda, the Wetlands Management Department, clearly have an interest in and impact on the management of the Semliki delta wetland area. For example in Uganda, the Ministry of Water and Environment (MWE) is the lead agency for implementation of Catchment based Water Resources Management (CbWRM) through the Directorate of Water Resources Management (DWRM), who is operationalizing the CbWRM framework through the Albert Water Management Zone (AWMZ). However, decisions made by governmental bodies related to finance or livelihoods such as fishing and agriculture may also impact the wetlands.

This influence can be direct, for example by determining which fishing methods are legal, or indirect by designing or affecting budgets. The national enforcement and judiciary branch are important, as the regulation and enforcement of laws and policies depends on these actors. The army and national immigration offices are especially important along the Uganda-DRC border. Aside from the governmental agencies, there are NGO's that operate within a country in particular and are involved with the environment and/or livelihoods. In Uganda, an example of such an NGO is the Uganda Environmental Education Foundation, which provides training and education services about agroforestry, water and sanitation and environmental rights.

4.1.4 Local level

The local level is unique in that it may include organizations as well as collections of individuals. Local institutions include not only the local government, but also local NGOs. At village level, there are CBOs within the study area. Institutions representing livelihoods are also important actors at this level, including for example Beach Management Units and Fish Farmers Associations, which are involved in management of fisheries resources. A local environmental youth group, the Budiba Youth Group is another example of a local institution. Finally, there are individuals that have an interest and/or influence

on the Semliki Delta area. Though some of these groups are represented by user associations and other local institutions, the interests of the institutions may not reflect the interests of all individual users. In the Semliki Delta, fisherfolk and fish mongers account for a large part of the local population. In addition, there are livestock keepers, charcoal burners and traditional healers that all make use of the wetland resources in different ways. Religious and cultural leaders play an important role in communities, and therefore can also influence wetland management. Tourists and migrants also have an interest in how the wetland is managed. In many cases, the local population does not fall into distinct groups, but have an interest in or impact on the wetlands through several channels. For example, one person may use water for domestic use, but also keep livestock and harvest resources from the wetland.

4.2 POLICIES AND LEGISLATIONS

The sustainability of agriculture, livestock production, fisheries and aquaculture is of a global concern. There are international and regional policies, legal instruments and institutions to support f.e. fisheries development, establishments and practices in East Africa. These can influence the management of wetland landscapes directly or indirectly.

These policies, if ratified by all countries containing the transboundary wetland, have the advantage that the objectives are aligned for the entire wetland area. Other policies and institutions are active at national or sub-national levels. While these may be more specifically tailored to local conditions, it is also possible that differing policies between neighbouring countries can complicate the management of transboundary wetlands. This subchapter gives an overview of the most relevant policies and legislation at different levels for the Semliki Delta wetland landscape. An extensive list of all policies and legislations relevant for Semliki Delta can be found in the Wetland Management Plan.

4.2.1 Global

Policies developed by international organizations at the global level can be adopted by national governments to support a range of sectors from agriculture and livestock production to the environment to governance issues and development. One example of an international treaty is the Ramsar convention, which has been ratified by both DRC and Uganda. The contracting parties commit to cooperate in the management of transboundary wetlands. The convention also stipulates the need to include

wetland management in river basin planning. In addition to the Ramsar convention, wetlands may be recognized and protected by being UNESCO biosphere reserves or parks. Another environmental global treaty that have been ratified by both DRC and Uganda is the Convention on the Conservation of Migratory Species of Wild Animals (also known as the Bonn convention). This convention not only aims to protect the migratory species, but also aims to conserve and restore their habitats and remove obstacles to their respective migrations. Other global-scale policies may be more indirectly linked to wetland areas, such as policies set out by the Food and Agricultural Organization of the United Nations (FAO). These treaties are related to the regulation of fisheries, livestock production and agriculture.

4.2.2 Regional

Regional policies and legislation are often developed at the level of the African Union, East African Community (EAC) or the Nile Basin Initiative (NBI). For example, the members of the EAC ratified a treaty in 1999 which aimed to promote the sustainable utilization of natural resources in the partner states. Specific articles cover the management of the environment and natural resources, which includes wetland areas like the Semliki Delta wetland.

NBI has developed several policies and frameworks for the Nile riparian countries, with the overall aim to promote joint development, protection and management of common Nile River Basin water resources. For example, the Nile Basin Sustainability Framework adopted in 2011 describes the priority thematic fields of activity for sustainable transboundary management. In addition, NBI has developed several strategies, including the wetland management strategy, a climate change strategy and an environmental flow strategy, which are all relevant for wetland management. As part of the LEAF II project, the harmonization of fisheries legislation and regulation was completed and a Bilateral Agreement between Uganda and DRC on the Fisheries Management and Development was signed during the 7th Uganda – DRC Joint Permanent Commission on October 20, 2018 (MWE 2019).

4.2.3 National

At national level, policies and legislation focusing on a large variety of sectors can directly or indirectly influence how wetlands are used and managed. The national government is an important initiator of policies at this level, though other national institutions may also be relevant. The most obvious

examples of relevant policies, legislation and regulation are those related to wetland management specifically. For example, the Ugandan National Wetlands Policy of 1995 aims to ensure wise use and sustainable management of wetlands to ensure their ecological and socio-economic functions for present and future generations. Similarly, the Wetlands Sector Strategic Plan 2011 – 2020 aims to enhance the knowledge base and improve the institutional and technical capacities to ultimately improve wetland management. Recently Uganda published the first edition of the Communication Education Participation and Awareness (CEPA) Strategy for the Ministry of Water and Environment (MWE) for the period 2019 – 2024.

Currently, the Environmental and Social issues are being addressed basing on the National Environment Management Policy and other guiding documents including the Environment Impact Assessment (EIA) guidelines and other Tools developed by National Environment Management Authority (NEMA) while some projects have been using the World Bank Environment and Social Safeguards Policies and other donor -specific ES policies. Other policies that more directly affect wetlands are environmental and forestry policies and those related to water resources. Both countries have acts related the environment or environmental management and concerning wildlife. The policies related to wetland and environmental conservation may or may not be formalized into law and should be translated into practical management to be effective.

Other policies not directly linked to the environment and wetlands are equally important. For example, policies related to water and sanitation services may result in higher water extraction rates from wetland areas, potentially decreasing water availability. At the same time, improved sanitation has the potential to reduce contamination of water resources. Similarly, regulations related to water abstraction and wastewater affect water availability and water quality. In addition, policies and legislation related to agriculture, livestock production and fisheries, the most important livelihood activities that are likely to conflict with wetland conservation and restoration, are important to take into account.

Legislation related to the administration and stewardship of land and wetlands is particularly relevant in the development of a successful wetland management plan. In Uganda, for example, the Land Act of 1988 states that the government or local government holds land in trust for the people and protects environmentally sensitive areas such as natural lakes, rivers, and wetlands.

4.2.4 Local

The local government, but also Water User Associations, Beach Management Units and other local institutions, are responsible for the final level of policies, legislation and regulation. Each institution has developed policies pertaining to their specific mandate. For the local government, this may span several sectors. For other institutions such as the BMUs these may be focused on a particular sector, such as fisheries.

4.3 PROTECTED AREAS

Semliki Delta and the last part of the river Semliki are located in the Semliki Controlled Hunting Area which extends up to River Semliki and Semliki Wildlife Reserve, both forming the Important Bird Area, part of which is a protected area managed by the Uganda Wildlife Authority. Fish breeding areas in Lake Albert area are also protected areas, in which no fishing activities are allowed. The Semliki Delta is recognized as a fish breeding area and the development and management of fisheries resources is one of the three components of the LEAF II project.

The LEAF II Project proposes to engage in innovation and knowledge generation activities aimed towards improving the aquatic biodiversity of the LEA through the expansion of the fishing ground and protection of sensitive breeding sites. The project will build on the

knowledge acquired from implementation of similar regional projects by NBI in developing effective strategy to i) improve regional capacity to conduct research on the fish biology, taxonomy studies, stock assessment and water quality study ii) outline management steps needed for establishment of protected areas for fish breeding within LEA basin iii) identify capacity needs of the stakeholders especially in raising awareness on environmental, social and health benefits of the activities (AU-IBAR 2016).

In the financial year 2018-2019 two patrol boats to aid in the surveillance operations in both lakes Edward and Albert were procured where 21 marines/coxswains were trained in the operation & maintenance of the patrol boats (Figure 29). Also one research vessel for Lake Albert was procured and the award of contract made. The construction/building of the vessel is to commence in September 2019 (MWE 2019).

4.4 NATURAL RESOURCES MANAGEMENT

Natural resource management refers to the management of natural resources such as land, water, soil, plants and animals, with a particular focus on how management affects the quality of life for both present and future generations. Natural resource management deals with managing the way in which people and natural landscapes interact. It brings together land use planning, water



FIGURE 29: PATROL BOAT DURING TRAINING OF MARINES/COXSAINS, TO AID IN THE SURVEILLANCE OPERATIONS IN LAKE ALBERT (MWE 2019).

management, biodiversity conservation, and the future sustainability of industries like agriculture, mining, tourism, fisheries and forestry. It recognises that people and their livelihoods rely on the health and productivity of our landscapes, and their actions as stewards of the land play a critical role in maintaining this health and productivity.

Land ownership and tenure in DRC

For centuries customary systems on land and resource rights governed the livelihoods of communities that lived interdependently with their surroundings and the rich biodiversity in it. During colonial times these systems were overturned and so they are until today. Under the formal law, the state owns all the DRC's natural resources (land, water, forests, and minerals); people can obtain various types of use and exploitation rights under an evolving set of laws and regulations. In practice, customary law endures, and natural resource rights are subject to parallel, incomplete, and often contradictory systems of formal and customary law. Land rights are often ambiguous, usually undocumented, and tenuous. The DRC is currently looking at the need to revise the legal framework for land tenure, which should secure security for landholders and subsequently foster more productive and sustainable use of land (LandLinks by USAID 2010). Increasingly there are competing demands over access and control of land: customary land rights of indigenous and local communities compete with infrastructure projects, commercial and industrial scale agriculture, nature conservation and resource exploitation: mining, oil and forestry (IUCN 2016). To establish a solid basis for community conservation there is first a need to secure and restore community land rights of indigenous people and local communities.

Land ownership and tenure in Uganda

Most of land in the Ugandan part of Semliki Delta, especially outside protected areas, is owned customarily; with small holdings of between 1-3 hectares. In pastoral areas, the grazing and livestock watering areas are mainly communally owned. The communal land ownership is considered to be destructive in terms of environment conservation, often leading to overgrazing and spread of diseases. Moreover, the communal ownership does not relegate responsibility for promotion of good land management practices, leading to "the tragedy of the commons."

According to the Ntoroko District (Uganda) planning department, the peripheral areas of Semliki Delta wetlands are under a mail land tenure system (a

land tenure system where registered land is held in perpetuity).

Interest groups of natural resources

The following interest groups are affected in the way of managing natural resources:

1. Pastoralists: These include owners of cattle, some limited pigs, sheep and goats. Most do practice zero grazing and not very much open land.
2. Farmers: These include those that practice agriculture or get agricultural products from open lands. These may grow crops in general lands as well. There is a group that collects grass for use as mulch in their banana farms and or grass for thatching.
3. Traditional healers: These do collect some plants for use both inside and outside the protected areas.
4. Fishermen: These do fishing in Lake Albert, wetlands, rivers and tributaries.

Fisheries management

As in the case of Lake Edward the role of the NBI/NELSAP as a regional organization that could coordinate harmonization of management measures between the two countries (DRC and Uganda) is currently not in the plan. NBI/NELSAP intends to promote dialogue and to facilitate development of Management and Investment plans of rivers and wetland ecosystems (Regional Workshop in Kampala, held on 9 April 2019; Wetlands International 2019a). Discussions with a Government official at Kanara town council (Ntoroko District) revealed that, the impact of management and community institutions on fisheries resources has been limited because of the lake's remoteness from major administrative centers. There have been some efforts from NGOs, such as WWF, especially in relation to biodiversity conservation in the Albertine region. There are also national regulations and international agreements that could be applied to the development and conservation of natural resources. Fisheries management, as for the other lakes, has been restricted to gear and fish size restrictions, licensing and closed access but this is complicated by the large number of species and wide variety of fishing gear used to catch them in Lake Albert. Consequently these regulations have been unsuccessful and fishing effort has continued to increase (Taabu-Munyaho 2012), as also shown by the high number of fishing boats at Kamuga landing site.

5.1 LIVELIHOOD AND ECONOMIC SYSTEM

The main economic activities in the project area are fishing (with nearly 73% of the population depending on this for their livelihoods), livestock and subsistence small holder farming (the main crops grown being beans, maize and bananas) for subsistence but sometimes for commercial use. Tourism is becoming an increasingly important activity in the wetland landscape. 41.3% of households are engaged in crop growing, 57.8% engaged in livestock; 68.4% crop and/or livestock (MoA 2009).

5.2 LIVESTOCK PRODUCTION AND AGRO-PASTORAL SYSTEM

Livestock is an important activity in the area and most households are cattle keepers. Cattle's grazing is a major economic activity along the river banks on both sides of the boarder. On the Ugandan side, the area has been over stocked and over grazed, leading to severe trampling of the vegetation especially around the watering points on the river which occur randomly about every 5 km along the river. Further to this, the Hema immigrants fleeing political instability in the DRC also come with their cattle adding to the already overstocked area.

Livestock of former Bundibugyo district, now split into Bundibugyo and Ntoroko districts show that 87.3% of the households own livestock, with a median landholding size of 0.8 ha, of which 53% is used for agriculture and 43% for pasture (Table 8). 31.9% of adult cows are milked (MoA 2009).

TABLE 8: LIVESTOCK STATISTICS FOR FORMER BUNDIBUGYO DISTRICT, UGANDA

	Cattle	Goats	Sheep	Pigs*	Chickens
% of households	6.4	44.7	4.1	20.6	53.9
Average size	39.5	3	5	1	8

*Western sub-region

Table 9 shows livestock population for both Uganda at different administrative levels. For DRC however, only national numbers (from 2002) were available, which reports 1.5 million cattle, 49 million goats, 4.8 million pigs and an especially high number of chickens (2 billion), based on MoA 2009 and GoU 2009. Uganda (data from 2002) shows higher number of cattle (11 million) but lower numbers for

the rest. The Western Province shows proportionate numbers of livestock compared to the national level, but a relatively high amount of cattle at Bundibugyo district level.

Livestock population patterns for the whole of Uganda show that a rapid growth is reported since 1991, especially between 2002 and 2008 with numbers of cattle, sheep and goats doubling and the number of pigs quadrupling. Livestock numbers can be volatile however (demonstrated in the year 2002 for pigs), so it is hard to say whether this growth has continued over the last decade and even more difficult to predict future livestock numbers.

According to the TEEB study of Semliki Delta (NBI 2019b), the total livestock population was estimated at over 119,225 heads of cattle, 94,840 goats and 7,124 sheep accounting for over 67 percent, 70 percent, and 46 percent of the respective categories of livestock units in Ntoroko District. The livestock numbers on the DRC side were 24,150 cattle, 800 goats and 10,000 sheep.

5.3 CROP PRODUCTION AND FORESTRY

Despite the climate being favourable for crops such as tea, cassava, beans, maize, banana and cotton which are grown by subsistence farmers on small-holdings in Lake Albert region, crop production in Semliki Delta is limited to vegetables growing on the river banks due to unfavourable (saline) soils.

Cultivation along the river is so rampant especially in Masaka parish stretching northwards towards the Lake Albert area. Common crops planted include bananas, maize, sweet potatoes, cassava and sugarcane. Cultivation goes on all the way to the water mark removing the natural vegetation that would have stabilised the riverbanks. This has caused severe silting of the riverbanks and has thus led to the farmland being barren as the top soil has been washed away into the river. Anecdotal information indicates that officials in the DRC now charge a fee for those who cultivate across the river. There have been attempts by the community in Kabimbiri village to block the water that was just about to break off their land but this foiled by a local chief in the DRC using armed personnel.

TABLE 9: LIVESTOCK POPULATION NUMBERS FOR UGANDA AND DRC AT DIFFERENT ADMINISTRATIVE LEVELS

	DRC				Uganda			
	Cattle	Goats	Pigs	Chickens	Cattle	Goats	Pigs	Chickens
National	1.5 million	49 million	4.8 million	2 billion	11 million	12 million	3.2 million	37 million
Region/province					2.5 million	3.5 million	0.78 million	7.2 million
District					160,000	130,000	15,000	310,000

5.4 FISHERIES AND AQUACULTURE

The Lake Albert fishery is the second largest in Uganda, after Lake Victoria, with an estimated catch of 172,000 t per year in 2014. It supports about 15,400 fishers in Uganda and about 20,000 fishers in DRC, who depend on the lake for their livelihoods (NaFIRRI 2010).

The Semliki Delta – Lake Albert ecosystem provides abundant quantities of fish as a nutritious source of food, income and employment for the population along its lake shores and further inland in both Uganda and the Democratic Republic of Congo (DRC). Improved infrastructure (tarmac road) in Uganda has enabled demand for fish from the lake to spread too far off markets that were previously not accessed.

The main cross-border markets for the fish products from Lake Albert include the two riparian states (Uganda and DRC) and the Sudan with a combined population of close to 140 million people. Worldwide demand for fresh fish has enhanced fish, especially the Nile Perch exports, to markets in Europe and other continents and has led to increased fishing pressure on the fishery resources. In Uganda, a fish processing plant has been established on the Lake Albert shore at Butiaba in addition to the numerous factories in Kampala and Entebbe that process fish from Lake Albert and Victoria. Although the factories originally targeted Nile Perch from Lake Victoria, the smaller Albertine *Lates macrophthalmus* and Nile Tilapia are currently part of the processing chain. There is potential for cage fish farming and some pilot cage farms have been established on the lake.

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The fishery has become increasingly heavily exploited because of the demand for fish both in Uganda and DRC which is driven by a high Multidimensional

Poverty Index (74% of the population in DRC and 55% in Uganda is in multidimensional poverty; UNDP 2019b) and limited opportunities for alternative livelihoods, and aggravated by the open access fishery with limited enforcement of existing fishing laws. As a result, the catch has shifted from large species to small ones, and formerly important species such as moonfish and butterflyfish are no longer captured and the endemic *Albert Lates* is endangered. Over-exploitation has led to reductions in catch per unit effort, decline in catches and reduced fish (Mbabazi et al., 2012). The lake is becoming eutrophic, is rich in phytoplankton and primary production is high, and in some places green algae (*Anabaena*; Appendix B2 - Plate 13) causes anoxic conditions with considerable mortality of Nile perch (Mbabazi et al., 2012).

The increasing pressure on fish stocks is greatly contributing to the decline in species. Overfishing and the use of illegal fishing methods is reducing fish stock indiscriminately and breeding sites are disappearing and fish (by-)laws are violated with the fishermen often not even being aware of doing so.

The following species are especially on the decline: “*Rwoso*” (*mudfish*), “*Ekibanda*”, “*Eminama*”, “*Ebijojo*”, “*Entira*” (*electric fish*), “*pendakula*”, “*ebisomo*”, “*engasa*”, “*ebitumbi*”, “*blaya*”, “*eminozi*”, “*ensa*” (*Nile perch*), “*ensira*” (*tilapia*), “*emaba*” (*lungfish*).

The TEEB study estimated the total annual fish catch in the delta using household production information. Household interviews were supplemented with field observations, key informant interviews and the 2014 Population Census projections for the Uganda side of the delta and administrative records from the area Chefferie for the DRC side respectively to determine the amount of fish caught, consumed and or sold per household per day. The average catch per household per day across the delta was estimated at 3kg per day generating a total catch of 5,118,030 kgs (5,118 tonnes) for all households per annum (NBI 2019b).

The LEAF II Project plan to develop a Fisheries Management Information System for which data and information would be attained through Key Fisheries Assessments, which commenced in 2018/2019 for Lake Albert with the Frame Surveys completed, Catch Assessment Surveys ongoing, identification of fish breeding areas ongoing, and the assessment of the cage aquaculture potential ongoing (MWE 2019).

Fisheries Resources Development and Management is one of the components of the LEAF II project. In 2018/2019, capacity building, training and re-enforcement of fishermen and women organizations

in modern processing techniques was conducted with a total of 197 groups of 3062 participants (42% being women). In order to enhance local communities' capacities to adopt responsible alternative sources of income that reduces the strain on the lakes, the project conducted 3 trainings (Figure 30) of identified groups in alternative livelihoods with 1451 participants (78% being women). The project procured and delivered starter kits to communities in Ntoroko and Kamwenge as an incubator for alternative sources of income e.g. making of liquid soap, bar soap, disinfectant, hair shampoo, school chalk, cake baking (MWE 2019).

5.5 ENERGY SOURCES AND TRANSPORT

The main sources of energy for cooking and lighting in both areas are firewood, charcoal, electricity, paraffin and solar energy. More efforts are highly needed to promote the use of solar energy especially in the rural areas in order to avoid and reduce environmental degradation through charcoal burning. Water transport is the most important means of movement of people and goods especially between fishing

villages in Uganda and those in the DRC.

Oil exploration companies have discovered at least 1.5 billion barrels of oil on the Ugandan shore of Lake Albert. But exploration is expected to continue southwest of the lake, where the Semliki divides the two countries. The aim is to avoid exploration into the DRC borders which might amplify the current disputes between the two countries.

5.6 TRADE AND INDUSTRIES

The trade between Uganda and DRC includes food items, beverages, domestic goods and construction materials, sometimes originating from far inland.

5.7 ECO-TOURISM

Ecotourism is a form of tourism involving visiting fragile, pristine, and relatively undisturbed natural areas, intended as a low-impact and often small scale alternative to standard commercial mass



FIGURE 30: ASSESSMENT OF THE LIVELIHOOD IMPROVEMENT INITIATIVES (MWE 2019)

tourism. Because of its natural beauty, Semliki Delta wetland landscape has a high yet underdeveloped potential for eco-tourism. More efforts are needed to promote community based low-impact eco-tourism, combining both income generation and nature conservation.

Parts of the area are geologically active with the presence of hot springs which are a tourist attraction in the area such as the Sempaya, Kibuku and Buranga hot springs. These hot springs, apart from being prospective site for geothermal energy also attract a large number of birds and supply salt for many animals.

Some of the most visited National Parks of Uganda like Queen Elizabeth, Murchison Falls and Kibale Forest National Parks are located in the Albertine Rift region which is the main centre of tourism in Uganda. In Uganda, these protected areas are managed by the Uganda Wildlife Authority (UWA).

Potential for Eco-Tourism:

1. Community tourism

The Karugutu Community Conservation Association (KCCA) is a community based association whose

objective is conservation education through Music Dance and Drama (MDD). They organize traditional dances for the visitors and they have a shop for handcrafts at the entrance of the reserve which they sell to visitors. Members of the KCCA perform for visitors

2. Boat rides

This is conducted on Lake Albert and the main attractions are Shoebills, African Pygmy Goose, Blue-breasted and Blue-Cheeked Bee-eaters and Blue-headed Coucal

3. Accommodation services

A number of tourist accommodation facilities have been developed in the area. However, due to the low tourism potential of the area, there are not many of these and the ones present are mainly budget bandas and campsites. The most popular are the campsites and budget bandas run by UWA on the shores of Lake Albert at Ntoroko and at the reserve headquarters in Karugutu; Semliki Safari Lodge with a tented camp run by The Uganda Safari Company- a private concessionaire; and the Ntoroko Game Lodge which offers luxury tented camps and a campsite at Ntoroko Landing site.

6.1 HUMAN DEMOGRAPHY

The two main ethnic groups in the region are the Amba people (Baamba, Bwamba) and the Bakonjo (Konjo). People in the Semliki Delta include Batuku, pastoral cattle keepers whose herds graze on grasslands along the river. The Batuku, who mainly live in Rwebisengo community, are believed to be descendants of the Abarusula who were the royal army of the king Kabalega of Bunyoro-Kitara Kingdom. Small populations of Batwa (pygmies), who have traditionally been forest hunter-gatherers, also live in the valley. High population density on the Semliki flats which is also increasing continuously and the active exploration for oil over the last couple of years, which brings in additional immigrants has led to significant investment and urban development along the river. For instance in Rwebisengo town which is only 1.5 km from the river bank, land is now at a premium with the result that there is limited access to this land. Literacy is 60.7% in Ntoroko district in Uganda, where 80.2% of adults are working (UBS 2017). Most people live in fishing communities along the lakeshore, where there has been a tremendous population growth in recent years. For example Similiki village in DRC, located in the Semliki Delta close to Lake Albert, experienced a tremendous growth with around 25 houses in 2003 to more than 300 houses in 2014 (Figure 31).

The TEEB study noted that the delta is undergoing rapid transformation with the development of many urban growth centres. There are also many road construction projects in the area with the overall impact of drawing more settlements into the area. The notable urban growth centres in the delta included Rwebisengo, Kibuku, Ntoroko or Kanara, Nyakasenyi and Kyabukunguru on the Ugandan side and Nyacucu, Kalyabugongo and Kikoga on the DRC side. The urban growth centres, this study noted, have increased demand pressure on local wetland resources like fuel-wood, water and fencing and

construction materials including water reeds, sand and clay. Recent influx of displaced persons from the DRC led to the increase of both people and livestock in the delta on the Ugandan side (TEEB study Semliki Delta, NBI 2019b).

Overall demography figures Semliki Delta

The study area falls within the four sub-counties of Butungama, Bweramule, Kanara and Rwebisengo in Ntoroko District in Western Uganda and parts of Nyacucu, Kalyabugongo, Buguma, Rubungura, Kikoga and Nyanzige Groupings in Ituri province on the DRC side.

The total population Semliki Delta wetland landscape in 2019 was calculated from census data (UN 2019; UBS 2017). In Table 10 population estimates for 2019 are shown, from national level to project area level. The DRC has a population of 87 million, and Uganda has a population of 44 million. In Irumu territory of Ituru province in DRC, and Ntoroko district in Uganda, about 1.3 million and 74,000 inhabitants live respectively. Within the project area, about 24,000 people live on the DRC side and 24,000 on the Ugandan side, for a total of 48,000 people.

This total figure corresponds well with the TEEB study, which estimates the total population in Semliki Delta in 2017 at 45,803 people (NBI 2019b). The TEEB study uses the 2014 National Census and Household Survey data for Uganda, that enumerated the population in the four sub-counties at 41,877 and projected it to slightly decline to 41,353 by 2017. The same census projected the total number of households in the delta in 2017 at 4,769. The population on the DRC side was 4,450 persons living in 967 homesteads (personal communication with the Chief Mugenyi Area Chefferie, Bahema Sud), according to the TEEB study (NBI 2019b)



FIGURE 31: EXPANSION OF SIMILIKI VILLAGE IN DRC, BETWEEN 07/07/2003 (UPPER IMAGE) AND 02/04/2014 (LOWER IMAGE) AS CAN BE SEEN ON SATELLITE IMAGERY FROM GOOGLE EARTH. LAT: 1°15'46.55"N / LON: 30°21'29.36"E.

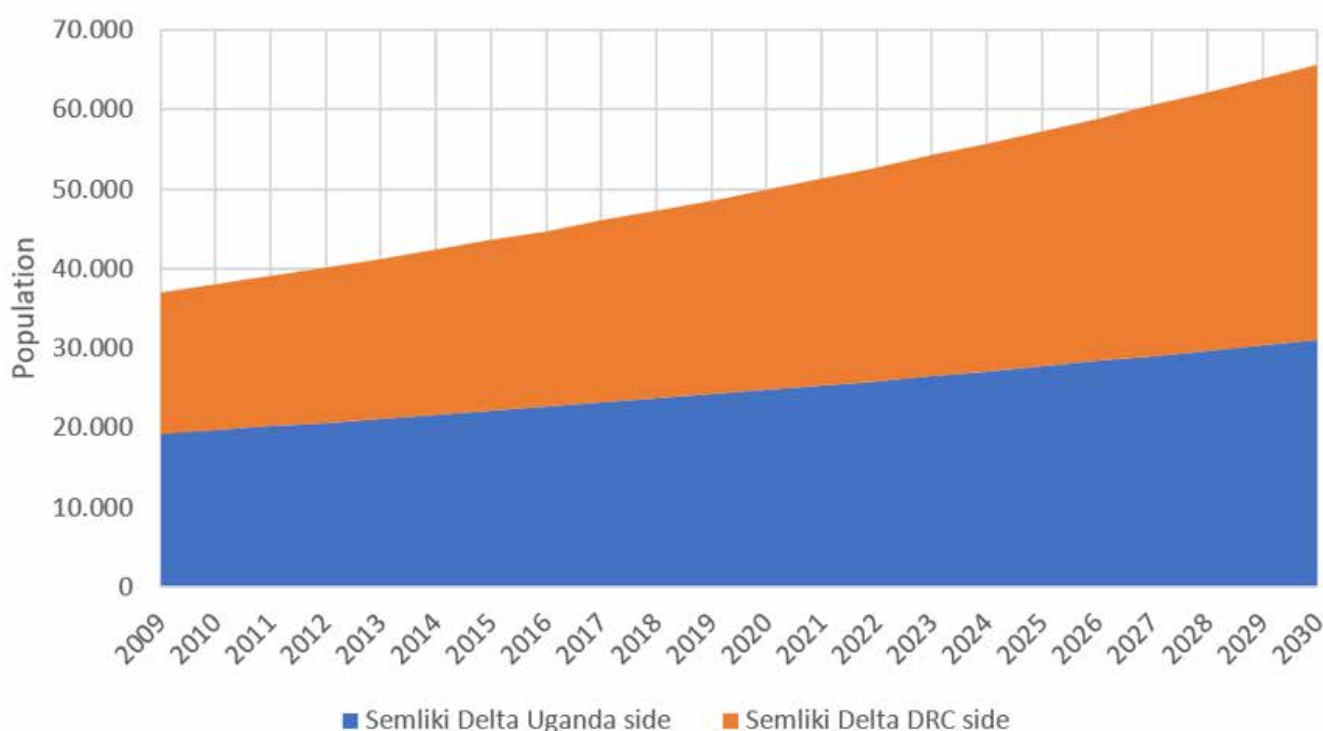
TABLE 10: 2019 POPULATION ESTIMATES AT DIFFERENT ADMINISTRATIVE LEVELS

	DRC side		Ugandan side		Semliki Delta total	
	Population	Growth rate	Population	Growth rate	Population	Growth rate
Country level	87 million	3.22	44 million	3.59		
District/Territory level	1.3 million	3.24	74,000	2.3		
Project area level	~24,000	~3.24	~24,000	2.3	~ 48,000	~ 2.77

The same census data (UN 2019; UBS 2017) was also used to forecast the total population in Semliki Delta wetland landscape until the year 2030, as shown in

(Figure 32), which is expected to rise from the current 48.000 (2019) to 57.000 in 2025 and 65.000 in 2030 with an average population growth rate of 2.77.

