

Monograph for the Sango Bay Minziro (Tanzania - Uganda) Wetland landscape

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II. FOREWORD

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.

Sango Bay-Minziro is a transboundary wetland between Uganda and Tanzania wetland located where River Kagera flows into Lake Victoria. Minziro Forest Reserve, on the Tanzanian side, was gazzeted in 1947 as a nature reserve. It is a groundwater-forest with extensive areas of grasslands, swamps and marshes and is the largest forested area in north-west Tanzania, part of the Guinea–Congo lowland forests. To its north is the contiguous Malabigambo Forest Reserve on the Ugandan side, part of the Sango Bay complex. Sango Bay is also home to Lake Nabugabo Wetland system designated as a RAMSAR site in 2004 and covering 22,000 hectares mostly in Masaka District.

After extensive studies and in order to enhance integrity and ensure conservation and restoration actions were effective, at the end of the five years action plan the area increased three and a half times to 77,000 hectares in 2009, after consultations and an agreement to incorporate new areas in surrounding districts of Kalungu, Mpigi, Gomba and Butambala of Uganda in order to protect the unique biodiversity of birds, fish, insects and reptiles; as well as continue to provide natural water purification and other important ecosystem services. This would increase and secure economic value of the wetland from USD 4.55 million or USD 333/ha/year to more than USD 44 million or USD 566/ha/year; while securing economically important wetland resources for an additional 167,000 local stakeholders; and safeguard more than USD 281 million of ecosystem service values over the next 25 years if appropriate conservation measures and activities are implemented only if wetland resources and habitats are not further degraded, but enhance wetland conservation and wise use (The Lake Nabugabo Wetlands System Ramsar Site Management Plan, 2017 – 2027, Ministry of Water & Environment, Uganda).

It is the ambition of the current wetland management and conservation investment plan underway to compound these initiatives even further using a similar model, to combine the contiguous wetlands in the Sango Bay-Minziro region to create East Africa's first transboundary RAMSAR designated site.

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' riparian to the wetlands.

Special thanks are due to the NELSAP Technical Advisory Committee, the Wetland Management Team, GIZ, Sango Bay and Minziro local government officials as well as national technical officers who contributed with valuable information, data and support; community leaders and stakeholder groups who adopted the project as their own and finally the Missenyi and Kyotera government officers who expedited the consultations.

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Valuable contributions were made by stakeholders of the Sango Bay – Minziro wetland landscape during field campaigns and consultative stakeholder workshops. These include wetland dependent communities, National and District government officials and Non-Governmental Organisations. Together with the Nile Technical Advisory Committees (Nile-TACs) from Tanzania and Uganda.

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IV. ACRONYMS

AGL	-	African Great Lakes
amsl	-	above mean sea level
ASARECA	-	Association for Strengthening Agricultural Research in East and Central Africa
AU	-	African Union
BMU	-	Beach Management Units
BMUB	-	Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit
BMUB-ICI	-	BMUB- International Climate Initiative
CBD	-	Convention on Biological Diversity
CBOs	-	Community Based Organizations
CFR	-	Central Forest Reserve
CIP	-	Conservation Investment Plan
CMP	-	Catchment Management Plan
CMS	-	Convention on the Conservation of Migratory Species of Wild Animals
CSO	-	Civil Society Organization
CWMP	-	Community Wetland Management Plan
DiFR	-	Directorate of Fisheries Resources
DO	-	Dissolved Oxygen
DRC	-	Democratic Republic of Congo
DSA	-	Deep Sea Authority
DWRM	-	Directorate of Water Resources Management
EAC	-	East African Community
EMCA	-	Environmental Management and Coordination Act
ENSAP	-	Eastern Nile Subsidiary Action Program
ENTRO	-	Eastern Nile Technical Regional Office
ESRF	-	Economic and Social Research Foundation
EU	-	European Union
FAO	-	Food Agricultural Organization
FNR	-	Forest Nature Reserve
FTI	-	Fisheries Training Institute
GDP	-	Gross Domestic Product
GEF	-	Global Environment Facility
GIZ	-	The Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GIZ-NEL	-	GIZ Nile Equatorial Lakes region project
IBA	-	Important Birding Area
IFMP	-	Implementation of Fisheries Management Plan
ITCZ	-	Inter-Tropical Convergence Zone
IUCN	-	International Union for Conservation of Nature
IWRM	-	Integrated Water Resources Management
KTB	-	Kenya Top Bar Hive
LGAs		Local Government Authorities
LVB	-	Lake Victoria Basin

LVBC	-	Lake Victoria Basin Commission
LVEMP	-	Lake Victoria Environmental Management Project
LVFO	-	Lake Victoria Fisheries Organization
m	-	Meter
MNFR	-	Minziro National Forest Reserve
MEA	-	Multilateral Environmental Agreement
MUIENR	-	Makerere University Institute of Environment and Natural Resources
MWE	-	Ministry of Water and Environment
NAADS	-	National Agricultural Advisory Services
NaFIRRI	-	National Fisheries Resource Research Institute
NBI	-	Nile Basin Initiative
NDA	-	National Drug Authority
NDVI	-	Normalized Difference Vegetation Index
NELSAP	-	Nile Equatorial Lakes Subsidiary Action Program
NELSAP-CU	-	NELSAP Coordination Unit
NEMA	-	National Environment Management Authority
NEMC	-	National Environmental Management Council
NFR	-	Nature Forest Reserve
NILE COM	-	The 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
NPA	-	National Planning Authority
NRBC	-	Nile River Basin Commission
NT	-	Near Threatened
NTU	-	Nephelometric Turbidity Units
NUSAF	-	Northern Uganda Social Action Fund
NWSC	-	National Water and Sewerage Corporation
PMTCT	-	Prevention Mother to Child Transmission
RAMCEA	-	Ramsar Centre for Eastern Africa
RPOA-IUU	-	Regional Plan of Action to prevent, deter and eliminate Illegal, Unreported and Unregulated fishing
SAMUKA	-	Sango Bay-Musambwa Island-Kagera Wetland System
SFD	-	the State Department of Fisheries and Blue Economy
SUA	-	Sokoine University of Agriculture
SUMATRA	-	Surface and Marine Transport Regulatory Authority
SWL	-	Static Water Level
TAFIRI	-	Tanzania Fisheries Research Institute
TASAF	-	Tanzania Social Action Fund
TBS	-	Tanzania Bureau of Standards
TFDA	-	Tanzania Food and Drugs Authority
TFS	-	Tanzania Forest Services
TIC	-	Tanzania Investment Centre

TNC	-	The Nature Conservancy
TZS	-	Tanzanian shilling
UDSM	-	University of Dar Es Salaam
UGX	-	Ugandan shilling
UIA	-	Uganda Investment Authority
UNBS	-	Uganda National Bureau of Standards
UNRA	-	Ministry of Water and Transport
UWA	-	Uganda Wildlife Authority
VCT	-	Voluntary Counseling and Testing
VWMZ	-	Victoria Water Management Zone
VU	-	Vulnerable
WB	-	World Bank
WRA	-	Water Resources Authority
yr	-	Year
µS/cm	-	micro Siemens per centimetre

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 Sango Bay-Minziro 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 Sango Bay-Minziro wetland landscape. In addition, it identifies the main challenges the wetland landscape faces and on which to develop successful management plans and investment portfolios.

The Sango Bay-Minziro wetlands are of high bio-geographic importance because they are located in the transition zone between the East and West African vegetation zones. They are home to rare and endemic forest swamp tree species, over 300 species of birds, endangered mammals and various amphibians, fish and reptiles. The area plays an important role in supporting ecosystem processes and regulating the dynamics of the hydrological system, reducing peak flow and contamination, and storing potable water.

The main challenges in Sango Bay-Minziro include the destruction of wetlands, over-exploitation of wetland resources, and unsustainable land use practices that enhance ecosystem degradation and soil erosion. The main causes underlying these challenges include a high population growth rate (2.04% per year), widespread poverty, weak institutional capacity, a lack of awareness, and climate change. An additional threat the wetlands faces is the possibility of oil exploitation and acceleration of land use change.

Water resources are likely to be increasingly strained in the future due to changing climatic and socio-economic conditions of the wider Sango Bay-Minziro and its contributing rivers and streams. 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 Sango Bay-Minziro wetland landscape needs better protection from human disturbance and climatic changes to protect the ecosystem and local livelihoods.

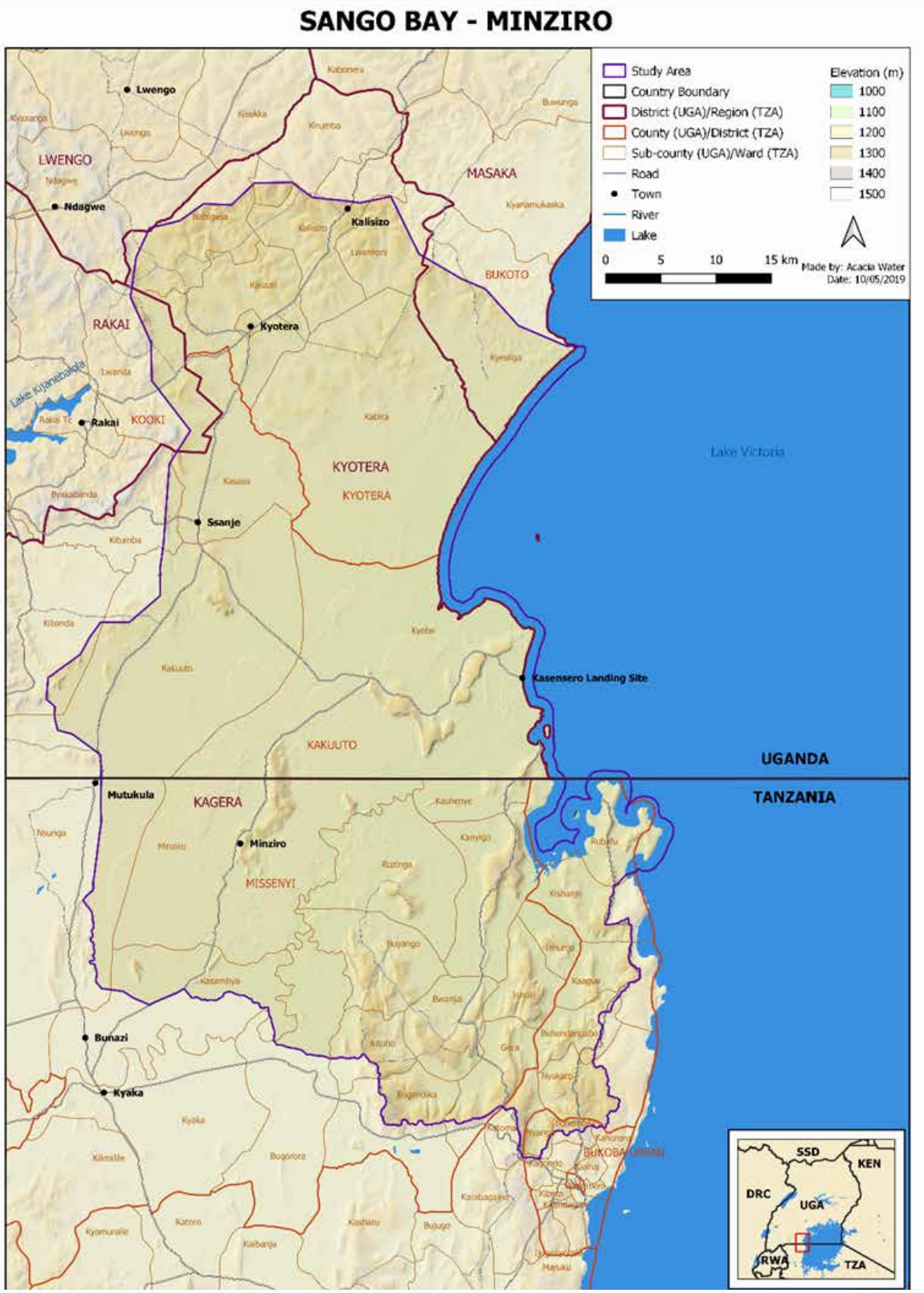
In order to develop successful and sustainable management and investment plans, it is crucial to understand the environmental and socio-economic system of the wetland landscape and the main threats it faces. The first step and cornerstone of this action plan is this Wetland Monograph, which serves as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

1 INTRODUCTION

1.1 OVERVIEW OF THE WETLAND LANDSCAPE

1.1.1 Geographical location

The Sango Bay-Minziro wetland landscape is located west of Lake Victoria and encompasses the Sango Bay-Musambwa Island-Kagera (often shortened to SAMUKA) Wetland System in Uganda and the Minziro Forest Reserve in Tanzania (Figure 1). The Sango Bay-Minziro wetlands lie between latitude 0.51 - 1.30 °S and longitude 31.38 - 31.88 °E and has an area of approximately 3000 square kilometres.



1.1.2 Ecological potential

Wetlands have a 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 Sango Bay-Minziro ecosystem is a large, biologically rich, transboundary wetland that expands across the SAMUKA wetland system in southwest Uganda and the Minziro National Forest Reserve in northwest Tanzania. The Ramsar site SAMUKA is a mosaic of wetland types (Figure 2) including the biggest tract of swamp forest in Uganda, papyrus swamps, herbaceous swamps interspersed with palms and seasonally flooded grasslands, sandy, rocky and forest shores. The Minziro Forest Reserve is a groundwater-forest with extensive areas of grasslands, swamps and marshes and is the largest forested area in north-west Tanzania, part of the Guinea-Congo lowland forests.



FIGURE 2: THE SANGO BAY-MINZIRO 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 REEDS.

1.1.3 Social economic potential

Besides the ecological value of wetlands, the Sango Bay-Minziro wetland landscape provides important social economic services to 500.000 people living in the Kyotera District of Uganda and Kagera Region of Tanzania. Sango Bay-Minziro's natural resources are harvested to provide food (f.e. honey, fish, fruits and mushrooms) and materials for construction and crafts, such as grass and reeds for weaving matts and baskets and timber for making luxurious sofa chairs. In addition, the fertile floodplains are used for agriculture and the big numbers of cattle use the flat grasslands for grazing. Other important ecosystem services provided by the Sango Bay-Minziro wetlands include water filtration and purification, water buffering, protection against erosion, and also cultural services (Figure 3).

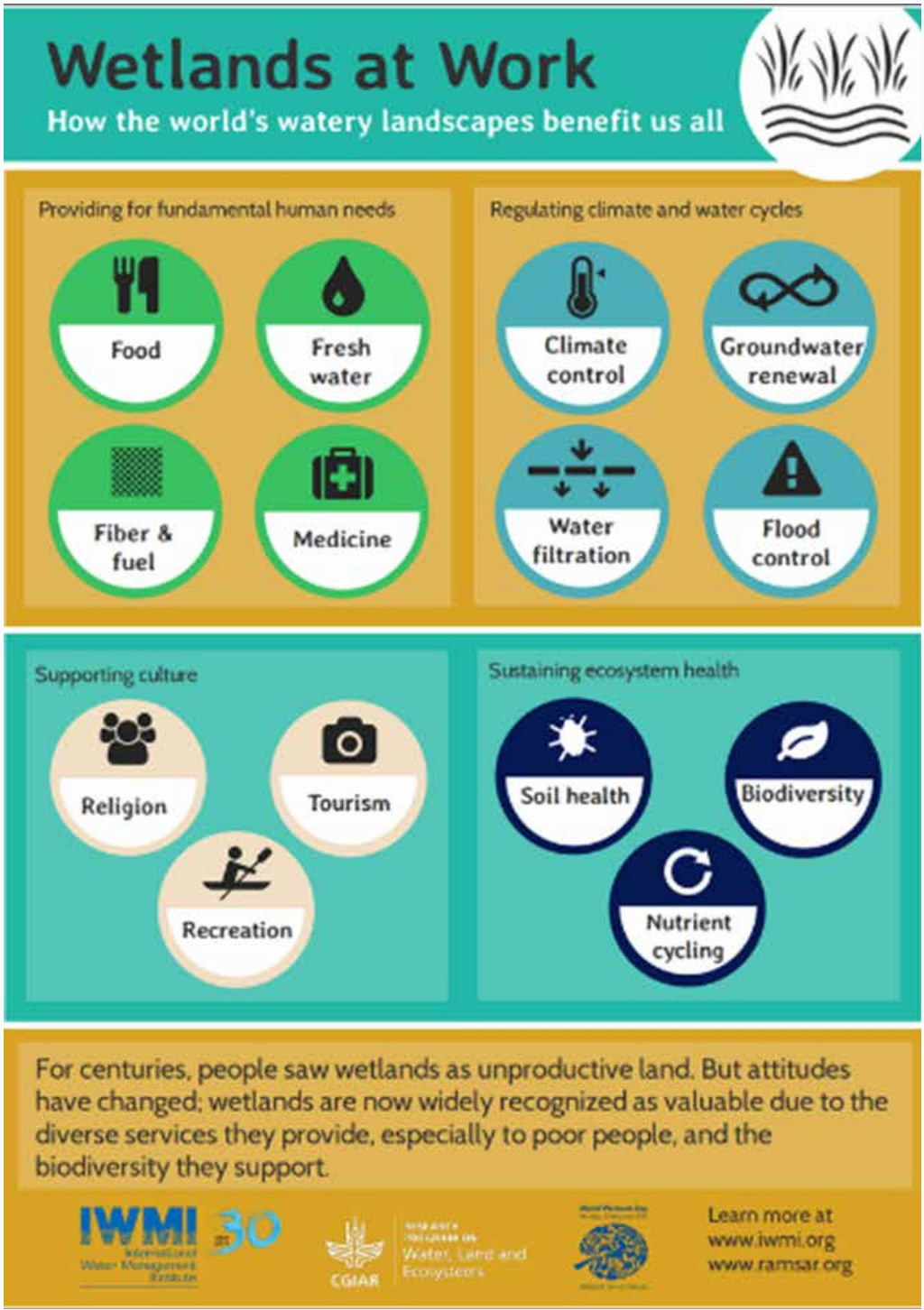


FIGURE 3: OVERVIEW OF ECOSYSTEM SERVICES OF WETLAND LANDSCAPES (SOURCE: IWMI).

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.

1.2 DIGESTION OF PREVIOUS PLANS AND PROGRAMS

A number of initiatives have been undertaken in and around the region in an effort to ensure the management of wetlands resources through regional authorities and bodies, international communities, governments, inter-governmental organisations, non-governmental organisation and other stakeholders.

Specific priorities and plans for Sango Bay-Minziro Ecosystem

- Transboundary ecosystem management plan
- Transboundary investment plan
- Harmonization of legal and policy documents for trans-boundary natural resource management (e.g. forest, wetland, wildlife, fisheries policy legal and policy documents)
- Sustainable funding mechanisms for transboundary resource management
- Establishment of well management and administrative structure by NBI/NELSAP from the region to the districts level for proper coordination and implementation of transboundary issues and national issues of interest.

Several pertinent studies have been done, of which the Kagera River Basin Monograph (2008) being the most extensive, despite covering only part of the Sango Bay – Minziro wetland system. Information on conservation investment can be found in the CIP for Sango Bay (2017) and information on forest management in the MP of Minziro Forest Reserve (2016/17 - 2020/21).

The most recent on ground conservation initiative was through the GEF East Africa Cross border Biodiversity project (1997 to 2003), which amongst other initiatives the following were conducted.

- Institutional capacity building at District down to community levels including Steering committees, Village environment committee, Local transboundary initiatives, Social entertainments like football and dances across the borders, Joint planning of conservation projects, implementation and monitoring.
- Awareness of biodiversity values
- Biodiversity surveys (timber, botanical and birds)
- Alternative income generation initiatives (beekeeping, efficient stoves, handicrafts (including use of water hyacinth), tree and fruit tree nurseries amongst others.

The other most recent project was the USAID funded Planning for Resilience in East Africa through Policy, Adaptation, Research and Economic Development (PREPARED) This project documented on the following three areas:

- Climate change adaptation technical capacity, policy leadership and action readiness of regional institutions improved;
- Resilient and sustainable management of biologically significant trans-boundary freshwater ecosystems in the EAC region strengthened; and
- Resilient and sustainable water supply, sanitation, and wastewater treatment services in the Lake Victoria Basin enhanced.

In 2016, an economic valuation of Sango Bay – Minziro Ecosystem was undertaken as part of the Planning for Resilience in East Africa through Policy, Adaptation, Research and Economic Development (PREPARED) project (USAID 2016). The overall aim of this economic valuation study was to provide baseline data on the benefits derived from different ecosystem goods and services from the area; which includes forests and wetlands, and their associated habitats; see also the valuation of Ecosystem Services in chapter 3.2.

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 Sango Bay-Minziro 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. Specifically, the project will incorporate information and planned measures from recent studies and action plans in both Minziro and Sango Bay.

It is the ambition of the current wetland management and conservation investment plan underway to compound the PREPARED initiative even further using a similar model, to combine the contiguous wetlands in the Sango Bay-Minziro region to create East Africa's first transboundary RAMSAR designated site.

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 Sango Bay-Minziro wetland landscape. In addition, it identifies the main challenges the wetland landscape faces and on which to develop successful management plans and investment portfolios.

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 utilisation, 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 Sango Bay-Minziro 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 Sango Bay-Minziro 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, the current climate and expected climate change and how these influence the wetland, as well as the land use and land 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 covers 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 Sango Bay-Minziro wetland landscape is located west of Lake Victoria and lies at the boundary between Uganda and Tanzania. Within Uganda, the wetland landscape is concentrated in the Kyotera and Kakuuto counties in Kyotera District. In Tanzania, the bulk of the area lies within Missenyi District, with smaller portions in Bukoba Rural and Bukoba Urban Districts. The city of Bukoba is located southeast of the Sango Bay-Minziro wetlands. See Figure 1 and for more detail the Administrative Boundary Map in Appendix A.

The boundaries of the wetland landscape are based on a combination of existing protected areas and topography. The delineation of the northern half of the project area is based on the Sango Bay-Musambwa Island-Kagera Wetland System (SAMUKA) Ramsar site established in Uganda in 2006. The southeastern boundary is determined by the topography, following the water divide. The southwestern boundary encompasses the Minziro Forest Reserve. Note that the project area extends one kilometer into Lake Victoria to account for seasonal changes in the shoreline and more long-term effects of erosion and sedimentation.

The total study area, including the wetlands and their area of influence, covers approximately 3000 square kilometres and is located between latitude 0.51 and 1.30 °S / longitude 31.38 and 31.88 °E.

2.2 TOPOGRAPHY, GEOLOGY AND SOILS

2.2.1 Topography and geomorphology

The general elevation in the Sango Bay-Minziro wetland landscape varies between 1,135 and 1,180 meter above mean sea level (m amsl). It has an absolute minimum elevation of 1,134 m amsl, corresponding to the average lake level of Lake Victoria. Some of the rocky hills, on top of which most villages are located, rise up to elevations of 1,350 m amsl. See Figure 1 and for more detail the Elevation Map in Appendix A.

The topography is generally flat with Minziro Forest Reserve (Tan) and Kaiso, Malabigambo, Tero and Namalala Forest Reserve (Uganda) ranging from 1,150 to 1,170 m amsl. Most areas below 1,150 m amsl are subject to seasonal inundation between October and May and consist of grass plains and papyrus swamps (permanently inundated). The area is dotted with small rocky hills, such as Kere Hill, a small rocky outcrop in Minziro Forest rising up to 1,180 m amsl, the hill of Minziro village at 1,325 m amsl and the hill of Kanyigo village at 1,350 m amsl. These rocky hills appear as high ridges stretching in a north-south orientation, forming the backbone of the area's landforms.

The gently undulating hills are composed of relatively soft rocks that are easily weathered. On the shorter face-slopes the high ridges give way to a fringe of almost flat plains at 1,140 - 1,150 m amsl that separates the rocky hills from the surrounding swamps. The flat to almost flat lowlands comprise the greater part of a lacustrine plain (in earlier Quaternary times part of Lake Victoria) that consists of extensive seasonal flood plains and permanent riverine and lakeshore wetlands. The River Kagera flows across this plain in an incised channel before entering Lake Victoria.

The left photo in Figure 4 shows a viewpoint over the wide flat plains of seasonally flooded grassland with pockets of woodland and papyrus that are located in between the Kagera riverbanks and a North-South orientated elongated rocky hill. The plain is very flat (1,142 m amsl) and, nearly unhabituated (protected area) and is covered with grassland and some remaining patches of forest. Photo taken on 25 April 2019 at Lat: 1° 2'39.99"S / Lon: 31°45'27.53"E / elevation 1,296 m amsl along the road heading north from Kanyigo town. The photo right is taken at viewpoint (Lat: 0°53'51.24"S / Lon: 31°44'0.02"E) on the escarpment and Ssekaningo Forest Reserve situated on the low plain at the foot of the ridge (photo right), giving rise to a high productive (12 m3/hr for 12 hours a day) protected spring (located at Lat: 0°54'7.75"S / Lon: 31°44'1.81"E) supplying water to Kasensero town and surroundings.

The extensive flat sandy river terrace along the River Kagera splits up in a number of delta-arm levees, spreading out over the lakebed area eastward. The lake shoreline along the Sango Bay-Minziro area is fringed by different wetland zones, merging into extensive flood-plains of the different river inflow zones to the lake; which in most areas have beautiful deltas. The shore is mainly sandy, rocky and forested with three rocky islets about 3 km offshore in the so-called Sango Bay.



FIGURE 4A: VIEWPOINT OVER THE WIDE FLAT PLAINS OF SEASONALLY FLOODED GRASSLAND WITH POCKETS OF WOODLAND AND PAPYRUS



Figure 4b: Viewpoint on the escarpment and Ssekaningo Forest Reserve situated on the low plain at the foot of the ridge.

On the Tanzanian side, the drainage density of River Kagera is low with Ngono River as only tributary. The many meanders are produced by River Kagera swinging from side to side as it flows across its floodplain or shifts its channel within the valley. The width of Kagera's riverbed is very steady over its final course, between 50 and 60 m wide. On the Ugandan side the Ugandan, the drainage density is also low, with Bukoola and Kisoma being the main rivers and no significant tributaries. The overall low drainage density is an indication for a high permeability of the ground, meaning that surface water runoff is relatively limited and groundwater flow significant. It also means that the flood risk of River Kagera and the other rivers is low as the rising limb and falling limb of the hydrograph is not very steep.

2.2.2 Geology and soils

The geology of the Sango Bay-Minziro wetland landscape is characterized by crystalline basement rock (granites and gneiss), covered by thick layers of sedimentary rocks (sandstones and siltstones) that form the hills in the area. In the valleys, the sedimentary rocks are covered by unconsolidated sediments (sands and clays).

The Precambrian Karagwe-Ankolean metamorphic system underlies most of the Kagera basin area, of which Sango Bay-Minziro is part. These basement rocks are covered by sedimentary rocks of Mesoproteroizoic age (1,600 – 1,000 My), which in most areas are covered by Holocene (< 11,700 y) alluvial and lacustrine deposits. The sedimentary rocks are orange-pink (TZA side) and blue-green (UGA side) coloured on the geological map (Appendix A – Geological Map), while the unconsolidated sediments are white-pink (TZA side) and orange-yellow (UGA side) on the geological map. The sedimentary rocks are known as the Bukoban Sandstone Formation (Tanzania) or Mityana series (Uganda), part of the Bukoban System. The Bukoban System is built up of a series of shallow water sediments and lavas deposited around the western margin of the Tanganyika craton (> 2,000 My). The margin of the Tanganyika craton underwent a major tilting episode at the end of the Bukoban Sandstone times with a relative sinking to the south-west, and the formation was concentrically folded and partially eroded before the deposition of the later sediments. The Bukoban Sandstone Formation has a total thickness of around 1,300 m and it is built up of alternations of fine to medium grained mature white sandstones and conglomerates and finely laminated siltstones and shales (Figure 5). It is unmetamorphosed and only locally is it strongly deformed. They clearly post-date the low-grade metamorphic rocks of the Kibaran orogenic belt, which is outcropping more to the west of the study area. Around the town of Bukoban, a series of dykes and sills intrude the Bukoban Sandstone Formation (Piper, 1971).



Figure 5: Outcrops of jointed sedimentary rocks, consisting of alterations of fine grained siltstones (thin beds, photo left) and coarse grained sandstones (thicker beds, photo right), outcropping along the Ngono River near the bridge at the Bukoba-Kyaka road. Photos taken on 24 April 2019 at Lat: 1°14'22.80"S / Lon: 31°35'45.36"E.

The fine-grained siltstones and shales are relatively soft and can only be found outcropping along erosive river banks. The medium to coarse-grained sandstones and conglomerates form the higher parts of the area and can be found in elongated ridges with an overall North-South orientation. They form an elevation difference of 50 m up to 150 m. Often springs can be found on the slope or the foot of this ridge, like for example in Gera ward, Missenyi District, Tanzania, where 'Bwenoni spring' (with a year round constant flow of around 3 liter/second) is located on the slope of this sandstone ridge (Figure 6). In the field these sandstones and conglomerates appear as highly weathered banks or big boulders, orientated in N-S orientation (Figure 7).

The thick layers of sedimentary rock form the rocky outcrops in the area and are poor to very poor in nutrient releasing minerals. In the lower parts of the area, the sedimentary rocks are covered with alluvial infills and lacustrine deposits and swamp deposits of Holocene age. These unconsolidated sediments are sandy or clayey.



FIGURE 6: AN ELONGATED RIDGE OF QUARTZITIC SANDSTONES AND CONGLOMERATES CAN CLEARLY BE SEEN ON GOOGLE EARTH BY THE GREY LINE OF BOULDERS (IN THE CENTRE OF THE IMAGE, NW-SE DIRECTION) FORMING A TOPOGRAPHICAL JUMP IN THE LANDSCAPE (AS CAN BE SEEN ON THE ELEVATION PROFILE PERPENDICULAR TO THE RIDGE), WHICH GIVE RISE TO SPRINGS IN THE EASTERN PART OF MISSENYI DISTRICT, TANZANIA.



FIGURE 7: BOULDERS OF HIGHLY WEATHERED QUARTZITE SANDSTONES AND CONGLOMERATES OUTCROPPING AT KYABASIMBA LANDING SITE, UGANDA, ALONG LAKE VICTORIA (PHOTO LEFT) AND NEAR KASHAMBIA VILLAGE, GERA WARD, TANZANIA (PHOTO RIGHT). PHOTO LEFT TAKEN ON 27 APRIL 2019 AT LAT: 0°52'32.34"S / LON: 31°45'56.05"E. PHOTO RIGHT TAKEN ON 25 APRIL 2019 AT LAT: 1°15'32.56"S / LON: 31°44'55.72"E.

The sandy and loamy soils (fluvisols; blue coloured in the soil map of Appendix A) are formed by erosion of the Precambrian Karagwe-Ankolean metamorphic system and the sedimentary rocks of the Bukoban system that underlies the Sango Bay-Minziro wetland landscape, and are mainly deposited by River Kagera and some of the smaller rivers.

Towards the outlet of the River Kagera, a plain of lacustrine sediments of imperfectly drained silt over clay deposits is found which was in earlier Quaternary times part of Lake Victoria. The extensive flat sandy river terrace along the River Kagera is made up of well to excessively drained brown loamy sand to sandy loams (cambisols). These cambisols (brown coloured in the soil map) are in the beginning of soil formation, due to active erosion, and make good agricultural land. These terraces gradually merge into extensive swamps in the down slope direction with a soil of

an order comprising peaty soils, with a deep surface layer of purely organic material (histosols).

At some of the hills ferralsols (and nitisols further away from Lake Victoria) are formed (orange-brown coloured in the soil map). Ferralsols are red-orange weathered soils whose colours result from an accumulation of metal oxides, particularly iron and aluminium. Because of the residual metal oxides and the leaching of mineral nutrients, they have low fertility and require additions of lime and fertilizer if they are to be used for agriculture, but tree crops like coffee are suitable.

In the northern part of Sango Bay-Minziro, around Kalisizo, Alisols can be found. Alisols have a high cation exchange capacity and are acidic (increased by limited drainage) and therefore need liming, contain few nutrients and therefore need fertilizer, and do not have much surface coherence so are easily eroded.

On the western edge of Sango Bay-Minziro, around Rakai, shallow soils that are very gravelly/stony (Leptosols) can be found as a result of the metamorphic rocks outcropping nearby. Leptosols are unattractive soils for rainfed agriculture because of their inability to hold water.

Wetland soil fertility and agriculture

The wetland soils found in the lower parts of Sango Bay-Minziro are characterized by a 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 and/or low suitability for agriculture of the ferralsols, nitisols, alisols and leoptosols that are found on higher grounds, as described above. 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 Sango Bay-Minziro. Due to unsustainable land use management, farmers have to leave their plots on the hills/slopes and go down in the wetland valley for new land, further enhancing the encroachment; especially during dry season and periods of drought.

2.3 HYDROLOGY AND WATER RESOURCES

Meteorology

The mean annual rainfall in the Sango Bay-Minziro wetland landscape is around 1,400 mm per year, with the long rains falling in mid-March to May and the short rains in October to November. There is a strong spatial variation in rainfall, with the north-western part of Sango Bay-Minziro wetland (around Kalisizo and Kyotera town, Uganda) receiving 800-1,000 mm per year, while the south-eastern part near Bukoba, Tanzania, receives as much as 1,600-2,000 mm per year (Appendix A - Precipitation Map). The average annual evapotranspiration is about 800 mm in the forest area and 500 in the grassland and cropland areas according to data from the Moderate Resolution Imaging Spectroradiometer mission (Mu et al. 2011).

The trees in the forested areas of Sango Bay and Minziro are characterized by epiphytes and mosses that capture mist and rainwater directly from the air. As such these forests are able to capture significantly more water than only the direct rainfall and therefore play an essential role in the amount of water that is captured and stored in the Sango Bay-Minziro wetland landscape, as well as in regulating the micro-climate.



FIGURE 8: EPIPHYTES AND MOSSES IN THE TREES OF MINZIRO FOREST ARE CAPABLE OF CAPTURING SIGNIFICANT AMOUNTS OF MIST AND RAINWATER DIRECTLY FROM THE AIR. PHOTO TAKEN ON ON 24 APRIL 2019 AT LAT: 1°05'30.63"S / LON: 31°31'01.37"E.