FIGURE 32: POPULATION FORECAST OF SEMLIKI DELTA WETLAND LANDSCAPE



6.2 SOCIAL ORGANIZATIONS

6.2.1 Pastoralist organisations

Stakeholders and governmental bodies in the livestock and pastoral, agro-pastoral and semi-intensive cattle and poultry systems in Uganda include the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) and the Dairy Development Authority (DDA). On a local level, PENHA is a distinguished non-governmental organisation with 30 years of experience working on the African pastoral and environmental issues. PENHA’s mission is to reduce poverty among the pastoralists in the Horn of Africa through the empowerment of communities and to foster sustainable and dignified livestock-based and non-livestock-based livelihoods.

6.2.2 Nature and wildlife reserve management

The Uganda Wildlife Authority (UWA) and the Wildlife Conservation Society (WCS) are two of the governing bodies that regulate wildlife conservation in Uganda. In the DRC, over the past 25 years Wildlife Conservation Society (WCS) has been the government’s principle conservation partner, assisting the Ministry of Forest Economy (MEF) in managing wildlife and its habitat in several of the country’s national parks, reserves, and protected area buffer zones. Several international actors support in the conservation and management of wildlife in the Democratic Republic of Congo. On a local level, the Districts Environment officer, Forest officer, Land officer, Entomologist, Natural resource officer, as well as Catchment management committees for both countries (Ug & DRC), NGOs (FLEVICA, LEAF II

for DRC and Nature Uganda and LEA II, JESE for Uganda) are recognized.

6.2.3 Forestry management

In Uganda, in terms of land ownership, 70% of the forest area is on private and customary land, while 30% is in the permanent forest estate (PFE), such as Forest Reserves (central and local), National Parks and Wildlife Reserves. Most of these forests are managed by the National Forestry Authority (NFA) or the Uganda Wildlife Authority (UWA). Local actors recognized in forestry management of Semliki Delta are the Catchment management committees for both countries, Government technical services, NGOs (Nature Uganda, JESE) and CBOs/OPBs.

6.2.4 Fisheries management

Implementation of the multinational Lakes Edward and Albert Integrated Fisheries and Water Resources Management (LEAF II) Project is done nationally by Uganda and Democratic Republic of Congo on one hand and regionally by the Nile Basin Initiative (NBI)/ Nile Equatorial Lakes Subsidiary Action Program (NELSAP) on the other hand. Local actors recognized in fisheries management of Semliki Delta are DFO, DCDO, S/C Chief, S/C Local Leaders, UPDF, RDC (in Uganda) and IPPEL, EDD, ETD, Fishermen's Organization, Local Authorities (in DRC).

6.2.5 Water and sanitation sector

The Water and Sanitation sector comprises of the rural water supply, sanitation and mobilization of benefiting communities. This sector is a self-funded sector of works and technical services. The sector is mandated to carry out supervision, construction of water points, rehabilitation of boreholes, sanitation awareness, mobilization and monitoring of community responses on issues concerning operation and maintenance constructed facilities. However, there are constraints to the performance of the water supply and sanitation sectors such as weak local private sector plays (contractors, consultants and private operator and insufficient funding to meet the high population demands and limited financing options such as infrastructure bonds.

The national Ministries of Water and Environment (MWE) in Uganda and of Planning (through the National Water and Sanitation Committee; CNAEA) in DRC are the key institution responsible for the water and sanitation sector. On local level, some Community Based Organisations (CBO's) or involved in the water and sanitation sector such as BUDA CBO,

BUMASI CBO, LUMA CBO, as well as some NGO's. The Uganda Water and Sanitation NGO Network (UWASNET) is the national umbrella organisation for Civil Society Organisations (CSOs) in the Water and Environment sector. UWASNET is crucial in helping government realise its targets of alleviating poverty and achieving Millennium Development Goals (MDGs) through universal access to safe, sustainable water and improved sanitation. UWASNET plays this vital role in partnership with other key sector players such as the Government of Uganda, Development Partners (DP's) and the private sector. In DRC, the National Sanitation Program/National Directorate of Hygiene (PNA) within the Ministry of Environment, and the Office of Roadways and Drainage (OVD) within the Ministry of Infrastructure, Public Works and Reconstruction have a nominal mandate for sanitation interventions. The PNA is supposed to have a particular focus on vector control through local brigades at the municipal (communes) and district (territoires) levels, but its current reach is extremely limited. In rural areas, the primary interventions are the sanitation components of the Villages Assainis and Écoles Assainies programs supported by the Ministry of Public Health and UNICEF.

6.3 WATER SUPPLY AND SANITATION

6.3.1 Water supply

From the community level meetings (see meeting report; Wetlands International 2019b) and field surveys performed in April 2019 (see Appendix B) it becomes clear that in Semliki Delta severe water shortage is experienced, both for animals and for humans. This can be explained in terms of inadequate resources exploitation and poor technology rather than resource scarcity, as sufficient water resources are available; both groundwater and surface water. The geology and soils (chapter 2.2.2) in Semliki Delta are favourable for groundwater exploitation and in addition huge reserves of fresh water are available such as River Semliki and Lake Albert. As per June 2019, the rate of access to a safe source of water (safe water coverage) in Ntoroko District, Uganda, was estimated at 88%, with a functionality of 74%. The current strategic directive by the Uganda government is to ensure provision of at least one improved water source per village. In Ntoroko District, a total of 96 villages (55%) are with a source of safe water, against a total of 80 villages (45%) that are still without a source of safe water supply (MWE 2019).

According to the Uganda Water Supply Atlas 2017, Ntoroko District has a total population of 68,267 of which 79% have access to safe water. Access rates vary from 39% in Kanara subcounty to 95% in Rwebisengo Town Council, Rwebisengo and Butungama subcounties. However, the source functionality in Butungama and Kanara is low with 54% and 53% respectively. The source functionality in Rwebisengo Town Council and Rwebisengo subcounty is reasonably high with 90% and 87%. The map (Figure 33) shows that within Semliki Delta, most non-functional point water sources can be found around Rwangara settlement and in the area southwest of Rwebisengo town, which was also observed during the field mission of April 2019 (Appendix C). Reasons for non-functionality are reported to be mainly technical breakdown (46,2%) and low yield (42,3%). However,

during the field mission of April 2019 it was observed that most wells don't function due to the presence of brackish groundwater, making the water unpalatable and corroding the borehole pipes causing technical breakdown. According to the Uganda Water Supply Atlas 2017, Ntoroko District has 372 domestic water points and 2 piped schemes which serve a total of 53,600 people, of which 37,383 in rural areas. 104 water points have been non-functional for over 5 years and are considered abandoned. In Ntoroko District, people are served mainly by shallow wells (45,4%), deep boreholes (24,3%) and protected springs (21,8%). Only 8.2% of the people are served by public tap, and roof water harvesting comprises only 0.3% (Figure 34). No information is available regarding the access rate to safe water in Irumu territory of Ituru District, DRC.

FIGURE 33: MAP SHOWING THE LOCATION AND FUNCTIONALITY OF DIFFERENT POINT WATER SOURCES (AS OF JUNE 2017) IN THE SUBCOUNTIES OF RWEBISENGO, BUTUNGAMA AND KANARA, NTOROKO DISTRICT, UGANDA. SOURCE: UGANDA WATER SUPPLY ATLAS, 2017

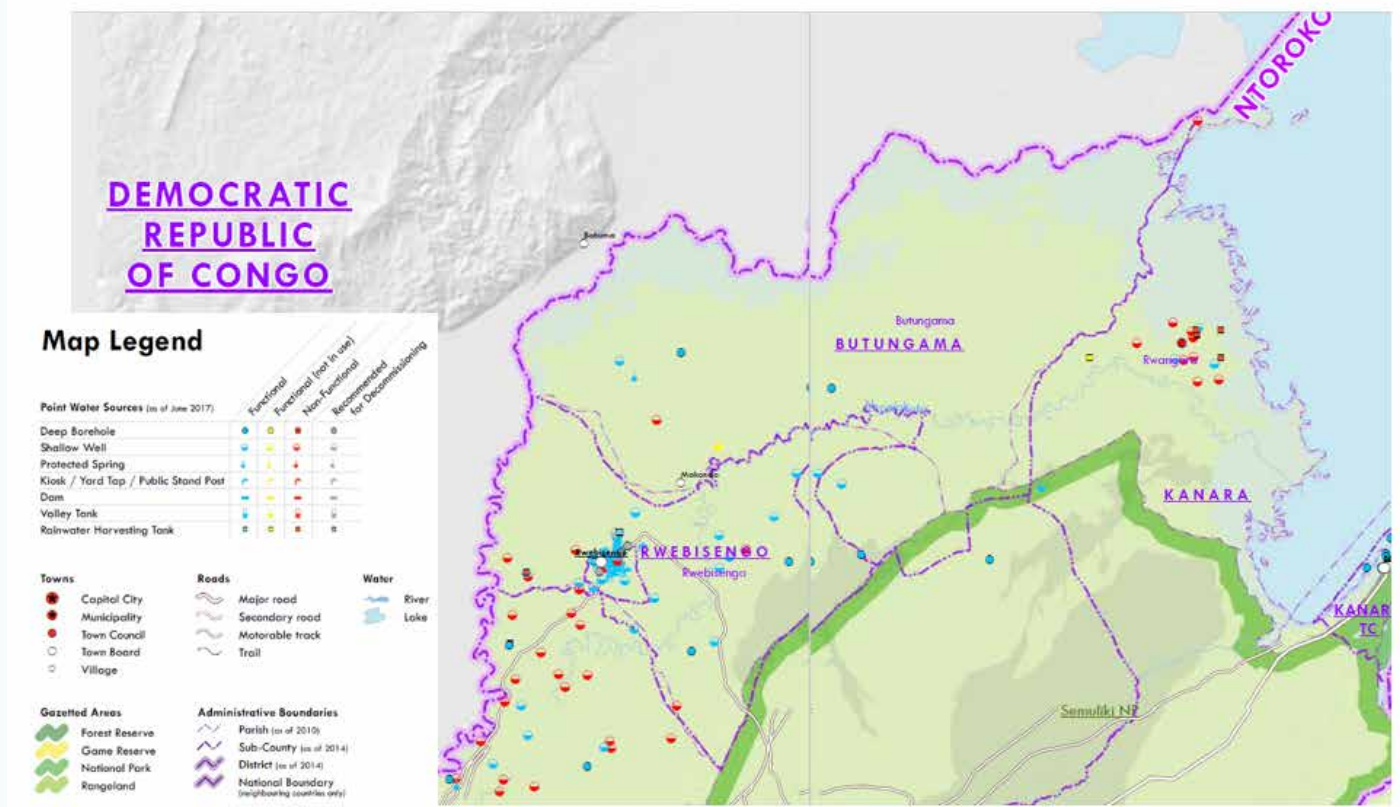
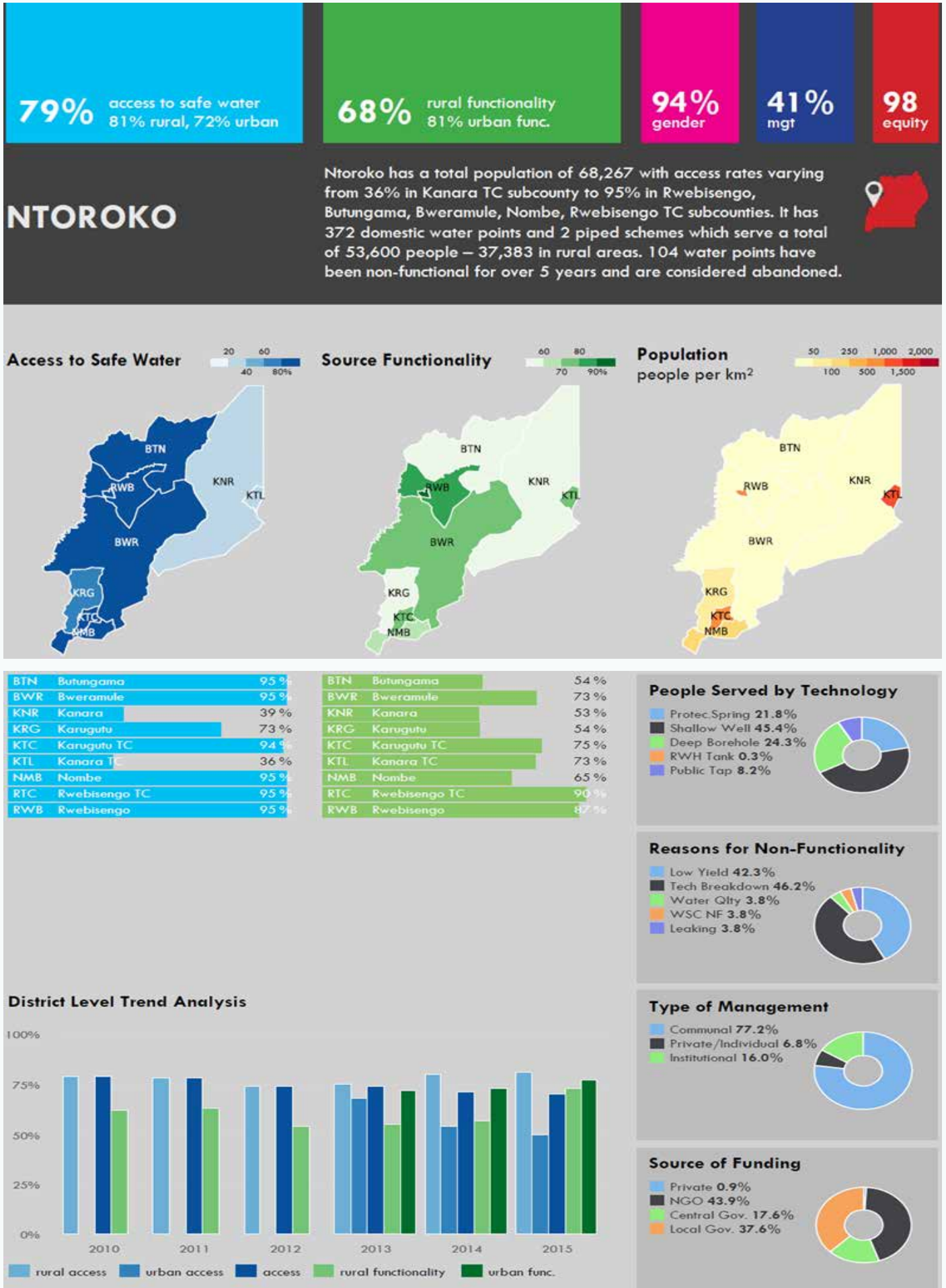


FIGURE 34: INFOGRAPHIC SHOWING THE ACCESS TO SAFE WATER AND WATER SOURCE FUNCTIONALITY (AS OF JUNE 2017) IN NTOROKO DISTRICT, UGANDA. SOURCE: UGANDA WATER SUPPLY ATLAS, 2017



Along Lake Albert, most of the fishing villages depend on lake water with occasional use of boreholes where they are available. On a number of locations, however, the borehole water is found to be salty and communities don't find it palatable. It is common therefore for them to abandon safe borehole water for the lake water (LEAIBMP, 2016). During the field mission of April 2019, several point water sources were visited, including 2 unprotected open wells, 14 boreholes and protected wells of which 8 non-functional and only 6 functional. In Rwebisengo town several private operated boreholes with elevated tanks were observed. Throughout the area, roof water harvesting tanks were observed at large buildings such as schools and hospitals.

In Butungama subcounty a functioning borehole with handpump was found (DWD33745) containing water with a high mineral content ($EC\ 1525\ \mu S/cm$), located next to an abandoned open well with concrete rim was found full with waste (Figure 35). Near the Butungama subcounty administrative block a non-functional borehole was reported to have mechanical problem since 2016 due to salty water (corrosion), people used this water for washing but it was already too salty for drinking from the start. Next to this broken borehole, an unprotected open well is providing fresh water ($EC\ 874\ \mu S/cm$). This water might be unsafe to drink, not only because it is unprotected but also because of a pit latrine nearby.



FIGURE 35: ABANDONED RING WELL FULL WITH GARBAGE (PHOTO LEFT) LOCATED NEXT TO A FUNCTIONING BOREHOLE WITH HANDPUMP, PRODUCING SLIGHTLY BRACKISH WATER ($EC = 1525\ \mu S/cm$) WITH A SLIGHTLY BROWN COLOUR (ORGANIC MATERIAL). THE WATER TABLE IN THE OPEN RING WELL WAS MEASURED AT 3,1 M BGL ON 15 APRIL 2019. LAT: $1^{\circ}05'52.31''N$ / LON: $30^{\circ}18'59.98''E$.

In Rwebisengo town, the government buildings and people who can afford a private connection (UGX 400.000) are being supplied by piped water that is being pumped from a deep borehole located 2.5 km west of town, that was installed there around 10 years ago. The water is pumped from the production borehole with an electric submersible pump with a generator, powered by 64 solar panels, through

a single pipe to a big elevated tank in the centre of Rwebisengo town, from where it is further distributed (Figure 36). Ntoroko District was not able to provide the well completion report, pumping test report, or water quality analysis. Also the depth of the borehole or the yield is not known. Water quality is reported to be good (not as salty as some other boreholes in the area) and the borehole never runs dry.



FIGURE 36: PRODUCTION BOREHOLE WITH SOLAR POWERED PUMP (PHOTO LEFT), SUPPLYING WATER TO THE ELEVATED TANK IN RWEBISENGO TOWN (RIGHT) AND FROM THERE IS DISTRIBUTED TO PRIVATE CONNECTIONS AND GOVERNMENT BUILDINGS. BOTH PHOTOS WERE TAKEN ON 15 APRIL 2019, WITH THE BOREHOLE LOCATED AT LAT: $1^{\circ}02'18.09''N$ / LON: $30^{\circ}15'02.66''E$ AND THE ELEVATED TANK LOCATED AT LAT: $1^{\circ}02'42.58''N$ / LON: $30^{\circ}16'20.86''E$.

At the landing site Kamuga (or Rwangara Landing Site, according to TEEB study, NBI 2019b) on Lake Albert, in Kanara subcounty, around 3000 people are living in a fishing village without any kind of protected water source available. According to the residents, the local soil (Solonchak type, see chapter 2.2.2) “is not good for crops”, so the only source of income is fishing, and the soil makes the groundwater “too salty”, hence people use water directly from the

lake for daily use (Figure 37). This water from Lake Albert is used as main source of potable water and water for household use. The villagers indicate they “sometimes boil the water” before drinking, or add a certain powder to the water to form a flocculent for the removal of suspended solids. Even though this might improve the taste, this does not make the water safe to drink.



FIGURE 37: AT KAMUGA LANDING SITE IN KANARA DISTRICT, WATER IS FETCHED FROM LAKE ALBERT AS MAIN SOURCE OF POTABLE WATER AND WATER FOR HOUSEHOLD USE. PHOTO TAKEN ON APRIL 16TH 2019 AT LAT: 1°09'12.45"N / LON: 30°28'49.98"E.

In Katanga town, Kanara subcounty, all the boreholes and protected wells broke down recently due to corrosion of the pipes as a result of brackish water (see also chapter 2.3.4). Hence, people in town use water from open wells or directly from Lake Albert. Also the borehole at the school is non-functional, and at the school they have to buy water from a borehole 2,5 km away (jerry can is 1000 UGX).

A new elevated tank is being constructed next to the health centre, where water will come by pipe (under gravity) from Karagutu Town Council (reported to be

finished in May 2020). At the health centre, also rain water harvesting is used, but this only provides water in rainy season. At 1,5 km south of Katanga, people use water from a hand dug open well (Figure 38), for potable water and water for household use, despite the water being brackish (EC 2720 $\mu\text{S}/\text{cm}$). Only a few meters away from the open well, a watering place for cattle is located, which increased the risk of faecal contamination from runoff water during heavy rains. This was confirmed by the elevated concentration of nitrate (10 mg/l).



FIGURE 38: OPEN HAND-DUG WELL, USED AS SOURCE OF POTABLE WATER DUE TO LACK OF ANY PROTECTED WATER SOURCES, WITH A HIGH RISK OF FAECAL CONTAMINATION FROM THE CATTLE WATERING POINT ON THE LEFT JUST A FEW METERS AWAY. PHOTO TAKEN ON APRIL 16TH 2019 AT LAT: 1°07'04.20" N / LON: 30°27'58.29" E.

At Butangama Primary School, a borehole (placed in 2018 and reported depth of ~42m) with handpump is used as source of potable water, providing not too salty water (EC 1385 $\mu\text{S}/\text{cm}$) and without an indication of any contamination (nitrate 0 mg/l). After pumping for a while, this boreholes is reported to give sand and colour apparently turns black.

During the site visit this was not observed. On the other side of the road, a protected well with handpump is non-functional, according to the school teacher as there was no more water. Rainwater is harvested from the roofs of the school and stored in big tanks. However, this rainwater harvesting system is out of use as all the connection pipes and guts were stolen (Figure 39).



FIGURE 39: RAINWATER HARVESTING (LEFT) FROM THE ROOFS OF BUTANGAMA PRIMARY SCHOOL IS NOT FUNCTIONAL BECAUSE OF GUTS AND PIPES BEING STOLEN (RIGHT). PHOTO TAKEN ON APRIL 15TH 2019 AT LAT: 1°04'57.54" N / LON: 30°17'35.02" E.

At the community and district level meeting in Ntoroko District (see meeting report; Wetlands International 2019b), the issue was raised that the LEAF I project “promised production wells for watering animals, irrigation and domestic use but instead boreholes were constructed and not completed and the community did not have the water”. Community members indicated that “the

parts of the borehole which make it function were taken out and people are still drinking dirty water, the cows are dying due to drought and hunger”. Community requested for irrigation schemes. In response, the LEAF II representative said that “hand pumps will be installed instead but the boreholes will not be motorized as promised because water is only available in some seasons.”

As a means of ensuring appropriate access to water, the LEAF II Project completed in 2018/2019 the drilling of 20 community boreholes, including 1 drilled in Ntoroko District (location not provided by LEAF/MWE). The completed borehole is recommended for a motorized pump (24 m³/hr) and have been handed over to the communities whilst the management structures for the borehole has been updated and trained (MWE 2019).

Borehole drilling reports (Mazzi, 2018 and GIC, 2018) and geophysical survey reports (Scan, 2018) provided by the District Water Officer of Ntoroko District show that both borehole siting and borehole drilling and construction are not done in an entire professional way. Geophysical survey results are not interpreted in a correct way (or not at all) and several sites are suggested for the drilling of a borehole despite the VES already showing the presence of saline groundwater (very low apparent resistivities (<10 Ohm.m) at depths below survey depths (ab/2) of 40 m). The borehole completion reports indicate that at some sites boreholes are being constructed and completed despite saline groundwater was observed already during drilling. At other boreholes, the construction of screens and gravel pack was done (partly) in clay layers, causing fine particles to enter the borehole and clogging the screens and hence lowering the yield. These examples indicate that the water supply issues observed in Ntoroko District are not only due to natural conditions but also due to unprofessional borehole siting and construction practices and a lack of experienced supervision. In addition, the natural conditions are not favourable in some areas where salt and carbonate deposits make the groundwater brackish and hence unsuitable as potable water or household use.

However, there are constraints to the performance of the water supply sectors such as:

- Environmental degradation of the natural resources which act as ground water recharge
- Power cuts results to water shortages particularly in urban centers (electric pumps)
- Destruction of water pumps and other equipments as a result of poor awareness, poor knowledge and lack of understanding of how to use them
- Poor rehabilitation and maintenance schemes of streams and water wells
- Long distance from safe water sources to human settlement in rural area.

6.3.2 Sanitation and Hygiene

Open defecation, overflowing latrines and failing home septic systems can allow microbes to end up into the groundwater, drainage ditches and nearby surface waters, contaminating the water. Because of inadequate sanitation and low latrine coverage in Semliki Delta - use of improved sanitation facilities is around 34% (WHO 2015b) - open defecation is a common practice where sanitation infrastructure and services are not available, which is especially the case in the landing sites along the Lake Albert shoreline, like Kamuga. High population growth rate, rapid and often uncontrolled urbanisation and industrialisation have led to a deterioration in the surface water quality. In combination with the poor sanitary facilities and rudimentary water supply, the population in Semliki Delta is very susceptible to faecal contamination that can cause infections and waterborne diseases like cholera, bilharzia and diarrhoea.

The seriousness of the situations at these hotspots and the threats are increasing exponentially so if left unchecked, the magnitude of the pollution problem will become severe with serious social and economic consequences. Already outbreaks of cholera on both sides of Lake Albert are a regular and serious occurrence (LEAIBM 2018).

During the Field Mission of April 2019, hygiene promotion were observed at Butungama primary school where a handwash facility was installed in the middle of the school yard.

As a means of ensuring appropriate access to sanitation, the LEAF II Project commenced in 2018/2019 the works for the construction of three community sanitation facilities in Ntoroko District, of



FIGURE 40: HANDWASH FACILITY AT BUTUNGAMA PRIMARY SCHOOL. PHOTO TAKEN ON APRIL 15TH 2019 AT LAT: 1°04'58.53"N / LON: 30°17'35.23"E.

which progress reached 95%. The completed facilities have been handed over to the communities whilst the sanitation committees/management structures for the facilities have been formed and trained (MWE 2019).

All of the landing sites and associated fishing villages lack adequate sanitation facilities, in many cases they are even entirely absent, and also the sanitation in Butungama and Rwebisengo subcounty is rudimentary. With the growing population there is an ever-increasing quantity of untreated sewage directly or indirectly entering Lake Albert or Semliki River. There is also an absence of disposal facilities for fish waste along Lake Albert and this is generally thrown straight back into the lake (LEAIBM 2018). In combination with inadequate garbage disposal facilities throughout Semliki Delta, the sanitation and hygiene conditions are worsening. Among others, this is due to:

- Lack of access to sanitation facilities in rural areas compared to urban centers
- Poor construction and unprotected water wells – causes contaminations from animal and human solid and liquid wastes
- poor rehabilitation and maintenance of WASH facilities
- Poor arrangement in separating water sources for domestic and animal use and domestic use, e.g. lake area, rivers and ponds
- Water sources used as dumping areas e.g. lakes and rivers (defecating and urinating while bathing, dumping liquid and solid wastes, bathing etc)
- Poor water handling facilities – e.g. containers for fetching water are left near the wells in poor condition
- Investment in water sector is still at high percentage by governments (relying on NGO support), private sectors have not well invested in this crucial sector
- Pollution from upstream and socioeconomic activities – e.g. agriculture, fish landing sites, fishing activities (fuel, oil etc)
- There is localized nomadism during the prolonged dry periods when water and pastures are in short supply, leading to movement of cattle in water sources which results to pollution and contamination
- Over population/high concentration in

human settlements – e.g. in Kamuga landing site in Uganda

6.4 PUBLIC HEALTH

6.4.1 Public health facilities

Ntoroko District (Uganda) and Ituru Province (DRC), like other districts in the region, has been experiencing shortage of health facilities, medical personnel such as assistant medical officers, clinical officers, dental surgeons, radiologists and radiographic assistants as well as medical equipment and medicines. These shortages have caused unnecessary loss of peoples' lives due to incomplete treatment of preventable diseases. The number of specialized doctors is limited, especially because they are not motivated to work in rural areas.

6.4.2 Health issues

The national health indicators for DRC and Uganda are shown in Table 11 (source: UNDP 2019; WHO 2018a and WHO 2015). On a national level, diarrhoea has the highest disability-adjusted life years (DALYs) per 1000 capita in both Uganda and DRC, followed by Respiratory infections and Malaria (Table 12; source WHO 2009).

The Multidimensional Poverty Index use a range of indicators to calculate a summary poverty figure for a given population, in which a larger figure indicates a higher level of poverty (UNDP 2019b).

On a national level, diarrhea has the highest disability-adjusted life years (DALYs) per 1000 capita in both Uganda and DRC, followed by Malaria and Respiratory infections (Table 12; source WHO 2009).

Mental health

Estimates suggest that up to 35% of Ugandans suffer from a mental disorder and 15% require treatment (Ndyanabangi et al, 2004). This is likely to be an underestimate given international norms, relatively recent high-intensity conflicts and ongoing regional civil unrest. Uganda spends 9.8% of gross domestic product on healthcare, or US\$146 annually per person. Less than 1% of this goes into mental healthcare, compared with 10% in the UK (WHO, 2016). Ugandan mental health services have been characterised as inadequate, with little or no community care and in-patient services that are unable to meet demand. The World Health Organization (2006) estimates that 90% of people

Table 11: Health indicators at national level

	Uganda	DRC
Child health		
DTP3 immunization coverage among 1-year-olds (%) (2016)	78	72
Demographic and socio-economic statistics		
Life expectancy at birth (years) (2015)	62.3 (Both sexes)	52
	64.3 (Female)	54
	60.3 (Male)	51
% population under 15 (2015)	48.1	44.9
% population over 60 (2015)	3.8	4.5
Multidimensional Poverty Index (population in multidimensional poverty) – (2019)	0.269 (55.1%)	0.389 (74%)
Literacy rate among adult aged >= 15 years (%) (2007-2012)	73	66.8
Gender Inequality Index rank and value (2018)	127 (0.531)	156 (0.655)
Human Development Index rank (2018)	159	179
Health systems		
Total expenditure on health as a percentage of gross domestic product (2014)	7.22	3.5
Private expenditure on health as a percentage of total expenditure on health (2014)	75.06	46.9
General government expenditure on health as a percentage of total government expenditure (2014)	10.97	12.9
Physicians density (per 1000 population) (2015)	0.093	0.107
Nursing and midwifery personnel density (per 1000 population) (2015)	0.648	0.529
Mortality and global health statistics		
Neonatal mortality rate (per 1000 live births) (2016)	21.4	38
Under-five mortality rate (probability of dying by age 5 per 1000 live births) (2016)	53	119
Maternal mortality ratio (per 100,000 live births) (2015)	343	730
Births attended by skilled health personnel (%) (2011)	57.4	80.4
Public health and environment		
Population using safely managed drinking water services (2015)	18 (Urban)	46
	5 (Rural)	9
	6 (Total)	29

with mental illness receive no treatment. There is no national coverage of community mental healthcare. A network of 28 out-patient facilities can provide follow-up care, but they are thinly spread and often starved of funds for even essential medication. A 2006 survey found that only 57% of clinics had at least one psychotropic medication in each class (WHO, 2006). Many users have epilepsy rather than mental illness. Mental health issues are expected to be even worse in DRC, where no health information system(s) exist

and no mental health data have been compiled in a report for policy, planning or management purposes in the last three years (WHO 2011b).

Malnutrition

Besides vaccination, under five children are weighed to reveal the prevalence of underweight or overweight to understand the extent of child malnutrition. Nutritional food intake is associated with child health and therefore, poor diet can result into severe

TABLE 12: ENVIRONMENTAL BURDEN BY DISEASE CATEGORY [DALYS/1000 CAPITA], PER YEAR

Disease	Lowest rate	Uganda	DRC	Highest rate
Diarrhea	0.2	35	65	107
Respiratory infections	0.1	19	39	71
Malaria	0	22	27	34
Other vector-borne diseases	0	1.1	1.9	4.9
Lung cancer	0	0.1	0.1	2.6
Other cancers	0.3	1	1.3	4.1
Neuropsychiatric disorders	1.4	1.7	1.8	3
Cardiovascular disease	1.4	2.1	3	14
COPD	0	0.6	0.9	4.6
Asthma	0.3	1.8	1.9	2.8
Musculoskeletal diseases	0.5	0.5	0.6	1.5
Road traffic injuries	0.3	4.7	5	15
Other unintentional injuries	0.6	10	12	30
Intentional injuries	0	2	2.6	7.5

malnutrition which in turn manifests itself in high infant and child mortality rates. However, lack of health facilities particularly in rural areas and lack of gathered data in the districts make it difficult to quantify significance of severe malnutrition.

Immunisation programmes

Protection of expectant/lactating mothers and children from measles, tuberculosis and other diseases through immunisation programme (CSPD) is highly supported by development partners and to a large extent it has helped to reduce the risk of their

being infected. Reduction of deaths among children and their mothers is attributed to the wide coverages of immunisation campaigns in the district.

6.4.3 Waterborne diseases

Waterborne diseases are conditions caused by pathogenic micro-organisms that are transmitted in water. Disease can be spread while bathing, washing, drinking water, or by eating food exposed to contaminated water. Contaminated water can cause many types of diarrheal diseases, including Cholera, and other serious illnesses such as Guinea worm disease, Schistosomiasis (also known as snail fever or bilharzia), Typhoid Fever, Hepatitis A and E, Salmonella, E.coli and Dysentery. The World Health Organization estimates that 58% of the waterborne diseases, almost a million deaths per year, is attributable to a lack of safe drinking water supply, sanitation and hygiene (WHO, 2014).

Many people in and around Semliki Delta, particularly in fishing communities, experience a lack of access to clean drinking water and improved sanitation. Waterborne diseases can be spread via groundwater which is contaminated with fecal pathogens from pit latrines (Figure 41), and as a result cholera and diarrhea are common amongst communities around the lake.

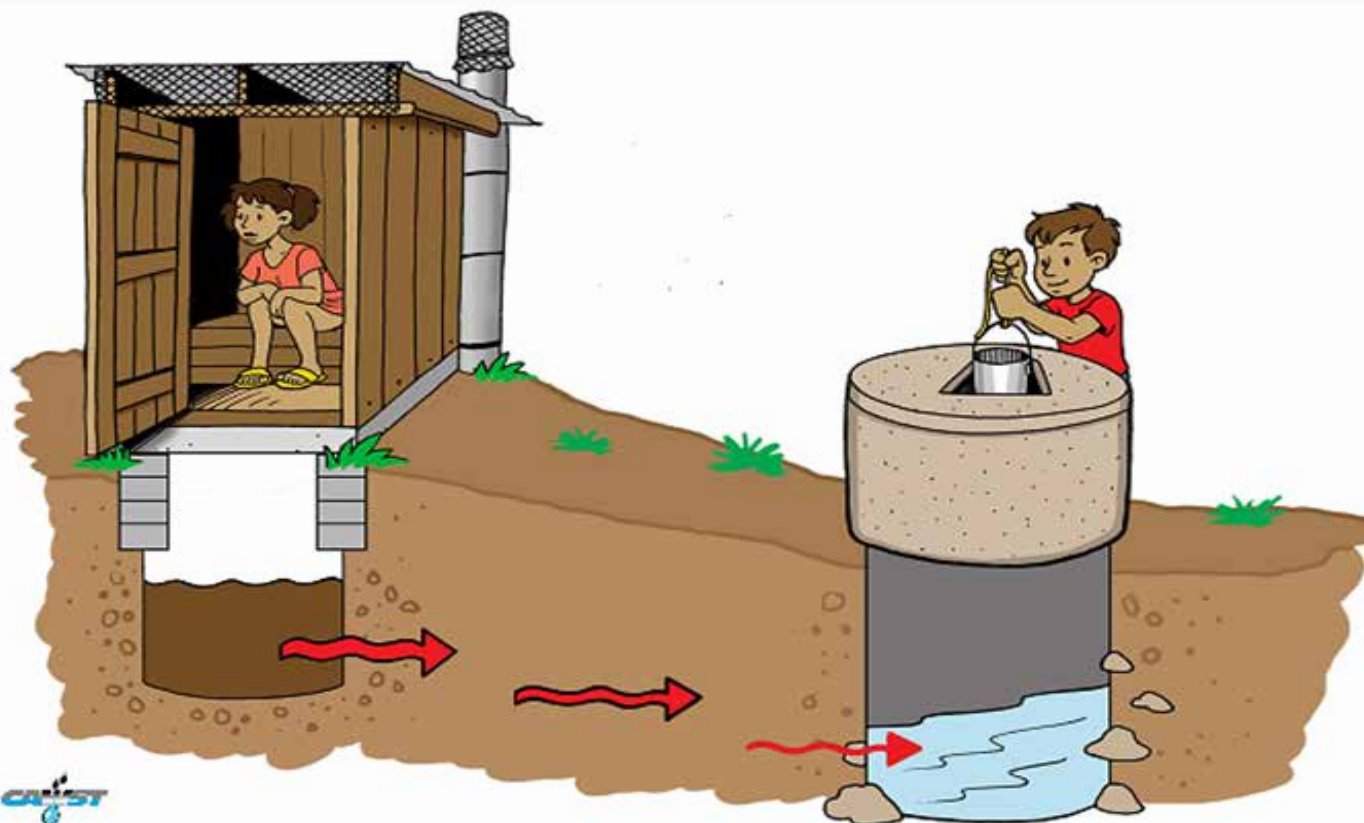
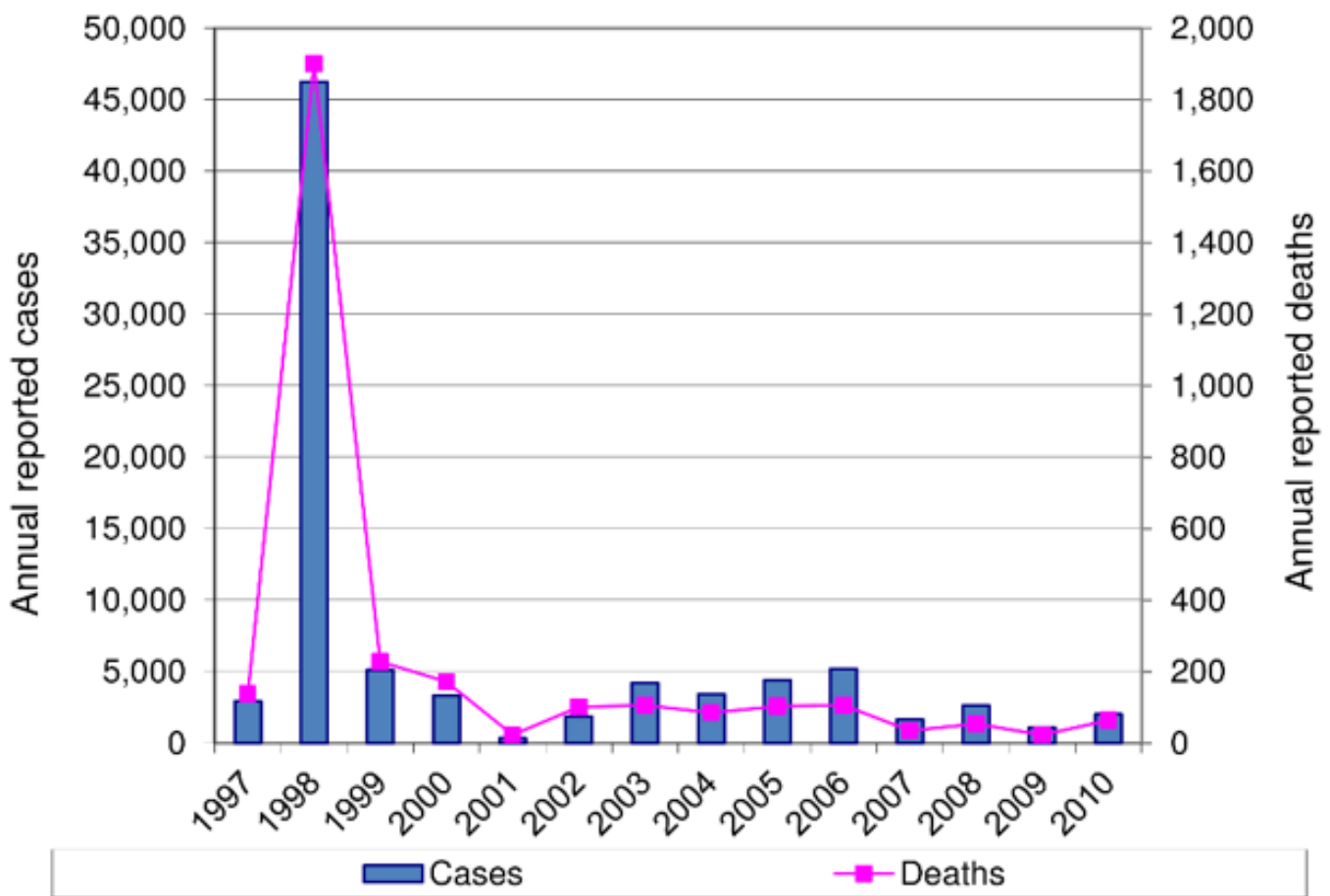


FIGURE 41: WATERBORNE DISEASES CAN BE SPREAD VIA GROUNDWATER WHICH IS CONTAMINATED WITH FECAL PATHOGENS FROM PIT LATRINES. SOURCE: CENTRE FOR AFFORDABLE WATER AND SANITATION TECHNOLOGY

FIGURE 42: ANNUAL NUMBER OF CHOLERA CASES AND DEATHS REPORTED IN UGANDA 1997-2010.



Since 1994, cholera is reported annually in Uganda, fluctuating between 250 and 5,000 cases per year with the exception of a large outbreak in 1998 with almost 50,000 cases (Figure 42). Bundibugyo district is considered an endemic area for cholera, with cases reported almost every year and with more than 15 people per 100,000 hospitalized with cholera between 2005-2010 (Bwire 2013).

The Democratic Republic of the Congo (DRC) accounts for an estimated 189,000 (5%–14%) of the 1.34–4.01 million cholera cases worldwide annually. It is described as endemic for the Eastern provinces, including Ituri Province; once specific outbreak in Ituri Province of Jan–Sep 2012 recorded 4,696 cases, 17% of which of children under 5 (Ingelbeen et al. 2019).

6.4.4 Airborne diseases

Airborne diseases are caused by pathogens (viruses, bacteria or fungi) that can be transmitted through the air, spread through breathing, talking, coughing, sneezing, raising of dust, spraying of liquids, toilet flushing or any activities which generates aerosol particles or droplets. Many common infections can

spread by airborne transmission at least in some cases, including Chickenpox, Influenza, Measles, Smallpox, Cryptococcosis, and Tuberculosis.

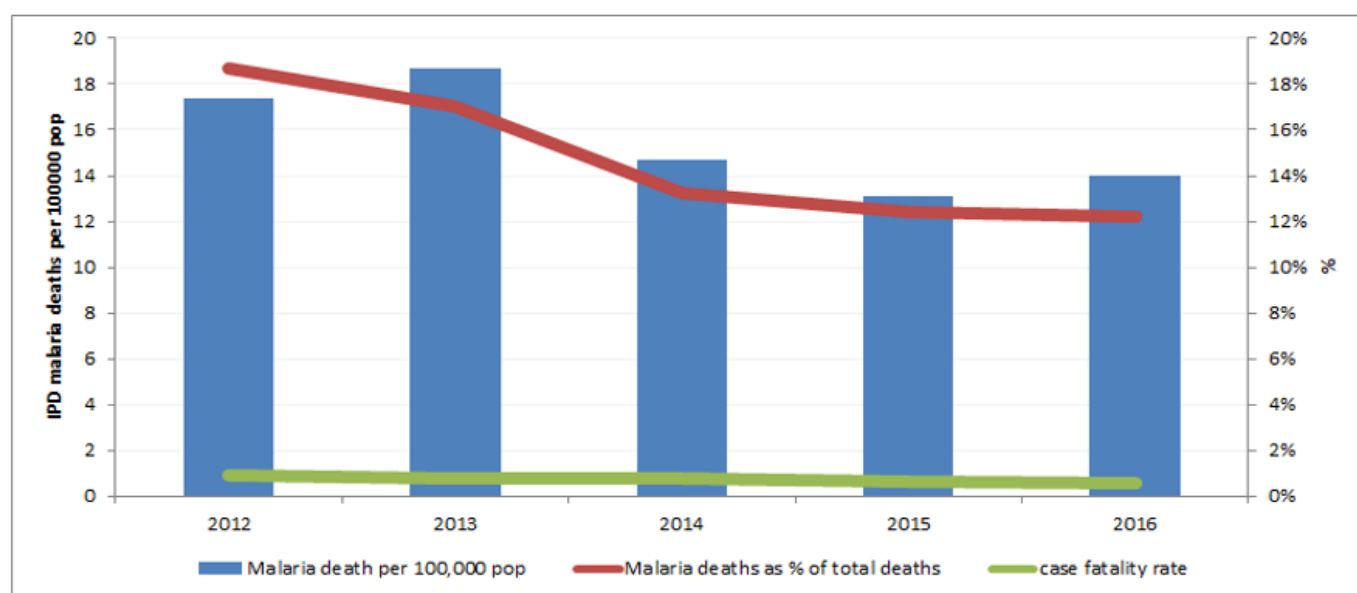
TBC is the most common airborne disease in Uganda with a reported 45,300 cases in 2014/2015, decreasing to 45,900 cases in 2016/2017 (MoH 2017). Main constraints on Tuberculosis prevention are weak management and procurement of TBC drugs, weak mechanism for tracing defaulters and new cases, and inadequate numbers and trained health workers in treatment and diagnosis of TBC.

6.4.5 Endemic and epidemic diseases

Malaria

Malaria is a major public health problem associated with slow socio-economic development and a high multidimensional poverty index and the most frequently reported disease at both public and private health facilities in Uganda. Clinically diagnosed malaria is the leading cause of morbidity and mortality, accounting for 30-50% of outpatient visits at health facilities, 15-20% of all hospital admissions, and up to 20% of all hospital deaths.

FIGURE 43: 2012-2016 TREND IN DEATHS IN UGANDA DUE TO MALARIA



27.2% of inpatient deaths among children under five years of age are due to malaria. A significant percentage of deaths occur at home and are not reported by the facility-based Health Management Information System (HMIS). Malaria is endemic (a disease that exists permanently in a particular region or population) in approximately 95% of the country, affecting over 90% of the population of 3 million. The 2009 Malaria Indicator Survey (MIS) reported high prevalence of malaria parasites in children <5 years of age ranging from 5% in Kampala to 63% in mid northern region, with a national average of 45%.

Dragonflies (chapter 3.1.7) are among the major biological control agents for mosquitoes and are therefore valuable in counteracting the spread of Malaria.

Malaria remains a major public health challenge in Uganda as the country with Uganda having the fourth highest number of annual malaria cases accounting for 4% of the estimated 220,500,000 global cases in 2016. In 2013/2014, 460 cases per 1000 people were reported (MoH 2017). The main malaria vectors in Uganda are *A. gambiae*, *A. Funestus*, *A. arabiensis*, *A. bwambae*. The total malaria deaths in Uganda has gradually decreased between 2012 and 2016 (Figure 43), with a case fatality rate of circa 0.5%. Malaria accounts for 52% of all reported cases of disease in Bundibugyo district (GoU 2019).

In 2007, an estimated 64.3% (62 million) of the population lived in areas with an average *P. falciparum* prevalence above 50% (hyper-endemic to holoendemic transmission), making the DRC one of the most intense transmission areas of Africa.

29% of the 2007 population lived under conditions of mesoendemicity (parasite rates 10-50%) and only 0.2% of the country's population live in areas that would be classified as hypoendemic (PNLP et al, 2014).

An additional threat are small water ponds created by water accumulation in areas where materials like clay and sand have been extracted near human settlements, as these ponds might turn into mosquito-breeding grounds and malaria reservoirs.

HIV/AIDS epidemic

The HIV virus is transmitted through certain body fluids and weakens the immune system by destroying cells that fight disease and infection. Left untreated, HIV reduces the number of CD4 cells in the body, making it more difficult for the immune system to fight off infections and other diseases, which can lead to the development of AIDS (acquired immunodeficiency syndrome).

In Semliki Delta, social services such as health facilities are poor and there is still fear, stigma and ignorance around HIV/AIDS. Many people living with HIV or at risk for HIV infection do not have access to prevention, treatment, and care, and there is still no cure. As a result the incidence of diseases such as HIV/AIDS is high, especially among fishers with prevalence of 24% (NaFIRRI Frame survey 2012).

HIV statistics for Uganda and DRC (UNAIDS 2018a and UNAIDS 2018c) show that each year a total of 53,000 and 19,000 people get newly infected with HIV in Uganda and DRC respectively each year.

TABLE 13: NATIONAL HIV STATISTICS FOR UGANDA AND DRC

	Uganda	DRC
Number of people with HIV	1,400,000	45,000
HIV incidence (%)	1.4	0.21
HIV prevalence (%)	5.7	0.8
Number of people newly infected with HIV	53,000	19,000
Number of deaths from an AIDS-related illness	23,000	17,000
Percentage of people with HIV aware of their status	84	62
Percentage of people with HIV receiving treatment	72	57

The number of deaths from an AIDS-related illness is 23,000 (Uga) and 17,000 (DRC) people per year (Table 13).

In Ntoroko district, Uganda, 2.2% of people tested were suffering from HIV, and 95% of people with HIV receive treatment (Uganda AIDS Commission 2017).

Constrains on HIV/AIDS prevention

- Increased prevalence of HIV/AIDS due to absence of a coherent strategy to control the disease.
- High rates of discordance in marriage and in stable sexual relationships.
- High level of complacency.
- Inadequate provision of the PMTCT.
- Shortage of safe blood.
- Inability to provide comprehensive HIV/AIDS care
- Inability to provide home based care.

Ebola epidemic

The Democratic Republic of the Congo is grappling with the world's second largest Ebola epidemic on record, with more than 2000 lives lost and 3000

confirmed infections since the outbreak was declared on 1 August 2018, which began in the traditional way, with handling of infected bushmeat. The outbreak is occurring in North Kivu, South Kivu and Ituri Provinces. In the Gety WHO health zone in Ituri Province however, where the Congolese side of the project area is located, no cases of Ebola were recorded as of 2 July 2019 (WHO 2019).

The Ebola virus is not waterborne or airborne, but can be transmitted to others through direct contact with blood or secretions and fluids of an infected person. Exposure to any objects contaminated by infected bodily secretions and fluids can also transmit the disease from person to person. The 2018-2019 Ebola outbreak is epidemic as the outbreak attacks



FIGURE 44: MEDICAL CHECK POINT FOR EBOLA ON KANARA LANDING SITE (PHOTOS TAKEN ON APRIL 15TH 2019)

many peoples at about the same time and may spread through one or several communities and could become pandemic (spreads throughout the world).

During the April 2019 field visits, a medical check point for Ebola was visited on the Kanara Landing Site (Figure 44). On 10 June 2019, the Ministry of Health and the World Health Organization (WHO) confirmed a case of Ebola Virus Disease in Kasese District, Uganda. Although there have been numerous previous alerts, this is the first confirmed case in Uganda during the Ebola outbreak on-going in neighbouring Democratic Republic of the Congo (WHO 2019).

6.5 EQUITY AND GENDER

Most of the wetland resources are used by all sectors of society. However, gender roles can be relevant in harvesting and utilization of various resources. For example, males are more likely to harvest and use clay for construction and brick-making, while females are more likely to use clay for pottery. Collecting water for domestic use is mainly performed by girls and women, while livestock watering tends to be a task for boys. For a detailed overview of gender roles for different activities, see the meeting reports of the Regional Workshop (Wetlands International 2019a) and the community level meetings (Wetlands International 2019b and 2019c).

Women play essential roles in agriculture - providing inputs, managing production, stewarding natural resources and generating off-farm income - but often benefit less than men. High-value agricultural production chains are usually run by male-dominated institutions, while women are often limited to local markets where they sell low-quality and residual products. All landscape-level interventions therefore need to attend to this imbalance through gender mainstreaming, in order to maximize the benefits of agriculture to women farmers, providing incentives to increase their productivity.

Uganda and DRC are ranking #127 and #156 respectively (out of 189 countries) on the Gender Inequality Index rank of 2018 (Table 11; UNDP 2019). The Gender Inequality Index is 0.531 for Uganda and 0.655 for DRC, where a value of 0 expresses perfect equality, while a value of one represents perfect inequality. Within Semliki Delta wetland landscape difficulties/challenges are still experienced in enhancing gender mainstreaming due to the following:

- Inadequate funding of gender programmes and lack of facilitation for the gender focal point

person because of lack of clarity of gender investments and gender outcomes.

- Intangibility of gender mainstreaming initiatives because there is not direct benefits visible from carrying out gender related activities, hence little or no commitment in investing in such activities.
- Inability to transform women's representation in gender sensitive decision making that is in spite of the fair representation of women in the decision-making process, gender sensitive decisions are rarely made.
- Non utilization of key guidelines for gender mainstreaming by respective officers in respective sector programmes.
- During the gender trainings, the process and role of mainstreaming is still conceived as a responsibility of the gender officer.
- The centrality and cross cutting influence of gender on outcomes of poverty eradication programmes has not been fully realized by programme designers and implementers.
- Absence of the line ministry technical support to the department of gender and other departments.
- Gender mainstreaming is not emphasized in most project designs and guidelines from ministries, and gender is not well emphasized in project implementation monitoring and supervision guidelines.
- Some bad traditions and culture which prohibit women from advancements.
- Central and Local governments often aim at overall livelihood improvement of people but should concern more whether poverty eradication programmes benefit the marginalized groups or actually increase inequality.

In Uganda, the Ministry of Gender, Labour and Social Development (MGLSD) is responsible for gender responsiveness and community development/mobilisation. It assists the sector in gender responsive policy development and supports districts to build staff capacity to implement sector programmes. The percentage of Water User Committees, Water Boards, Environmental management/Water catchment management committees with women holding key positions has been stable in Uganda in rural areas (86% in 2015/2016 and 85% in 2018/2019) and

increased in urban areas (67% in 2015/2016 and 82% in 2016/2017), according to the Sector Performance Report (MWE 2019).

As an example, the Catchment Management Committee of the Semliki Catchment Management Plan consists of 26 Male and 2 Female only (MWE 2019). However, as part of the LEAF II project, capacity building and training in gender inclusive integrated water resources management and effective catchment management was conducted in 2018/2019 with a total of 3301 participants of which 38% being women (MWE 2019).

Climate change and gender inequality

Women tend to be responsible for procuring and providing food in households and are the primary workers

engaged in subsistence agriculture. They make up an average of 43 percent of the agricultural workforce in developing countries. Even so, they experience inequitable access to land and agricultural inputs, which can affect their productivity in the sector, generating a gap in comparison with men's productivity. In Ethiopia, Malawi, Rwanda, Tanzania and Uganda the gender gap in agricultural productivity ranges from 11 percent to 28 percent (UNDP 2019). The difference is due to access to credit, ownership of land, use of fertilizers and seeds, and availability of labour.

As in many other dimensions, gendered norms and traditions at the household level are behind the inequitable allocations of production factors, thus limiting women's agency, decision-making power and

participation in the labour market. Furthermore, the gender agricultural gap hinders poverty reduction, inequality reduction and the mitigation of climate change effects and environmental degradation. Greater female participation in natural resource management, productive agricultural activities and natural disaster responses can enhance the effectiveness and sustainability of policies and projects. Closing the gender gap in agricultural productivity would increase crop production by 7–19 percent in Ethiopia, Malawi, Rwanda, Tanzania and Uganda (UNDP 2019).

Climate change can affect women's income, education, access to resources, access to technologies and access to information. It is entangled with economic and social consequences for women. Women in developing countries are highly vulnerable when they depend heavily on local natural resources for their livelihood. Yet women are powerful agents of change. As key players in core productive sectors, they are well placed to identify and adopt appropriate strategies to address climate change at the household and community levels.

MAIN CHALLENGES

This monograph describes the historical and current situation of the Semliki Delta wetland landscape, including its issues and causes, threats and pressures. This chapter summarizes the main challenges in the wetland landscape, which is the starting point for the (improved) management of the wetland area and possible interventions and investments, which will be discussed in the Wetland Management Plan and Conservation Investment Plan respectively.

7 MAIN CHALLENGES

7.1.1 Destruction of the wetland

The high and rapidly rising rate of encroachment, pollution, drainage, conversion and destruction of wetlands leads to a rapid decline in the area covered by Semliki Delta wetlands. **Wetland encroachment** and **deforestation** are widespread problems as farmers extend farmlands, herders need increasingly large areas to graze their livestock, and communities cut papyrus and trees for household use or commercial purposes. Wetland encroachment is taking place in Semliki Delta, with more and more informal settlements originating along the river banks at the river mouth, that are only accessible by boat (Figure 20). At these settlements, natural vegetation is being replaced (sometimes through **bush burning**) by cultivated land used for construction of houses and for agriculture. Besides leading loss of important vegetation (papyrus, reeds, palm-oil trees and bamboo) and biodiversity, these pressures are aggravating **soil erosion**, causing greater **siltation** of River Semliki and Lake Albert and fuelling conflicts amongst the different user groups. Semliki Delta is a hotspot for biodiversity, but the **habitat** of these species is being **degraded**, and their future in Semliki Delta wetland is no longer certain. The fragmentation of the natural vegetation, intensification of natural resources use by humankind and increasing **invasive species** entering the ecosystem have resulted in **declining species populations**. Sewage, animal waste, agricultural waste and solid waste has resulted in **pollution of water and environment**. Watering of livestock at the River Semliki has resulted in **river bank destruction**, pollution with animal waste and soil erosion. Currently cattle tramples the fragile river banks and farmers produce until the very edge of the rivers.

The peatlands of the Semliki Delta wetland landscape can be seen as an important carbon sink. However, deterioration of these peatlands (f.e. through drainage) enhances national carbon emissions at a significant scale, as explained in the NBI Carbon Study 2019. Hence, the unsustainable use of Semliki Delta wetlands for water supply, agriculture or energy generation, can **turn these peatlands from a carbon sink into a huge carbon source**.

7.1.2 Overexploitation of natural resources

Products like papyrus, wild game, wood and fish are being overharvested. **Unregulated harvesting**

of tree products, especially firewood, **charcoal production** and poles for wall construction, roofing and fencing, has resulted in overexploitation of wood almost to near depletion. The TEEB study (NBI 2019b) estimated that 100 percent of the households in the Semliki Delta depend on wetland sourced **fuel wood** for their domestic cooking needs. Field interviews indicated that households on average used a head-load of fuelwood every two days for domestic cooking purposes. Especially at fish landing sites, the local communities require a lot of firewood for cooking and smoking fish.

Overfishing and the use of **illegal fishing methods** is reducing fish stock indiscriminately and breeding sites are disappearing. The increasing pressure on fish stocks and **illegal fishing in protected fish breeding sites** is greatly contributing to the decline in fish species.

Game meat is acquired through **illegal hunting**. The game meat in Semliki Delta is mainly from animals such as hippopotamus, crocodiles and buffalos. The illegal hunters most often **burn** wetlands to scare animals so that they can easily hunt them, which is a big problem to the biodiversity and ecosystem at large.

7.1.3 Unsustainable resource management practices in upstream areas of Semliki catchment

Resource management practices in upstream areas can have both beneficial and adverse effects on downstream areas. By influencing transfer of water and sediment downstream, **economic activities and developments in upstream areas of River Semliki Catchment** can drastically affect crucial ecological functions in the Semliki Delta downstream. Some of the 'external factors' of activities taking place within the catchment of River Semliki and ultimately affecting the status of Semliki Delta 'downstream' are:

- **Poor agricultural practices, unsustainable land use management and river bank degradation**, resulting in increased erosion, destabilization of the river banks and siltation of the river mouth where River Semliki flows into Lake Albert
- Land cover changes upstream (like **deforestation** and **wetland encroachment**) can have a negative effect on:

- Flood control, water buffering and drought mitigating capacity of Semliki Delta
- Water purification and filtration, deterioration of water quality in Semliki Delta
- Soil loss, removal of vegetated buffer strips, resulting in siltation of Semliki Delta

7.1.4 Boundaries are unclear and changing

Boundaries are unclear and changing due to both physical processes and weak institutional capacity on land, water resources and catchment management. Quite often these issues come with power struggles between powerful stakeholders, including politicians and large investors.

- The country boundary between Uganda and the DRC has always been defined by River Semliki. However, **the River Semliki is changing its course** both during the seasons and over the years making it unclear which lands belong to whom, and which country is responsible for which area. At the same, infrastructure, such as electricity lines and roads, is being destroyed as river banks erode and disappear into the swirling stream;
- A **demarcation of areas that should be protected, conserved or restored is missing**, and when it is there it is unclear which policies, by-laws and regulations apply. Enforcement is difficult;
- Clear delineation would help to **avoid cattle trampling the fragile river banks and farmers producing until the very edge of the rivers**. Non-utilization and protection of these river banks is essential to allow the regeneration of vegetation in these areas;
- Conflicts arise between different users as **land tenure is unclear or not respected**. F.e. Livestock enters farmlands and destroys crops, farmers open up new lands in the wetlands destroying fish breeding grounds, and fishermen pollute landing sites aggravating water quality problems for domestic water use in nearby villages;
- The dispute about changing borders due to the actively meandering River Semliki requires decision making at the highest level.

7.2 ROOT CAUSES

7.2.1 Widespread poverty

A high Multidimensional Poverty Index (74% of the population in DRC and 55% in Uganda is in multidimensional poverty; UNDP 2019b), as a consequence of low income, large families, high incidence of Malaria and HIV/AIDS, and loss of crops and livestock to droughts and floods are of serious concern. The continuous striving for a better life has put unprecedented pressure on water and environment resources in the Semliki Delta wetlands. Only by addressing the environmental and nature challenges in combination with strengthened livelihood resilience can conservation become a success.

7.2.2 Rapid population growth

The future of the Semliki Delta wetlands is inextricably linked to **rapid population growth**, which is currently at 2.74%. Increasing pressure from rapid population growth increases the demand for raw materials, food and water from the wetlands, as well as land for human settlement, livestock grazing and agriculture. Rapid population growth also causes an increase solid and liquid waste accumulation, in faecal contamination and many other development-related pressures.

7.2.3 Weak law enforcement and institutional capacity

Weak law enforcement of existing policies and legislation is increasing the occurrence and impacts of illegal overexploitation of natural resources and destruction of the wetland system. There is also a **lack of a wetland-specific law** to combat rampant degradation and support effective conservation efforts. This is further enhanced by **weak institutional capacity** on land, water resources and catchment management. For example poaching is hard to curb because of the transboundary nature of the wetland. When Ugandan Authorities for example seek poachers they sneak into the DRC and vice-versa. Overfishing and the use of illegal fishing methods is reducing fish stock indiscriminately and breeding sites are disappearing. Fish (by-) laws are violated with the fishermen often not even being aware of doing so. This requires better law enforcement in both Uganda and DRC side of Semliki Delta, and compliance with the newly signed bilateral agreement on sustainable management of fisheries (see chapter 4.2.2).