2.3.2 Surface water

River Kagera

The River Kagera is the largest of the 23 rivers that drain into Lake Victoria, contributing roughly 34% of the total river inflow of the lake. The river basin covers some 60,500 km² in four countries of Burundi, Rwanda, Tanzania and Uganda. The runoff in the River Kagera catchment responds to seasonal rainfall; the peak flow occurs in April in the upper tributaries, in May at Kigali and Rusumo Falls, and is delayed to July at Kyaka Ferry on the lower Kagera, close to the outlet into Lake Victoria. The monthly flow series of the River Kagera at Kyaka Ferry (just outside the study area) shows the high base flow component of the Kagera flow, resulting from the storage in and release of water in the various wetlands and swamps upstream (Sutcliffe, 1999). At Kyaka Ferry, the catchment area of Kagera is 55.800 km2, with a monthly average flow of 263 m3/s and a mean yearly flow of 8.3 km3/year. During the field visit on 24 April 2019, the discharge was estimated to be 180 (± 40) m3/s.

The wetlands prove to be effective in reducing the amount of water entering Lake Victoria. According to Haskoning et al (2002), rainfall and evapotranspiration are about 10 times the absolute value of the runoff in the lower reaches of the River Kagera in Sango Bay-Minziro wetlands. The River Kagera flow regime is different from other tributaries to Lake Victoria, mainly because of this wetland attenuation. Every year, in the two peak rainfall months of April and May, the stream flow surplus overflows the river banks and floods the marshy valley and the lakes. The river levels of the tributaries reduce between June to September, with annually the lowest levels experienced from August to October (Kagera River Basin Monograph, 2008).

The hydrometric station at the Kagera mouth is poorly positioned and the rating curves and water levels are affected by growth of papyrus plants and backwater effects from Lake Victoria (Kagera River Basin Monograph, 2008). Upstream of the Kagera mouth, before the confluence of the Kagera with the River Ngono, the hydrometric station Kyaka Ferry is positioned in the River Kagera. Theoretically, the annual flow at the Kagera mouth should be close to the sum of the flows at Kyaka Ferry (8.3 km3/year) and of the River Ngono (0.7 km3/year), and therefore amount to about 9.0 km3/year. Both gauging stations were visited during the Field Mission of April 2019 (Figure 9). At Kyaka station it was observed that the water scale gauging station had been washed aside and was not relocated, hence water level reading was not reliable. At the gauging station near the Kagera mouth, the water level at the scale was 0.88 m on 26 April 2019. At both stations it was noted that there is only one scale located higher than the scale currently standing in the water. This means that water levels seem to get higher only 1 meter compared to the current water level.



FIGURE 9: WATER LEVEL GAUGING STATIONS IN RIVER KAGERA IN KYAKA TOWN, TANZANIA, JUST BEFORE THE BRIDGE OF THE BUNAZI-KYAKA ROAD (PHOTO LEFT) AND NEAR THE KAGERA RIVER MOUTH, 2.5 KM SOUTH OF KASENSERO LANDING SITE, UGANDA. LEFT PHOTO TAKEN ON 24 APRIL 2019 AT LAT: 1°14'09.21"S / LON: 31°24'45.26"E. RIGHT PHOTO TAKEN ON 26 APRIL 2019 AT LAT: 0°56'21.15"S / LON: 31°45'47.82"E.

The time series of historic and current water levels (discharge) recorded at the two gauging stations in River Kagera could not be obtained from the Ugandan nor the Tanzanian water authorities. However, the Global Runoff Data Centre has monthly discharge records for two stations, Kyaka Ferry and Rusumo, for the period 1940–1985 (GRDC 2019). These data show strong seasonal patterns and interannual variability (Figure 10). Within the year, discharge is highest in May for the station at Rusumo and in June/July for Kyaka Ferry, which lies farther downstream (Figure 11). Flows are lowest in September to October for the Rusumo site, and in November to February for the Kyaka Ferry site. As the River Kagera moves downstream from Rusumo to Kyaka Ferry, the difference between seasons is attenuated, meaning that seasonal differences are lower at the Kyaka Ferry station, where discharge in the high flow season is 40% higher than in the low flow season, than at the Rusumo station, where the high flows are close to twice as high as the low flows (Figure 11). It should be noted that Rusumo is located upstream from Kyaka Ferry, so the relative differences observed in average monthly discharge between the two stations is a difference in time (1940 – 1972 versus 1965 – 1985) rather than in location (upstream versus downstream).

An abrupt change in the flow regime, with higher discharge and notably higher peak flows, is visible in the data from Kyaka Ferry around 1962 (Figure 10). It is unclear whether this change reflects actual changes in streamflow, or whether the discharge was in reality the same, but that local conditions affecting the rating curve such as the shape of the river bed and vegetation condition were abruptly changed. This type of change could for example be caused by an extreme flooding event. The Rusumo station shows no changes in seasonality over the period with available data.

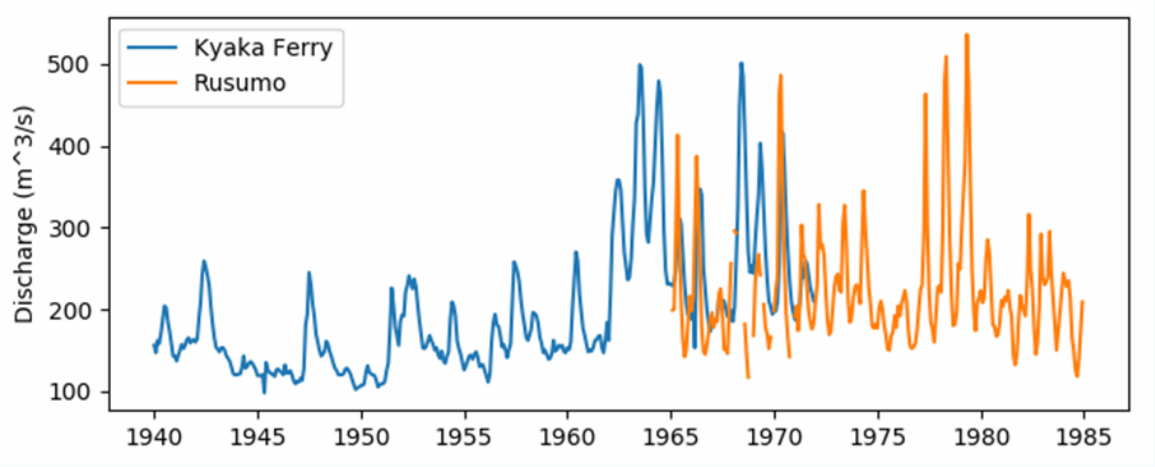


FIGURE 10: MONTHLY AVERAGE STREAMFLOW DATA FROM THE KYAKA FERRY (DOWNSTREAM) AND RUSUMO (MORE UPSTREAM) DISCHARGE STATIONS IN THE RIVER KAGERA.

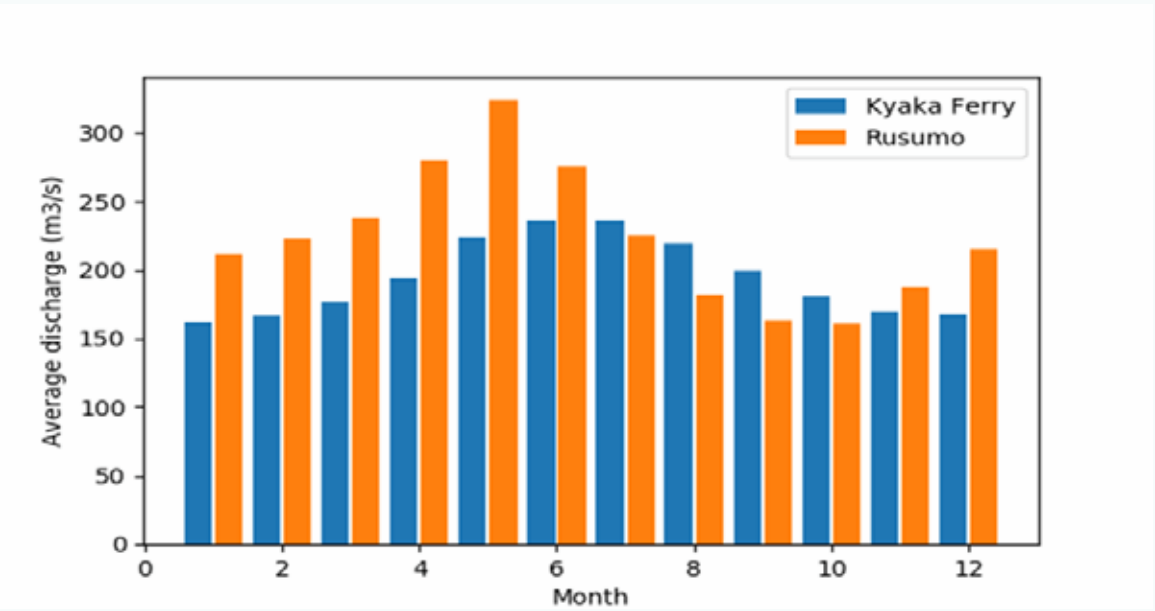


FIGURE 11: MONTHLY AVERAGE DISCHARGE OF RIVER KAGERA, MEASURED AT KYAKA FERRY (1940 - 1972) AND AT RUSUMO (1965 - 1985).

The River Kagera flows across an extensive seasonal flood plain (around 5 km wide) in an incised channel, between 50 and 60 m wide, before entering Lake Victoria. Within the Sango Bay-Minziro area, River Kagera is characterized by heavy meandering and many sharp curves (Figure 12), even though there are only very few oxbow as they have been filled up due to the high sedimentation rate. The limited number of scales used at the gauging stations, the relative high permeability of the surrounding soils, and the presence near the river mouth of concrete constructions located very near (<50 m) and only slightly above (1 m) the riverbed, indicate that the flood risk of River Kagera outside the flood plain is small.

The Sango Bay-Minziro wetland landscape is receiving a lot of water during the long rains in mid-March to May, resulting in a rise of the groundwater table, especially in the flat lowlands that surrounds the Kagera flood plain. This is followed by a peak flow in River Kagera, normally during the months June-August which, despite being a relatively small rise in water level, avoids the flat lowlands to drain the excessive amount of rainwater received in the months before. As a result, the seasonal flooding often results in several feet of water covering the floor of most of the low-lying landscape of the Sango Bay-Minziro wetlands during a period of four to eight months.

The River Kagera is characterized by a year-round high sediment load (the turbidity, used as indicative proxy for sediment load, was measured around 80 to 90 NTU in April 2019) that leads to siltation of Lake Victoria. The siltation is mainly due to soil erosion from uncontrolled agricultural practices and other changes in land use like deforestation within (upstream parts of) the catchment. Land cover depletion including deforestation is widespread with almost total absence of reforestation activities. The silt and suspended solids from soil erosion culminates in increased nutrient load in the river as well as into Lake Victoria, leading to severe problems of water hyacinth and eutrophication. Nutrients stimulate algae growth which reduces oxygen leading to eutrophication and reduction in fish. The delta at the mouth of the river has shifted more into the lake and it is likely to join with the small island below the mouth of the river (NEMA 2009). The satellite images of 1987 and 2008 show high reflectance of water from the River Kagera due to silt and suspended solids (Figure 13).





FIGURE 12: KAGERA RIVER AS SEEN NEARBY THE OUTLET AT LAKE VICTORIA, CARRYING A HIGH SEDIMENT LOAD AND FLOATING WATER HYACINTH WITH ITS FLOW ALONG THE PAPYRUS SWAMP ON THE SOUTH BANK (PHOTO LEFT) AND A VIEW POINT FROM THE HILL OF KAKIRA TOWN LOOKING SOUTHWARDS TO THE MEANDERING KAGERA RIVER A WHERE ITS CROSSING THE TANZANIA-UGANDA BORDER (PHOTO RIGHT). LEFT PHOTO TAKEN ON 26 APRIL 2019 AT LAT: 0°56'20.40"S / LON: 31°45'47.54"E; RIGHT PHOTO TAKEN ON 9 JANUARY 2019 AT LAT: 0°58'28.56"S / LON: 31°41'12.22"E.



FIGURE 13: THE SATELLITE IMAGES OF 1987 (LEFT) AND 2008 (RIGHT) SHOW HIGH REFLECTANCE OF WATER FROM THE RIVER KAGERA DUE TO THE HIGH SEDIMENT LOAD. THE DELTA AT THE MOUTH OF THE RIVER HAS MOVED FURTHER INTO THE LAKE DUE TO HIGH SILTATION RATES (SOURCE NEMA 2009).

River Ngono

The River Ngono is a perennial river located entirely in Tanzania, flowing from south to north for a distance of about 125 km. The River Ngono has a catchment area of 3.200 km2 and joins the Kagera from its mouth with a 0.7 km3/year total yearly flow. The West Ngono and the Rubare are the two main tributaries. The catchment is well-defined by steep hills which parallel the west shore of Lake Victoria. Over most of its course it flows on a very flat gradient through swamp and lake terrain. The River Ngono is draining an area of with rainfall of over 2,000 mm/year (Appendix A - Precipitation Map), and contributes a highly seasonal flow to the River Kagera. Ngono have a strong response to rainfall, resulting in a high oscillation of the monthly average annual level. During the field visit on 24 April 2019, the discharge was estimated to be 20 (± 5) m3/s (Figure 14). At the gauging station at the bridge of the Kyaka-Bukoba road, the water level reading at the scale was 2.24 m. At this station, a total of seven 1m-scales were located higher than the scale currently standing in the water. This means that the water level in River Ngono can get as high as 7 meters above the current water level.



FIGURE 14: THE CLEAR (LOW-SEDIMENT LOAD) WATER OF NGONO RIVER AS SEEN AT THE BRIDGE OF THE KYAKA-BUKOBA ROAD (PHOTO LEFT) AND THE BRIDGE CROSSING NGONO RIVER FURTHER DOWNSTREAM (PHOTO RIGHT). LEFT PHOTO TAKEN ON 24 APRIL 2019 AT LAT: 1°14'21.88"S/ LON: 31°35'45.58"E; RIGHT PHOTO TAKEN ON 25 APRIL 2019 AT LAT: 1°12'26.16"S/ LON: 31°36'43.47"E.

River Ngono has an average monthly flow of 22 m3/s, with a minimum daily flow of 5 m3/s and a maximum daily flow of 106 m3/s and runoff coefficient of 0.12-0.15, (Kagera River Basin Monograph, 2008). Seasonal swamps exist along the middle reaches of the River Ngono, and have an important role for water quality improvement of the wetland. The buffering capacity of wetlands has been studied using a model called DUFLOW which describes the cycling of nutrients and fate of behaviour of heavy metals in wetlands (LVEMP, Vol 1 & 2, 2001). The study revealed that Ngono wetland has a retention capacity of 50-80% for suspended solids and total phosphorus, and 40-60% for total nitrogen. The water of River Ngono is very clear compared to the River Kagera (Figure 17).

River Bukoola

The 70 km long River Bukoola is an ungauged perennial river flowing from west to east through the southern part of Uganda feeding the Sango Bay and Lake Victoria ecosystems. At its origin in Rakai District it is known as River Kibaale until it reaches the Sango Bay - Minziro wetland system.

During the field visit on 26 April 2019 the River Bukoola was visited at the Kyotera-Mutukula road (Figure 15) on the edge of the Sango Bay - Minziro wetland system, where the discharge was estimated to be around 0.05 (± 0.02) m3/s. Here, the water smells and the riverbed is very muddy, which is the result of human activities further upstream. After passing through the papyrus swamps of Sango Bay-Minziro Wetland, the discharge increases and the water becomes clearer, as could be seen further downstream at the bridge of the road to Kasensero (Figure 8). Here the discharge was significantly higher and estimated to be around 0.5 (± 0.2) m3/s. According to the District Water Officer, the bridge had been flooded only once, around 20 years ago.

River Bukoola is reported to be heavily under pressure of encroachment and over-degradation that has led to severe siltation of the river and lowering of the water table. A river rehabilitation and management project was initiated in 2007, aiming to restore the river banks (Explainer 1).





FIGURE 15: RIVER BUKOOLA FLOWING UNDERNEATH THE BRIDGE OF THE ROAD TO KASENSERO (PHOTO LEFT) AND THE WIDE PAPYRUS SWAMP ALONGSIDE RIVER BUKOOLA AS SEEN FROM THE KYOTERA-MUTUKULA ROAD LOOKING IN WESTERN DIRECTION. BOTH PHOTOS TAKEN ON 26 APRIL 2019 AT LAT: 0°53'57.00"S / LON: 31°34'58.27"E (PHOTO LEFT) AND AT LAT: 0°50'33.07"S / LON: 31°29'18.57"E (PHOTO RIGHT).

Explainer 1 - The Integrated Rehabilitation and Management of the Bukoola River Project

River Bukoola has for decades served a significant role to the local people as a source of water, fish and pasture for animals, but since 2000 many farmers have encroached on the river banks in search for fertile land for cultivation. In recent years its water levels have drastically dwindled due to indiscriminate destruction of its banks through tree cutting, uncontrolled grazing, river bank degradation and land degradation. The river has suffered the effects of siltation causing some parts to dry up, thus posing a great danger to the local population and the ecosystems. The over-degradation of River Bukoola and its water catchment has led to a significant change in the course of the river. An estimated 90% of River Bukoola is on the verge of depletion after encroachers destroyed its banks.