7.2.4 Low community awareness

Community awareness on the value of wetlands is low. Governments (at all levels) should provide the right frameworks and support to make change and improvements possible at community level. There is a **need for better communication, education, participation and awareness on the value of wetland landscapes and its ecosystem services**. For many years, Ugandans and Congolese have taken water and environment resources for granted, expecting these resources to always be available. The continuous strive for a better life and increasing population growth have put unprecedented pressure on water and environment resources. The drastic changes in weather and climate across the globe, the declining condition of the rivers, lakes, groundwater, forest and wetland cover as a result of unregulated conflicting human action represent an important aspect of environmental issues that require urgent attention. The balance in Semliki Delta is a fragile one. The population is fully dependent on the wetland natural resources for their livelihoods, but there is little awareness on the need for conservation and sustainable utilization. Lack of participation also leads to silent and open resistance to wetland management from the public.

7.2.5 Poor access to safe water resources and sanitation facilities

Water access for domestic, livestock and crop production is poor. The **water resources are available but access to water of sufficient quality at an affordable price, in a safe manner, and without negative consequences to the environment is not in place**. The infrastructure is simply not in place or broken down. Safe water coverage for domestic varies between 39% and 95%. Water quality is (locally) negatively impacted both by the volcanic geology of the area (brackish or saline groundwater), and by the limited use (around 34%) of improved sanitation facilities. **Open defecation** is especially a problem close to fish landing sites. Water abstraction for crop irrigation, albeit still very limited, is on individual basis, and neither controlled by policies or regulations, nor supported by means of organized infrastructure to avoid expansion and destruction of natural water bodies.

7.2.6 Climate change

Climate change already has, and is expected to continue presenting an additional stress on development in the Semliki Delta region, especially with its high dependency on rain-fed agriculture and cattle grazing. The main threats are the **increasing variability in rainfall and rising temperature**. Although highly uncertain, models indicate that rainfall may increase with 5 to 8% in October through December, and decrease by 17% in March. Temperature may increase with 1.5°C to 2.0°C. Rising temperatures and shifting or increasingly unpredictable rainfall patterns can reduce the amount of grazing areas and agricultural land, shorten growing seasons, hamper crop production, undermine the (ground) water resources and alter the occurrence and distribution of pests. Climate change is a threat to the resources in the lake region and could aggravate the impact of human population growth rates, conflicts over resources and widespread poverty.

7.3 THREATS AND PRESSURES

Local communities see the increasing interest in **oil extraction** as a major threat to their livelihoods. Most of the Semliki local settlers, have continued to express fear of suspected loss of the wetland due to planned extraction of oil especially in DRC Congo side. This has made the locals more sceptical and fearful about the interest of any unknown person spotted around the wetland. Although oil exploration has the potential to create jobs, its can cause pollution and damage the environment, especially the vulnerable Semliki Delta wetland landscape. Urbanization is expected to increase with oil exploitation and this is likely to cause further deterioration of the lake. Oil exploitation could have adverse impacts on biodiversity and ecosystem services if oil spills occur. Addressing the possible impacts of oil extraction requires decision making at the highest level.

A major threat is also the **acceleration of land use change**. The natural system is being changed into one at the mercy of mankind, where loss of ecosystem services and key habitats, sedimentation, pollution and eutrophication are increasingly problematic.

PHYSICAL CONTEXT

Location and delineation

The Semliki Delta lies across the boundary of the Democratic Republic of Congo (Ituri Province) and Uganda (Ntoroko district). The western boundary of the Semliki Delta wetland landscape is defined by the bottom of an escarpment and the Semliki River. In the north and west, the project area is bounded by Lake Albert. In the south, the boundary includes the influence area of the Nyanjakufa branch of the Semliki River.

Topography, geology and soils

The Semliki Delta wetland landscape is located in the Albertine Rift and the delta area is very flat with an altitude between 620 to 630 meter above mean sea level (m amsl). The geology is characterized by thick layers of consolidated and unconsolidated rift valley sediments, covered by fluvial-deltaic and lacustrine sediments, consisting of silts and sands where gypsum and clays have been deposited along bedding planes and along vertical fractures.

Hydrology and water resources

The valley floor of Semliki Delta receives an average of about 900 mm per year of precipitation, which is significantly less than the amount of precipitation that the high parts of the rift valley and Rwenzori Mountains receive. The rainfall has a seasonal pattern with a first rainy season between March and May and a second rainy season between August and December.

River Semliki drains Lakes George & Edward and the high rainfall area of the Rwenzori Mountains and Nyamulagira Mountains. River Semliki is the largest river in the Albert Water Management Zone (AWMZ), and along its 140 km course in the Albertine Rift Valley a series of tributaries join it before draining into Lake Albert at the Semliki Delta wetland system. Recent discharge data of River Semliki (2006–2011) shows strong interannual and seasonal variability. Annual low flows are in the order of 20 – 40 m³/s, while annual high flows are in the order of 60 – 160 m³/s.

The thick layers of rift valley sedimentary rock and alluvial infills and lacustrine deposits produce an almost continuous aquifer. However, deep groundwater has not yet been explored in Semliki Delta, and the shallow groundwater is found to be brackish and hard in some areas. Deposits of gypsum and calcium carbonates are present locally in the subsoil, which give rise to the Solonchak soil type and highly mineralized groundwater. As a result,

brackish groundwater causes corrosion and borehole breakdown in some areas. Solonchak soil type are only suitable for extensive grazing or would require extensive irrigation and drainage if they are to be used for agriculture.

Water quality and hydrological functions of wetland system

River Semliki has a high sediment load (turbidity, used as indicative proxy of sediment load, was measured at 225 NTU), due to unsustainable land use practices that enhance river bank, lakeshore and wetland degradation and soil erosion, resulting in siltation of Lake Albert (sedimentation of the delta at a rate of more than 150 m/year in some areas). Faecal contamination due to inadequate sanitation and low latrine coverage is also a major health concern. The Semliki Delta wetland landscape plays an important role by supporting ecosystem processes and regulating the dynamics of the hydrological system (buffer function) for the waters entering Lake Albert, reducing peak flow and contamination and storing potable water.

Climate change and carbon sequestration

Water resources are likely to be increasingly strained in the future climate of the wider Semliki Delta area. Overall, precipitation totals are projected to be similar to the current climate in 2050, expect for a slight (5–8%) increase in October–December and 17% decrease in March. The uncertainty of the projections is very high, however, meaning that even in other periods of the year, significant increase or decreases in precipitation cannot be ruled out. Temperatures are expected to increase by as much as 2°C by 2050. These rising temperatures can increase the frequency and intensity of extreme droughts and floods, thereby reducing crop yields and causing a loss in livestock, which will have important implications for food security. The rising temperatures do increase snowmelt and continued loss in glacier ice in Rwenzori Mountains, causing a shift in the peak discharge of River Semliki. Despite popular believe, the glacial recession does not change significantly the total amount of water flow of River Semliki, as the total amount of precipitation within Semliki Catchment remains nearly equal (see also Explainer 1 in chapter 2.4.4 Effects of climate change).

Wetlands are an effective sink for carbon, playing a key role in buffering the effects of climate change, thereby supporting climate adaptation and resiliency. Therefore, the Semliki wetland landscape needs better protection from human disturbance and increasing temperatures, to avoid the release of carbon dioxide. The unsustainable use of Semliki Delta peatlands

could turn these peatlands from a carbon sink to a huge carbon source (NBI Carbon Study; Elsehawi et al. 2019).

Land use

The pressure on land and resources is increasing due to population growth. Forests are cleared to provide firewood more land for grazing and agriculture. The grazing land in turn is threatened by poor agricultural practices, such as overgrazing, which contribute to declining soil fertility. Wetland encroachment is taking place in Semliki Delta, with more and more informal settlements originating along the river banks at the river mouth, some of which are only accessible by boat.

BIODIVERSITY AND ECOSYSTEM SERVICES

Biodiversity

The Lake Albert basin supports a considerable biodiversity of flora and fauna with endemic mammals, birds, amphibians, and plants. The delta is a species rich habitat with a bird species list of 325 species and more than 19 fish species were found in Lake Albert and Semliki wetland. The tall vegetation along the marshy shores of the lake is home to the *Shoebill Balaeniceps rex* and other wetland birds. A total of 253 species of butterflies and 72 species of dragonflies have been recorded in the Semliki Delta.

Wetland ecosystem services

Wetlands provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational and cultural benefits and ecosystem health services that maintain the conditions for life on earth, such as nutrient cycling. The Semliki Delta wetland has ecological and socioeconomic impact by improving water quality, water supply, flood control, storm protection, and is a source of fish to the people of the area, of medicinal plants, of grazing and of raw materials for building and making crafts.

POLICIES AND INSTITUTIONAL CONTEXT

Main stakeholders

The main actors range from global and regional organizations, that are by definition transboundary in nature, to institutions at national level and local institutions; see Figure 27.

Policies and legislations

The main policies that have direct bearing wetlands include Environment, Water, Agriculture, Forestry, Livestock, Fisheries, Tourism, Land and Wildlife

Policies. The transboundary Semliki Delta wetland system provides for a call of a multi-layered participatory approach which should carefully be linked to the transboundary conservation interests.

Protected areas

Semliki Delta and the last part of the river Semliki are located in the Semliki Controlled Hunting Area which extends up to River Semliki and Semliki Wildlife Reserve, both forming the Important Bird Area, part of which is a protected area managed by the Uganda Wildlife Authority. The Rwengara protected area covers close to 10% of the entire study area.

Natural resource management

There are four distinct ownership of resources: Private land, Central government resources, Communal resources and Local/District council resources. Transboundary institutional arrangement on natural resources is fairly absent, except for project supported initiatives.

SOCIO-ECONOMICS AND LIVELIHOOD ANALYSIS

Livelihood and socio-economic system

The main economic activities in the project area are fishing (with nearly 73% of the population depending on this for their livelihoods), livestock and subsistence small holder farming (the main crops grown being beans, maize and bananas) for subsistence but sometimes for commercial use. Tourism is becoming an increasingly important activity in the wetland landscape.

Livestock and agro-pastoralism

Cattle's grazing is a major economic activity along the river banks on both sides of the boarder. On the Ugandan side, the area has been over stocked and over grazed, leading to severe trampling of the vegetation especially around the watering points on the river. Cross-border migration of cattle keepers from DRC adds to the already overstocked area.

Crop production and forestry

Despite the climate being favourable for crops such as tea, cassava, beans, maize, banana and cotton which are grown by subsistence farmers on small-holdings in Lake Albert region, crop production in Semliki Delta is limited to vegetables growing on the river banks due to unfavourable (saline) soils.

Fisheries and aquaculture

The Semliki Delta – Lake Albert ecosystem provides

abundant quantities of fish as a nutritious source of food, income and employment for the population along its lake shores and further inland in both Uganda and the Democratic Republic of Congo (DRC). However, over-exploitation has led to decline in catches and reduced fish size. Also, Lake Albert is becoming eutrophic and in some places green algae causes anoxic conditions with considerable mortality of Nile perch.

Energy sources and transport

Water transport is the most important means of movement of people and goods especially between fishing villages in Uganda and those in the DRC. Nearly 100 percent of the households in the Semliki Delta depend on wetland sourced fuel wood for their domestic cooking needs, which has resulted in overexploitation of wood.

Trade and industries

The trade between Uganda and DRC includes food items, beverages, domestic goods and construction materials, sometimes originating from far inland.

Eco-tourism

Because of its rich and relatively undisturbed natural areas, Semliki Delta wetland landscape has a high yet underdeveloped potential for eco-tourism. Eco-tourism potential includes community tourism, boat rides (Lake Albert) and accommodation services.

SOCIAL DIMENSION

Human demography

Population growth in Semliki Delta exerts pressure on meagre land resources and complicates and exacerbates environmental problems, mismanagement of the land, natural resource depletion and environmental degradation. The Population and Housing Census shows that at Ntoroko District (UGA) the population stood at 74,000 in 2012, and at Imuru Territory (DRC) the population stood at 1.3 million in 2012. The total population in Semliki Delta wetland landscape is calculated to be currently 48,000 (2019) and is expected to rise to 57,000 in 2025 and 65,000 in 2030 with an average population growth rate of 2.77 (see Table 10 and Figure 32).

Water supply and sanitation

In Ntoroko District, Uganda a total of 96 villages (55%) are with a source of safe water, against a total of 80 villages (45%) that are still without a source of safe water supply (MWE 2019). A shortage of water for domestic consumption, livestock watering and

irrigation is experienced especially during the dry season in Semliki Delta wetland area. This can be explained in terms of inadequate resources exploitation and poor technology rather than resource scarcity, as sufficient water resources are available; both groundwater and surface water. The geology and soils in Semliki Delta are favourable for groundwater exploitation and in addition huge reserves of fresh water are available such as River Semliki and Lake Albert. There is limited access to adequate sanitation in most of Semliki Delta wetland area, especially at the landing sites and associated fishing villages.

Public health and diseases

Many people in and around Semliki Delta, particularly in fishing communities, experience a lack of access to clean drinking water and improved sanitation, while other social services, such as health facilities are poor. As a result the incidence of diseases such as HIV/AIDS is high, especially among fishers with prevalence as high as 24%. Water related diseases such as malaria, bilharzia, cholera and diarrhea are common amongst communities around the lake. The nearby Ebola outbreak in DRC is still ongoing. Ituri Province of DRC is still grappling with the outbreak of Ebola, which is the world's second largest Ebola epidemic on record, with more than 2000 lives lost and 3000 confirmed infections since the outbreak was declared on 1 August 2018.

Equity and gender

Both Ntoroko District in Uganda and Ituri Province in DRC experience difficulties/challenges in enhancing gender mainstreaming. Uganda and DRC are ranking #127 and #156 respectively (out of 189 countries) on the Gender Inequality Index rank of 2018 (Table 11; UNDP 2019).

MAIN CHALLENGES

Main challenges

The high and rapidly rising rate of encroachment, pollution, drainage, conversion and destruction of wetlands leads to a rapid decline in the area covered by Semliki Delta wetlands. The unsustainable use of Semliki Delta peatlands can turn the wetland from a carbon sink into a huge carbon source. Products like papyrus, wild game and wood are being harvested unregulated, leading to overexploitation of natural resources. Overfishing and the use of illegal fishing methods is reducing fish stock indiscriminately and breeding sites are disappearing. Poor

agricultural practices, unsustainable land use management, deforestation, encroachment and river bank degradation in upstream areas of the Semliki river basin results in adverse effects on the Semliki Delta area downstream. The (naturally) changing course of River Semliki results in border disputes, making it unclear which lands belong to whom, and which country is responsible for which area. Clear delineation and better demarcation would help to avoid disputes about changing borders.

Root causes, threats and pressures

The continuous striving for a better life has put unprecedented pressure on water and environment resources in the Semliki Delta wetlands. Increasing pressure from rapid population growth increases the demand for raw materials, food and water from the wetlands, as well as land for human settlement, livestock grazing and agriculture. Only by addressing the environmental and nature challenges in combination with strengthened livelihood resilience can conservation become a success. Weak law

enforcement of existing policies and legislation is increasing the occurrence and impacts of illegal overexploitation of natural resources and destruction of the wetland system. There is also a need for better communication, education, participation and awareness on the value of wetland landscapes and its ecosystem services. Water resources are available but access to water of sufficient quality at an affordable price, in a safe manner, and without negative consequences to the environment is not in place. Combined with poor access to sanitation facilities, this puts more pressure on the wetland system. The changing climate is increasing variability in rainfall and rising temperatures, which already has, and is expected to continue, presenting an additional stress on development in the Semliki Delta region, especially with its high dependency on rain-fed agriculture and cattle grazing. Local communities see the increasing interest in oil extraction as a major threat to their livelihoods.

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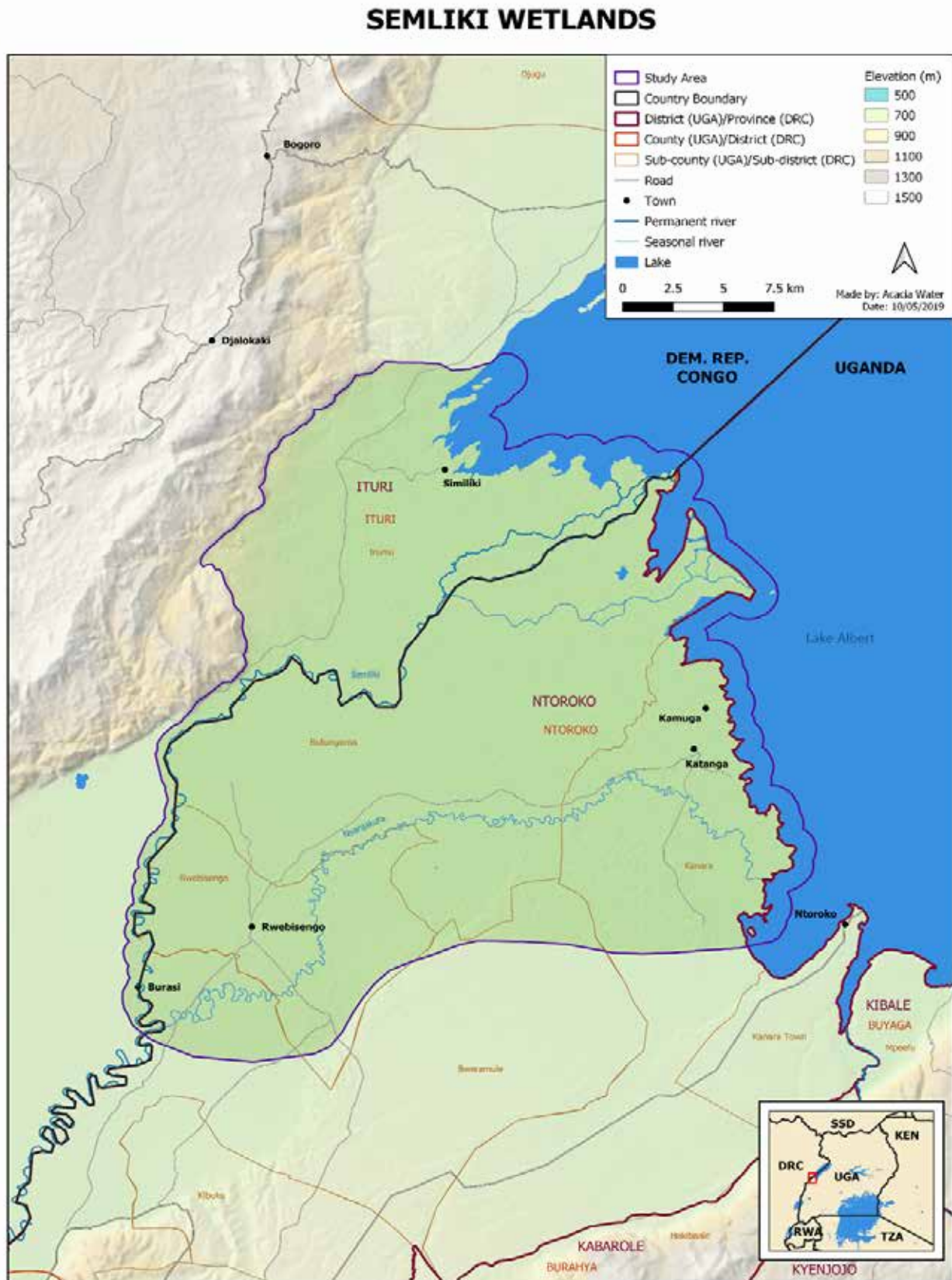
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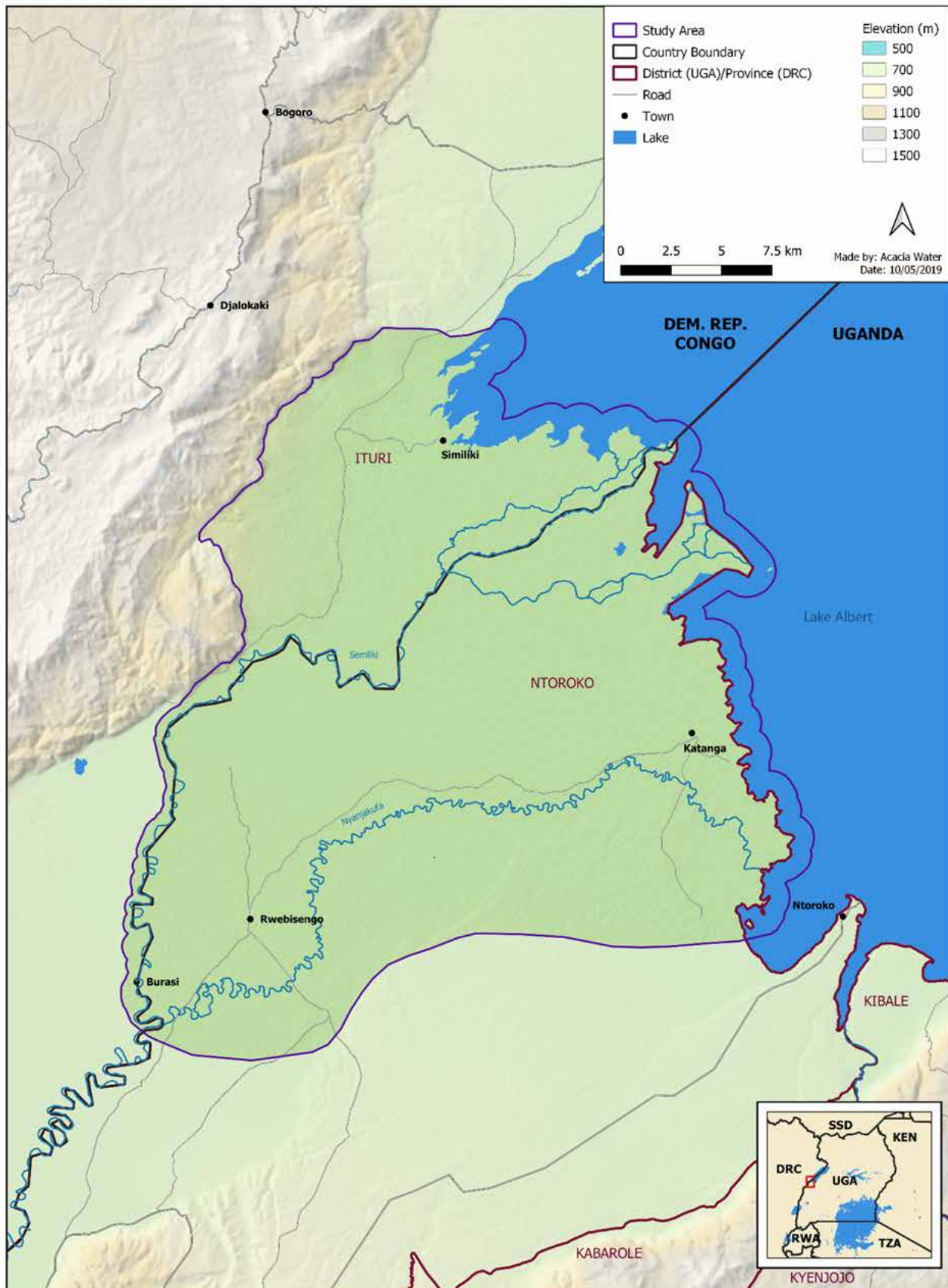
APPENDIX A: MAPS

A1. Semliki Delta - Administrative boundaries



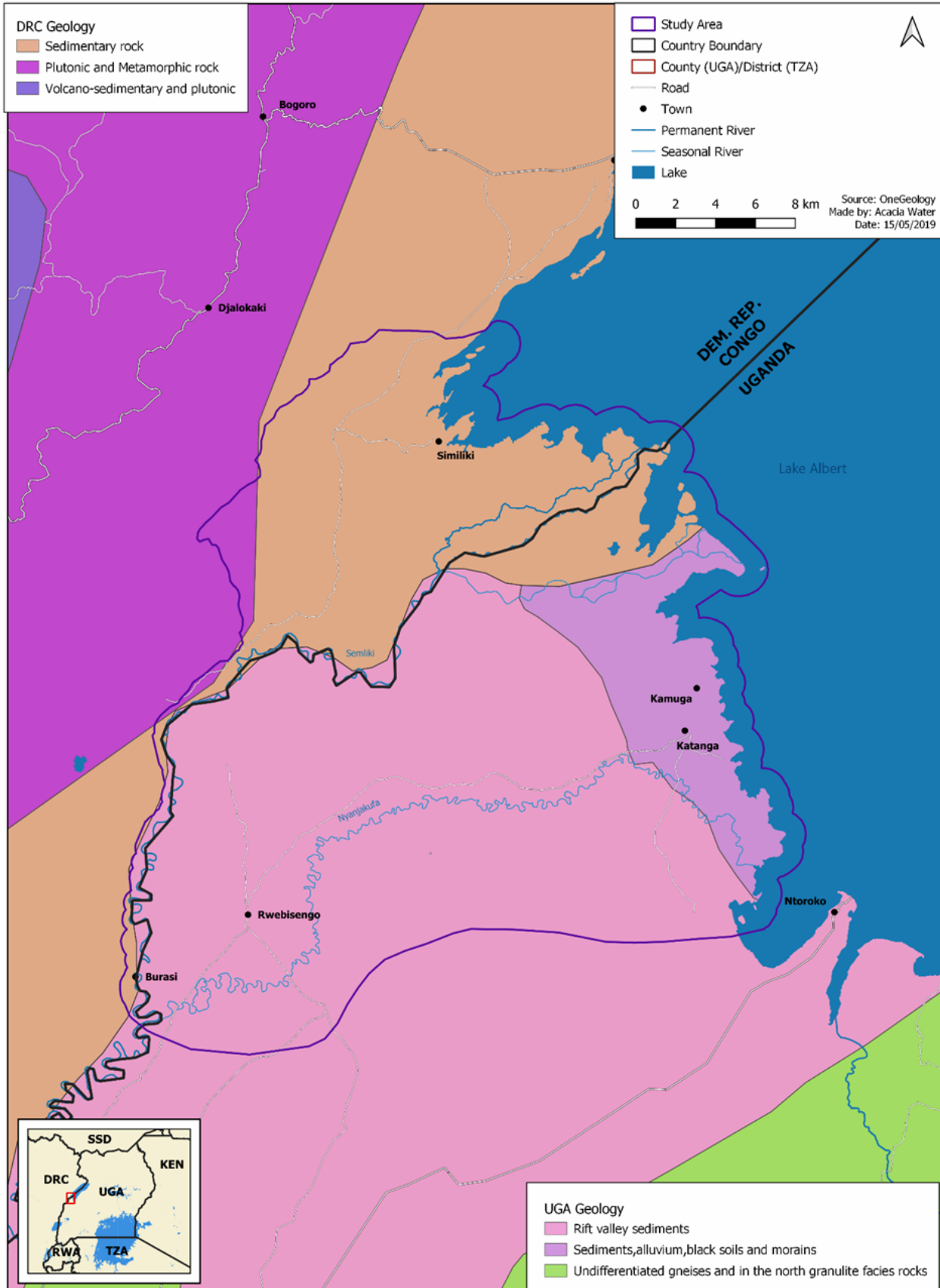
A2. Semliki Delta - Elevation

SEMLIKI WETLANDS



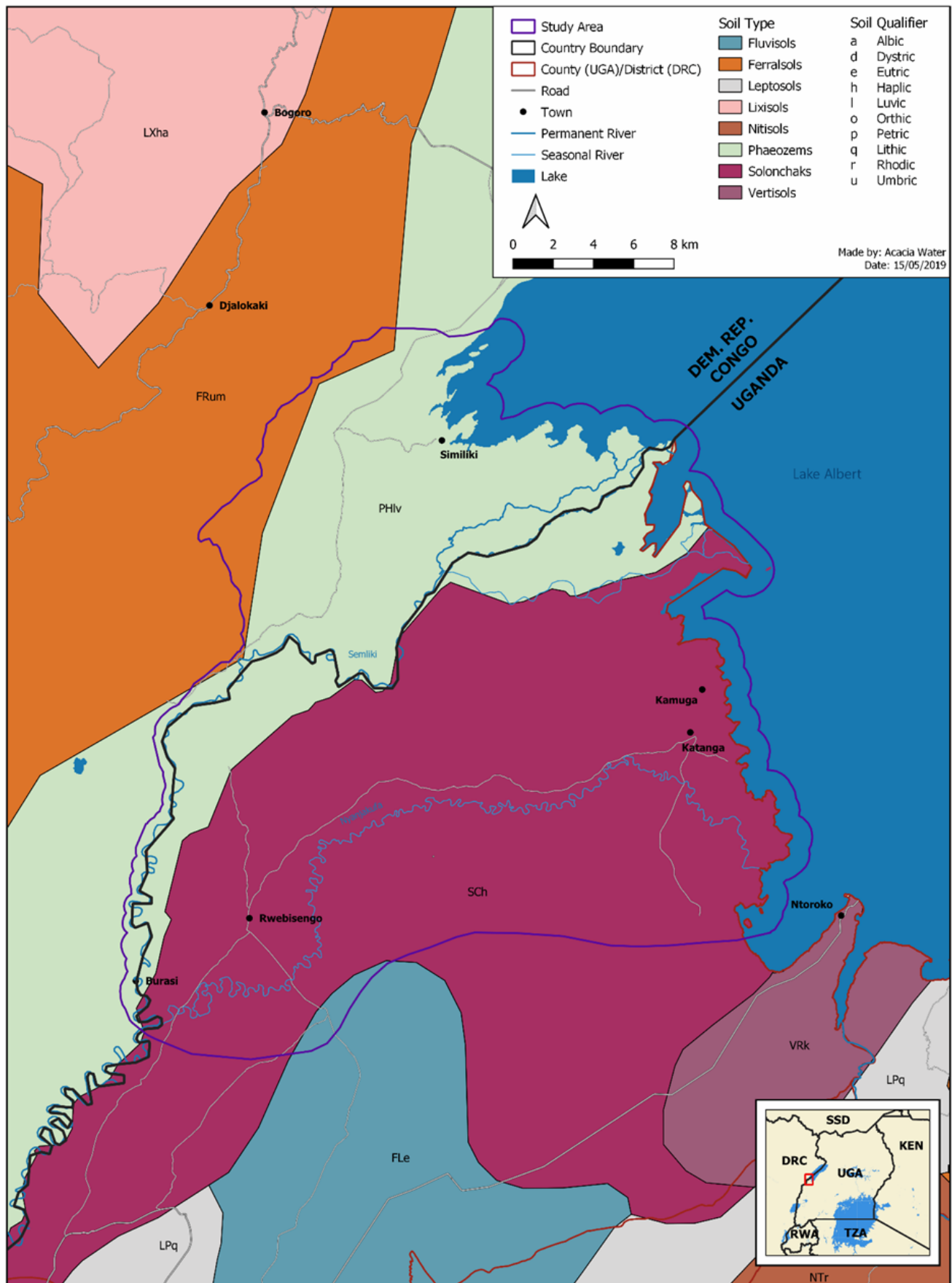
A3. Semliki Delta – Geology

SEMLIKI WETLANDS



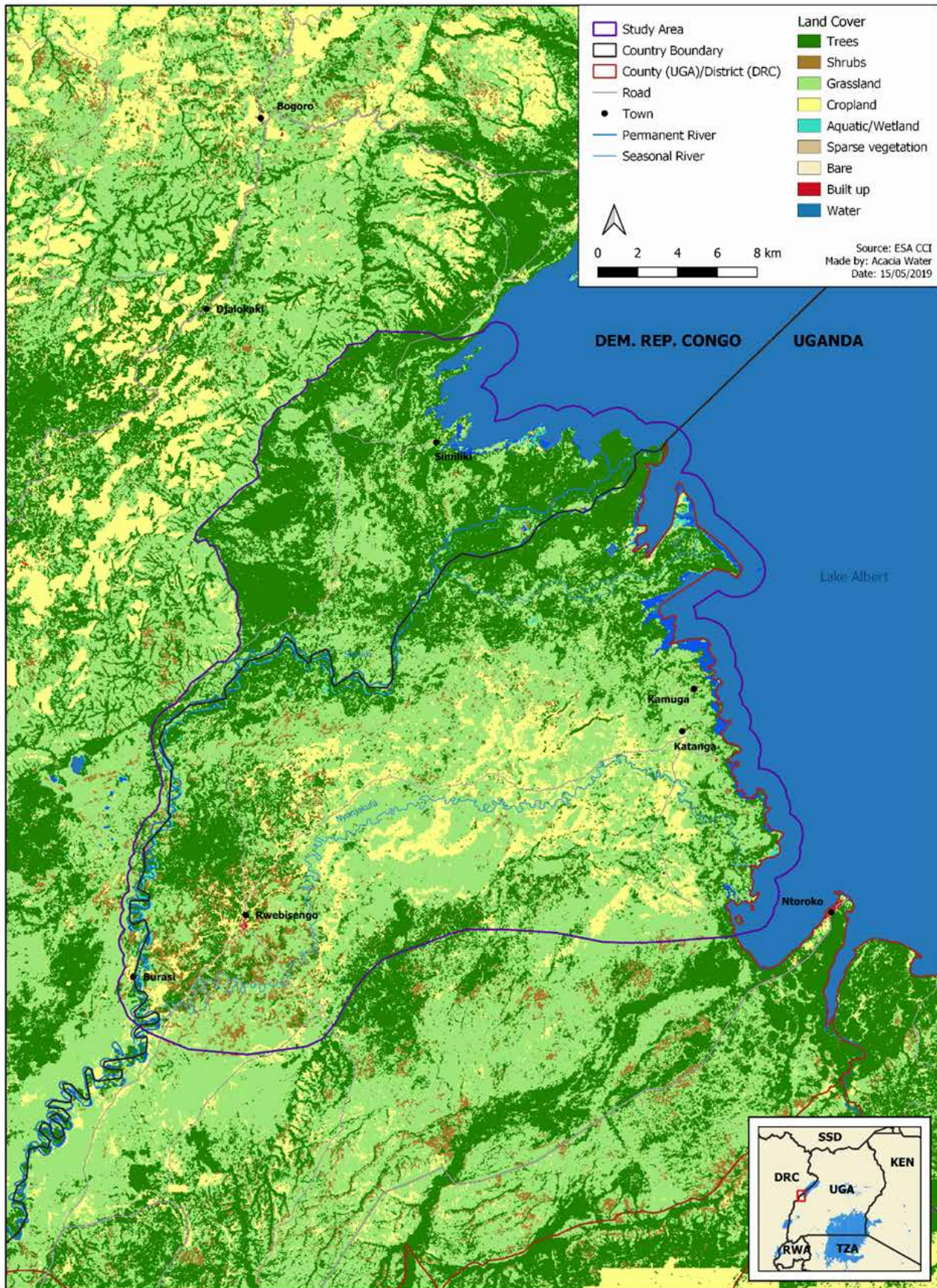
A4. Semliki Delta – Soils

SEMLIKI WETLANDS



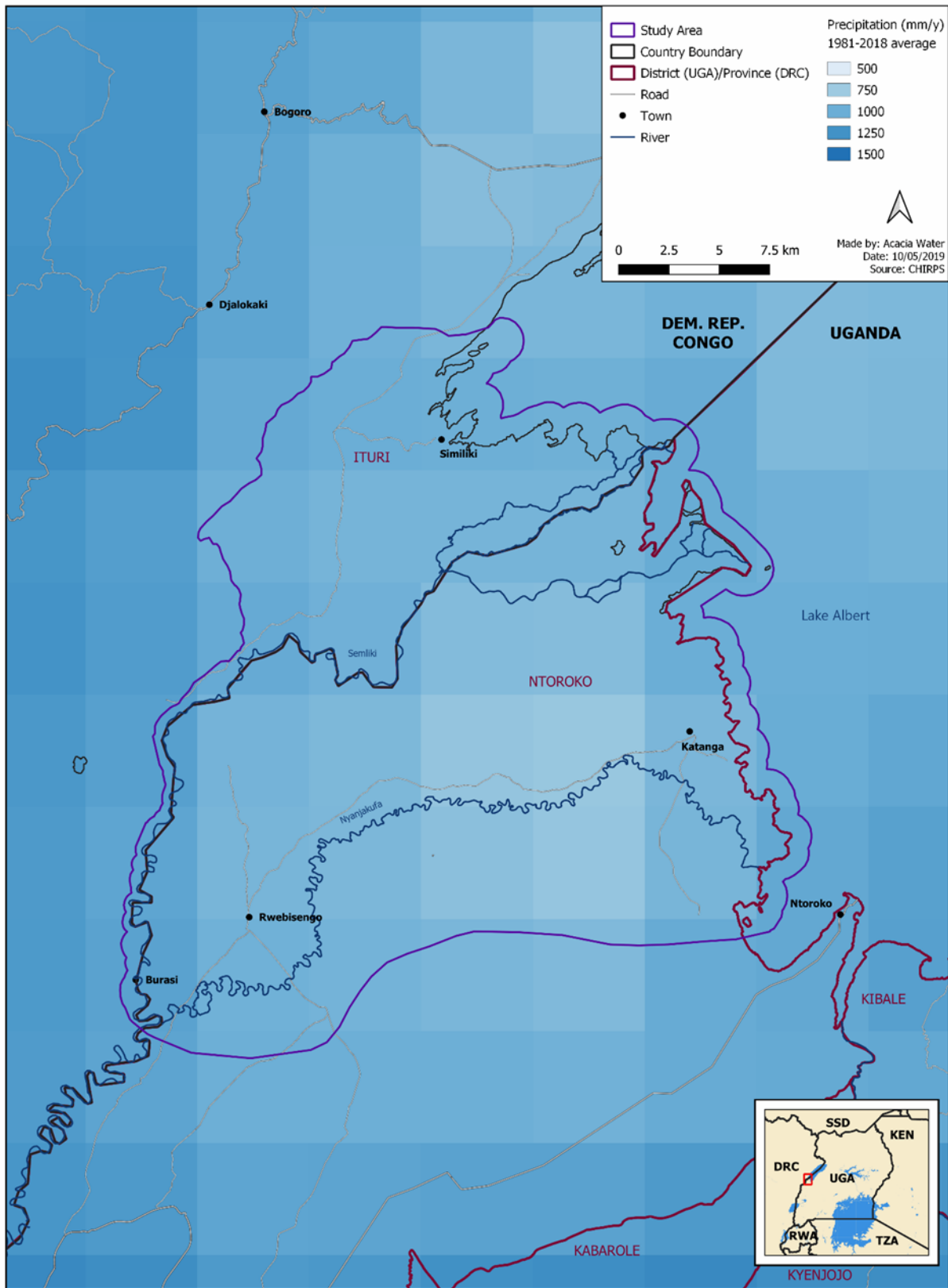
A5. Semliki Delta - Land cover

SEMLIKI WETLANDS



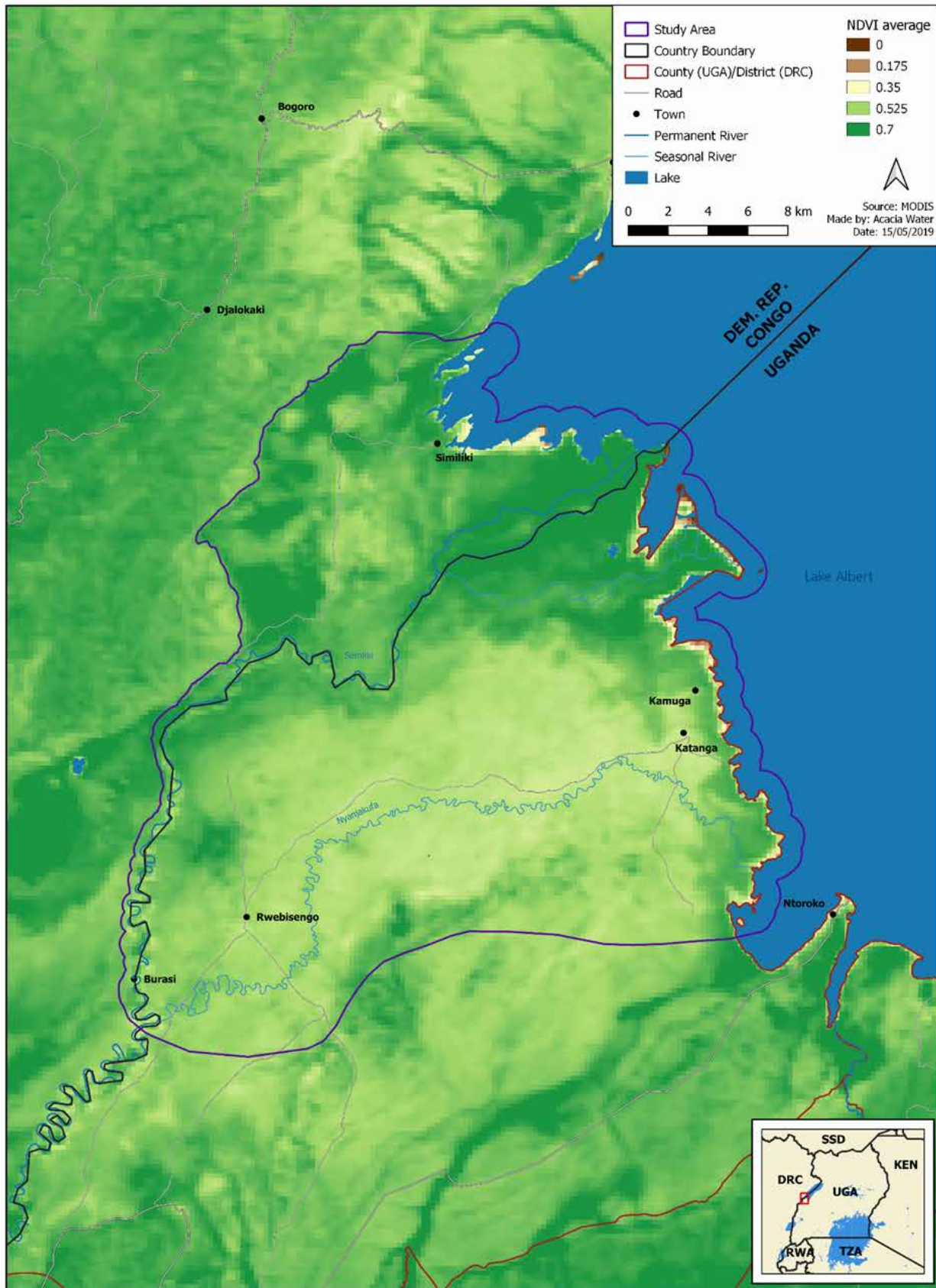
A6. Semliki Delta – Precipitation

SEMLIKI WETLANDS



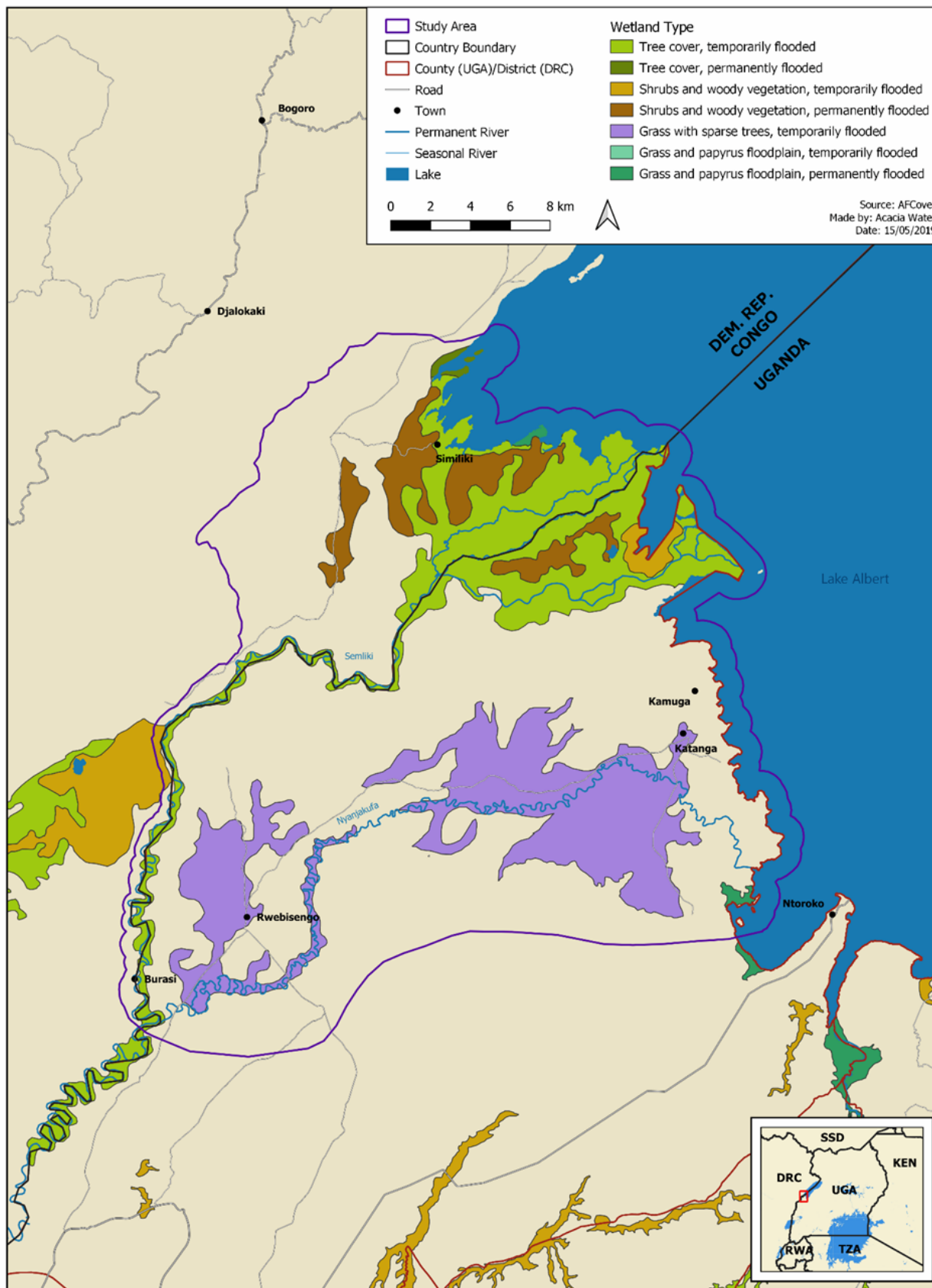
A7. Semliki Delta - Vegetation greenness (NDVI)

SEMLIKI WETLANDS



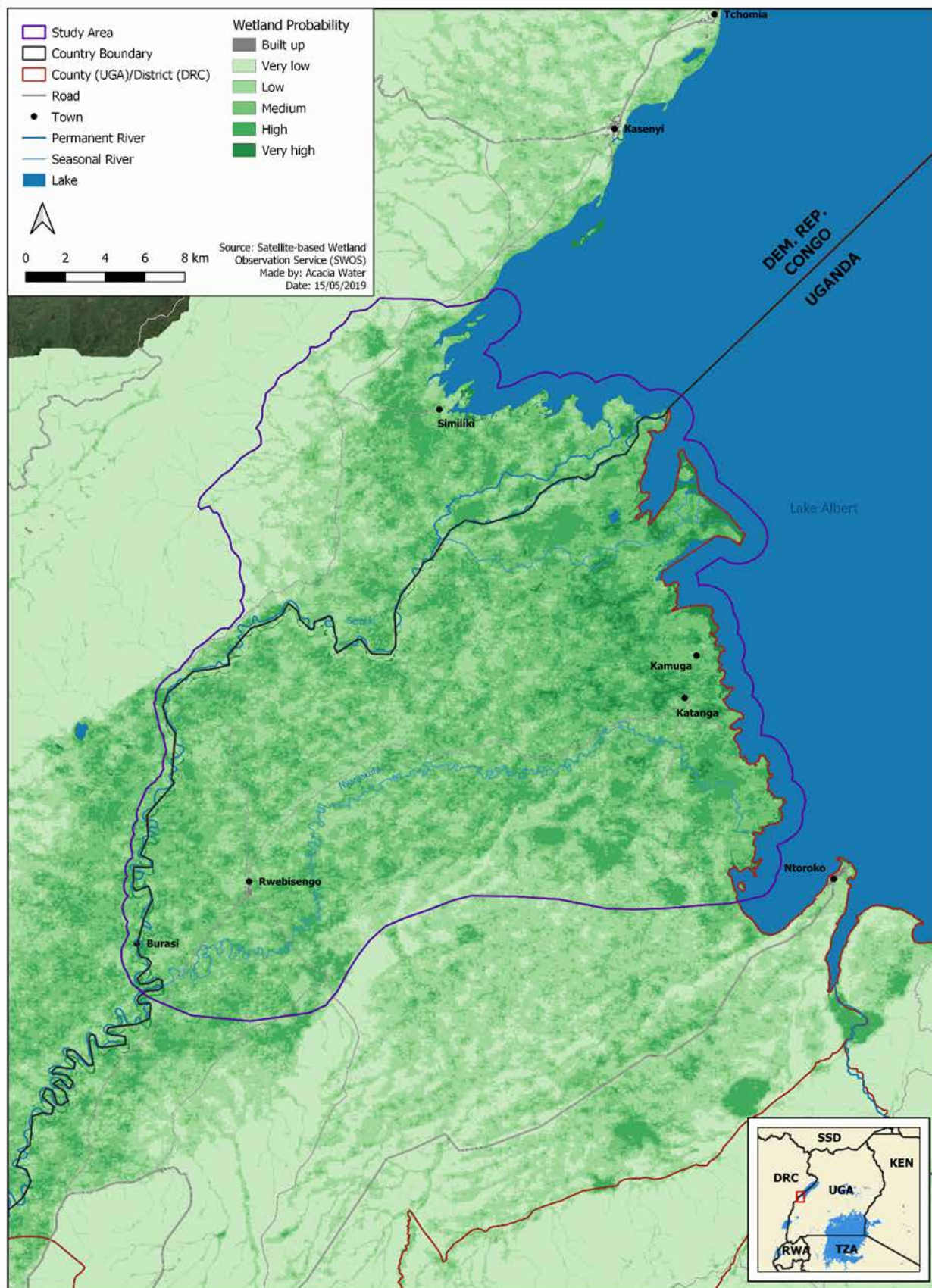
A8. Semliki Delta - Wetland types

SEMLIKI WETLANDS



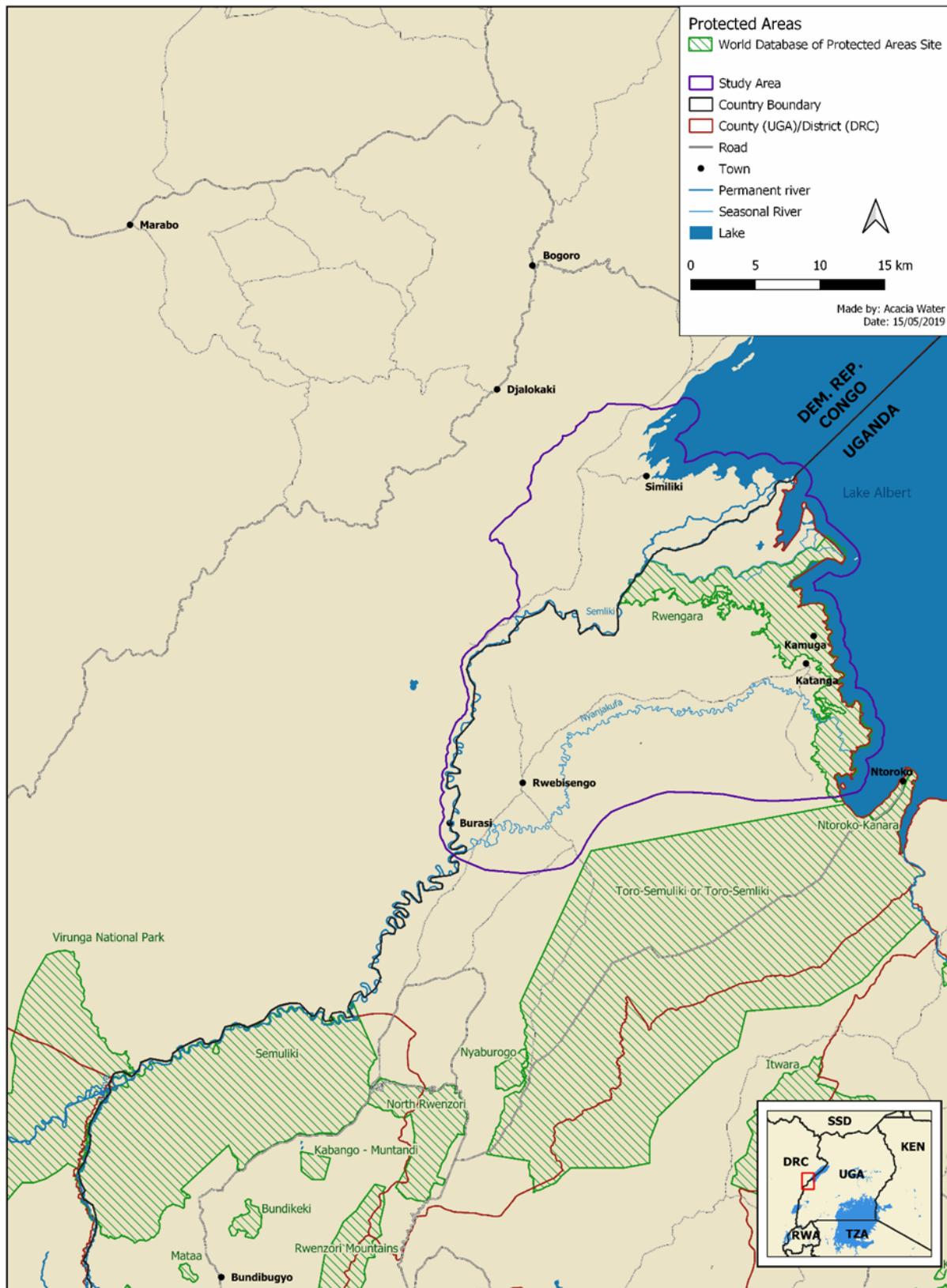
A9. Semliki Delta - Probability of wetland cover

SEMLIKI WETLANDS



A10. Semliki Delta - Protected areas

SEMLIKI WETLANDS



Appendix A MAIN FINDINGS FIELD VISITS

Appendix B1 – Field notes waypoint

Waypoint	Lat UTM 36N	Lon UTM 36N	Elevation (m)	Type	Status	Name	EC ($\mu\text{S}/\text{cm}$)	T ($^{\circ}\text{C}$)	NO3 (mg/l)	Turbidity (NTU)	Borehole number	Borehole placement
788				Borehole (see wp...)								
789	0203302	0123186	633	Open well	in use		874	24.5	0			
790				Borehole	non functional							
791	0201360	0121474	637	Borehole	in use (handpump)		1525	27.5	0		DWD 33745 (or 3)	1/12/2011
792				Elevated tank / private borehole?								
793	0191521	0113980	638	River	Year round	Semliki River	677	26.6	0	225		
794	0192258	0113718	641	Protected well	in use (handpump)		1371	27.2	0			
795				Elevated tank / private borehole?								
796	0194004	0114903	642	Borehole	in use (electric pump -							

Borehole depth	Depth to GW (m)	Activities	Vegetation	Animals	Wetland Services	Comments
	3.3	cattle grazing (fenced cows)	Grassland with Borassus Palms		Potable water, cattle grazing	Hand dug open well, latrine nearby (~70m), open well used as borehole nearby (wp 790) is non-functional
~ 15 m						Mechanical problem (since 2016) due to salty water (corrosion), people used this water for washing but too salty for drinking, salty from the start
~30 - 40 m	3.1	cattle grazing (fenced cows and goats) and some small-scale farming (cassava, maize, potato)	Grassland with Borassus Palms	secret ibis (black-white) and grey ibis,	Potable water, cattle grazing, smallholder farming	Water is clear but slightly brown (organic material?), 5m next to BH is an open well with concrete rim which is no longer in use / full of waste (but possible to measure groundwater level)
						Observation: one hour after heavy rains the town (Rwebisengo) and some places with cattle are still inundated in many places, but not the grassland/natural vegetation. Cattle especially in Rwebisengo sub-county
		cattle grazing (cows and goats), UPDF barracks	Grassland with Borassus Palms		Cross-border migration, transport service, water for household, cattle grazing	River is ~70m wide, and on average 1,5m deep (max 2,0m) - depths based on wooden stick (5,9m) used for crossing river by boat - flow of river (along the side) as measured with 'floating stick method' is 1 m/s (19 sec / 20 m and 22 sec / 20 m) --> Q = 100 m ³ /sec (Note: flow velocity likely higher in middle of river). No engine boats around. Riverbank is ~3m higher than current water level, which is also the max river height. Barracks of UPDF (Uganda Army) located here, they use water from River for cooking and water from borehole for drinking
~ 3 m		cattle grazing (fenced cows), agriculture (cassava)	Grassland with Borassus Palms		Potable water, cattle grazing, smallholder farming	Protected well dries during dry season (when they have to use river water for drinking), the houses in this area are made of mud with corrugated iron roof, big herds of cows (with deep marks/numbers in their skin) and many palms
						Pastoralist (cattle keeper) with big big house
			Grassland with Borassus Palms		Potable water	Borehole with electric pump, 1 generator, powered by 64 solar panels, water being pumped to elevated tank in Rwebuzengo village (one pipe) and from

Waypoint	Lat UTM 36N	Lon UTM 36N	Elevation (m)	Type	Status	Name	EC ($\mu\text{S}/\text{cm}$)	T ($^{\circ}\text{C}$)	NO3 (mg/l)	Turbidity (NTU)	Borehole number	Borehole placement	Borehole depth
					solar panel)								
797				Elevated tank / private borehole?									
798	0195 701	0115 419	640	Protected well	in use? (handpump working but very corroded)		2490	28.1	0			1/2/2010	~3 m
799	0198 587	0113 228	638	River	Seasonal (dry)	Nyangatuva (check map?) River							
800	0198 920	0119 877	634	Protected well	non functional								
801	0198 716	0119 765	634	Borehole	in use (handpump)	Butungama Primary School	1385	29.6	0			2018	~ 42m
802				Rock									
803				Birds									

Depth to GW (m)	Activities	Vegetation	Animals	Wetland Services	Comments
					there to government buildings and private connections (UGX 400.000). Water quality is apparently good (not too salty) and borehole always working. Depth of borehole unknown. Was installed 10 years ago by district
	cattle grazing (fenced cows) and big cow farm next door	Grassland with Borassus Palms		Potable water, cattle grazing	Probably not in use because of very salty water. Iron handpump/pipes are strongly corroded
		Reeds, grasses, torony trees			Seasonal river (side-branch of Semliki River) only flowing during rainy season (high water level), bridge has 5 culverts of 1,5m diameter each, no signs of groundwater seepage, water level is reported to be up to 2,5 - 3,0 m above river bed (bridge is 4 m above river bed), water flowing for ~3 months per year, EC of stagnant water/swamp is 720 uS/cm, while water from very small stream (rain water?) is 270 uS/cm. Stones of bridge are schists, coming from higher grounds nearby Fort Portal
				Potable water, cattle grazing	Protected well with handpump, non-functional, there was no more water, according to school teacher
	Primary School			Potable water	After pumping for a while, this boreholes is reported to give sand and color turns black, constructed last year by the District + co-funding school, users: school & community, borehole has never dried. Note: big tanks next to roofs of school for rainwater harvesting, but non-functional because pipes/connections/guts are stolen
					Pictures of sedimentary rock on the edge of the Albertine Graben (pictures taken before are from banded gneiss/schists on the high side (horst) of the normal fault)
			2 crested crane birds (Uganda national symbol) ,also many stork, flocks of 20-30 small white 'herons', black-white-black Ibis and grey Ibis		

Waypoint	Lat UTM 36N	Lon UTM 36N	Elevation (m)	Type	Status	Name	EC (μ S/ cm)	T (°C)	NO3 (mg/l)	Turbidity (NTU)	Borehole number	Borehole placement	Borehole depth
804				Borehole with handpump	unknown								
805				Roof water harvesting									
806				Borehole	broken down								
807				Landscape change									
808				Borehole with handpump	unknown								
809				Landscape change									
810-813				Boreholes and protected wells	non- functional								
814				Fishing village		Kamuga							
815				Landing site		Kamuga							
816	0220 183	0128 337	622	Lake		Lake Albert	600	30.1	0	<5			

Borehole depth	Depth to GW (m)	Activities	Vegetation	Animals	Wetland Services	Comments
			Flat grassland with scattered Borassus Palms and many termite hills			Roof Water Harvesting observed at several big houses and schools (although many seem to be non-functional / broken down)
						No handpump, only platform left
			Grassland with few scattered palms and some bushes			Change in landscape, less and less Borassus Palms, more ... bushes and flat open grassland with wide views
			Grassland with very few palms and some bushes & reeds	2 crested cranes		Soils are getting more black and wet, very wide views (less bushes and palms), more reeds (with feathery plume)
			Grassland, very few shrubs, no trees		Fish, only source of potable water	Fishing village (~3000 people) close to Lake Albert. Soil is not good for crops, only source of income is fishing. People use water from the lake as the groundwater is "too salty". No boreholes or open wells in town. Lake water used for household, sometimes they boil the water or use "Water God" (some kind of chemical that settles down the suspended solids?) Solid waste is an issue (plastic bottles everywhere). "Oil will be abstracted in Ntoroko very soon". Old car/truck tires are burned and the thin metal lines inside are used to waive baskets for fishing.
			Reeds and some papyrus		Fish, only source of potable water	Landing site on Lake Albert for fishing boats. 100-200 boats. Wetlands along the coast are protected area (fishing prohibited) but fishing taking place on a large scale, using traditional methods and poor-quality equipment.
			Reeds and papyrus along the coastline, green water plants/algae in the water	Many types of water birds, a lot of storks around the fishing boats, according to fishermen there are buffalo's, many hippo's and		Small tour by boat: gradual transition from shallow muddy water to more clear water with algae and water plants; depth of lake is still only 0.5 meter at several hundreds of meters from the shoreline, with manual boat not possible to get close to Semliki River (would take 1-1,5 hour, speed of manual boat is measured at 2,5-3,5 km/hour) engine boat required, EC routing: in the shallow mud the EC is around 720 (max: 750 uS/cm), a bit deeper around 670 uS/cm and in the deeper water at wp816 EC is

Waypoint	Lat UTM 36N	Lon UTM 36N	Elevation (m)	Type	Status	Name	EC (μ S/cm)	T ($^{\circ}$ C)	NO3 (mg/l)	Turbidity (NTU)	Borehole number	Borehole placement
817				High water level mark								
818	0218 450	0124 767	630	Borehole	non-functional	sub county Kanara					DWD 35080	6/17/2011
819				Borehole	non-functional							
820				Protected well	non-functional						DWD 59965	
821				Protected well	non-functional							
822	0218 010	0123 676	628	Open well	in use		2720	31.6	10			
823				River	Seasonal (dry)							
824	0217 634	0121 725	624	Protected well	functional but drying up		323	33	5			2015-2016
825				Borehole with handpump	non-functional							

Borehole depth	Depth to GW (m)	Activities	Vegetation	Animals	Wetland Services	Comments
				some crocodiles (but not that many as in Semliki River)		around 600 (min: 595 uS/cm), changes are gradual. Protected park "Bulango Park", part of "Semliki Park". Burning observed far away ("people burn the grass to kickstart new grass growing"?)
			Grassland, very few shrubs, no trees			The water (of Lake Albert) comes up to here in rainy season (but never as high as the village), according to fisherman: "they received a lot of rain this year" and "the rains are normally in Dec-Feb)
unknown			Grassland, some trees, village			Borehole next to school, broke down 3 years ago (and never repaired), all boreholes in this village are broken because of salt water (corrosion). They buy water from a borehole 2,5 km away (jerrycan is 1000 UGX)
			Grassland, some trees, village			No handpump, only platform left
						Protected open well, not working for 3 years (because of salt water)
					Rain Water Harvesting	Protected open well, was working until recently but broke down a year ago (corrosion?), was used for drinking even though water was too salty. New elevated tank is being constructed next to health center, water will come by pipe (gravity flow) from Karugutu town council (will be finished in May 2020). Rain Water Harvesting used at health center (but only provides water in rainy season)
	2,5 m		Grassland, with thorny bushes	Big group of ~30 maribou storks	Potable water	Hand dug open well, watering place for cows is only a few meters away --> contamination during heavy rains. Water is used for drinking, household, cattle, everything
			Grassland with thorny bush and some trees		Cattle grazing	Protected well, pump still working, but after less than 1 jerrycan the borehole is dry,

Appendix B2 – Field notes taken at Kamuga landing site (L. Albert), Kanara Sub-county (Ntoroko District) - Uganda

Kamuga is one of the landing sites in Kanara sub-county in Lake Albert, Uganda. Majority of resident of this landing sites are owners of fishing gear and boats, food vendors, tea rooms, guest house owners, owners of recreational centers such as bars, public video show rooms, porters of fish, porters of water for domestic use from the lake, sellers of porridge at the landing site, fish traders and processors, shop owners, shops of fishing gears, medical shops, soft drinks, fabrics and others. Women were mainly involved in activities such as selling plantains, sweet potatoes, yams, fresh and fried fish, maize and cassava flour, selling water and other fast household moving items. Others owned bars, guest rooms and tea rooms.