The Integrated Rehabilitation and Management of the Bukoola River Project was initiated by the Nature Palace Foundation to enhance the adaptability capacity of local communities and the environmental sustainability of Lake Victoria and Sango Bay, a wetland of international importance, through river banks rehabilitation using a riverbank rehabilitation and food security improvement model. This uses documentation, continuous education and environmental advocacy (through a video documentary, education and advocacy materials and environment education for sustainable development); and the Clean Up and Fix Up campaigns which are annual events organised for awareness and advocacy on issues to do with environmental protection and climate change, and activities involving physical removal of wastes, filling sand pits and planting trees.

In this second phase of the project, the aim is to build the adaptation capacity of local communities in the climate-change-prone region while ensuring environmental sustainability in the wider context of enhancing the contribution of Sango Bay Wetland to climate change mitigation. Project activities included awareness-creation about the importance of the wetlands, the impacts of climate change and community adaptation strategies.
http://apeuk.org/bukoola-river-project/

In 2007, the National Environment Management Authority (NEMA) destroyed two acres of crops planted on the banks of River Bukoola in Rakai District during a river bank restoration campaign in the district. The Environment Act demands that farmers should not cultivate within 200 metres of the river banks.
https://ugandaradionetwork.com/story/nema-destroys-crops-along-river-bank-in-rakai

In 2012, the water levels were reported to have increased a lot. The Falls are back and according to the community, they expect more water. The water at the Mutukula bridge is dirty an indicator of mud but at the Kasensero point its clean.
http://apeuk.org/bukoola-river-project/

However, also in 2012 environmentalists accused Rakai district leaders and the Water Minister of sabotaging and frustrating their campaign to restore and reclaim destroyed wetlands in the district. The Rakai district environment authorities had issued their last ultimatum beyond which a forceful eviction would be carried out to remove an estimated 15,000 residents encroaching on a number of wetlands in the district. Some of the encroached wetlands include Sango Bay, Lake Kijanebarora, Lake Kacheera, and River Bukoola among others. The forceful eviction was meant to give way for reclamation of destroyed wetlands in the district starting with the 70km long River Bukoola.
https://ugandaradionetwork.net/story/official-rakai-politicians-frustrating-eviction-of-wetland-encroachers

River Kisoma

River Kisoma is a seasonal river in Uganda flowing eastwards into the Sango Bay - Minziro wetland landscape. During the field visit on 26 April 2019 at the bridge of the Kyotera-Mutukula road the water was found to be stagnant. The culvert of the road is 2x2 m, indicating that during rainy season a significant amount of water is flowing in River Kisoma.

Lake Victoria

The Lake Victoria water level changes are directly translated in a rise or fall of fringing wetland water levels changes. These lake changes are primarily the result of differences in rainfall; for the total Lake level rainfall constitutes about 100 x 106 m3, as compared to 18 x 106 m3 from inflowing rivers (River Kagera Basin Monograph, 2009). Up to date measurements of the Lake Victoria water level (USDA, 2019) show height variations of the water level of maximum 2 meters over the period 1992 - 2019 (Figure 16). The water level show a seasonal pattern, with a general reducing trend from 1992 - 2007 and a general increase in water level for 2007 - 2019. This means that water levels in the Sango Bay - Minziro wetland also has been increasing slightly (+ 1.5 m) over the past 12 years.

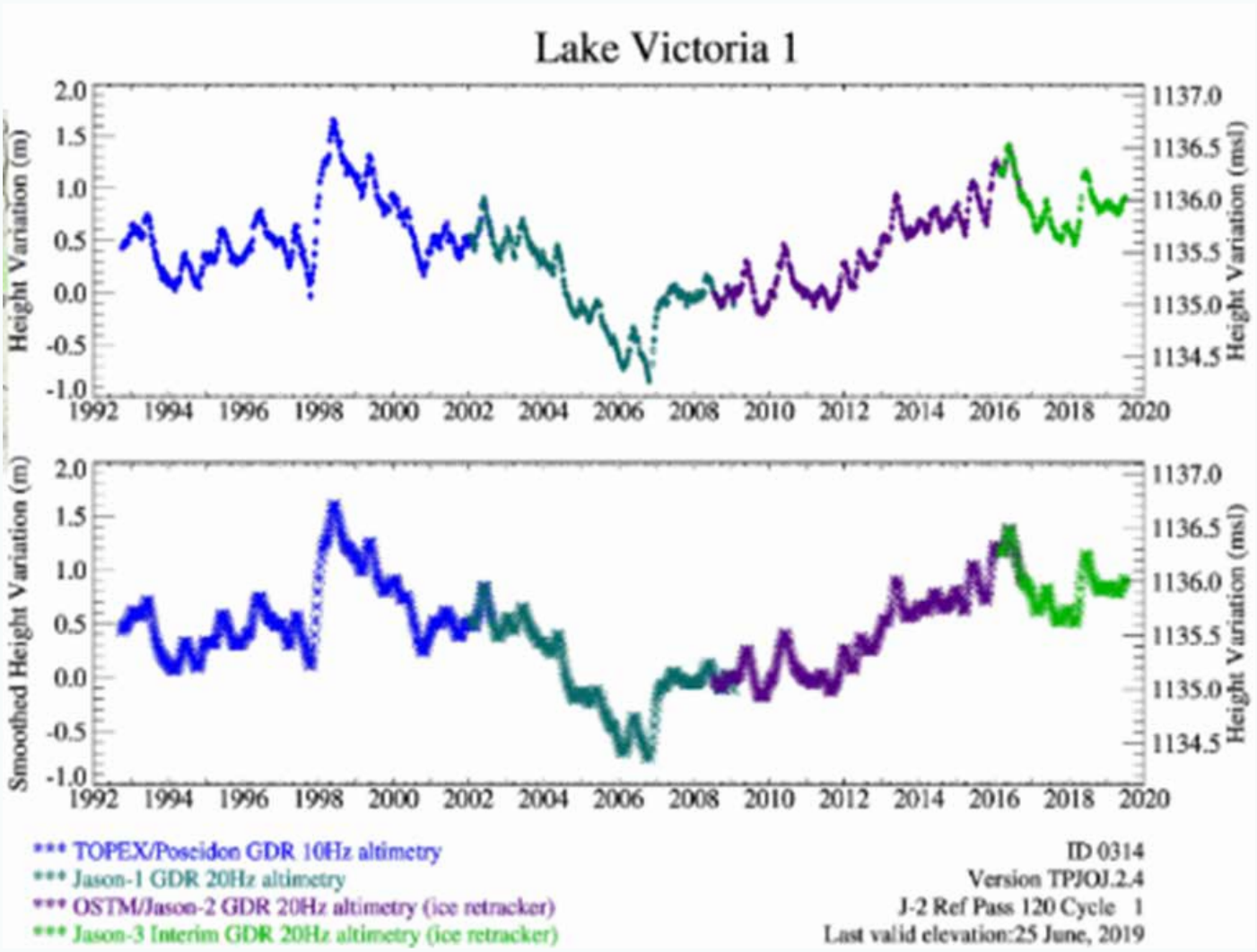


FIGURE 16: RELATIVE LAKE HEIGHT VARIATIONS IN LAKE VICTORIA OVER THE PERIOD 1992 - 2019 (USDA, 2019)

2.3.3 Ground water

Groundwater resources can be found in the Precambrian crystalline basement rocks when weathered and/or fractured. These aquifers generally have low permeability and low storage and no boreholes are known within Sango Bay-Minziro wetland landscape to penetrate into the basement rock. The thick layers of consolidated sedimentary rocks that cover the basement rocks can store big volumes of groundwater. Often springs can be found on the slope or the foot of these sandstone ridges, like 'Bwenoni spring' (Figure 6).

The Sango Bay Minziro wetland area consists of tens to hundreds of meters of alluvial unconsolidated deposits, with medium to high groundwater potential. The alluvial infills and lacustrine deposits produce an almost continuous aquifer, whereas the yield depends on the transmissivity of the sediments. Coarse grained fluvial beds within the lacustrine deposits present the best yields. Typical sustainable yields are expected to be in the range of 0.5 to 6.0 m3/hr.

Due to the overall high permeability, surface runoff is relatively limited and a significant part of precipitation infiltrates in the soils recharging groundwater. Most of the flat areas below 1,150 m amsl consist of grass plains that are subject to seasonal inundation during the wet months of October-November and March-May. This seasonal inundation is due to a combination of heavy rains that make the groundwater table rise above the ground level; followed by high water levels in River Kagera that makes it impossible to drain the area.

Generally groundwater flow is significant. Only the flat Kagera floodplain dictates that the hydraulic gradient within the valley bottom is gentle and consequently groundwater flow here is low, even during the rainy season. During the field mission of April 2019, the groundwater table could only be measured in one non-functional protected well in which the handpump was removed. Here (Appendix C - waypoint 444) at an elevation of 1147 m amsl a static groundwater level of 0,58 m bgl (1,03 m below rim) was measured.

According to anecdotal evidence, springs use to provide water year-round and no boreholes running dry have been reported. The participants in the District level meeting in Sango Bay (Wetlands International 2019c) identified a "Reduction in wetland water level due to unsustainable abstraction of water for various uses by domestic and agricultural use" as a challenge. Unfortunately, no measurements of groundwater level are available to confirm these observations.

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 Kagera and ultimately Lake Victoria are the final recipient of human and municipal wastes and eroded soils from natural and human-initiated processes within the Kagera river basin, and hence are vulnerable to contamination. The general water quality within Sango Bay-Minziro is overall good, especially the groundwater resources which are less vulnerable to contamination than surface water.

During the field visit in April 2019, field measurements of water quality were performed at various rivers, streams, lakes, springs and boreholes throughout the Sango Bay-Minziro 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 Sango Bay Minziro

Type	Name	Latitude (UTM)	Longitude (UTM)	Date	EC (µS/cm)	T (°C)	NO_3 (mg/l)	Turbidity (NTU)
River (perennial)	Ngono river	0343790	9862966	24/04/2019	17,1	22,4	<5	<5
Borehole (handpump)	Bugorora Primary School	0340728	9864643	24/04/2019	63,5	24,3	<5	<5
River (perennial)	Kagera river	0324038	9861714	24/04/2019	133,2	23,1	<5	80-95
River (perennial)	Ngono river	0345578	9866521	25/04/2019	16,8	22,5	<5	<5
Spring (protected)	Ruzinga town	0351260	9878452	25/04/2019	50,0	22,5	10	<5
Stream (seasonal)	Buyango stream	0349527	9872711	25/04/2019	12,8	19,9	<5	<5
Stream (seasonal)	Chabazaire	0355328	9866271	25/04/2019	47,5	23,6	5	<5
Lake	Lake Victoria - Kabindi Landing Site	0365102	9889485	25/04/2019	101,7	28,8	<5	<5
Stream (perennial)	Kishaba	0360839	9882071	25/04/2019	28,7	21,6	<5	<5
Swamp (perennial)	Kadia swamp	0359116	9864493	25/04/2019	13,6	24,3	<5	<5
Spring (unprotected)	Bwenoni spring	0360952	9860733	25/04/2019	12,6	22,6	<5	<5
River (seasonal)	River Kisoma	0336679	9924835	26/04/2019	292,0	18,5	<5	<5
River (perennial)	River Bukoola (Kibaale)	0342310	9900584	26/04/2019	370,0	18,8	<5	<5
Borehole (handpump)	Mutegombura village	0349934	9897841	26/04/2019	43,7	23,5	35	<5
Borehole (handpump)	Kibumbe village	0353567	9895556	26/04/2019	148,3	23,3	<5	<5
River (perennial)	River Kagera	0362426	9896104	26/04/2019	155,3	22,6	<5	75-90
Spring (protected)	Ssekaningo Forest Reserve Production spring	0359113	9900260	26/04/2019	33,9	22,1	5 to 10	<5
Lake	Lake Victoria – Kyabasimba Landing Site	0362616	9903230	26/04/2019	105,0	24,7	5	<5
Borehole (handpump)	Mirugwe village	0356422	9898132	26/04/2019	57,9	25,0	<5	<5
Shallow well (handpump)	Kasuli village / Kasuli forest	0354529	9895695	26/04/2019	31,4	23,4	<5	<5
Spring (protected)	Buvango village	0331275	9913175	27/04/2019	47,5	23,8	5	<5
River (perennial)	River Bukoola (Kibaale)	0331806	9906844	27/04/2019	436,0	21,6	<5	<5

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

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 Kagera River has a high sediment load, indicated by measurements of turbidity as proxy, which was measured at 75-90 NTU on 26 April 2019 near the river mouth (crossing near Kasensero fishing village) and at 80-95 NTU on 24 April 2019 at the Kyaka bridge. Once this water flows into Lake Victoria, the sediment load settles down due to the reduction in flow velocity. The turbidity (as indicative proxy for sediment load) in Lake Victoria is therefore much lower, and was measured to be <5 NTU on 25 April 2019, at Kashenye sub-county. The expansion and shifting of the shoreline at River Kagera (Figure 13) is due to increased siltation of Lake Victoria as a result of the deposition of the sediment load of River Kagera.

The siltation of Kagera River 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 the delta of Kagera River and Lake Victoria 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 at the river mouth of Kagera.

The high sediment load in River Kagera is mainly coming from areas in Rwanda and Burundi far upstream in the river catchment. Other rivers in Sango Bay-Minziro wetland landscape have a much lower sediment load (turbidity, used as indicative proxy for sediment load, was measured <5 NTU in River Ngono and River Bukoola), of which a striking example can be seen on satellite imagery at the confluence of River Ngono and River Kagera (Figure 17).



FIGURE 17: GOOGLE EARTH SATELLITE IMAGE CLEARLY SHOWING THE HIGH SEDIMENT LOAD IN RIVER KAGERA, COMPARED TO RIVER NGONO AS SEEN HERE AT ITS CONFLUENCE (LAT: 1° 7'24.85"S / LON: 31°35'33.88"E)

The participants in the District level meeting in Sango Bay (Wetlands International 2019b) identified "Increased water pollution of the wetland waters" as a challenge. Unfortunately, no measurements of long term detailed measurements of water quality are available to confirm these observations.

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 Missenyi and Kyotera Districts is very susceptible to faecal contamination. Because of inadequate sanitation and low latrine coverage in Sango Bay Minziro, open defecation is a common practise where sanitation infrastructure and services are not available, which is especially the case in the landing sites along the Lake Victoria 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 diarrhoea.

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 NO3-) was measured at several water points using test strips as indicator for faecal contamination.

Field measurements (Table 1) show that nitrate concentrations in groundwater are found to be generally low in the range of 0-10 mg/l. The highest concentration of NO3 was measured at 35 mg/l in a borehole in Mutegombura village. This concentration is above 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. 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 contaminators 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

Chemical fertilizers, pesticides, herbicides among others are used on a limited scale, but unregulated, killing living organisms in the soil, water pollution, loss of soil fertility among others leading to environmental degradation. The quantities of pesticide and fertilizers which are being washed into the River Kagera and Lake Victoria system are expected to increase due to agricultural development and the high population growth rate within the River Kagera catchment.

Domestic waste

Contamination of surface water with domestic waste takes place in fishing villages and landing sites on the Lake Victoria shore as well as urban settlements on or close to water courses 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.

Iron

According to anecdotal evidence, the groundwater can have a high iron content, especially in Koochi county, Rakai District. High concentrations of iron in drinking water are not directly of health concern, but might be problematic in terms of bad taste, giving stains (washing) and/or clogging of pipes. In the few well completion reports provided by the district water officers of Missenyi and Kyotera, no concentrations of iron above national standards were found.

No 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. No signs of harmful mining activities were encountered during the field mission or reported during the community and district level meetings (see meeting reports Wetlands International 2019b and 2019c).

Low salt content

The electrical conductivity measured in the groundwater in the Sango Bay – Minziro wetland landscape was low to very low (range: 10 – 150 µS/cm; Table 1). No issues with 'salty groundwater' were reported during the community and district level meetings (see meeting reports Wetlands International 2019b and 2019c). This is very different from the other wetland landscape areas (see Monograph Semliki Delta and Monograph Sio-Siteko).

2.3.5 Hydrological functions of the wetland system

The Sango Bay-Minziro wetland landscape plays an important role by supporting ecosystem processes and regulating the dynamics of the hydrological system for the waters entering Lake Victoria. It is therefore considered to provide a vital service. The Sango Bay-Minziro wetland landscape includes permanent and seasonal swamp-forests, papyrus swamps, herbaceous swamps interspersed with palms and seasonally flooded grasslands, which is influenced by the River Kagera floodplain.

Most of the area is drained by several streams flowing into the Kagera, Bukoola, Kisoma and Ngono Rivers, whose waters ultimately end up in Lake Victoria. Most of the wetland landscape is low-lying and flat and large areas are regularly inundated by rising groundwater table in combination with high water levels in River Kagera. It is thus an important ecological component of the floodplain ecosystem, regulating the flow of water through the river system. Forests, grasslands and wetlands serve to store and purify water, facilitate groundwater recharge, mitigate and control floods, protect against erosion and stabilize the lake shoreline. During the dry season, the system maintains a steady discharge of water stored in the natural ecosystem and supplements the water supply to the surrounding areas.