The settlement is a fish landing site with leadership and some committees namely; peace and security, discipline, ceremony and death committee and the main committee for coordinating other committees which is composed of chairperson, vice chairperson, secretary and other 3 elected members.

Fishing is organized in rented rooms by boat/gear owners. In this case each room is regarded as a camp with its leadership and crewmembers. Both owner and crew slept in one room which was subdivided by curtains/bed sheet. During the visit there were about 85-100 boats, 5 outboard engines and a number of illegal monofilament nets and under mesh gillnets nets of 2.5- 4 inches. Long line hooks were also observed and the common sizes in use were number 14 and 16. This size is mainly catching immature fish. With long line they used bait such as *ugali* made from cassava, fish offal's, cow-dung and worms.

On average the landing site was occupied by 150-250+ boats. Each boat had average of 50-60 nets of single or double panels. Each boat had two crew members. Fishing time varied depending fish type. Some crew left early in the morning while others at 10-11 am or in the evening. Main food in most individual camps was fish and *ugali* (*kaunga*) – made by maize or cassava. Green plantains were reported to be expensive. Crewmembers carried food stuff and charcoal burners for cooking while on lake.

Interview with fishers at Kamuga reported that majority of fishers and traders were from DRC. They lived there for more than 30 years. Some had wives in both Uganda and DRC. Others had cattle's in DRC and Uganda and grazed in either of the side. Fish trading was mainly done in DRC. Other markets were Bwera (Kasesse), Fort Portal, Bundibujjo, Kagana and Ishasha.

Fishers and traders at Kamuga revealed that, boats landed at their site varied from 150-250+ during rainy (high catches) and dry seasons when trading fish and other crops was at peak, which means fish was highly demanded throughout the year. Boat types were flat bottomed boats locally known as “*Congo barque*”. Other types of boats included Sesse boats and a few dugout canoes. These boats were hired for fishing as well as fetching water for domestic use. Many women engaged in water supply business. They fetched water by boat and hired porters to distribute in different households based on their daily orders: in small tea rooms, guest rooms, shops, butchers and individual households. During the interview, few respondents reported to boil water for drinking or use of water guard disinfectant. Majority used raw water for drinking and all domestic purposes.

Seven fish types were mentioned to be common in their locality; *Ngege*, *lung fish*, *mud fish*, *Mbuta*, *Fodofodo*, *Sardines* and *Jogojo*. Majority of fishers owned nets and rented boats and accessories (pole – locally known as ‘*coda*’ for peddling) on a daily basis at UGX 4,000. Fishers used single (26 meshes) or two paneled nets (52 meshes) because of shallow lake and poor fishing technology. Fishing was mainly done in shallow waters except for those who owned outboard engines. Those with engines, their main target fish were Tilapia and Nile Perch. Theft of nets was pointed to be one of the critical problems in the area.

Enrollment of crew was not permanent. New crew fished for some weeks or a month and they went home to rest before others would come and seek for the same job. Share system (remuneration) between owner and crewmembers was 40% for gear/boat renter/owner and 60% crew crewmembers after deducting costs (food, gear repair and money for renting boat on a daily basis).

Each fishing camp had bylaws prescribed by boat/gear owners to crewmembers during job enrollment. These bylaws were replicated in individual camps and became common for the entire Kamuga landing site. This means, the awareness of fisheries rules and regulations does not exist and therefore illegality or violation of fishing laws and regulation is a common phenomenon.

When asked which fisheries regulations they knew, they mentioned individual camp rules as follows:

- a) Not allowed to go out fishing while you are drunk;
- b) Not allowed to fight while on lake;
- c) Not allowed to abuse each other;
- d) Theft of fishing gear and fish is not allowed;
- e) Not allowed to sell fish while on lake;
- f) Not allowed to sell fish which are meant to be set aside for food at the camp;
- g) Not allowed to sell owner's share of the catch;
- h) Not allowed to take someone's boat for fishing without permission or paying rent fee;
- i) Owner should pay his crew promptly; and
- j) Not allowed to go fishing with local brew/beer.

This is an indication of lack of knowledge and awareness on existing fisheries laws and regulations and continued fishing illegalities (**Table 3**).

Generally, no sanitary and hygienic facilities were available at Kamuaga. The facilities examined included landing sheds (*bandas*), cold rooms, pontoon/ jetties, fish stores, potable water, toilet facilities, fish drying and processing racks, designated areas for boat and net repair, engine repair and electricity supply. Interestingly, about five small thatched toilets which were filthy and dirty existed some meters away from the landing site. The place had no access to piped water supply and with poor roads. It was a narrow and muddy landing site' (**Plate no. 12&14**).

Figure 10: A view of the camp site at Kamuaga during the camp season. The fish stores are placed to about 200m away from the shore due to the unpredictable nature of the lake. The camp is situated in a narrow channel through the lake. As shown in the picture, the lake has been filled by muddy water from upstream into the lake. The entire lake is turbid and this affects both fish and other aquatic life.



Plate 1



Plate 2



Plate 3



Plate 4



Plate 5



Plate 6



Plate 7



Plate 8



Plate 9



Plate 10



Plate 11



Plate 12

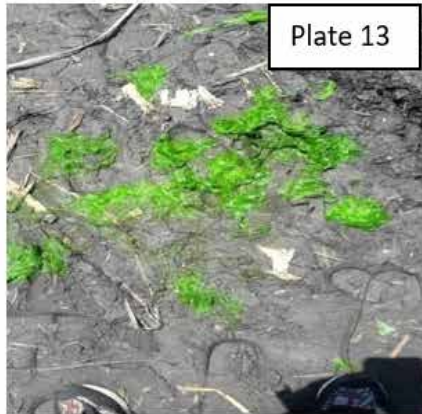


Plate 13



Plate 14



Plate 15



Plate 16

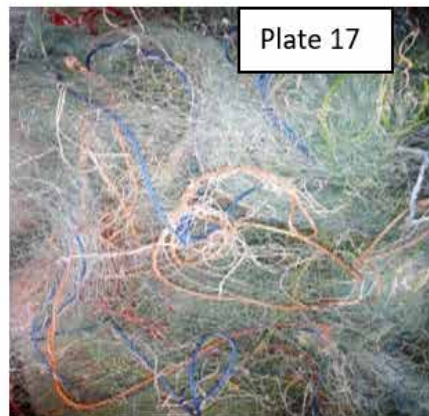


Plate 17

It was reported that Beach Management Units (BMUs) did not exist in their landing sites. Their landing site was headed by a chairperson who was at Kamuga for more than 25 years.

Photographs of indigenous and commercial fish species, boats, gears and other information taken from Lake Albert on 16th April, 2019. Photos taken by Modesta Medard.

Plate 1: Haplochromines with some young Tilapia

Plate 2: *Lates niloticus* (Linnaeus, 1758) and one *Nile Tilapia* (Linnaeus, 1758)

Plate 3: African cat fish, *Clarias* spp. (Burchell, 1822)

Plate 4: *Hydrocynus vittatus forskahilii* (Cuvier, 1819)

Plate 5: *Brycinus nurse*

Plate 6: *Auchenoglanis occidentalis* spp

Plate 7: Dried and salted Nile Tilapia *Oreochromis niloticus* (Linnaeus, 1758)

Plate 8: Nile Tilapia, *Oreochromis niloticus* (Linnaeus, 1758) and one specimen of Nile perch

Plate 9: Catfish, *Bagrus* spp (Forsskål, 1775; Forsskål, 1775)

Plate 10: *Protopterus aethiopicus*

Plate 11: Reeds for making traditional fishing traps in river mouth (ready to be taken by fishers)

Plate 12: Packed fishing boats without nets because of theft at the landing site in Kamuga landing site

Plate 13: Green algae scooped out of the lake

Plate 14: Boats packed in congested landing site because of reeds and papyrus

Plate 15: Long line fishing gear (hooks no 14, 15)

Plate 16: Consultants and tour guides. On the ground Tilapia, Nile Perch and monofilament net

Plate 17: Hip of monofilament nets

Fish biodiversity, fishing methods and fishing gear

Studies undertaken by NaFIRRI in 2013, showed that the dominant species in the commercial fisheries of Lake Albert were *Neobola bredoi* (67.5%), *Brycinus nurse* (21.1%) and *Lates spp* (3.4%). The three species maintained their dominance in 2014 (Table 14). On the Albert Nile system, *Oreochromis niloticus* (21.7%), *Oreochromis leucostictus* (17.9%) and *Lates spp* (12.9%) dominated the commercial fisheries in 2013. In 2014 however, the commercial fisheries on Albert Nile were majorly constituted of *Clarius gariepinus* (24.2%), *Oreochromis niloticus* (15.2%), *Lates spp* (8.9%) and *Labeo horrie* (8.3%). Overall the ten top most important commercially exploited fish taxa on Lake Albert include *Neobola bredoi*, *Brycinus nurse*, *Lates spp/Nile perch*, *Hydrocinus forskalli*, *Oreochromis niloticus*, *Alestes baremose*, *Bagrus bayad*, *Clarias gariepinus*, *Protopterus eathiopticus*, and *Barbus bynni* in the respective order (Table 14).

The other species (Table 14) contributed variably in small proportions to the commercial catches in both systems between 2013 and 2014. Both *N. bredoi* (Muziri) and *B. nurse* (Ragoogi) which form a major component of the commercial fisheries on Lake Albert are harvested at night using light attraction using small seines mostly 5 mm mesh size. Besides, Ragoogi is also harvested during day time similar harvesting gears but baited by **Cassava “Ugali”** mixed with **fish offals** and sometimes **cow-dung**. Other fishers (especially women) used **perforated basins** to harvest Ragoogi.

TABLE 14: FISH SPECIES AND TOTAL ANNUAL FISH CATCHES (TONNES) LANDED ON ALBERT NILE AND THE UGANDAN PART OF LAKE ALBERT IN SEPT. 2014

Species	Albert Nile						Lake Albert						overall	
	Adju- mani	Arua	Moy o	Neb bi	Total	%	Buliisa	Hoima	Kibaale	Neb bi	Ntorok o	Total		%
<i>Lates niloticus</i>	72.5	78.5	78.3	158.8	388.2	8.3	915.8	1,088.1	265.3	243.4	453.8	2,966.5	5.0	3,355
<i>Lates macrophthalmus</i>	5.1	5.5	5.5	11.2	27.4	0.6	245.9	292.1	71.2	65.3	121.8	796.4	1.3	824
<i>Oreochromis niloticus</i>	134.2	145.2	144.9	293.8	718.1	15.3	371.6	441.5	107.7	98.8	184.2	1,203.8	2.0	1,922
<i>Neobola bredoi</i>	-	-	-	-	-	-	10,526.2	12,506.4	3,049.8	2,797.5	5,216.5	34,096.4	57.0	34,096
<i>Brycinus nurse</i>	40.7	44.1	44.0	89.2	217.9	4.7	4,191.6	4,980.1	1,214.5	1,114.0	2,077.2	13,577.5	22.7	13,795
<i>Barilius niloticus</i>	1.4	1.5	1.5	3.0	7.3	0.2	4.4	5.2	1.3	1.2	2.2	14.1	0.0	21
<i>Haplochromines</i>	-	-	-	-	-	-	84.1	99.9	24.4	22.3	41.7	272.3	0.5	272
<i>Bagrus docmac</i>	7.0	7.5	7.5	15.2	37.2	0.8	-	-	-	-	-	-	0.0	37
<i>Protopterus aethiopicus</i>	63.8	69.0	68.9	139.7	341.5	7.3	102.1	121.3	29.6	27.1	50.6	330.8	0.6	672
<i>Clarius gariepinus</i>	211.7	229.1	228.6	463.6	1,133.1	24.2	88.1	104.7	25.5	23.4	43.7	285.3	0.5	1,418
<i>Mormyrus kannume</i>	17.9	19.4	19.3	39.2	95.9	2.0	12.3	14.6	3.6	3.3	6.1	39.8	0.1	136
<i>Tilapia zillii</i>	12.1	13.1	13.0	26.4	64.6	1.4	16.9	20.1	4.9	4.5	8.4	54.8	0.1	119
<i>Oreochromis leucosticus</i>	65.2	70.5	70.4	142.7	348.9	7.5	4.7	5.6	1.4	1.3	2.3	15.3	0.0	364
<i>Synodontis victoriae</i>	2.4	2.6	2.6	5.2	12.7	0.3	-	-	-	-	-	-	0.0	13
<i>Synodontis afrofisheri</i>	10.4	11.2	11.2	22.8	55.6	1.2	2.1	2.5	0.6	0.6	1.0	6.7	0.0	62
<i>Synodontis frontosus</i>	0.6	0.6	0.6	1.2	2.9	0.1	42.5	50.4	12.3	11.3	21.0	137.5	0.2	140
<i>Synodontis schall</i>	32.4	35.0	35.0	70.9	173.3	3.7	7.0	8.3	2.0	1.9	3.5	22.7	0.0	196
<i>Alestes baremose</i>	11.8	12.8	12.7	25.8	63.1	1.3	445.6	529.5	129.1	118.4	220.8	1,443.5	2.4	1,507
<i>Barbus bynni</i>	16.9	18.3	18.2	36.9	90.3	1.9	182.6	217.0	52.9	48.5	90.5	591.5	1.0	682
<i>Auchenognalis occidentalis</i>	1.3	1.5	1.4	2.9	7.2	0.2	142.6	169.4	41.3	37.9	70.7	461.8	0.8	469
<i>Malapterus electricus</i>	11.1	12.0	12.0	24.4	59.5	1.3	1.6	1.9	0.5	0.4	0.8	5.1	0.0	65
<i>Hydrocynus forskahlii</i>	15.3	16.6	16.5	33.5	81.9	1.8	910.4	1,081.7	263.8	242.0	451.2	2,949.0	4.9	3,031
<i>Bagrus bajad</i>	5.0	5.4	5.4	10.9	26.5	0.6	129.1	153.3	37.4	34.3	64.0	418.1	0.7	445
<i>Mormyrops anguilloides</i>	4.9	5.3	5.3	10.8	26.4	0.6	0.2	0.2	0.1	0.0	0.1	0.6	0.0	27
<i>Distochodus niloticus</i>	17.0	18.4	18.3	37.2	90.8	1.9	16.0	19.0	4.6	4.3	7.9	51.9	0.1	143
<i>Gnathonemus victoriae</i>	4.7	5.1	5.1	10.3	25.1	0.5	-	-	-	-	-	-	0.0	25
<i>Labeo horrie</i>	72.6	78.6	78.4	159.0	388.5	8.3	9.3	11.1	2.7	2.5	4.6	30.3	0.1	419
<i>Labeo coubie</i>	2.2	2.4	2.4	4.9	11.9	0.3	-	-	-	-	-	-	0.0	12
<i>Labeo forskahlii</i>	9.0	9.8	9.7	19.8	48.3	1.0	-	-	-	-	-	-	0.0	48
<i>Gnathonemus longibarbis</i>	5.7	6.1	6.1	12.4	30.3	0.6	-	-	-	-	-	-	0.0	30
<i>Mormyrus grahami</i>	2.6	2.8	2.8	5.6	13.8	0.3	-	-	-	-	-	-	0.0	14
<i>Hyperopisus bebe</i>	2.7	2.9	2.9	6.0	14.6	0.3	-	-	-	-	-	-	0.0	15
Others	7.65	8.27	8.26	16.75	40.93	0.9	1.44	1.71	0.42	0.38	0.71	4.67	0.0	46
Domestic consumption	6.6	7.2	7.2	14.5	35.5	0.8	-	-	-	-	-	-	-	36
Total	874.4	946.0	944.2	1,914.6	4,679.3		18,454.1	21,925.7	5,346.8	4,904.4	9,145.3	59,776.4		64,456

The trends in fishing effort are characterized by an increase in the number of actively operated gill nets, large boat seines, monofilaments (**Plate 16 and 17**), traditional basket traps and long lining (**Plate 15**). Taabu-Munyaho et al. (2012) also reported that majority of fishers in Lake Albert (41%) used multifilament gillnets and followed by small seine (38%) and the remaining in long line fishery. Monofilament nets, cast nets, river mouth

traps and small seines. Likewise, Mbabazi et al. (2012) reported that between 2007-2012 numbers of illegal fishing gears increased. For example, those of monofilament gillnets increased by over 260% largely in the Tilapia fishery. Other notable increases were on multifilament (31%), cast net (64%), traps (14%) and small seine nets (42%) (Table 15).

TABLE 15: OVERALL TREND OF FISHING GEAR AND ILLEGALITY IN LAKE ALBERT AND SEMLIKI WETLAND BASIN

Gear type	2007	2012	change
Multifilament gillnets	96,655	126,575	31%
Monofilament gillnets	1,049	3,774	260%
Long line hooks	1,978,224	745,706	-62%
Beach/boat seines	47	22	-53%
Cast nets	81	125	64%
Hand lines	246	447	82%
Traps	655	745	14%
Scoop nets	30	0	-100%
Small seines for light fishery	1619	2297	42%

Source: Mbabazi et al. 2012

In recent years, a light fishery targeting the small pelagic species *Neobola bredoi* and *Brycinus nurse* developed to meet the local domestic demand for human and animal food and they are transported to larger urban areas such as Kampala and other countries such as DRC and Sudan. These small (<10 cm long) fishes contribute at least 90% of the estimated yield of **160,000t (30%)** annually from the lake and the commonly-cited estimates of 35,000 t do not take these small fish into account and are therefore inaccurate (NaFIRRI CAS Report 2007).

In their search for large fish, especially Nile Perch, Tilapia and *Alestes baremose*, fishers have employed

a new strategy (*salsio or Luzira*) in which they stay on the water for three days up to two weeks while simultaneously processing (salting and sun-drying) the catch. These fishers are very destructive and use gillnets of 2.5-3.5 mesh size to target Nile Perch and Bagrus fish species. On return they land several tons of salted fish (weather especially the high temperatures) in the area favour rapid sun-drying. In addition to depleting further the remaining large fishes with its implications for the gene pool, this strategy has potentially detrimental impacts on water quality through the use of large quantities of salt and the dumping of fish remains and human wastes into the water.

SPECIES LIST SEMLIKI DELTA

Birds of Semliki Delta (Source: NU Records, UWA website, Field sightings)

COMMON NAME (Scientific Name)	Habitat
ABDIM'S STORK <i>Ciconia abdimii</i>	AMAG
ABYSSINIAN GROUND-HORNBILL <i>Bucorvus abyssinicus</i>	
AFRICAN MOURNING DOVE <i>Streptopelia decipiens</i>	
AFRICAN PIPIT <i>Anthus cinnamomeus</i>	
AFRICAN BROADBILL <i>Smithornis capensis</i>	FF
AFRICAN CRAKE <i>Crex egregia</i>	R-NTAwG
AFRICAN CUCKOO HAWK <i>Aviceda cuculoides</i>	R-NTAF
AFRICAN DARTER <i>Anhinga rufa</i>	R-VUW
AFRICAN DUSKY FLYCATCHER <i>Muscicapa adusta</i>	F
AFRICAN DWARF KINGFISHER <i>Ceyx lecontei</i>	FF
AFRICAN FIREFINCH <i>Lagonosticta rubricata</i>	
AFRICAN FISH EAGLE <i>Haliaeetus vocifer</i>	W
AFRICAN GREEN-PIGEON <i>Treron calvus</i>	F
AFRICAN GREY HORNBILL <i>Tockus nasutus</i>	
AFRICAN HARRIER HAWK <i>Polyboroides typus</i>	
AFRICAN MARSH HARRIER <i>Circus ranivorus</i>	R-NTW
AFRICAN OPENBILL STORK <i>Anastomus lamelligerus</i>	
AFRICAN PALM SWIFT <i>Cypsiurus parvus</i>	
AFRICAN PARADISE-FLYCATCHER <i>Terpsiphone viridis</i>	f
AFRICAN PIED HORNBILL <i>Tockus fasciatus</i>	F
AFRICAN PIED WAGTAIL <i>Motacilla aguimp</i>	w
AFRICAN PYGMY GOOSE <i>Nettapus auritus</i>	W
AFRICAN PYGMY KINGFISHER <i>Ceyx pictus</i>	fw
AFRICAN SCOPS OWL <i>Otus senegalensis</i>	
AFRICAN THRUSH <i>Turdus pelios</i>	f
AFRICAN WATTLED LAPWING <i>Vanellus senegallus</i>	
AFRICAN YELLOW WHITE-EYE <i>Zosterops senegalensis</i>	f
ALPINE SWIFT <i>Apus melba</i>	p
ARROW-MARKED BABBLER <i>Turdoides jardineii</i>	
AUGUR BUZZARD <i>Buteo augur</i>	
BAGLAFECHE WEAVER <i>Ploceus baglafecht</i>	f
BANDED MARTIN <i>Riparia cincta</i>	AG
BARE-FACED GO-AWAY BIRD <i>Corythaixoides personatus</i>	R-RR
BARN SWALLOW <i>Hirundo rustica</i>	
BATELEUR <i>Terathopius ecaudatus</i>	NTG
BEAUDOUIN'S SNAKE EAGLE <i>Circaetus beaudouini</i>	
BEAUTIFUL SUNBIRD <i>Cinnyris pulchellus</i>	
BLACK COUCAL <i>Centropus grillii</i>	R-NTW
BLACK CRAKE <i>Amaurornis flavirostris</i>	W
BLACK CUCKOO <i>Cuculus clamosus</i>	Af/FF
BLACK CUCKOO-SHRIKE <i>Campephaga flava</i>	Af
BLACK KITE <i>Milvus migrans</i>	

BLACK-AND-WHITE CASQUED HORNBILL <i>Bycanistes subcylindricus</i>	F
BLACK-AND-WHITE FLYCATCHER <i>Bias musicus</i>	
BLACK-BELLIED BUSTARD <i>Lissotis melanogaster</i>	
BLACK-BILLED BARBET <i>Lybius guifsobalito</i>	
BLACK-BILLED TURACO <i>Tauraco schuetti</i>	FF
BLACK-CHESTED SNAKE EAGLE <i>Circaetus pectoralis</i>	
BLACK-CHINNED QUAILFINCH <i>Ortygospiza gabonensis</i>	wG
BLACK-CROWNED TCHAGRA <i>Tchagra senegalus</i>	
BLACK-CROWNED WAXBILL <i>Estrilda nonnula</i>	f
BLACK-HEADED BATIS <i>Batis minor</i>	f
BLACK-HEADED GONOLEK <i>Laniarius erythrogaster</i>	f
BLACK-HEADED HERON <i>Ardea melanocephala</i>	w
BLACK-HEADED WEAVER <i>Ploceus melanocephalus</i>	
BLACK-LORED BABBLER <i>Turdoides sharpei</i>	
BLACK-RUMPED WAXBILL <i>Estrilda troglodytes</i>	w
BLACK-SHOULDERED KITE <i>Elanus caeruleus</i>	G
BLACK-WINGED BISHOP <i>Euplectes hordeaceus</i>	
BLACK-WINGED STILT <i>Himantopus himantopus</i>	pW
BLUE QUAIL <i>Coturnix adansonii</i>	
BLUE-BREASTED BEE-EATER <i>Merops variegatus</i>	W
BLUE-BREASTED KINGFISHER <i>Halcyon malimbica</i>	Fw
BLUE-CHEEKED BEE-EATER <i>Merops persicus</i>	PMP
BLUE-HEADED COUCAL <i>Centropus monachus</i>	W
BLUE-SPOTTED WOOD DOVE <i>Turtur afer</i>	F
BLUE-THROATED BROWN SUNBIRD <i>Cyanomitra cyanolaema</i>	FF
BROAD-BILLED ROLLER <i>Eurystomus glaucurus</i>	Afw
BRONZE MANNIKIN <i>Lonchura cucullata</i>	
BROWN ILLADOPSIS <i>Illadopsis fulvescens</i>	FF
BROWN SNAKE EAGLE <i>Circaetus cinereus</i>	R-NT
BROWN TWINSPOUT <i>Clytospiza monteiri</i>	f
BROWN-BACKED WOODPECKER <i>Picoides obsoletus</i>	
BROWN-THROATED WATTLE-EYE <i>Platysteira cyanea</i>	
BUFF-BELLIED WARBLER <i>Phyllolais pulchella</i>	f
BUFF-SPOTTED FLUFFTAIL <i>Sarothrura elegans</i>	
CABANIS' BUNTING <i>Emberiza cabanisi</i>	
CARDINAL QUELEA <i>Quelea cardinalis</i>	R-RRA
CARDINAL WOODPECKER <i>Dendropicops fuscescens</i>	
CASPIAN PLOVER <i>Charadrius asiaticus</i>	PMP
CATTLE EGRET <i>Bubulcus ibis</i>	G
CHESTNUT-WINGED STARLING <i>Onychognathus fulgidus</i>	FF
CHIN-SPOT BATIS <i>Batis molitor</i>	f
CINNAMON-CHESTED BEE-EATER <i>Merops oreobates</i>	R-RRF
COLLARED PRATINCOLE <i>Glareola pratincola</i>	
COLLARED SUNBIRD <i>Hedydipna collaris</i>	F
COMMON CUCKOO <i>Cuculus canorus</i>	
COMMON SWIFT <i>Apus apus</i>	PMP

COMMON BULBUL <i>Pycnonotus barbatus</i>	
COMMON BUZZARD <i>Buteo buteo</i>	
COMMON FISCAL <i>Lanius collaris</i>	G
COMMON GREENSHANK <i>Tringa nebularia</i>	PMPW
COMMON HOUSE MARTIN <i>Delichon urbicum</i>	
COMMON SAND MARTIN <i>Riparia riparia</i>	
COMMON SANDPIPER <i>Actitis hypoleucos</i>	PMPW
COMMON SCIMITARBILL <i>Rhinopomastus cyanomelas</i>	
COMMON WAXBILL <i>Estrilda astrild</i>	wG
COMPACT WEAVER <i>Ploceus superciliosus</i>	fw
COPPER SUNBIRD <i>Cinnyris cupreus</i>	
CRESTED FRANCOLIN <i>Francolinus sephaena</i>	
CRESTED GUINEAFOWL <i>Guttera pucherani</i>	F
CRIMSON-RUMPED WAXBILL <i>Estrilda rhodopyga</i>	
CROAKING CISTICOLA <i>Cisticola natalensis</i>	G
CROWNED EAGLE <i>Stephanoaetus coronatus</i>	R-VUFF
CROWNED HORNBILL <i>Tockus alboterminatus</i>	f
CROWNED LAPWING <i>Vanellus coronatus</i>	
DARK CHANTING-GOSHAWK <i>Melierax metabates</i>	
DIDRERIC CUCKOO <i>Chrysococcyx caprius</i>	
DOUBLE-TOOTHED BARBET <i>Lybius bidentatus</i>	f
EASTERN GREY PLANTAIN-EATER <i>Crinifer zonurus</i>	
EGYPTIAN GOOSE <i>Alopochen aegyptiaca</i>	WG
EURASIAN HOOPOE <i>Upupa epops</i>	
EUROPEAN BEE-EATER <i>Merops apiaster</i>	PMPf
FAWN-BREASTED WAXBILL <i>Estrilda paludicola</i>	
FLAPPET LARK <i>Mirafraga rufocinnamomea</i>	G
FORK-TAILED DRONGO <i>Dicrurus adsimilis</i>	
GIANT KINGFISHER <i>Megaceryle maxima</i>	R-NTW
GLOSSY IBIS <i>Plegadis falcinellus</i>	pW
GOLIATH HERON <i>Ardea goliath</i>	R-NTW
GREAT BLUE TURACO <i>Corythaëola cristata</i>	F
GREAT WHITE EGRET <i>Egretta alba</i>	
GREAT WHITE PELICAN <i>Pelecanus onocrotalus</i>	R-RRW
GREATER CORMORANT <i>Phalacrocorax carbo</i>	
GREATER HONEYGUIDE <i>Indicator indicator</i>	
GREEN CROMBEC <i>Sylvietta virens</i>	F
GREEN HYLIA <i>Hylia prasina</i>	F
GREEN WOOD-HOOPOE <i>Phoeniculus purpureus</i>	
GREEN-BACKED CAMAROPTERA <i>Camaroptera brachyura</i>	
GREEN-HEADED SUNBIRD <i>Cyanomitra verticalis</i>	F
GREEN-THROATED SUNBIRD <i>Chalcomitra rubescens</i>	F
GREY APALIS <i>Apalis cinerea</i>	FF
GREY CROWNED CRANE <i>Balearica regulorum</i>	VU,R-NTWG
GREY HERON <i>Ardea cinerea</i>	R-NTW
GREY KESTREL <i>Falco tinnunculus</i>	