A number of land uses such as crop and livestock farming generate run off, which in addition to high sediment loads has residues of agrochemicals and acaricides from crop and livestock farming. The Sango Bay-Minziro wetland system also plays an important role in trapping the sediments and effluents from surrounding catchments; and hence reduces the level of sediments carried to Lake Victoria, thereby helping to maintain the natural clean water conditions important for the survival of fish and many other aquatic living organisms in the lake. The forests and wetlands also help to control the speed of the water flowing along the streams and rivers that flow into Lake Victoria, therefore helping to manage flooding.

The Sango Bay-Minziro wetland landscape is receiving a lot of water during the long rains in mid-March to May, resulting in a rise of the groundwater table, especially in the flat lowlands that surrounds the Kagera flood plain. This is followed by a peak flow in River Kagera, normally during the months June-August which, despite being a relative small rise in water level, avoids the flat lowlands to drain the excessive amount of rainwater received in the months before. As a result, the seasonal flooding often results in several feet of water covering the floor of most of the low lying landscape of the Sango Bay-Minziro wetlands during a period of four to eight months. The seasonal flooding in most of the areas, which alters the conditions within the forest and affects much of the ground dwelling flora and fauna. The resident flora and fauna that occur in Sango Bay and Minziro are thus comprised of unique assemblages of species which are tolerant to such extreme conditions.

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 downstream part of River Kagera plain, 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 catchments of the rivers Kagera, Ngono, Bukoola and Kisoma determine what the effects of climate change are on the water resources, food security and wetlands services in the Sango Bay-Minziro study area. Hence, this paragraph assesses the climate and climate change within the wider region.

2.4.1 Current climate

The wider area of Sango Bay-Minziro 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 800 mm to 2,000 mm, generally falling in two seasons (March to May and September to November). Average daily temperature is around 28 ºC, but varies with altitude. 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. The effects of the ITCZ are considerably altered by the presence of Lake Victoria. 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 ºC per decade over de 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

Global climate change projections downscaled to Uganda and the surroundings predict potentially large changes in precipitation between 2015 and 2045 (Semazzi 2005), as shown in Figure 18. For example, in northern Uganda rainfall is expected to increase, while precipitation is expected to decrease in northern Tanzania. Overall, rainfall in the Kagera basin is expected to decrease slightly. However, in the study area, the decrease is expected to be more significant. Results of CMIP-5 (Taylor et al. 2012) give insight into the potential changes in rainfall by month. These results indicate that overall precipitation totals are not expected to change significantly by 2050, though precipitation may increase by 5–8% in November–February (Figure 19). In the dry season, the uncertainty is low and all models predict that precipitation will not change significantly. In the wet seasons, and November in particular, the uncertainty is larger, and different models predict a range from a 20% decrease to a 40% increase in precipitation.

Figure 18: Projected changes in annual rainfall (blue is decrease, red is increase) due to climate change across Uganda, with the location of Sango Bay-Minziro indicated with a black star.

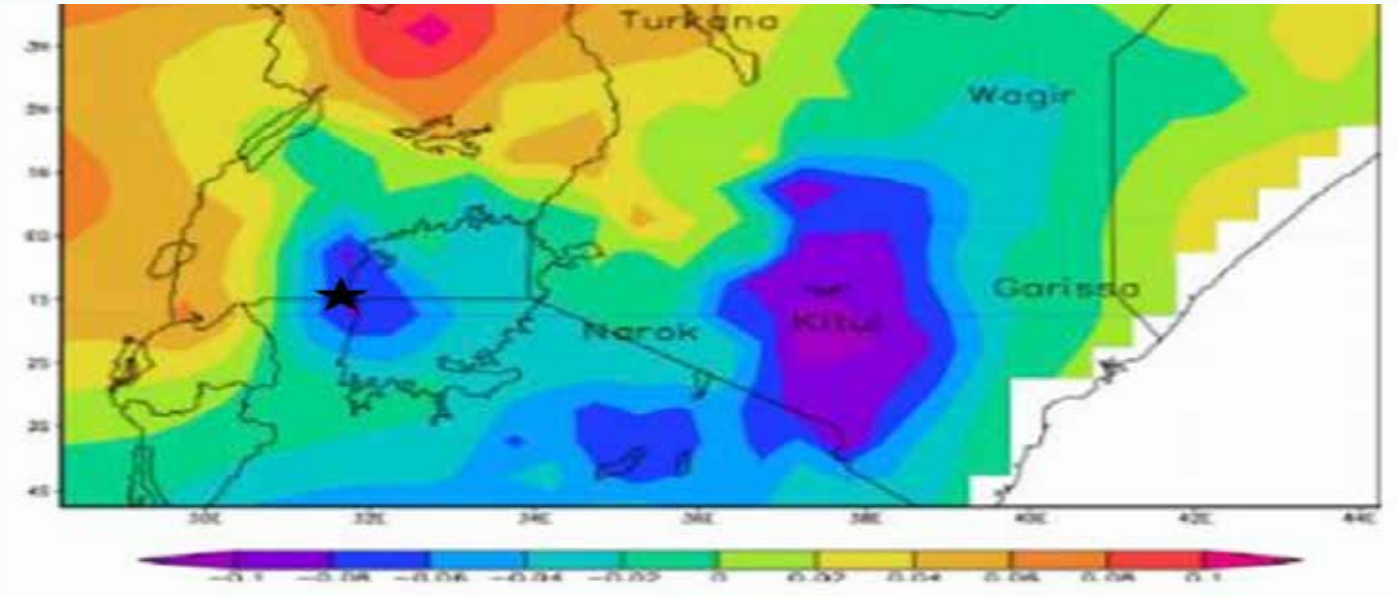


Figure 18: Projected changes in annual rainfall (blue is decrease, red is increase) due to climate change across Uganda, with the location of Sango Bay-Minziro indicated with a black star.

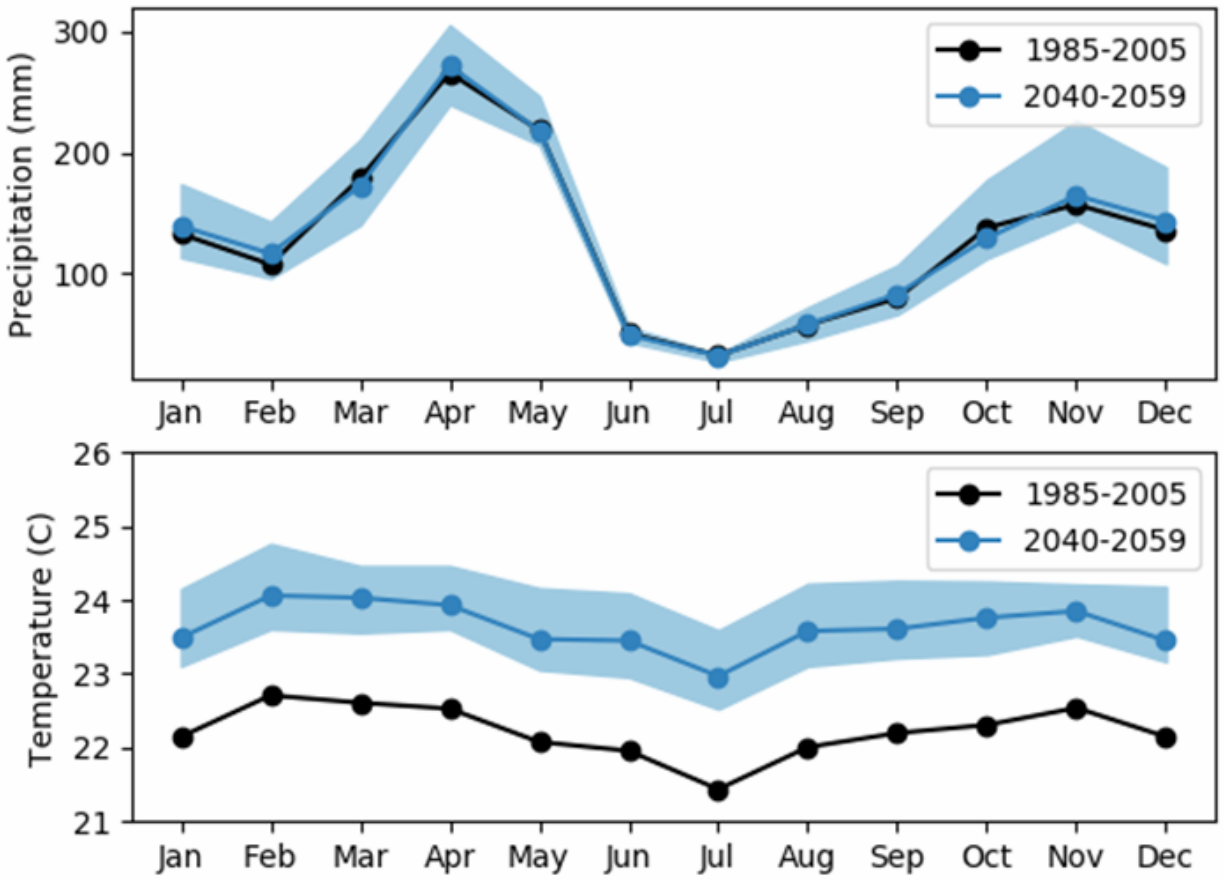


FIGURE 19: HISTORICAL MONTHLY PRECIPITATION AND MONTHLY AVERAGE TEMPERATURE FOR THE PERIOD 1985 - 2005 AND FOR THE RCP4.5 CLIMATE SCENARIO CONSIDERING THE PERIOD 2040-2059. THE BLUE LINE SHOWS THE MODEL ENSEMBLE MEDIAN, THE SHADED AREA SHOWS THE 10TH - 90TH PERCENTILES OF THE MODEL ENSEMBLE (N=35).

Warming and extreme events

The temperature is projected to increase by about 1.5 °C by 2050 (Figure 19) based on the results of the CMIP-5 experiment (Taylor et al. 2012) , though some models predict temperature increases of more than 1.5 °C. These projections are in line with the observed warming trend. The warming is projected to be more intense in the slightly cooler period between May and August, and slightly less intense in November. 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 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 Sango Bay-Minziro (see community level meeting report; Wetlands International 2019b).

2.2.4 Effects of climate change

Water resources

Water resources are likely to be increasingly strained in the future climate of the wider Sango Bay-Minziro area. While it is projected that the total rainfall will increase, warmer temperatures will accelerate evapotranspiration, reducing the benefits of increased rainfall. With more frequent and severe droughts, the River Kagera basin will likely experience negative impacts on water supply and biodiversity. 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.

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 Sango Bay-Minziro. The expected increase in

rain during the dry season (June-September and December-mid March) 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 in the Sango Bay-Minziro wetland system.

Wetlands

Climate change may affect the health of the wetland and forest ecosystems of Sango Bay-Minziro, which provide critical ecosystem (and economic) services for the surrounding communities. Wetlands are 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. Especially the temporarily flooded groundwater forests of Sango Bay-Minziro are extremely sensitive to decreasing surface water and ground water levels. Longer term (per annual) influence of the Lake Victoria water level change on the fringing wetlands can cause permanent wetlands to become seasonal wetlands, and vice-versa.

Therefore, climate change will likely cause the loss of, or reduction in, the total wetland area of Sango Bay-Minziro 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 Tanzania ranks slightly higher as 147 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 widespread poverty (the Multidimensional Poverty Index is high, with 55% of the population in Tanzania and Uganda is in multidimensional poverty; UNDP 2019b), low rural incomes, lack of income diversity and heavy dependence on rainfed-agriculture, the Sango Bay-Minziro wetland area and its people are very vulnerable to climate change. High population growth rate (2.04% per year, Table 19) 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 Sango Bay Minziro 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 2.5-6.0 billion tonnes of organic carbon. The Kagera basin is estimated to contain more than 50% of all peatlands in the Nile Equatorial Lakes region, with possibly containing more than 70% of its total carbon stock (1.8-4.2 billion tonnes or organic carbon). This does include the upstream areas of the Kagera river, where thick peat layers are encountered in Burundi, Rwanda and southwest Uganda (Elsehawi et al. 2019).

Figure 20 puts the total amount of carbon in the Sango Bay area peatlands around 0.25 billion tonnes. Although currently, the emissions from Sango Bay-Minziro are lower than average emissions across the Nile Equatorial Lakes region, accelerating land-use change under the business-as-usual scenario are observed, giving cause for alarm (Elsehawi et al. 2019).

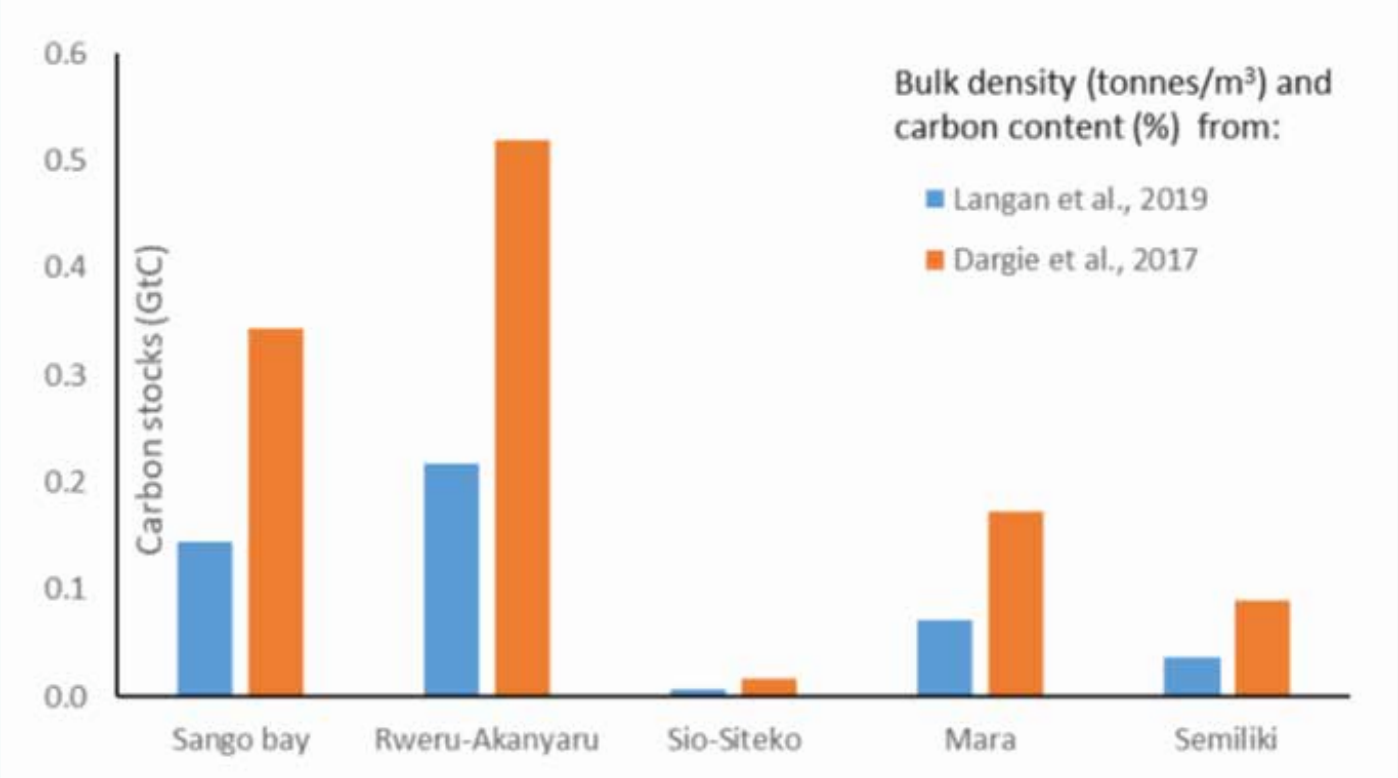


FIGURE 20: CARBON STOCKS (IN GIGATONNES OF CARBON) OF SOME OF THE TRANSBOUNDARY WETLANDS IN THE NILE BASIN (ELSEHAWI ET AL. 2019).

Globally, the draining of peatlands emit about 2 giga tonnes of CO_2, which amounts to ~5 % of the global CO_2 emissions. In Uganda, CO_2 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 Sango Bay-Minziro project area mainly consists of grasslands (42%) and forests (35%), with some cropland (14%) in the northern part. Cropland and built-up area are more common in the northern part of the project area where villages and towns are located on higher ground. The largest towns within the study area are Kyotera and Kalisizo. 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 of Appendix A and summarized 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.



FIGURE 17: OVERVIEW OF THE SANGO BAY-MINZIRO WETLAND LANDSCAPE, WITH VISIBLE PATCHES OF GROUNDWATER FOREST SURROUNDED BY GRASSLAND.

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

Land cover	Coverage (%)
Trees*	35.2
Shrubs	4.7
Grassland	42.4
Cropland	13.9
Aquatic/regularly flooded	0.1
Bare	0.1
Built up	0.2
Water	3.2

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

Different wetland types

Several wetland types are included within the Sango Bay-Minziro landscape (Appendix A - Wetland Map), covering a total of more than 1500 km2 (Table 3), or more than half of the study area. Some of these wetlands are classified as forests or grassland in the land cover map of the CCI land cover programme. The similarities and differences between the land cover and wetlands data sets are explained in Explainer 2.