GREY TIT- FLYCATCHER <i>Myioparus plumbeus</i>	
GREY WAGTAIL <i>Motacilla cinerea</i>	PMPFW
GREY WOODPECKER <i>Dendropicos goertae</i>	f
GREY-BACKED FISCAL <i>Lanius excubitoroides</i>	Afw
GREY-CAPPED WARBLER <i>Eminia lepida</i>	R-RRfw
GREY-HEADED KINGFISHER <i>Halcyon leucocephala</i>	
GREY-HEADED GULL <i>Larus cirrocephalus</i>	W
GREY-HEADED NEGROFINCH <i>Nigrita canicapillus</i>	
HADADA IBIS <i>Bostrychia hagedash</i>	w
HAMERKOP <i>Scopus umbretta</i>	w
HELMETED GUINEAFOWL <i>Numida meleagris</i>	G
HOLUB'S GOLDEN WEAVER <i>Ploceus xanthops</i>	w
HONEYGUIDE GREENBUL <i>Baeopogon indicator</i>	FF
HOODED VULTURE <i>Necrosyrtes monachus</i>	f
HORUS SWIFT <i>Apus horus</i>	
INTERMEDIATE EGRET <i>Mesophoyx intermedia</i>	
JACANA <i>Actophilornis africana</i>	W
JACOBIN CUCKOO <i>Clamator jacobinus</i>	
KLAAS' CUCKOO <i>Chrysococcyx klaas</i>	f
KNOB-BILLED DUCK <i>Sarkidiornis melanotos</i>	
KURRICHANE BUTTONQUAIL <i>Turnix sylvaticus</i>	
LANNER FALCON <i>Falco biarmicus</i>	
LAUGHING DOVE <i>Streptopelia senegalensis</i>	
LEAF-LOVE <i>Pyrhurus scandens</i>	F
LESSER BLUE-EARED STARLING <i>Lamprotonis chloropterus</i>	
LESSER GREY SHRIKE <i>Lanius minor</i>	PMP
LESSER HONEYGUIDE <i>Indicator minor</i>	f
LESSER JACANA <i>Microparra capensis</i>	R-NTW
LESSER KESTREL <i>Falco naumanni</i>	VU,R-VUP
LESSER MASKED WEAVER <i>Ploceus intermedius</i>	
LESSER STRIPED SWALLOW <i>Hirundo abyssinica</i>	
LESSER SWAMP WARBLER <i>Acrocephalus gracilirostris</i>	
LEVAILLANT'S CUCKOO <i>Clamator levaillantii</i>	
LITTLE BEE-EATER <i>Merops pusillus</i>	G
LITTLE BITTERN <i>Ixobrychus minutus</i>	pW
LITTLE EGRET <i>Egretta garzetta</i>	W
LITTLE GREBE <i>Tachybaptus ruficollis</i>	
LITTLE GREENBUL <i>Andropadus virens</i>	F
LITTLE SPARROWHAWK <i>Accipiter minullus</i>	f
LITTLE STINT <i>Calidris minuta</i>	PMPW
LITTLE SWIFT <i>Apus affinis</i>	
LITTLE WEAVER <i>Ploceus luteolus</i>	
LIZARD BUZZARD <i>Kaupifalco monogrammicus</i>	F
LONG-CRESTED EAGLE <i>Lophaetus occipitalis</i>	F
LONG-TAILED CORMORANT <i>Phalacrocorax africanus</i>	
LONG-TAILED NIGHTJAR <i>Caprimulgus climacurus</i>	A

LONG-TOED LAPWING <i>Vanellus crassirostris</i>	
MADAGASCAR BEE-EATER <i>Merops superciliosus</i>	AMA
MALACHITE KINGFISHER <i>Alcedo cristata</i>	
MARABOU STORK <i>Leptoptilos crumeniferus</i>	w
MARICO SUNBIRD <i>Cinnyris mariquensis</i>	
MARSH TCHAGRA <i>Tchagra minuta</i>	w
MARTIAL EAGLE <i>Polemaetus bellicosus</i>	NT, R-VU
MOUSTACHED GRASS WARBLER <i>Melocichla mentalis</i>	
NAMAQUA DOVE <i>Oena capensis</i>	
NARINA,S TROGON <i>Apaloderma narina</i>	F
NORTHERN BLACK FLYCATCHER <i>Melaenornis edoliodides</i>	
NORTHERN CROMBEC <i>Sylvietta brachyura</i>	
NORTHERN GREY-HEADED SPARROW <i>Passer griseus</i>	
NORTHERN PUFFBACK <i>Dryoscopus gambensis</i>	F
NORTHERN RED BISHOP <i>Euplectes franciscanus</i>	G
NUBIAN WOODPECKER <i>Campethera nubica</i>	
OLIVE-BELLIED SUNBIRD <i>Cinnyris chloropygius</i>	F
ORANGE-BREASTED BUSH-SHRIKE <i>Telophorus sulfureopectus</i>	
OSPREY <i>Pandion haliaetus</i>	PMPW
PALE FLYCATCHER <i>Melaenornis pallidus</i>	
PALM-NUT VULTURE <i>Gypohierax angolensis</i>	
PENNANT-WINGED NIGHTJAR <i>Macrodipteryx vexillarius</i>	AMA
PIAPIAC <i>Ptilostomus afer</i>	
PIED KINGFISHER <i>Ceryle rudis</i>	W
PINK-BACKED PELICAN <i>Pelecanus rufescens</i>	W
PIN-TAILED WHYDAH <i>Vidua macroura</i>	G
PLAIN-BACKED PIPIT <i>Anthus leucophrys</i>	G
PURPLE STARLING <i>Lamprotornis purpureus</i>	
PURPLE HERON <i>Ardea purpurea</i>	R-NTW
RATTLING CISTICOLA <i>Cisticola chiniana</i>	
RED-BACKED SHRIKE <i>Lanius collurio</i>	PMP
RED-BELLIED PARADISE-FLYCATCHER <i>Terpsiphone rufiventer</i>	F
RED-BILLED FIREFINCH <i>Lagonosticta senegala</i>	
RED-BILLED QUELEA <i>Quelea quelea</i>	A
RED-BREASTED SWALLOW <i>Cercropis semirufa</i>	
RED-CHEEKED CORDON-BLEU <i>Uraeginthus bengalus</i>	
RED-CHESTED CUCKOO <i>Cuculus solitarius</i>	AF
RED-CHESTED SUNBIRD <i>Cinnyris erythrocerca</i>	R-RRW
RED-EYED DOVE <i>Streptopelia semitorquata</i>	f
RED-FACED CISTICOLA <i>Cisticola erythrocephalus</i>	w
RED-FACED CROMBEC <i>Sylvietta whytii</i>	F
RED-HEADED MALIMBE <i>Malimbe rubricollis</i>	FF
RED-HEADED QUELEA <i>Quelea erythrocephala</i>	A
RED-NECKED FALCON <i>Falco chicquera</i>	R-NT
RED-NECKED SPURFOWL <i>Francolinus afer</i>	
RED-RUMPED SWALLOW <i>Hirundo daurica</i>	

RED-SHOULDERED CUCKOO-SHRIKE <i>Campephaga phoenicea</i>	
RED-TAILED ANT-THRUSH <i>Neocossyphus rufus</i>	FF
RED-TAILED BRISTLEBILL <i>Bleda syndactylus</i>	FF
RED-THROATED BEE-EATER <i>Merops bullocki</i>	W
RED-WINGED GREY WARBLER <i>Drymocichla incana</i>	R-NTw
RING-NECKED DOVE <i>Streptopelia capicola</i>	
ROSS'S TURACO <i>Musophaga rossae</i>	F
RUFIOUS-NAPED LARK <i>Mirafraga africana</i>	
RUPPELL'S STARLING <i>Lamprolornis purpuropterus</i>	
RÜPPELL'S VULTURE <i>Gyps rueppellii</i>	NT, R-NTG
SACRED IBIS <i>Threskiornis aethiopicus</i>	W
SADDLE-BILLED STORK <i>Ephippiorhynchus senegalensis</i>	R-VUW
SCALY-BREASTED ILLADOPSIS <i>Illadopsis albipectus</i>	FF
SCARLET-CHESTED SUNBIRD <i>Chalcomitra senegalensis</i>	f
SEDGE WARBLER <i>Acrocephalus schoenobaenus</i>	PMPw
SENEGAL COUCAL <i>Centropus senegalensis</i>	f
SENEGAL LAPWING <i>Vanellus lugubris</i>	
SHIKRA <i>Accipiter badius</i>	
SHOEBILL <i>Balaeniceps rex</i>	VU, R-VUW
SHORT-WINGED CISTICOLA <i>Cisticola brachypterus</i>	
SINGING CISTICOLA <i>Cisticola cantans</i>	
SNOWY-CROWNED ROBIN-CHAT <i>Cossypha niveicapilla</i>	Fw
SOOTY CHAT <i>Myrmecocichla nigra</i>	
SOUTHERN GROUND-HORNBILL <i>Bucorvus leadbeateri</i>	B
SOUTHERN RED BISHOP <i>Euplectes orix</i>	
SPECKLED MOUSEBIRD <i>Colius striatus</i>	
SPECKLED-BREASTED WOODPECKER <i>Dendropicos poecilolaemus</i>	
SPECTACLED WEAVER <i>Ploceus ocularis</i>	f
SPLENDID STARLING <i>Lamprolornis splendidus</i>	
SPOTTED CRAKE <i>Porzana porzana</i>	PMPw
SPOTTED FLYCATCHER <i>Muscicapa striata</i>	PMP
SPOTTED PALM-THRUSH <i>Cichladusa guttata</i>	
SPOTTED REDSHANK <i>Tringa erythropus</i>	PMPW
SPUR-WINGED GOOSE <i>Plectropterus gambensis</i>	W
SPUR-WINGED LAPWING <i>Vanellus spinosus</i>	
SQUACCO HERON <i>Ardeola ralloides</i>	W
SQUARE-TAILED NIGHTJAR <i>Caprimulgus fossii</i>	
STANDARD-WINGED NIGHTJAR <i>Macrodipteryx longipennis</i>	AMA
STRIATED HERON <i>Butorides striatus</i>	
STRIPED KINGFISHER <i>Halcyon chelicuti</i>	
SWAMP NIGHTJAR <i>Caprimulgus natalensis</i>	
SWAMP FLYCATCHER <i>Muscicapa aquatica</i>	W
TAMBOURINE DOVE <i>Turtur tympanistria</i>	F
TAWNY EAGLE <i>Aquila rapax</i>	
TAWNY-FLANKED PRINIA <i>Prinia subflava</i>	fw
TEMMINCK'S COURSER <i>Cursorius temminckii</i>	AG

THICK-BILLED WEAVER <i>Amblyospiza albifrons</i>	
TRILLING CISTICOLA <i>Cisticola woosnami</i>	
TROPICAL BOUBOU <i>Laniarius aethiopicus</i>	f
VARIABLE SUNBIRD <i>Cinnyris venusta</i>	f
VERREAUX'S EAGLE OWL <i>Bubo lacteus</i>	
VEILLOT'S BLACK WEAVER <i>Ploceus nigerrimus</i>	f
VILLAGE WEAVER <i>Ploceus cucullatus</i>	
VILLAGE INDIGOBIRD <i>Vidua chalybeata</i>	
VIOLET-BACKED STARLING <i>Cinnyricinclus leucogaster</i>	
WAHLBERG,S EAGLE <i>Aquila wahlbergi</i>	
WATER THICK-KNEE <i>Burhinus vermiculatus</i>	
WESTERN MARSH HARRIER <i>Circus aeruginosus</i>	PMPw
WESTERN BANDED SNAKE EAGLE <i>Circaetus cinerascens</i>	R-VUF
WESTERN CITRIL <i>Serinus frontalis</i>	
WESTERN NICATOR <i>Nicator chloris</i>	F
WESTERN VIOLET-BACKED SUNBIRD <i>Anthreptes longuemarei</i>	Af
WHINCHAT <i>Saxicola rubetra</i>	PMP
WHISKERED TERN <i>Chlidonias hybridus</i>	PMW
WHISTLING CISTICOLA <i>Cisticola lateralis</i>	
WHITE-BACKED VULTURE <i>Gyps africanus</i>	NT, R-NTG
WHITE-BROWED COUCAL <i>Centropus superciliosus</i>	
WHITE-BROWED ROBIN-CHAT <i>Cossypha heuglini</i>	f
WHITE-BROWED SCRUB-ROBIN <i>Cercotrichas leucophrys</i>	
WHITE-CRESTED TURACO <i>Tauraco leucolophus</i>	F
WHITE-FACED WHISTLING DUCK <i>Dendrocygna viduata</i>	
WHITE-HEADED BARBET <i>Lybius leucocephalus</i>	
WHITE-HEADED SAW-WING <i>Psalidoprocne albiceps</i>	
WHITE-HEADED VULTURE <i>Trigonoceps occipitalis</i>	VU, R-VU
WHITE-RUMPED SWIFT <i>Apus caffer</i>	
WHITE-SPOTTED FLUFFTAIL <i>Sarothrura pulchra</i>	
WHITE-TAILED LARK <i>Mirafra albicauda</i>	
WHITE-THROATED BEE-EATER <i>Merops albicollis</i>	AMAf
WHITE-WINGED TERN <i>Chlidonias leucopterus</i>	
WHITE-WINGED BLACK TIT <i>Parus leucomelas</i>	
WHITE-WINGED WIDOWBIRD <i>Euplectes albonotatus</i>	G
WILLOW WARBLER <i>Phylloscopus trochilus</i>	PMPf
WINDING CISTICOLA <i>Cisticola galactotes</i>	w
WIRE-TAILED SWALLOW <i>Hirundo smithii</i>	w
WOOD SANDPIPER <i>Tringa glareola</i>	PMPW
WOODLAND KINGFISHER <i>Halcyon senegalensis</i>	A
YELLOW WAGTAIL <i>Motacilla flava</i>	PMPwG
YELLOW-BELLIED HYLIOTA <i>Hyliota flavigaster</i>	
YELLOWBILL <i>Ceuthmochares aereus</i>	F
YELLOW-BILLED STORK <i>Mycteria ibis</i>	W
YELLOW-CROWNED BISHOP <i>Euplectes afer</i>	w
YELLOW-FRONTED CANARY <i>Serinus mozambicus</i>	

YELLOW-FRONTED TINKERBIRD <i>Pogoniulus chrysoconus</i>	f
YELLOW-RUMPED TINKERBIRD <i>Pogoniulus bilineatus</i>	F
YELLOW-THROATED GREENBUL <i>Chlorocichla flavicollis</i>	
YELLOW-THROATED LONGCLAW <i>Macronyx croceus</i>	G
ZEBRA WAXBILL <i>Amandava subflava</i>	
ZITTING CISTICOLA <i>Cisticola juncidis</i>	

Amphibians of Semliki Delta

Family	Species	Common Name	IUCN Status	Location recorded
Ranidae	<i>Amietia nutti</i>	Nutt's River Frog	Least Concern	Ntoroko, Semliki FR
Ranidae	<i>Amnirana albolabris</i>	White-lipped Frog	Least Concern	Semliki FR
Bufoidea	<i>Sclerophrys gracilipes</i> cf.	French Congo Toad	Least Concern	Semliki FR
Bufoidea	<i>Sclerophrys gutturalis</i>	Guttural Toad	Least Concern	Semliki FR
Bufoidea	<i>Sclerophrys kisoensis</i>	Kisolo Yellow Toad	Least Concern	Semliki FR
Bufoidea	<i>Sclerophrys maculatus</i>	Flat Backed Toad	Least Concern	Semliki FR, Nkusi Delta
Bufoidea	<i>Sclerophrys pusilla</i>	Mertens Striped Toad	Least concern	Semliki FR
Bufoidea	<i>Sclerophrys regularis</i>	Common African Toad	Least Concern	Ntoroko, Semliki FR, Nkusi Delta
Bufoidea	<i>Sclerophrys vittatus</i>	Lake Victoria Toad	Data Deficient	Ntoroko, Semliki FR, Nkusi Delta
Dicroglossidae	<i>Hoplobatrachus occipitalis</i>	Common Bull Frog	Least Concern	Ntoroko, Semliki FR, Nkusi Delta
Hyperoliidae	<i>Africalus quadrivittatus</i>	Banded Banana Frog	Least Concern	Ntoroko, Semliki FR, Nkusi Delta
Hyperoliidae	<i>Hyperolius cinnamomeiventris</i>	Cinnamon Tree Frog	Least Concern	Semliki FR, Nkusi Delta
Hyperoliidae	<i>Hyperolius kivuensis</i>	Kivu Reed Frog	Least Concern	Ntoroko, Semliki FR, Nkusi Delta
Hyperoliidae	<i>Hyperolius viridiflavus</i>	Common Reed Frog	Least Concern	Semliki FR, Nkusi Delta
Hyperoliidae	<i>Kassina senegalensis</i>	Senegal Land Frog	Least Concern	Ntoroko, Semliki FR
Arthroleptidae	<i>Arthroleptis</i> sp			Semliki FR
Arthroleptidae	<i>Leptopelis christyi</i>	Christy's tree frog	Least Concern	Semliki FR

Phrynobatrachidae	<i>Phrynobatrachus acridoides</i>	East African Puddle Frog	Least Concern	Semliki FR
Prynobatrachidae	<i>Phrynobatrachus natalensis</i>	Natal Dwarf Puddle Frog	Least Concern	Semliki FR, Nkusi Delta
Prynobatrachidae	<i>Phrynobatrachus sp</i>			Semliki FR
Ranidae	<i>Ptychadena anchietae</i>	Anchietae's Ridged Frog	Least Concern	Ntoroko, Nkusi Delta
Ptychadenidae	<i>Ptychadena chrysogaster</i>	Yellow-bellied Ridged Frog	Least Concern	Semliki FR
Ptychadenidae	<i>Ptychadena nilotica</i>	Nile Grass Frog	Least Concern	Ntoroko, Semliki FR, Nkusi Delta
Ptychadenidae	<i>Ptychadena oxyrhynchus</i>	Sharp-nosed Frog	Least Concern	Ntoroko, Semliki FR
Ptychadenidae	<i>Ptychadena porosissima</i>	Grassland Ridged Frog	Least Concern	Ntoroko, Semliki FR, Nkusi Delta
Ptychadenidae	<i>Ptychadena sp.</i>			Semliki FR
Pipidae	<i>Xenopus pygmaeus</i> cf.	Bouchia Clawed frog	LC/EN B2ab(iii)	Semliki FR
Pipidae	<i>Xenopus ruwenzoriensi</i>	African Clawed frog	Data deficient	Semliki FR
Pipidae	<i>Xenopus sp.</i>			Semliki FR

Reptiles of Semliki Delta

Order	Family	Species	Common Name	IUCN Status	Location recorded
Chelonia	Trionychidae	<i>Trionyx triunguis</i>	African Soft-shelled Turtle	Vulnerable (VU)/CR	Nkusi Delta
Sauria	Scincidae	<i>Trachylepis striata</i>	Common Striped Skink	Least Concern	Ntoroko
Sauria	Scincidae	<i>Trachylepis macuilabris</i>	Speckle-lipped Mabuya	Least Concern	Semliki FR, Nkusi Delta
Sauria	Scincidae	<i>Trachylepis megalura</i>	Grass-top Skink	NE/NT	Semliki FR
Sauria	Geckonidae	<i>Hemidactylus cf. brookii</i>	Brooks Gecko	Least Concern	Nkusi Delta
Sauria	Geckonidae	<i>Hemidactylus sp</i>			Semliki FR
Sauria	Agamidae	<i>Acanthocercus atricollis</i>	Blue-headed Tree Agama	Least Concern	Semliki FR
Sauria	Agamidae	<i>Agama finchi</i>	Malaba Rock agama	Least Concern	Semliki FR
Sauria	Chamaeleonidae	<i>Chamaeleo gracilis</i>	Gracile Chameleon	Least Concern	Ntoroko
Sauria	Gerrhosauridae	<i>Brodleysaurus major</i>	Tawny Plated-lizard	Least Concern	Nkusi Delta
Sauria	Varanidae	<i>Varanus niloticus</i>	Nile Monitor	Least Concern	Ntoroko, Nkusi Delta
Crocodylia	Crocodylidae	<i>Crocodylus niloticus</i>	Nile crocodile	Least Concern	Ntoroko, Nkusi Delta
Serpentes	Colubride	<i>Boaedon cf. fuliginosis</i>	Common House Snake	NE/LC	Semliki FR
Serpentes	Colubride	<i>Philothamnus cf. angolensis</i>	Angola Green Snake	NE/DD	Semliki FR
Serpentes	Colubride	<i>Philothamnus semivariagetus</i>	Variiegated Bush Snake	Least Concern	Nkusi Delta
Serpentes	Colubride	<i>Philothamnus sp</i>			Nkusi Delta
Serpentes	Colubride	<i>Crotaphopeltis hotamboia</i>	White-lipped Herald Snake	NE/LC	Ntoroko, Semliki FR
Serpentes	Colubride	<i>Hapsidophrys smaragdina</i>	Keel-scaled Green Snake	Least Concern	Semliki Fr, Nkusi Delta
Serpentes	Colubride	<i>Dipsadoboa viridis gracilis</i>	Laurent's Green Tree Snake	NE/DD	Semliki FR
Serpentes	Elapidae	<i>Dendroaspis polylepis</i>	Black Mamba	Least Concern	Nkusi Delta
Serpentes	Elapidae	<i>Naja melanoleuca</i>	Forest Cobra	Least Concern	Ntoroko, Nkusi Delta
Serpentes	Viperidae	<i>Bitis arietans</i>	Puff-adder	Least Concern	Nkusi Delta
Serpentes	Viperidae	<i>Bitis gabonica</i>	Gaboon Viper	Least Concern	Nkusi Delta

Plant Species checklist for the Semliki Delta

Species name	Family	Habit	Habitat	Conservation status (IUCN)/ Use
<i>Acacia gerrardii</i>	Fabaceae	Tree	Woodland, Grassland, Bushland, Wetland	
<i>Acacia hockii</i>	Fabaceae	Tree	Woodland	
<i>Acacia kirkii</i>	Fabaceae	Tree	Wetland	LC
<i>Acacia polyacantha</i>	Fabaceae	Tree	Woodland	
<i>Acacia senegal</i>	Fabaceae	Tree	Grassland	
<i>Acacia sieberiana</i>	Fabaceae	Tree	Grassland	
<i>Acalypha spp.</i>	Euphorbiaceae	Shrub	Wetland	
<i>Acanthus pubescens</i>	Acanthaceae	Shrub	Wetland	
<i>Albizia coriaria</i>	Fabaceae	Tree	Wetland	LC
<i>Albizia grandibracteata</i>	Fabaceae	Tree	Woodland	LC/ Timber, Charcoal, Firewood
<i>Albizia zygia</i>	Fabaceae	Tree	Grassland	
<i>Antidesma venosum</i>	Euphorbiaceae	Tree	Grassland	LC
<i>Balanites aegyptiaca</i>	Balanitaceae	Tree	Grassland, Bushland	LC
<i>Borassus aethiopum</i>	Arecaceae	Tree	Woodland, Grassland	LC/ Firewood, Construction, Food
<i>Bothriochloa insculpta</i>	Poaceae	Herb	Grassland	
<i>Brachiaria brizantha</i>	Poaceae	Herb	Grassland	
<i>Brachiaria decumbens</i>	Poaceae	Herb	Grassland	
<i>Bridelia micrantha</i>	Euphorbiaceae	Tree	Wetland	LC
<i>Cadaba farinosa</i>	Capparaceae	Shrub	Bushland	LC
<i>Capparis spp.</i>	Capparaceae	Shrub	Bushland	
<i>Chamaescrista mimosoides</i>	Fabaceae	Herb	Grassland	
<i>Chloris gayana</i>	Poaceae	Herb	Grassland	
<i>Cissampelos mucronata</i>	Menispermaceae	Herb	Wetland	
<i>Cissus adenocaulis</i>	Vitaceae	Herb	Wetland	
<i>Cissus sp.</i>	Vitaceae	Herb	Bushland	
<i>Combretum collinum</i>	Combrataceae	Tree	Grassland	LC
<i>Combretum molle</i>	Combrataceae	Tree	Woodland	LC
<i>Crateva adansonii</i>	Capparaceae	Tree	Woodland, Grassland, Bushland	LC
<i>Cynodon dactylon</i>	Poaceae	Herb	Grassland	

<i>Cynometra alexandri</i>	Fabaceae	Tree	Wetland	LC/ Charcoal, Firewood	Timber,
<i>Cyperus articulatus</i>	Cyperaceae	Herb	Wetland	LC	
<i>Cyperus denudatus</i>	Cyperaceae	Herb	Wetland	LC	
<i>Cyperus latifolius</i>	Cyperaceae	Herb	Wetland	LC	
<i>Cyperus papyrus</i>	Cyperaceae	Herb	Wetland	LC	
<i>Dactyloctenium aegyptium</i>	Poaceae	Herb	Grassland		
<i>Desmodium salicifolium</i>	Fabaceae	Herb	Wetland	LC	
<i>Dichrostachys cinerea</i>	Fabaceae	Tree	Bushland	LC	
<i>Dryopteris striata</i>	Dryopteridaceae	Herb	Wetland		
<i>Eragrostis racemosa</i>	Poaceae	Herb	Grassland		
<i>Eragrostis superba</i>	Poaceae	Herb	Grassland		
<i>Eragrostis tenuifolia</i>	Poaceae	Herb	Grassland		
<i>Eriosema glomeratum</i>	Fabaceae	Herb	Grassland		
<i>Ethulia conyzoides</i>	Asteraceae	Herb	Wetland	LC	
<i>Euphorbia candelabrum</i>	Euphorbiaceae	Tree	Bushland	LC	
<i>Ficus natalensis</i>	Moraceae	Tree	Wetland	LC	
<i>Ficus sycomorus</i>	Moraceae	Tree	Wetland	LC	
<i>Ficus vallis-choudae</i>	Moraceae	Tree	Wetland		
<i>Ficus verruculosa</i>	Moraceae	Tree	Wetland		
<i>Ficus vogeliana</i>	Moraceae	Tree	Wetland	LC	
<i>Fimbristylis dochotoma</i>	Cyperaceae	Herb	Grassland	LC	
<i>Fimbristylis hispidula</i>	Cyperaceae	Herb	Grassland		
<i>Flueggea virosa</i>	Euphorbiaceae	Shrub	Bushland	LC	
<i>Fuirena umbellata</i>	Cyperaceae	Herb	Wetland	LC	
<i>Grewia mollis</i>	Malvaceae	Shrub	Bushland		
<i>Grewia similis</i>	Malvaceae	Shrub	Woodland, Grassland, Bushland		
<i>Gynura picridifolia</i>	Asteraceae	Herb	Wetland		
<i>Harrisonia abyssinica</i>	Simaroubaceae	Shrub	Wetland		
<i>Heteropogon contortus</i>	Poaceae	Herb	Grassland		
<i>Heterotis rotundifolia</i> (Sm.) Jacq.-Fel.	Melastomataceae	Herb	Wetland		
<i>Hibiscus ovalifolius</i>	Malvaceae	Herb	Wetland		
<i>Hyparrhenia filipendula</i>	Poaceae	Herb	Grassland, Woodland		
<i>Hyperthelia dissoluta</i>	Poaceae	Herb	Grassland		

<i>Impatiens eminii</i>	Balsaminaceae	Herb	Wetland	
<i>Imperata cylindrica</i>	Poaceae	Herb	Woodland	
<i>Kigelia africana</i>	Bignoniaceae	Tree	Grassland	LC/ Firewood, Timber, Medicine
<i>Lannea barteri</i>	Anacardiaceae	Tree	Woodland	LC
<i>Leersia hexandra</i>	Poaceae	Herb	Wetland	LC
<i>Maerua angolensis</i>	Capparaceae	Shrub	Grassland	LC
<i>Markhamia lutea</i>	Bignoniaceae	Tree	Grassland	LC
<i>Melanthera scandens</i>	Asteraceae	Herb	Wetland	
<i>Melinis repens</i>	Poaceae	Herb	Woodland	
<i>Melochia melissifolia</i> var. <i>mollis</i> K. Schum.	Malvaceae	Herb	Wetland	
<i>Microchloa kunthii</i>	Poaceae	Herb	Grassland	
<i>Mikania cordata</i>	Asteraceae	Herb	Wetland	
<i>Morella kandiana</i>	Myricaceae	Shrub	Wetland	
<i>Murdannia simplex</i>	Commelinaceae	Herb	Grassland	LC
<i>Oldenlandia goreensis</i>	Rubiaceae	Herb	Wetland	
<i>Opilia amentacea</i> Roxb.	Opiliceae	Shrub	Bushland	
<i>Ozoroa insignis</i>	Anacardiaceae	Tree	Grassland	LC
<i>Panicum maximum</i>	Poaceae	Herb	Grassland, Woodland, Wetland	
<i>Panicum parvifolium</i>	Poaceae	Herb	Wetland	
<i>Panicum trichocladum</i>	Poaceae	Herb	Wetland	
<i>Perotis patens</i>	Poaceae	Herb	Grassland	
<i>Phoenix reclinata</i>	Arecaceae	Tree	Wetland, Grassland	LC
<i>Piliostigma thoningii</i>	Fabaceae	Shrub	Woodland, Grassland	
<i>Polygonum pulchrum</i>	Polygonaceae	Herb	Wetland	
<i>Polygonum salicifolium</i>	Polygonaceae	Herb	Wetland	
<i>Pterygota milbraedii</i>	Malvaceae	Tree	Wetland	
<i>Pycnus mundtii</i>	Cyperaceae	Herb	Wetland	
<i>Rhus natalensis</i>	Anacardiaceae	Tree	Bushland	
<i>Rothmania urcelliformis</i>	Rubiaceae	Shrub	Wetland	
<i>Sarcostemma viminalis</i>	Asclepiadaceae	Herb	Bushland	
<i>Senna spectabilis</i>	Fabaceae	Tree	Wetland	LC
<i>Sesbania sesban</i>	Fabaceae	Shrub	Wetland	
<i>Setaria sphacelata</i>	Poaceae	Herb	Grassland, Woodland	
<i>Sporobolus festinus</i>	Poaceae	Herb	Woodland, Grassland	