The River Kagera is bordered by permanently flooded wetlands, consisting of papyrus swamps and other herbaceous vegetation. A unique feature of the landscape is the groundwater forest in the southwest of the project area. This area of about 400 km2 is seasonally flooded as a result of high groundwater levels. Despite the proximity to the River Kagera, river water is not responsible for flooding in the forest areas. In the northern part of the project area, the wetlands include papyrus swamps and are largely herbaceous with scattered trees and shrubs (see Figure 23). These wetlands can also contain floating islands of water hyacinth and floating grass. Most of the area is temporarily flooded, but sections closer to Lake Victoria are flooded permanently.



FIGURE 18: TYPICAL WETLAND LANDSCAPES OF PAPYRUS SWAMP (LEFT) AND GRASSY WETLAND AREAS (RIGHT)

TABLE 3: OVERVIEW OF THE AREAL COVERAGE OF DIFFERENT WETLAND TYPES IN THE SANGO BAY - MINZIRO STUDY AREA

Wetland type	Area (km²)
Groundwater forest, temporarily flooded	401
Shrubs and woody vegetation, temporarily flooded	83
Shrubs and woody vegetation, permanently flooded	1
Grass with sparse trees, temporarily flooded	816
Grass with sparse trees, permanently flooded	131
Grass and papyrus floodplain, permanently flooded	110
Total	**1542**

The land use within the project area varies with the land cover and the seasons. Small holder agriculture is a common activity in the floodplains and wetland areas, especially during the dry season when these areas have more available moisture than more elevated locations. Intercropping of bananas with coffee and other crops is a common farming method (USAID, 2016). Despite the potential for irrigation, most of the agriculture is rainfed. Grazing is another common land use, as the project area is situated in the "cattle corridor" of Uganda, and herds can contain as many as 1000 animals. Grazing activities are especially important during the dry season, when cattle from neighbouring districts where grazing grass has disappeared are moved to the Sango Bay-Minziro area (USAID 2016). Various products are also collected from the natural forest and wetland areas. These products include game meat and wild vegetables and mushrooms for food, medicinal plants, firewood, wood for construction, and papyrus and grasses for crafts.

The project area also includes several protected areas. The largest of these is the Ugandan Ramsar site Sango Bay-Musambwa Island-Kagera Wetland System (SAMUKA). However, there are extensive forest reserves such as the contiguous Malabigambo and Kaiso forests and the Minziro Forest Nature Reserve. In addition, there are several smaller protected areas (Appendix A – Protected areas map).

Wetland encroachment and wetland degradation

The land use in the area has changed over recent decades. A rapidly growing population has led to a sharp increase in agricultural land and residential areas, for example extra housing developments around Kanyigo town. In fact, data from the European Space Agency CCI Land Cover programme indicate that built up area more than tripled between 1995 and 2015 (ESA CCI Land cover 2017). The demand for land is the main driver of the large-scale deforestation in the project area, along with increasing demand for firewood. Increasingly, settlements and croplands are located on steep slopes, which increases the risk of landslides and erosion. Rice is becoming more important after a project to promote its production was implemented, and commercial farming of sugarcane is also on the rise. Both crops are commonly cultivated within the wetland areas, resulting in encroachment. Finally, residents also report that agricultural productivity in the croplands has decreased as a result of poor farming practices, leading people to turn to other activities such as fishing and the harvesting of natural forest and wetland products. However, 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).

Encroachment is also taking place along River Kagera, with more and more informal settlements of one or several huts and agricultural plots being found inside protected area along the river banks (Figure 21).



Figure 21: Encroachment of communities into natural areas along Kagera River, with the white circles indicating informal settlements of two or more huts, sometimes accompanied with agricultural fields, as can be seen on satellite imagery from Google Earth (imagery date 01/09/2018).

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 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 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.

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 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 Sango Bay-Minziro landscape, the groundwater forest in the AFcover dataset is mainly classified as tree cover in the land cover dataset. The grass with sparse trees wetland type is classified as a patchwork of mainly grassland with patches of trees and cropland, while the grass and papyrus floodplains are largely classified as grasslands with scattered trees. The scattered croplands may even be evidence of wetland encroachment. The largest discrepancy is observed in the wetland vegetation types characterized by shrubs. In these areas, the land cover map only shows scattered shrubland. Nevertheless, the general spatial patterns suggested by the AFcover wetland type are largely consistent with the vegetation type of the land cover map, despite the fact that the land cover dataset does not recognize them to be wetlands.

3.1 BIODIVERSITY

3.1.1 Bio-geographical significance of Sango Bay and Minziro areas

The Sango Bay and Minziro areas are situated predominantly in the Lake Victoria Regional Mosaic and are considered to be of high bio-geographic importance; because they are located in the transition zone between the East and West African vegetation zones. The Sango Bay and Minziro area therefore have peculiar features and have rich biodiversity due to their bio-geographical ecotone location in the Guinea-Congolian biome. This has made forests in the Sango Bay-Minziro area to have characteristic plants and animals similar to those in forests found in the areas covered by the characteristic special areas such as the Congo and Guinea; that reach their eastern range limits within the Sango Bay and Minziro area. Most studies of plants and animals have given evidence that the Sango Bay area therefore qualifies as a Pleistocene refugium of the Guinea-Congo lowland forests (Davenport and Howard, 996; Kasoma and Pomeroy, 1996; Bakamwesiga, 2000; Byaruhanga, 2002).

Sango Bay is connected with Musambwa Island-Kagera Wetland System (SAMUKA) in Masaka and Kyotera Districts. The Sango Bay–Minziro Ecosystem is a large, biologically rich, transboundary wetland that expands across the wetland system in southwest Uganda (SAMUKA; 55,100 hectares) and the Minziro National Forest Reserve (MNFR; 25,700 hectares) in northwest Tanzania. SAMUKA is a Ramsar site no. 1641 (RAMSAR, 2006) and an Important Bird Area (IBA). A mosaic of wetland types including the biggest tract of swamp forest in Uganda, papyrus swamps, herbaceous swamps interspersed with palms and seasonally flooded grasslands, sandy, rocky and forest shores, and three rocky islets about 3 km offshore in the Sango Bay. It 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 including luxurious sofa chairs and mattresses. The site contains Stone Age artefacts, internationally known as the Sangoan industry, which dates to about 130,000 to 10,000 years ago (Hoover 1974).

The Sango Bay–Minziro Forest Ecosystem is a large, biologically rich, wetland, which is home to rare and endemic flora and fauna. In sections below a summary is given of the most striking biodiversity features. A full overview of all species in the landscape is included in Appendix C – Species of Sango Bay-Minziro.

3.1.2 Biodiversity assessments of Sango Bay-Minziro

Several important biodiversity surveys have been conducted in the Sango Bay-Minziro area over the past years. These include:

- the wetland inventory done in 1994 for the Important Bird Area study;
- the surveys on distribution of amphibians and reptiles by Kasoma and Pomeroy in 1996;
- the GEF project 1997 document based on results from Davenport and Howard (1996)
- the study on dragonflies by Eyang (1998)
- the Blue Swallow survey in May 2001;
- the survey of herpetofauna of Musambwa Island in 2000 by Behangana in 2001;
- the survey on butterflies by Asasira (2003)
- the surveys for small mammals of Minziro Forest by Staley and Foley (2008)
- the general studies of the habitats of the area by Kaggwa (1995) and Akite (2008)
- the recent surveys on the taxa from Environmental Impact Assessments in the area in locations of Bethlehem, Bukalasa, Luanda, Kasoga, Kawenda river, Kabale river, Bukola and the airstrip ponds in Lukoma,
- the Rapid Assessment of biodiversity and conservation status of Minziro NFR by Martin and Rovero 2017-2019, and
- the biodiversity overview of Plumptre et al. 2019 for Sango Bay-Minziro.
- The Rapid assessment of biodiversity and conservation status of Minziro Forest Nature Reserve, Tanzania, in the context of the "EUREGIO's East Africa Livelihood Improvement Programme 2017-2019". This document compiles separate reports, each describing the results of the different studies conducted for the rapid assessment of biodiversity and conservation status of Minziro Forest Nature Reserve, Tanzania, during October-December 2018. These reports are the following:

o. Community perception and forest disturbance assessment, by E. Martin and F. Rovero (includes a

background to the overall survey)

o. Assessment of mammals, by F. Rovero, S. Shinyambala, A. Perkin and I. Greco.

o. Assessment of birds, by J. John and M. Mbilinyi

o. Assessment of amphibians and reptiles, by J. Lyakurwa, S. Loader, L. Pereira-da-Conceicoa, M. Menegon

Anecdotal information on mammals and birds occurrence exists and is registered and was obtained amongst others from http://datazone.birdlife.org/site/factsheet/7053/text.

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 times species counts and the sectioned transect method. 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. 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.

3.1.3 Plants

Being at the transition zone, Sango Bay and Minziro ecosystems are home to rare and endemic forest swamp tree species, several of which are known to be relics of the Albertine Rift. Examples are Pseudagrostistachys ugandensis, a grass not known elsewhere in Uganda, and Podocarpus usambaransis vardawei, an endemic variety, albeit the latter has been virtually wiped out due to intensified logging. Wild coffee (coffea canephora) is considered rare but found in several locations in Minziro (Nalwanga, 2019). Medicinal trees, such as Phoenix fricana , Prunus Africana, Rytigynia beniensis, “Omunyabuliko” and “Olikwatango” are well-known for it valuable ecosystem services by the local communities but increasingly threatened by land degradation in the area. The ecosystem can be classified as a Baikiaea-Podocarpus seasonal swamp forest and is known for having a high biodiversity value. The rich diversity of plant species in the Sango Bay and Minziro ecosystems is mapped 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.

In Sango Bay 410 plant species were identified out of which are 164 tree species (40%), 127 herb species (31%) and 119 shrubs (27%). More than 60% of the three species are habitat specific and were exclusively encountered in forest habitats. Other species occur across several habitat types, such as forest, woodland and grassland. Rhus natalensis is the predominant plant species recorded in all habitat types, except for wetlands. 174 species are reported to be of medicinal value, the majority of these being herbs (49.7%). According to IUCNs red listed species, currently four out of 410 species are threatened, Afrocarpus usambarensis being listed as ‘endangered’ (Namaganda, 2019).

Minziro plant diversity is reflected by the existence of massive bird species in the area. Minziro counts over 600 unique plant species that were identified during the GEF/UNDP East African Crossborders Biodiversity project 1999/2003. Amongst them are some interesting species that have been identified in Tanzania for the first time (Table 4).

	Family	Genus	species
1	Annonaceae	Artabotrys	velutinus
2	Apocynaceae	Baissea	major
3	Begoniaceae	Begonia	eminii
4	Campanulaceae	Lobelia	hartlaubii
5	Euphorbiaceae	Pseudogrostistachys	ugandensis
6	Rubiaceae	Gardenia	vogelii
7	Rubiaceae	Lasianthus	seseensis
8	Commelinaceae	Polyspatha	paniculata
9	Annonaceae	Friesodielsia	enghiana vel sp. Aff.
10	Acanthaceae	Thunbergia	sp. Nov.
11	Sapindaceae	Lychnodiscus	cerospermus var. mortehanii
12	Podocarpaceae	Afrocarpus	dawei
13	Violaceae	Rinorea	oblongifolia

TABLE 4: INTERESTING PLANT SPECIES IN MINZIRO NFR, IDENTIFIED IN TANZANIA FOR THE FIRST TIME (FROM: GEF/UNDP, 1999/2003)

3.1.4 Birds

Birds are among the best indicators for biodiversity. Nalwanga (2019) collated and verified data from existing studies on the presence of birds in the three transboundary wetlands. Brief field visits were conducted to assess the general characteristics and nature of the sites but no surveys were conducted for this study. The available birds data was collected mainly using the Timed Species Counts (Bibby et al. 2000) and the sectioned transect method (Nalwanga et al. 2012). The conservation status was assessed using the IUCN Red List. There are significant data gaps in the data available on birds in the three wetland sites, but the data for Sango Bay is relatively comprehensive. Sango Bay is located within the Ramsar site SAMUKA, which supports huge congregations of waterbirds, hosting an average of 16.5% of the population of Grey-headed Gulls (Larus cirrocephalus).

The total species checklist of the birds of Sango Bay-Minziro is 572, including 14 globally threatened species and one introduced species, the Papyrus Yellow-Warbler Calamonastides gracilirostris. The most abundant bird species in the wetland are the Common bulbul Pycononotus barbatus, followed by the Brown Illadopsis Illadopsis fulvescens, Cameroon Sombre Greenbul Andropadus curvirostris, Little Bee-eater Merops pusillus, Olive Sunbird Cyanomitra olivacea and Red-eyed Dove Streptopelia semitorquata (Nalwanga 2019).

About 300,000 Chlidonias leucopterus were reported by the Wetlands Inventory Team in 1994 as well as large numbers of Ardeola ralloides that occur in the area. Pelecanus onocrotalus roost at the mouth of the River Kagera in several hundreds and small numbers of Pelecanus rufescens occur. A count of 82 Hirundo atrocaerulea was made in May 2001.

The Minziro Nature Forest Reserve (NFR) is home to almost 250 bird species, 56 of which have only ever been seen in Tanzania in Minziro (Nalwanga 2019). The Minziro NFR, have been classified as an Important Bird Area due to the presence of globally threatened species i.e. Forest francolin (Francolinus lathami) and Blue swallow (Hirundo atrocaerulea) species (TFS 2019). Over 300 species of birds have been recorded at Minziro forests and its surrounding habitats on the Tanzanian side by TAWIRI lead studies; the check list is being updated (CAWM 2019). The following 11 species were recorded for the first time at Minziro: European Marsh Harrier, Thick-billed Cuckoo, Common Scimitarbill, Grey Hornbill, Lesser Grey Shrike, Flappet Lark, Buff-bellied Warbler, Banded Parisonma, Western Violet-backed Sunbird, White-winged Widowbird, and, Jameson's Firefinch. Minziro Forest Reserve contains significant number of Guinea-Congo biome restricted bird species (TFS 2019).

3.1.5 Mammals

A recent desk study documented the status of mammals in the wetland landscapes (Martin, 2019) and a total of 93 species of mammals are known for the Sango Bay area. Extensive biodiversity studies were carried out in the past for the Sango Bay area,



FIGURE 22: THE FIRST EVER RECORD OF THE GOLDEN CAT IN TANZANIA, CAPTURED ON A CAMERA TRAP IN MINZIRO FOREST NATURE RESERVE

including extensive assessments for mammals. However, little recent studies have been carried out. The area is well-known for being home to red-tailed monkey, the grey-cheeked mangabey, Thomas's dwarf galago, giant pangolin, western tree hyrax and the African golden cat Caracal aurata (Martin and Rovero 2019). The area hosts globally endangered mammals such as the African Elephant Loxodonta africana, Angola Colobus Colobus angolensis, Cyclops Leaf-nosed Bat Hipposideros Cyclops, Leopard Panthera pardus, Tree Pangolin Manis tricupsis, Hipopotamus Hipopotamus amphibious, Sitatunga Tragelaphus spekei, Northern Swamp Musk Shrew Crocidura maurisca and the near endemic Colobus Monkey (Colobus guereza adolfi-friederici) and a subspecies of the Blue Monkey Cercopithecus mitis doggetti. The Minziro Forest Reserve used to have large mammals regularly seen, including elephants, and is the only locality in Tanzania where the two primates Thomas' galago (Galagoides thomasi) and Grey-cheeked mangabey (Lophocebus albigena) are found in Tanzania (Martin, 2019).

The recent survey conducted on mammals (Rovero et al, 2019) as part of the Rapid Assessment of biodiversity and conservation status of Minziro Forest Nature Reserve, Tanzania (CAWM 2019) had interesting results. A total of 23 mammals were recorded using camera traps. The sitings include several species of antilope, monkeys, the near threatened African Buffalo, fire-footed rope squirrel and the vulnerable tree pangolin and giant pangolin ("scaly anteaters"). In addition, the Golden cat (Caracal aurata, also an IUCN-Vulnerable) was the first ever record in Tanzania (Figure 22), a vulnerable medium-sized felid typical of the tropical rainforest environments, whose population generally belongs to the western part of Africa.

Opportunistic surveys made by arboreal cameras, transects and direct sightings also reported the presence of Western tree hyrax, spotted hyena, cane rat, Thomas' galago, Demidoff's galago, African giant squirrel, and two more squirrel species still to be identified. This all indicates that the area of Sango Bay Minziro is of great importance for biodiversity, and an addition to existing protected areas.

The indicated status for conservation concern in the text above follows the IUCN Red List. In 2016 The Uganda Red List (National Uganda listing based on IUCN guidelines) was published, with different status indicators for endangered species. The 'national list of species of conservation concern' contributes to and guides conservation efforts nationally. Although the majority of the species are globally listed as of Least Concern (LC), at the country level the conservation concern for the majority is of higher levels of concern.

For example, the IUCN red list status of the African Elephant is vulnerable, while critically endangered on the national Uganda listing. Also the hippopotamus and tree pangolin are (critically) endangered according to the National Uganda listing.