<i>Stephania abyssinica</i>	Menispermaceae	Shrub	Bushland, Wetland	
<i>Stereospermum kunthianum</i>	Bignoniaceae	Tree	Woodland	LC
<i>Strychnos innocua</i>	Loganiaceae	Shrub	Woodland	LC
<i>Tamarindus indica</i>	Fabaceae	Tree	Grassland, Woodland	LC / Firewood, Charcoal, Food, Timber, Medicine
<i>Terminalia brownii</i>	Combrataceae	Tree	Woodland	LC
<i>Terminalia glaucescens</i>	Combrataceae	Tree	Grassland	LC
<i>Themeda triandra</i>	Poaceae	Herb	Grassland	
<i>Vitex</i> sp.	Lamiaceae	Tree	Woodland	
<i>Voacanga thouarsii</i>	Apocynaceae	Tree	Wetland	
<i>Ziziphus pubescens</i>	Rhamnaceae	Shrub	Bushland	

Butterfly Species of Semliki Delta

Family	Genus	Species	SEMULIKI	IUCN/Africa/E	Uganda status
HESPERIIDAE	<i>Acleros</i>	<i>mackenii</i>	1	NE	NT
HESPERIIDAE	<i>Acleros</i>	<i>neavei</i>	1	NE	VU
HESPERIIDAE	<i>Acleros</i>	<i>ploetzi</i>	1	NE	NT
HESPERIIDAE	<i>Afrogegenes</i>	<i>niso</i>	1	NE	LC
HESPERIIDAE	<i>Andronymus</i>	<i>neander</i>	1	NE	NE
HESPERIIDAE	<i>Borbo</i>	<i>borbonica</i>	1	NE	LC
HESPERIIDAE	<i>Borbo</i>	<i>fallax</i>	1	NE	LC
HESPERIIDAE	<i>Borbo</i>	<i>fatuellus</i>	1	NE	LC
HESPERIIDAE	<i>Borbo</i>	<i>lugens</i>	1	NE	LC
HESPERIIDAE	<i>Calleagris</i>	<i>lacteus</i>	1	NE	NE
HESPERIIDAE	<i>Celaenorhina</i>	<i>galenus</i>	1	NE	LC
HESPERIIDAE	<i>Coeliades</i>	<i>libeon</i>	1	NE	LC
HESPERIIDAE	<i>Eretis</i>	<i>lugens</i>	1	NE	LC
HESPERIIDAE	<i>Kedestes</i>	<i>brunneostriata</i>	1	NE	NT
HESPERIIDAE	<i>Lepella</i>	<i>lepeletier</i>	1	NE	NT
HESPERIIDAE	<i>Meza</i>	<i>cybeutes</i>	1	NE	VU
HESPERIIDAE	<i>Pardaleodes</i>	<i>incerta</i>	1	NE	LC
HESPERIIDAE	<i>Pelopidas</i>	<i>thrax</i>	1	NE	LC
HESPERIIDAE	<i>Prosopalpus</i>	<i>saga</i>	1	NE	DD
HESPERIIDAE	<i>Prosopalpus</i>	<i>styla</i>	1	NE	NT
HESPERIIDAE	<i>Sarangesa</i>	<i>bouvieri</i>	1	NE	NT
HESPERIIDAE	<i>Sarangesa</i>	<i>haplopa</i>	1	NE	VU
HESPERIIDAE	<i>Spialia</i>	<i>diomus</i>	1	NE	LC
HESPERIIDAE	<i>Tagiades</i>	<i>flesus</i>	1	NE	LC
HESPERIIDAE	<i>Teniorhinus</i>	<i>ignita</i>	1	NE	LC
HESPERIIDAE	<i>Teniorhinus</i>	<i>watsoni</i>	1	NE	CR
HESPERIIDAE	<i>Xanthodisca</i>	<i>vibius</i>	1	NE	EN

Dragonflies Species of Semliki Delta

Order	Family	Genus	Species	IUCN Status	Uganda Status
ANISOPTERA	AESHNIDAE	<i>Gynacantha</i>	<i>africana</i>	LC	VU
ANISOPTERA	AESHNIDAE	<i>Gynacantha</i>	"B"		
ANISOPTERA	AESHNIDAE	<i>Gynacantha</i>	<i>bullata</i>	LC	LC
ANISOPTERA	AESHNIDAE	<i>Gynacantha</i>	<i>cylindrata</i>	LC	VU
ANISOPTERA	AESHNIDAE	<i>Gynacantha</i>	<i>manderica</i>	LC	LC
ANISOPTERA	AESHNIDAE	<i>Gynacantha</i>	<i>nigeriensis</i>	LC	VU
ANISOPTERA	AESHNIDAE	<i>Gynacantha</i>	<i>sextans</i>	LC	EN
ANISOPTERA	AESHNIDAE	<i>Heliaeschna</i>	<i>trinervulata</i>	LC	CR
ANISOPTERA	AESHNIDAE	<i>Gynacantha</i>	<i>villosa</i>	LC	LC
ZYGOPTERA	CALOPTERYGIDAE	<i>Phaon</i>	<i>iridipennis</i>	LC	LC
ZYGOPTERA	CALOPTERYGIDAE	<i>Umma</i>	<i>saphirina</i>	LC	LC
ZYGOPTERA	CHLOROCYPHIDAE	<i>Chlorocypha</i>	"A"		
ZYGOPTERA	CHLOROCYPHIDAE	<i>Chlorocypha</i>	<i>cancellata</i>	LC	VU
ZYGOPTERA	CHLOROCYPHIDAE	<i>Platycypha</i>	"B"		
ZYGOPTERA	CHLOROCYPHIDAE	<i>Platycypha</i>	"A"		
ZYGOPTERA	CHLOROCYPHIDAE	<i>Platycypha</i>	<i>lacustris</i>	LC	VU
ZYGOPTERA	COENAGRIONIDAE	<i>Africallagma</i>	<i>elongatum</i>	LC	LC
ZYGOPTERA	COENAGRIONIDAE	<i>Agriocnemis</i>	<i>inversa</i>	LC	LC
ZYGOPTERA	COENAGRIONIDAE	<i>Ceriagrion</i>	<i>glabrum</i>	LC	LC
ZYGOPTERA	COENAGRIONIDAE	<i>Ishnura</i>	<i>senegalensis</i>	LC	LC
ZYGOPTERA	COENAGRIONIDAE	<i>Pseudagrion</i>	<i>hamoni</i>	LC	LC
ZYGOPTERA	COENAGRIONIDAE	<i>Pseudagrion</i>	<i>isidromerai</i>	LC	CR
ZYGOPTERA	COENAGRIONIDAE	<i>Pseudagrion</i>	<i>kersteni</i>	LC	LC
ZYGOPTERA	COENAGRIONIDAE	<i>Pseudagrion</i>	<i>kibalense</i>	LC	VU
ZYGOPTERA	COENAGRIONIDAE	<i>Pseudagrion</i>	<i>melanicterum</i>	LC	LC
ZYGOPTERA	COENAGRIONIDAE	<i>Pseudagrion</i>	<i>sublacteum</i>	LC	LC
ZYGOPTERA	COENAGRIONIDAE	<i>Pseudagrion</i>	<i>torridum</i>	LC	NT
ANISOPTERA	CORDULIDAE	<i>Hemicordulia</i>	<i>africana</i>	LC	DD
ANISOPTERA	GOMPHIDAE	<i>Diastatomma</i>	<i>Selysi</i>	LC	EN
ANISOPTERA	GOMPHIDAE	<i>Ictinogomphus</i>	<i>regisalberti</i>	NT	CR
ANISOPTERA	GOMPHIDAE	<i>Libyogomphus</i>	<i>bwambae</i>	DD	CR
ANISOPTERA	GOMPHIDAE	<i>Phyllogomphus</i>	<i>annulus</i>	LC	CR
ANISOPTERA	GOMPHIDAE	<i>Phyllogomphus</i>	<i>selysi</i>	LC	VU
ZYGOPTERA	LESTIDAE	<i>Lestes</i>	<i>dissimulans</i>	LC	LC
ZYGOPTERA	LESTIDAE	<i>Lestes</i>	<i>virgatus</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Brachythemis</i>	<i>leucosticta</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Chalcostephia</i>	<i>flavifrons</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Crocothemis</i>	<i>erythrea</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Crocothemis</i>	<i>sanguinolenta</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Crocothemis</i>	"A"		
ANISOPTERA	LIBELLULIDAE	<i>Crocothemis</i>	"B"		
ANISOPTERA	LIBELLULIDAE	<i>Diplacodes</i>	<i>deminuta</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Diplacodes</i>	<i>lefeburtii</i>	LC	LC

ANISOPTERA	LIBELLULIDAE	<i>Hadrothemis</i>	<i>coacta</i>	LC	NT
ANISOPTERA	LIBELLULIDAE	<i>Hadrothemis</i>	<i>camarensis</i>	LC	VU
ANISOPTERA	LIBELLULIDAE	<i>Hemistigma</i>	<i>albipunctum</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Neodythemis</i>	<i>afra</i>	LC	CR
ANISOPTERA	LIBELLULIDAE	<i>Neodythemis</i>	<i>preussi</i>	LC	CR
ANISOPTERA	LIBELLULIDAE	<i>Nesciothemis</i>	<i>farinosa</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Orthetrum</i>	"AA"		
ANISOPTERA	LIBELLULIDAE	<i>Orthetrum</i>	"BB"		
ANISOPTERA	LIBELLULIDAE	<i>Orthetrum</i>	<i>brachiale</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Orthetrum</i>	<i>julia</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Orthetrum</i>	<i>stemmale</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Palpopleura</i>	<i>deceptor</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Palpopleura</i>	<i>jucunda</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Palpopleura</i>	<i>lucia</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Pantala</i>	<i>flavescens</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Tetrathemis</i>	<i>denticauda</i>	DD	CR
ANISOPTERA	LIBELLULIDAE	<i>Thermochoria</i>	<i>equivocata</i>	LC	NT
ANISOPTERA	LIBELLULIDAE	<i>Tramea</i>	<i>basilaris</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Trithemis</i>	<i>aconita</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Trithemis</i>	<i>annulata</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Trithemis</i>	<i>arteriosa</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Trithemis</i>	<i>furva</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Urothemis</i>	<i>assignata</i>	LC	LC
ANISOPTERA	LIBELLULIDAE	<i>Zygonyx</i>	<i>torridus</i>	LC	LC
ANISOPTERA	MACROMIIDAE	<i>Phyllomacromia</i>	<i>bispina</i>	LC	CR
ZYGOPTERA	MEGAPODAGRIONIDAE	<i>Chlorocypha</i>	<i>trifaria</i>	LC	LC
ZYGOPTERA	MEGAPODAGRIONIDAE	<i>Platycypha</i>	<i>caligata</i>	LC	LC
ZYGOPTERA	MEGAPODAGRIONIDAE	<i>Platycypha</i>	<i>lacustris</i>	LC	VU
ZYGOPTERA	PLATYCNEMIDIDAE	<i>Elattoneura</i>	<i>lliba</i>	LC	CR

Mammals of Semliki Wetlands

Order	Family	Species	Semliki Status	IUCN Status	Uganda Status
Artiodactyla	Bovidae	Hartebeest <i>Alcelaphus buselaphus</i>	P	LR/cd	
Artiodactyla	Bovidae	White-bellied Duiker <i>Cephalophus leucogaster</i>	P	LC	NA
Artiodactyla	Bovidae	Waterbuck <i>Kobus ellipsiprymnus</i>	P	LC	LC
Artiodactyla	Bovidae	Uganda Kob <i>Kobus kob</i>	P	NE	LC
Artiodactyla	Bovidae	Pygmy Antelope <i>Neotragus batesi</i>	P	LC	EN B2ab(iii)
Artiodactyla	Bovidae	Bohor Reedbuck <i>Reduna redunca</i>	P	LC	EN C1
Artiodactyla	Bovidae	Common Bush Duiker <i>Sylvicapra grimmia</i>	P	LC	LC
Artiodactyla	Bovidae	Blue Duiker <i>Cephalophus monticola</i>	P	LC	LC
Artiodactyla	Bovidae	Buffalo <i>Syncerus caffer</i>	P	LC	LC
Artiodactyla	Bovidae	Bushbuck <i>Tragelaphus scriptus</i>	P	LC	LC
Artiodactyla	Bovidae	Sitatunga <i>Tragelaphus spekei</i>	P	LC	VU B1b(i)c(i)
Artiodactyla	Bovidae	Bongo <i>Tragelaphus eurycerus</i>	P	NT	NA
Artiodactyla	Swidae	Red river Hog <i>Potamochoerus porcus</i>	P	LC	DD
Artiodactyla	Swidae	Giant Forest Hog <i>Hylochoerus meinertzhageni</i>	P	LC	EN B1ab(iii)
Artiodactyla	Hipopotamidae	Hipopotamus <i>Hipopotamus amphibius</i>	P	VU	VU B2b(iii)c(iv)
Artiodactyla	Tragulidae	Water Chevrotain <i>Hyemoschus aquaticus</i>	P	LC	DD
Pholidota	Manidae	Tree Pangolin <i>Manis tricupsis</i>	P	VU (A4d)	EN B2ab(iii,v)
Lagomorpha	Leporidae	Bunyoro Rabbit <i>Poelagus marjorita</i>	P	LC	VU B1ab(i,ii)
Lagomorpha	Leporidae	Cape Hare <i>Lepus capensis</i>		LC	LC
Lagomorpha	Leporidae	Savanna Hare <i>Lepus victoriae</i>		LC	LC
	Canidae	Side-striped Jackal <i>Canis adustus</i>	P	LC	LC
Carnivora	Felidae	Leopard <i>Panthera pardus</i>	P	NT	VU C1+2(i)
Carnivora	Felidae	Lion <i>Panthera leo</i>	P	VU	
Carnivora	Felidae	Serval <i>Leptailurus serval</i>	P	LC	NT
Carnivora	Herpestidae	Marsh Mongoose <i>Atilax paludinosus</i>	P	LC	LC
Carnivora	Herpestidae	Egyptian Mongoose <i>Herpestes ichneumon</i>	P	LC	LC
Carnivora	Herpestidae	Banded Mongoose <i>Mungos mungos</i>	P	LC	LC
Carnivora	Herpestidae	Slender Mongoose <i>Herpestes sanguineus</i>	P	LC	LC
Carnivora	Herpestidae	White-tailed Mongoose <i>Ichneumia albicauda</i>	P	LC	LC
Carnivora	Mustelidae	African Spot-necked Otter <i>Hydrictis maculicollis</i>		NT	EN C1
Carnivora	Mustelidae	East African Stripped Weasel <i>Poecilogale albinuca</i>	P	LC	NA
Carnivora	Viveridae	African Civet <i>Civettictis civetta</i>	P	LC	LC
Carnivora	Viveridae	African Palm Civet <i>Nandinia binotata</i>	P	LC	NA
Carnivora	Viveridae	Rusty nosed Genet <i>Geneta tigrina</i>		LC	LC
Carnivora	Viveridae	Servaline Genet <i>geneta servalina</i>	P	LC	LC
Carnivora	Viveridae	Small-spotted Genet <i>Geneta genetta</i>	P	LC	LC
Carnivora	Hyenidae	Spotted Hyena <i>Crocuta crocuta</i>	P	LC	CR C1

Mega-Chiroptera	Macroglossinae	Nectar bat <i>Megaloglossus woermanni</i>	P	LC	NA
Mega-Chiroptera	Pteropodidae	Little Epauletted Fruit bat <i>Epomophorus labiatus</i>	P	LC	LC
Mega-Chiroptera	Pteropodidae	Epomophorus minimus	P	LC	LC
Mega-Chiroptera	Pteropodidae	Hammerhead Fruit Bat <i>Hypsignathus monstrosus</i>	P	LC	LC
Mega-Chiroptera	Pteropodidae	Franquet's Fruit Bat <i>Epomops franqueti</i>	P	LC	LC
Mega-Chiroptera	Pteropodidae	Egyptian Fruit bat <i>Rousettus aegyptiacus</i>	P	LC	LC
Mega-Chiroptera	Pteropodidae	Bocage's Fruit bat <i>Rousettus angolensis</i>	P	LC	LC
Mega-Chiroptera	Pteropodidae	Common Dwarf Epauletted Fruit Bat <i>Micropteropus pusillus</i>	P	LC	LC
Mega-Chiroptera	Pteropodidae	Common Collared Fruit Bat <i>Myonycteris torquata</i>	P	LC	NA
	Embalonuridae	Tomb bat <i>Taphozous mauritanus</i>	P	LC	NA
Micro - Chiroptera	Hipposideridae	Aba Leaf-nosed Bat <i>Hipposideros abae</i>	P	LC	VU D2
Micro - Chiroptera	Hipposideridae	Cyclops Leaf-nosed Bat <i>Hipposideros cyclops</i>	P	LC	VU C1
Micro - Chiroptera	Hipposideridae	Sundevall's Leaf-nosed Bat <i>Hipposideros caffer</i>	P	LC	LC
Micro - Chiroptera	Hipposideridae	Noack's Leaf-nosed Bat <i>Hipposideros ruber</i>	P	LC	LC
Micro - Chiroptera	Rhinolophidae	East African Horseshoe Bat <i>Rhinolophus eloquens</i>		LC	LC
Micro - Chiroptera	Rhinolophidae	Rueppell's Horseshoe Bat <i>Rhinolophus fumigatus</i>		LC	LC
Micro - Chiroptera	Rhinolophidae	Savanna Woodland Horseshoe Bat <i>Rhinolophus simulator</i>		LC	LC
Micro - Chiroptera	Megadermatidae	Yellow winged bat <i>Lavia frons</i>	P	LC	LC
Micro - Chiroptera	Molosidae	Little Free-tailed bat <i>Chaerophon pumila</i>	P	LC	LC
Micro - Chiroptera	Molosidae	Angolan Free-tailed Bat <i>Mops condylurus</i>	P	LC	LC
Micro - Chiroptera	Molosidae	Trevor's Free-tailed Bat <i>Mops trevori</i>	P	DD	EN B2b(iii) c(ii)
Micro - Chiroptera	Nycteridae	Bate's Slit-faced Bat <i>Nycteris arge</i>	P	LC	LC
Micro - Chiroptera	Nycteridae	Hairy Slit-faced Bat <i>Nycteris hispida</i>	P	LC	LC
Micro - Chiroptera	Nycteridae	Large-eared Slit faced Bat <i>Nycteris macrotis</i>		LC	LC
Micro - Chiroptera	Vespertilionidae	White-winged Serotine <i>Eptesicus tenuipinnis</i>	P	LC	LC
Micro - Chiroptera	Vespertilionidae	Cape Serotine <i>Eptesicus capensis</i>	P	LC	LC
Micro - Chiroptera	Vespertilionidae	Bibundi Butterfly Bat <i>Glauconycteris egeria</i>		LC	LC
Micro - Chiroptera	Vespertilionidae	Variegated butterfly bat <i>Glauconycteris variegata</i>		LC	LC

Micro - Chiroptera	Vespertilionidae	Banana Bat <i>Pipistrellus nanus</i>	P	LC	LC
Micro - Chiroptera	Vespertilionidae	Rueppell's Bat <i>Pipistrellus rueppellii</i>	P	LC	LC
Micro - Chiroptera	Vespertilionidae	Rufous Mouse-eared Bat <i>Myotis bocagei</i>		LC	LC
Micro - Chiroptera	Vespertilionidae	Scoteocus albobfuscus	P	LC	LC
Micro - Chiroptera	Vespertilionidae	Forest Brown House Bat <i>Scotophilus nux</i>		LC	LC
Micro - Chiroptera	Vespertilionidae	<i>Scotophilus leucogaster</i>	P	LC	LC
	Chrysochloridae	Stuhlmann's golden Mole <i>Chrysochloris stuhlmanni</i>	P	LC	NA
Insectivora	Soricidae	Long-tailed Musk Shrew <i>Crocidura dolichura</i>	P	LC	LC
Insectivora	Soricidae	Tiny Musk Shrew <i>Crocidura fuscomurina</i>	P	LC	LC
Insectivora	Soricidae	Peter's Musk Shrew <i>Crocidura gracilipes</i>	P	LC	NA
Insectivora	Soricidae	Hildegard's Musk Shrew <i>Crocidura hildegardeae</i>		LC	LC
Insectivora	Soricidae	Jackson's Musk Shrew <i>Crocidura jacksoni</i>	P	LC	LC
Insectivora	Soricidae	Musk Shrew <i>Crocidura ludia</i>	P	LC	LC
Insectivora	Soricidae	Greater Grey-brown Musk Shrew <i>Crocidura luna</i>	P	LC	LC
Insectivora	Soricidae	Dwarf Musk Shrew <i>Crocidura nanilla</i>	P	LC	LC
Insectivora	Soricidae	Uganda Forest Musk Shrew <i>Crocidura selina</i>	P	LC	LC
Insectivora	Soricidae	Musk Shrew <i>Crocidura denti</i>	P	LC	LC
Insectivora	Soricidae	Uganda Musk Shrew <i>Crocidura tarella</i>	P	LC	LC
Insectivora	Soricidae	Butiab Musk Shrew <i>Crocidura littolaris</i>		LC	LC
Insectivora	Soricidae	Greater Grey-brown Musk Shrew <i>Crociduara luna</i>		LC	LC
Insectivora	Soricidae	Dwarf Musk Shrew <i>Crocidura nanilla</i>	P	LC	LC
Insectivora	Soricidae	Matschie's Musk Shrew <i>Crocidura nigrofusca</i>		LC	LC
Insectivora	Soricidae	Northern Swamp Musk Shrew <i>Crocidura maurisca</i>		LC	VU D2
Insectivora	Soricidae	Olivier's Musk Shrew <i>Crocidura olivieri</i>	P	LC	LC
Insectivora	Soricidae	Small-footed Musk Shrew <i>Crocidura parvipes</i>		LC	LC
Insectivora	Soricidae	Southern Woodland Musk shrew <i>Crocidura turba</i>	P	LC	LC
Insectivora	Soricidae	Hero Shrew <i>Scutisorex somereni</i>	P	LC	NA
Insectivora	Soricidae	<i>Suncus infinitesimus</i>	P	LC	NA
Insectivora	Soricidae	Climbing Forest Shrew <i>Sylvisorex megalura</i>	P	LC	LC
Insectivora	Soricidae	Least Long-tailed Forest Shrew <i>Sylvisorex granti</i>	P	LC	LC

Insectivora	Soricidae	Pygmy Forest Shrew <i>Sylvisorex johnstoni</i>	P	LC	LC
Primates	Pongidae	Common Chimpanzee <i>Pan troglodytes</i>	P	EN	ENA4c
Primates	Cercopithecidae	Red-tailed Monkey <i>Cercopithecus ascanius</i>	P	LC	LC
Primates	Cercopithecidae	Vervet Monkey <i>Cercopithecus aethiops</i>	P	LC	LC
Primates	Cercopithecidae	Blue Monkey <i>Cercopithecus mitis</i>	P	LC	LC
Primates	Cercopithecidae	DeBrazza's Monkey <i>Cercopithecus neglectus</i>	P	LC	VU D2
Primates	Cercopithecidae	Uganda Mangabey <i>Lophocebus ugandae</i>	P	LC	VU A2c
Primates	Cercopithecidae	Olive Baboon <i>Papio anubis</i>	P	LC	LC
Primates	Cercopithecidae	Black and White Colobus <i>Colobus guereza</i>	P	LC	LC
Primates	Cercopithecidae	Angola Colobus <i>Colobus angolensis</i>		LC	VU D2
	Galagonidae	Spectacled Galago <i>Galago matschiei</i>	P	LC	DD
Proboscidea	Elephantidae	African Elephant <i>Loxodonta africana</i>	P	VU	CR A4a
Procavidae	Hyracoidea	Southern Tree Hyrax <i>Dendrohyrax arboreus</i>		LC	LC
Tubulidentata	Tubulidentidae	Aardvark <i>Orycteropus afer</i>	P	LC	LC
Rodentia	Anomaluridae	Lord Berdy's Flying Squirrel <i>Anomalurus beecrofti</i>	P	LC	LC
Rodentia	Anomaluridae	African Dwarf Flying Squirrel <i>Idiurus zenkeri</i>	P	LC	LC
Rodentia	Cricetidae	Savannah Pouched Rat <i>Cricetomys emini</i>	P	LC	LC
Rodentia	Cricetidae	Grey Climbing Mouse <i>Dendromus melanotis</i>	P	LC	LC
Rodentia	Cricetidae	Brant's Climbing Mouse <i>Dendromus mesorius</i>	P	LC	LC
Rodentia	Cricetidae	Chestnut Climbing Mouse <i>Dendromus mystacalis</i>		LC	LC
Rodentia	Cricetidae	Congo Forest Mouse <i>Deomys ferrugineus</i>	P	LC	LC
Rodentia	Cricetidae	Montane groove-toothed Rat <i>Otomys denti</i>	P	LC	LC
Rodentia	Cricetidae	Tropical Groove-toothed Rat <i>Otomys tropicalis</i>		LC	LC
Rodentia	Hystricidae	Crested Porcupine <i>Hystrix cristata</i>		LC	LC
Rodentia	Muridae	Northern Bush Rat <i>Aethomys hindel</i>	P	LC	LC
Rodentia	Muridae	Kaiser's Bush rat <i>Aethomys kaiseri</i>		LC	LC
Rodentia	Muridae	Nile Grass Rat <i>Arvicanthis niloticus</i>	P	LC	LC
Rodentia	Muridae	White-bellied Unstriped Grass Mouse <i>Arvicanthis testicularis</i>	P	LC	LC
Rodentia	Muridae	Peter's Striped Mouse <i>Hybomys univittatus</i>	P	LC	LC
Rodentia	Muridae	Common Brush-furred Rat <i>Lophuromys sikapusi</i>	P	LC	LC
Rodentia	Muridae	Eastern Brush-furred Rat <i>Lophuromys flavopunctatus</i>	P	LC	LC
Rodentia	Muridae	Velvet Rat <i>Colomys goslingi</i>	P	LC	NT
Rodentia	Muridae	Shaggy Swamp Rat <i>Dasymys incomtus</i>	P	LC	LC

Rodentia	Muridae	Common Thicket Rat <i>Grammomys dolichurus</i>	P	LC	LC
Rodentia	Muridae	Macmillan's Thicket Rat <i>Grammomys macmillani</i>		LC	DD
Rodentia	Muridae	Arboreal Thicket Rat <i>Grammomys rutilans</i>		LC	LC
Rodentia	Muridae	Stella Wood Mouse <i>Hylomyscus stella</i>	P	LC	LC
Rodentia	Muridae	Common Striped Grass Rat <i>Lemniscomys striatus</i>	P	LC	LC
Rodentia	Muridae	Peter's Stripped Mouse <i>Hybomys univittatus</i>	P	LC	LC
Rodentia	Muridae	Long footed Rat <i>Malacomys longipes</i>	P	LC	LC
Rodentia	Muridae	Northern Savanna Multimammate rat <i>Mastomys natalensis</i>	P	LC	LC
Rodentia	Muridae	Western Rift Pygmy Mouse <i>Mus bufo</i>	P	LC	LC
Rodentia	Muridae	Pygmy Mouse <i>Mus minutoides</i>	P	LC	LC
Rodentia	Muridae	<i>Mus musculooides</i>		LC	LC
Rodentia	Muridae	Grey-bellied Pygmy Mouse <i>Mus triton</i>		LC	LC
Rodentia	Muridae	Three-toed Grass Rat <i>Mylomys dybbskyii</i>			
Rodentia	Muridae	Rusty-nosed Rat <i>Oenomys hypoxanthus</i>	P	LC	LC
Rodentia	Muridae	Montane Groove-toothed Rat <i>Otomys denti</i>	P	LC	LC
Rodentia	Muridae	Tropical Groove-toothed Rat <i>Otomys tropicalis</i>		LC	LC
Rodentia	Muridae	Papyrus Rat <i>Pelomys hopkinsi</i>		DD	LC
Rodentia	Muridae	Jackson's Soft-furred Rat <i>Praomys jacksoni</i>	P	LC	LC
Rodentia	Muridae	Black Rat <i>Rattus rattus</i>		LC	LC
Rodentia	Muridae	Long-tailed Forest Rat <i>Stochomys longicaudatus</i>	P	LC	LC
Rodentia	Myoxidae	African Common Dormouse <i>Graphiurus murinus</i>	P	LC	LC
Rodentia	Rhizomyidae	Rueppell's Mole-ra <i>Tachyoryctes splendens</i>		LC	LC
Rodentia	Scuiridae	Cuvier's Fire-footed Squirrel <i>Funisciurus pyrrhopus</i>	P	LC	LC
Rodentia	Scuiridae	Red-legged Sun Squirrel <i>Heliosciurus rufobrachium</i>	P	LC	LC
Rodentia	Scuiridae	Alexander's Bush Squirrel <i>Paraxerus alexandri</i>		LC	LC
Rodentia	Scuiridae	Boehm's Bush Squirrel <i>Paraxerus boehmi</i>		LC	LC
Rodentia	Scuiridae	Giant Forest Squirrel <i>Protoxerus stangeri</i>		LC	LC
Rodentia	Scuiridae	Geoffrey's Ground Squirrel <i>Xerus erythropus</i>		LC	LC
Rodentia	Thryonomidae	Lesser Cane Rat <i>Thryonomys gregorianus</i>	P	LC	LC
Rodentia	Thryonomidae	Common Cane Rat <i>Thryonomys swinderianus</i>	P	LC	LC

Rodentia	Gerbillidae	Savanna Woodland Gerbil <i>Tatera leucogaster</i>	P	LC	LC
Rodentia	Gerbillidae	Northern Savanna Gerbil <i>Tatera valida</i>	P	LC	LC
Rodentia	Myoxidae	African Common Dormouse <i>Graphiurus murinus</i>	P	LC	LC



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Development of Wetland Management Plans for three wetland landscape; 1. Sio-Siteko wetland landscape (Kenya - Uganda)
2. Sango-Bay Minziro wetland landscape (Tanzania - Uganda) 3. Semliki Delta wetland landscape (Democratic Republic of Congo - Uganda)

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ONE RIVER ONE PEOPLE ONE VISION



Burundi



DR Congo



Egypt



Ethiopia



Kenya



Rwanda



South Sudan



The Sudan



Tanzania



Uganda

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