3.1.6 Amphibians and reptiles

During the survey of the College of African Wildlife Management Mweka (CAWM) in 2018, a total of 9 amphibian species from 6 families and 14 reptile species from 5 families were recorded. Five different species of snakes and frogs are new records for Tanzania (Figure 23) (Bothrophthalmus lineatus, Limaformosa cf savorgnani, Chiromantis rufescens, Leptopelis chrysti and Hyperolius cf. cinnamomeoventris). The snake Toxicodryas blandingii is reported to occur in Minziro Nature Forest Reserve (MNFR) for the first time. Eleven (48%) of the recorded species are typical guinea-congolian species and occur nowhere else in the Tanzania. This supports other authors who reported the MNFR to harbour large number of unique species in Tanzania.



FIGURE 23: HYPEROLIUS SP (LEFT) AND PSAMMOPHIS SP (RIGHT), PHOTOS FROM CAWM REPORT (2018)

Some extensive data on distribution of amphibians and reptiles (together: herpetofauna) were collected in the Sango Bay – Minziro wetland during the surveys of biodiversity of the Sango Bay area in the 1990's. This study, and recent Environmental Impact Assessments in the area, indicated that the sites with the highest diversity also correspond with habitat diverse wetlands and drier sites being the least diverse.

At that time, all amphibian species in the area were globally and nationally listed as of Least Concern. The exceptions are the Lake Victoria Toad and the frog Phrynobatrachus rouxi (endemic to Uganda). The Galama White-lipped Frog listed globally as of Least Concern (LC) was nationally assessed as Near Threatened (2016). Even more species in the transboundary Ramsar area could be identified with more intensive research and analyses carried out.

A total of 34 reptilian species of four orders (Chelonia, Sauria, Crocodylia and Serpentes), 15 families and 24 genera have been reported in the Sango Bay wetland area of Uganda (Behangana 2019) and are expected to be across the boundary in Tanzania. Sites that were more extensive with multiplicity of habitats ranging from forest, wetlands, grasslands (seasonally flooded and dry), woodlands, etc. tended to show more diversity than the rest. The rarest species recorded only in one site included the chameleon Trieceros ellioti, Lacerta jacksonii, the Egg-eating snake, Red-black striped snake, and the venomous snake Atractaspis irregularis.

Most of the reptile species for the Sango Bay –Minziro wetland area are globally Not Evaluated (NE) and nationally of Least Concern. The exceptions are the Grass-top Skink (nationally Near Threatened NT),

the East African Highland Grass Lizard (nationally NT), Olive Marsh Snake (nationally Data Deficient (DD)), Angola Green Snake and Variable Stiletto Snake (both nationally DD).

3.1.7 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 309 species of butterflies and 61 species of dragonflies have been recorded in the Sango Bay wetland landscape. These include 51 and 7 endangered species of butterflies and dragonflies listed as Vulnerable (VU), Endangered (EN) or Critically Endangered (CR) on the Uganda National Red List (Table 5).

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

		Sango Bay	
	Status	IUCN Red List	Uganda National Red List
BUTTERFLIES	CR	0	7
	EN	0	10
	VU	0	34
DRAGONFLIES	CR	0	0
	EN	0	1
	VU	1	6

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

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 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. Kaggwa (1995) carried out a baseline survey of the butterflies of Sango Bay area. This particular study was revisited by Akite (2008a,b) and there was notable decline in habitat areas over the ten year period.

According to Akite (2019), there are 309 species of butterflies recorded from different habitats within the Sango Bay wetland landscape. Some of them are included in the Uganda red list for endangered species: Seven with the threat status 'critical', ten with the threat status 'endangered' and 34 with the threat status 'vulnerable' (Akite 2019). According to the TFS agency, there is more than 600 butterfly species that are native to Minziro NFR, surpassing any other forests in Africa (TFS 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.

According to Akite (2019), there are 61 species of dragonflies that have been recorded in Sango Bay wetland landscape, but this survey is likely to not be exhaustive. Of these one species is listed with the threat status 'endangered' and six species have the threat status 'vulnerable.' The Sango Bay area has the damselfly Agriocnemis palaeforma, a species known to be endemic to Uganda until 2018 when it was recorded in Rwanda and is listed as Vulnerable on the global IUCN red list and as Endangered on the draft Uganda red list (Akite 2019).

3.1.8 Fish species

The Sango Bay-Minziro wetland landscape is an important habitat for fish, which are found mainly in Lake Victoria, rivers, and floodplains. Smaller water bodies such as streams, ponds, reservoirs and floodplains, in particular, have been singled out as important faunal reservoirs for endangered species in the Lake Victora catchments (Maithya and Jembe 1998, Katunzi et al. 2010), such as the lower reaches of River Kagera catchment. These smaller water bodies serve as gene banks and provide microhabitats for feeding and breeding (Katunzi et al 2010).

Before the 1980s, water quality in Lake Victora was

good and the diversity of species was high. Over 500 endemic haplochromine cichlid species and 36 other species, many of which were also endemic, were present in the lake. Their numbers were dramatically reduced after the introduction of the Nile perch, a predator species, although some species have started to recover.

Nowadays, 95% of the total catch and 90% of biomass from fisheries in Lake Victoria is composed of three key commercial species – Nile perch (Lates niloticus), Nile tilapia (Oreochromis niloticus) and Dagaa (Rastrineobola argentea) (LVFO, 2016). The main fish species harvested from the wetlands and rivers include Clarias alluadi (Nsonzi) and Clarias gariepinus (Male), which are locally consumed in the area and a big number is used as bait for catching the Nile Perch (Lates niloticus) from Lake Victoria. In addition to the Clarias spp. For bait, there are huge catches of Protopterus aethiopicus (Mamba), a local delicacy, mainly from wetlands fringing the Kagera and other streams and rivers. Other indigenous species such as Clarias, Protopterus and Haplochromines can be found in Kashenye Ward, Missenyi District.

Several species, however, are threatened to disappear, mainly because breeding areas have been cleared for farming, settlement and development projects. Endangered species include Ningu (Labeo spp), "Enkuyu" spp., Endera (Barbus spp), tilapia, and Ngege (Oreochromis esculentus).

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. The commonest vermin include hippos, baboons, elephants and buffaloes around the forest reserves of Sango Bay and Minziro. Control efforts will continue to involve community sensitization, with occasional destruction by killing where human lives are threatened such as in case of stray buffaloes.

In the current Management plan for lake Mburo Conservation area (UWA, 2015) specific actions are included to control people-wildlife conflicts arising from Elephants and Hippos. In the plan, it is proposed to construct barriers in the Sango Bay area for conflict prevention.

Invasive species

Habitat loss due to wetland degradation by human activities (e.g. grazing, cultivation, etc.) has been reported as the main challenge faced by this wetland. Human disturbances tend to open up the land and increase the occurrence of common weeds and species of ruderal sites, and also the spread of invasive species gets enhanced altering the habitat structure of the landscape. Invasive species are another threat to the habitat of Sango Bay as they tend to suppress the native species hence lowering the species richness and this could affect decision on whether to conserve the wetland or not to. In terms of invasive species the biggest damage to the ecosystem has been done by Nile perch and water hyacinth, but biologists foresee that Iguana spp and Kariba dam weed may become equally problematic in the near future.

Nile perch

Nile perch were introduced to Lake Victoria in the 1950s to boost the fishing industry. The decline of the native fish species in Lake Victoria has been attributed to predation by the introduced Nile perch, together with use of wrong and destructive fishing gears especially around the river mouths and to some extent destruction of spawning and nursery grounds through human encroachment.

The introduction of this species to Lake Victoria is one of the most cited examples of the negative effects alien species can have on ecosystems. Its introduction was ecologically disruptive and is attributed with causing the extinction or near-extinction of several hundred native species, with some populations fluctuating with commercial fishing and the actual Nile perch stocks. The Nile perch initially fed on native cichlids, but with decreasing availability of this prey, it now consumes mainly small shrimp and minnows. The introduction of Nile perch has also had additional ecological effects on shore. Native cichlids were traditionally sun-dried, but because Nile perch have a high fat content (higher than cichlids), they need to be smoked to avoid spoiling. This has led to an increased demand for firewood in a region already hard-hit by deforestation, soil erosion, and desertification.

Water hyacinth

The common water hyacinth (Pontederia crassipes) has become an invasive plant species on Lake Victoria after it was introduced into the area in the 1980s. Large quantities of mobile water hyacinth from River Kagera floats continuously into Lake Victoria, as was observed during the field mission in April 2019. In 1996, the daily weed influx from River Kagera into Lake Victoria was measured to be on average 0.8 ha (Aquatics Unlimited, 1996). When not controlled, water hyacinth clog waterways and can cover lakes and ponds entirely; this dramatically affects water flow and blocks sunlight from reaching native aquatic

plants which often die. The decay processes depletes dissolved oxygen in the water, often killing fish. The plants also create a prime habitat for mosquitos, the classic vectors of diseases such as malaria, and a species of snail known to host a parasitic flatworm which causes schistosomiasis (snail fever). Excessive nutrients from overfeeding and waste cause eutrophication and enhances growth of algae and water hyacinth.

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:

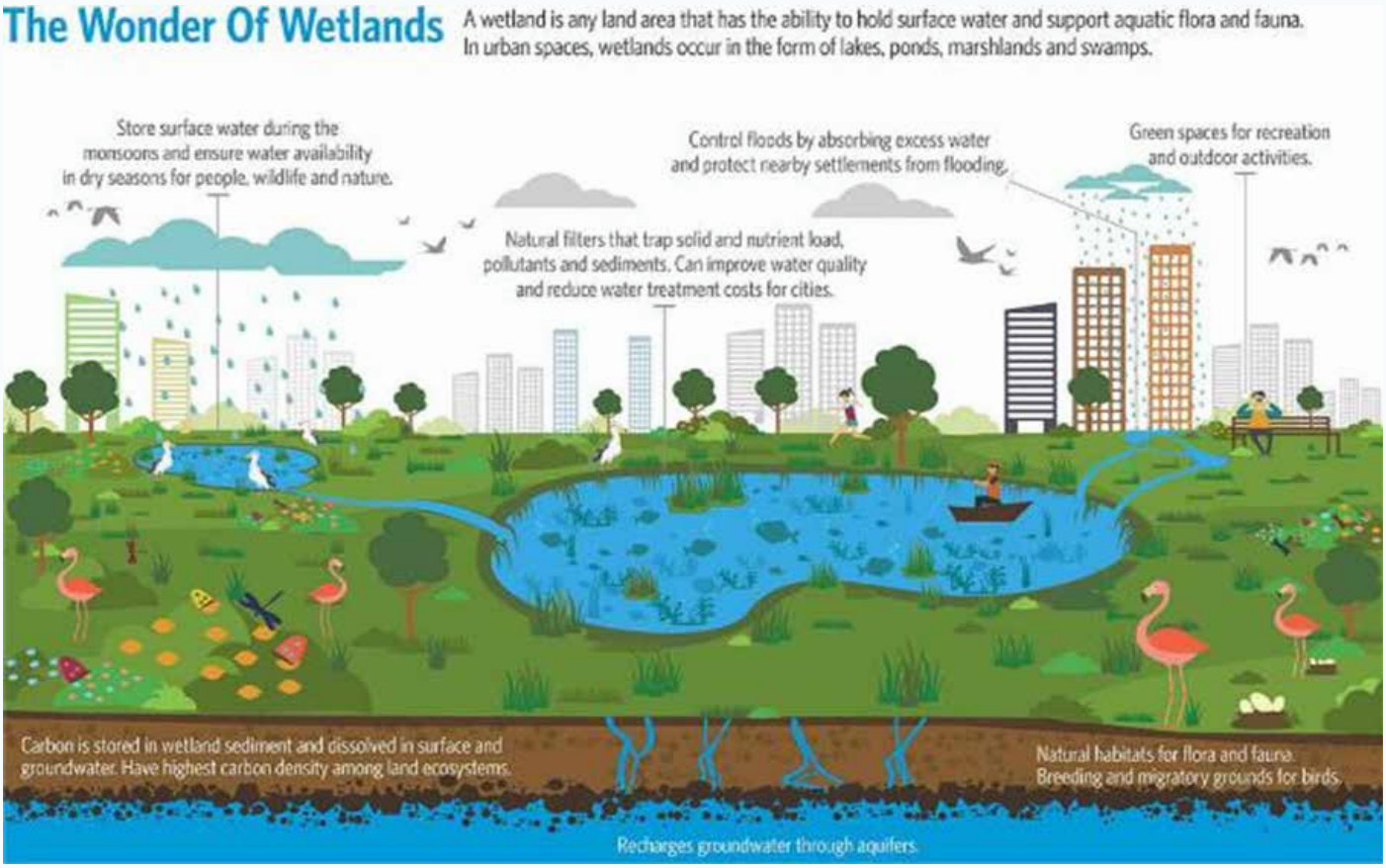


FIGURE 24: OVERVIEW OF WETLAND ECOSYSTEM SERVICES (SOURCE: THE NATURE CONSERVANCY INDIA).

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 500.000 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, whose perceptions and interests were collected.

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 for roofing and bedding, and mulches for agriculture (Table 6). Tree bark (Figure 25) is used both for medicinal purposes (Martin and Rovero, 2019) as well as traditional barkcloth making (Explainer 3 in chapter 5.3).

Also, clay is used as a building material, but also for medicinal purposes. Mushrooms, the Bubaala in particular, are used for food and medicinal purposes,

TABLE 6: CLASSIFICATION OF ECOSYSTEM SERVICES (ADAPTED FROM TEEB, 2010), AND SPECIFIC EXAMPLES OF THESE SERVICES IN SANGO BAY-MINZIRO STUDY AREA

Type of service	Ecosystem service	Examples in Sango Bay-Minziro
Provisioning services	1. Food	Fish, honey, (bush)meat, fruit, mushrooms, wild nuts, grass hoppers, white ants
	2. Water	Drinking water (domestic and livestock), irrigation, cooking and bathing
	3. Raw materials	Tree bark (bark clothes), snail shells (food supplement to livestock feeds), papyrus and reeds (mat making, houses-thatching), sand (construction material), clay, wood (for building houses, furniture and fuel), grass (for crafts, roofing, grazing and mulching)
	4. Genetic resources	Gene banks for sustainable food and agricultural products
	5. Medicinal resources	Tree bark, herbs, fish, animals (dung) and birds, clay
	6. Ornamental resources	Decorations and materials for handicrafts (palm leaves, papyrus, grasses, wood)
Regulating (and supporting) services	7. Air quality regulation	Fresh air by capturing particles
	8. Climate regulation	Rain formation, carbon sequestration (extensive peatlands at Kagera floodplains), weather regulation
	9. Moderation of extreme events	Water storage against flooding and drought
	10. Regulation of water flows	Natural drainage, buffering, water storage, irrigation, drought prevention
	11. Waste treatment	Water purification, nutrient retention
	12. Erosion prevention	Vegetated buffer strips, soil loss avoidance
	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	The natural beauty of the meandering River Kagera
	19. Opportunities for recreation and tourism	Eco-tourism to view animals and birds, and for local crafts, recreation
	20. Inspiration for culture, art and design	Animals with cultural significance
	21. Spiritual experience	Rituals (for example using Bubaala mushroom), religious practices and holy places
	22. Information for cognitive development	Research (f.e. on insects, birds, weather)

but also play an important role in rituals. Regulating and supporting services are less tangible, but this does not mean they are less important. Specific examples include 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. Regulation of nutrients and prevention of soil loss through erosion together ensure a beneficial environment for agriculture. 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 crucial to ensure 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.

In addition to fish, local communities along the shores of Lake Victoria in the Sango Bay area harvest snail shells, which are sold for use as a food supplement to



FIGURE 25: STRIPES OF TREE BARK ILLEGALLY HARVESTED INSIDE THE MINZIRO FOREST NATURE RESERVE FOR MEDICINAL PURPOSES (SOURCE: MARTIN AND ROVERO, 2019).

livestock feeds. The snail shells are packed and are mainly transported to Masaka and Kampala; where there are large scale livestock feed manufacturing industries. The PREPARED study reported that from Malembo landing site alone, at least two 8 ton truck loads full of snail shells are sold off to Kampala and Masaka traders every week (USAID 2016).

The Sango Bay area is also known for their production of high numbers of grasshoppers and white ants, which are considered a delicacy in most of the local communities. Of more significant value is the nutritional value of these insects, which can be easily collected from the forests, woodlands and grasslands, as a form of animal protein. The PREPARED study reported that harvesting of grasshoppers and ants, and selling them to other towns such as Masaka, Mbarara and Kampala, makes a significant contribution to the incomes of the people in Kyotera District (USAID 2016).

Economic valuation of Sango Bay – Minziro Ecosystem

In 2016, an economic valuation of Sango Bay – Minziro Ecosystem was undertaken as part of the Planning for Resilience in East Africa through Policy,

Adaptation, Research and Economic Development (PREPARED) project (USAID 2016). The overall aim of this economic valuation study was to provide baseline data on the benefits derived from different ecosystem goods and services from the area; which includes forests and wetlands, and their associated habitats. Towards the overall objective of providing information that can be used to provide an economic justification for the CIP, the rapid assessment of ecosystem service values seeks to answer three key questions:

1) How and for whom does the Sango Bay-Minziro complex generate economic benefits?

2) What is the current value of biodiversity and ecosystem services?

3) What are the gains, costs-avoided and economic justification for taking steps to invest in enhanced biologically significant area conservation?

The rapid assessment was conducted over a period of 13 days, and involved field visits to Sango Bay-Minziro; stakeholder and expert consultations at various levels; literature review; collation of existing national and district statistics; data entry, analysis and reporting. A range of techniques were used to estimate the economic value of the various ecosystem services, including:

- market prices paid to buy and sell different products and services;
- prices of goods that are alternatives or substitutes for environmental services;
- expenditure on goods and services directly linked to environmental benefits; and
- considering how a particular ecosystem service affects the value of other market goods.

For this study, primary users and beneficiary population were considered based on the dependency on ecosystem services from the Sango Bay-Minziro area. The coverage was set to administrative units and populations that are considered as the main users of ecosystem services (at least provisioning), and for whom values are calculated. For Uganda, the administrative units considered were eight sub-counties and two Town Councils in the former Rakai District (population: 219,788), now Kyotera District; while all the 20 wards in Missenyi District were considered for Tanzania (population: 202,632). A synthesis of findings from this study estimated that the Sango Bay – Minziro biologically significant area provide ecosystem services worth about 236 million US$ per year (Table 7).

The ecosystem services contribute to livelihoods through income, food and nutrition security and supporting different sub-sectors such as crop and livestock farming and through purification of the water and air. The benefits provide incentives that can strengthen conservation efforts. Results from the economic valuation for Sango Bay – Minziro ecosystem should be used as a clear justification for financing management and conservation of the biologically significant area.

TABLE 7: SYNTHESIZED ECONOMIC VALUES FROM THE SANGO BAY - MINZIRO BIOLOGICALLY SIGNIFICANT AREA (USAID 2016)

Ecosystem service	Total value (US$/ yr)
Provisioning Services	**89,620,224**
Capture fishery and other aquatic organisms	11,645,339
Wood-based energy & construction material	30,789,648
Water for domestic use	2,812,835
Water and grass for livestock production	19,648,418
Crop farming, irrigation and mulching	6,123,705
Other non-wood/ non-fish wetland products	18,600,279
Regulating and Supporting Services	**131,905,153**
Soil fertility & moisture	17,693,863
Pollination, seed dispersal & pest control	8,187,905
Water storage & recharge	30,155,455
Regulation of water quality	50,165,896
Flood attenuation	6,550,324
Carbon storage & sequestration	1,557,699
Habitat/ Refugia	17,534,099
Pharmaceutical value	59,912
Cultural Services	**14,378,760**
Nature-based tourism and cultural values	14,378,760
Total	**235,904,137**

4.1 MAIN ACTORS AND INTERACTIONS IN THE WETLAND LANDSCAPE

Due to the transboundary nature of the Sango Bay-Minziro wetland landscape, actors at several different institutional levels influence the management of the landscape. The actors range from global and regional organizations, that are by definition transboundary in nature, to institutions at national level and local institutions (Figure 26). Each actor has a different level of interest in the wetland landscape and a different level of influence to facilitate or impede changes to the wetland landscape. Proper identification of stakeholders and their motivations and interactions is a crucial step in recognizing the avenues of change within a landscape (Figure 27). A brief overview of the different levels and general delineation of the actors involved at each level is provided in this subchapter.

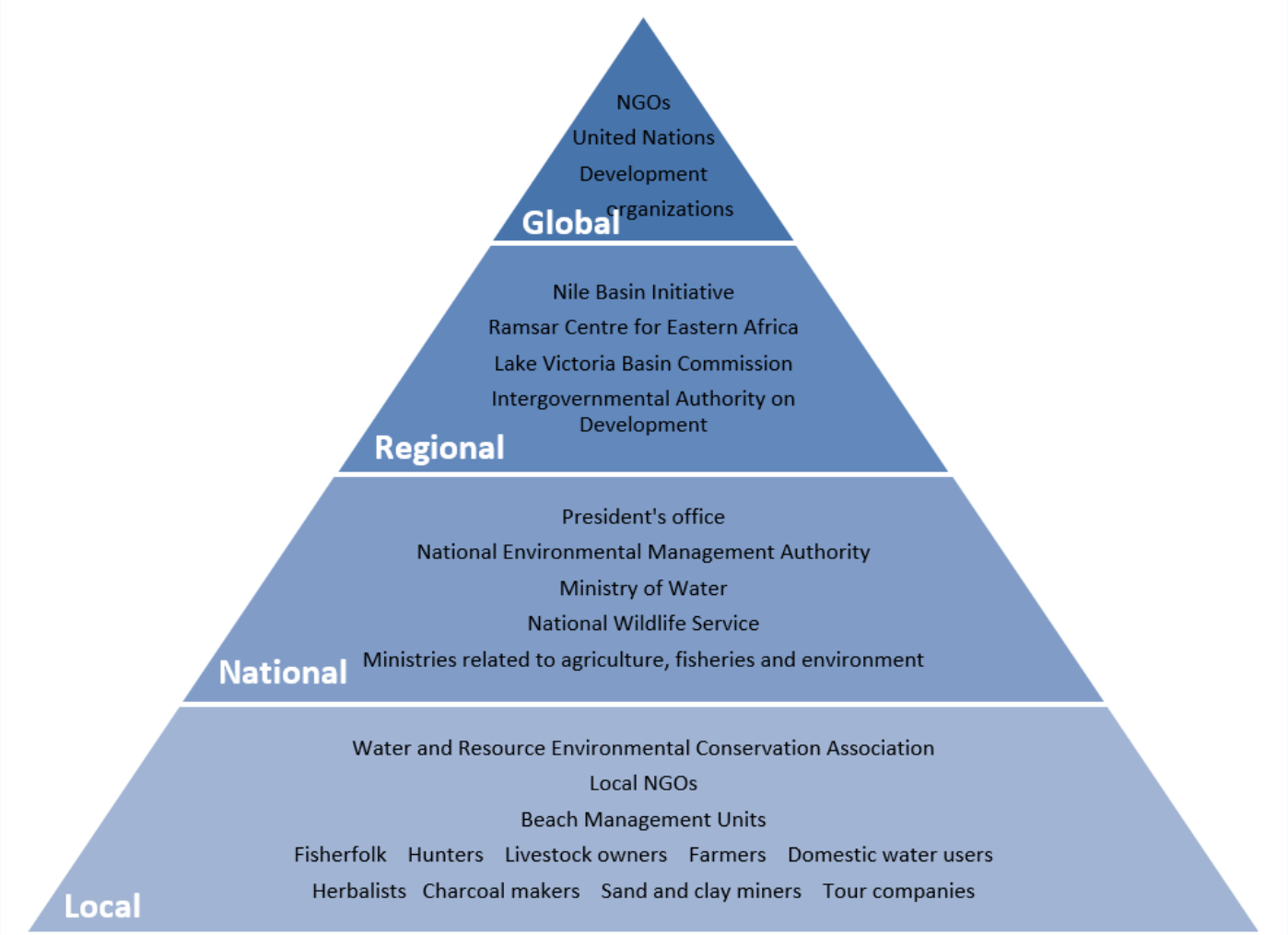


FIGURE 26: SCHEMATIZATION OF A SELECTION OF RELEVANT ACTORS AT DIFFERENT LEVELS.



FIGURE 27: REPRESENTATIVES FROM A BROAD RANGE OF GOVERNMENT MINISTRIES, NON-GOVERNMENTAL ORGANIZATIONS AND COMMUNITY BASED ORGANIZATIONS FROM KAGERA REGION, TANZANIA, AND KYOTERA DISTRICT, UGANDA.

4.1.1 Global level

At global level, there are several organizations that can influence the Sango Bay-Minziro wetland area, either directly or indirectly. Institutions linked to the United Nations, in particular, such as the FAO and UNEP, are important global-scale actors. International NGO's, for example the World Wide Fund for Nature (WWF) and Birdlife International, 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. This actor is especially relevant considering the planned delineation of a transboundary Ramsar site in this area. 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 Sango Bay-Minziro wetland drains into Lake Victoria. Several actors are involved in the management of the basin of the lake with varying scopes, including the Lake Victoria Basin Commission (LVBC) and the Lake Victoria Fisheries Organization (LVFO). The Lake Victoria Basin in turn falls within the Nile Basin. 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. An example of a regional NGO is the Albertine Rift Conservation Society.

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, including the National Environment Management Authority and Wildlife Services or, in the case of Uganda, the Wetlands Management Department, clearly have an interest in and impact on the management of the Sango Bay-Minziro 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 Victoria Water Management Zone (VWMZ). 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.

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. In Tanzania, an example is Nature Tanzania.

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, including the locally elected member of parliament, but also local NGOs. Examples of local NGOs in this study area are the Kayanga Diocese Development Organisation (KADRO) and KOLPING, a Catholic church initiative. Institutions representing livelihoods are also important actors at this level, including for example Beach Management Units, which are involved in management of fisheries resources. At village level, there are also CBOs.

Finally, there are individuals that have an interest and/or influence on the Sango Bay-Minziro wetland 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. People who harvest resources from the wetland, including clay and sand miners, reed harvesters, herbalists and firewood collectors. Other actors make use of the supporting eco-system services, such as farmers and livestock keepers. In addition, local religious or cultural leaders may have a large influence at this level. 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 grow subsistence crops 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. The Sango Bay-Minziro wetland system provides for a call of a multi-layered participatory approach which should carefully be linked to the transboundary conservation interests. These include wetlands, fisheries, forests, agriculture, wildlife, livestock, community development and land issues. This subchapter gives an overview of the most relevant policies and legislation at different levels for the Sango Bay-Minziro wetland landscape. An extensive list of all policies and legislations relevant for Sango Bay-Minziro can be found in the Wetland Management Plan.

4.2.1 Global level

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 Tanzania 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 Tanzania 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, bur 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 level

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 Sango Bay-Minziro 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.

4.2.3 National level

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. 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.

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. While there are also policies protecting wetlands in Tanzania, a study has suggested that the policies are poorly coordinated to sufficiently address the destruction of wetland systems (Materu et al. 2018). Since the study focused on Tanzania in particular, it is unclear whether the same conclusion may be applied to Uganda, as well. Other policies that more directly affect wetlands are environmental, forestry and tourism policies, as well as 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 such as Tanzania's Water supply and sanitation act of 2009 have the potential to reduce contamination of water resources. At the same time, better access to water services may also result in higher water abstraction in wetland areas. 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, 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. In Tanzania, resources that have interest to more than one region fall under the central government, which includes the Minziro Forest Nature Reserve.

4.2.4 Local level

The local government here covers all levels under national level. This includes district/region, county/district, sub-county/ward and village levels. However, Water User Associations, Beach Management Units and other local institutions are also 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

The Sango Bay-Minziro study area contains a number of protected areas (see Protected Area map in Appendix A) that cover approximately 75% of the total study area. The largest of these is the Sango Bay Musambwa Island-Kagera Wetland System (SAMUKA) in Masaka and Kyotera Districts (see the Protected Area Map in Appendix A). Comprising of some 55,110 ha, SAMUKA is a Ramsar site no. 1641 and an Important Bird Area (IBA).

Minziro Forest Reserve is one of the 20 Important Bird Areas of Tanzania (see the Maps in Appendix A). It is managed by Tanzania Forest Service (TFS). However, the issue of utilising other than trees shrubs and grass, comes under the Tanzania Wildlife Authority (TAWA). In the fall of 2018 a rapid assessment was conducted on the levels of human disturbances and community awareness on the importance of the Minziro Nature Forest Reserve, NW Tanzania (Martin and Rovero, 2019). This study shows that community members are generally aware of the protection status of the forest and activities not permitted, but encroachment and illegal activities are at high levels across the reserve. Indeed communities rely largely on the reserve for various natural resources such as firewood, medicinal plants and thatching grasses. Communities are generally also aware of the Reserve boundary and that Tanzania Forest Service (TFS) is the organization that manage the Reserve. Disturbance transects revealed that the reserve suffers from human disturbances in terms of illegal poles extraction, human paths, charcoal burning and illegal hunting for bushmeat, with the western area of the reserve being relatively more affected than the eastern part. Efforts to curb illegal human activities such as timber and pole cuttings especially near Mutukula (western part) and other surrounding villages should be reinforced and where necessary more anti-poaching facilities and efforts, including a ranger post on the western part of the forest, should be considered. This should be done in conjunction with involvement of local communities in conducting anti-poaching patrols.

The larger areas encompassing the seasonal and permanent wetlands, grasslands and thickets fall under general land. Together with the nature Reserve, it is earmarked to be designed as a Ramsar site under the Wildlife division of the Ministry of Natural resources and Tourism as the focal point for the Ramsar convention, hence a key player in Sango-Bay Minziro processes. Further, as this initiative is under the Nile basin initiative, it therefore comes under the NBI host institution, the Ministry of Water. All this requires a careful coordination of institutions with a good understanding of each designated role.

Towards designation of a transboundary wetland area (Ramsar site)

It is the ambition of the current wetland management and conservation investment plan underway to compound the PREPARED initiative even further using a similar model, to combine the contiguous wetlands in the Sango Bay-Minziro region to create East Africa's first transboundary Ramsar designated site. Currently, Sango Bay is already Ramsar site (as part of SAMUKA) and Minziro Natural Forest Reserve is not. This would require the consideration of Minziro (Tanzania) as a Ramsar site, in order to create a transboundary RAMSAR site with the already existing SAMUKA which includes Sango Bay (Uganda). This requires Minziro to be considered as a wetland of internationally importance. The following criteria are considered for Minziro:

1) it contains a representative, rare, and unique example of the largest seasonally freshwater lowland floodplain in East Africa. (The following were identified as unique in the area: Acacia woodland within Nature reserve and along the kagera river system; Papyrus mixed with Vossia swamp along the Kagera Rivers; Phoenix species in the swamp forest; and Miscanthus and Loudetia community in the permanent swamps)

2) the system supports rare, vulnerable, endangered, or critically endangered species or threatened ecological communities (The African Elephant Loxodonta Africana (Vunerable), The Blue Swallow Hirundo atrocaerulea (Vulnerable)

3) it supports populations of inter alia 58 of the 245 bird species recorded in the reserve which are not found outside Kagera Region in Tanzania, while 56 of these have only been seen in Minziro. In addition, more than 600 butterfly species are native in that area, surpassing any other forest in Africa

4) it provide refuge to the Blue Swallow, Hirundo atrocaerulea, who are classified as Vulnerable by IUCN. The birds are an intra African migrant that winters in lowland grassland areas in Minziro forest

5) it supports more than 20,000 or more water birds

taking into-consideration of a large number of birds in the areas

6) it supports 1% of the individuals in a population of one species or subspecies of water bird. The wetland is an important migratory stopover/ destination for migratory bird species. The site support population of Grey-headed Gulls (Larus cirrocephalus)

The Road Map towards designation shows that the next steps are stakeholder mapping, community consultations and demarcation and delineation of the Minziro wetland as well as the proposed Ramsar site boundaries. After this has been done, the Ramsar authorities can begin the formal designation process, which is scheduled for March – May 2020.

Ideally policy and regulatory mechanisms between Uganda and Tanzania should be harmonized under the East African Community Treaty. There are few key issues that bring the disconnect. The instruments that that govern land tenure and use f.e. differ across the borders. Albeit the traditional practices on both sides of the country boundary are very similar, formal land policies at local, regional and national level are different. As a case in point, grazing in the Sango Bay forest is allowed (Uganda), but against the law of the Tanzanian side. This is rather confusing for pastoralists herding their cattle in transboundary forests.

There have not been formal transboundary conservation investment plans harmonized across the borders. The GEF/UNDP cross-borders project (1997 – 2003) aimed at developing conservation investment plans for Sango Bay Minziro provides a good number of lessons on which future plans can build on. This includes good neighbourhood meetings between cross border districts, which currently mainly focus on livestock, peace and trade issues. The recent USAID PREPARED project also produced a good set of information that can be used for future planning purposes (USAID 2016).

The absence of formal transboundary initiatives exposes Sango bay – Minziro resources to an abuse and overexploitation with a pretense of unawareness or ignorance of the values of the wetland. This includes encroachment by farmers, livestock movements, human activities within the wetlands, fires, rice farming and many more. At the same time, governments have limited resources available for harmonization of planning and implementation activities; which is a major setback. Development partners are stepping in; currently by supporting livelihood initiatives as an entry point to conservation projects.

Many suggest that the best way forward is submitting an application to RAMSAR for Sango Bay-Minziro as a whole, building on the findings, experiences and instruments from former projects. There is good political support, a transboundary traditional base through communities, and almost homogenous wetland and forest resources and common needs. To ensure success, it would be best if Sango Bay (Uganda side) becomes a Nature Reserve which is the highest conservation status as per IUCN categories, alike Minziro Forest Reserve, and Minziro becomes a (part of the) RAMSAR site, which Sango Bay already is. Only then are policies aligned, is the status of conservation harmonized and can stakeholders really jointly build on wise use of the resources with support from government.

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 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.

The small land holdings exhibited in both Sango Bay and Minziro wetland landscape are used mainly for crop farming. Continuous cultivation results to soil infertility and less productive. Cases of land degradation through soil erosion are common and evident especially in sloping land areas. Declined land productivity is a disincentive to the agricultural land use and people end up seeking their alternative livelihood option to increase use of natural resources, such as fishing and forest and wetland products for sale.

Land ownership and tenure in Tanzania

Overall natural resources management falls within the Ministry of Natural Resources and Tourism. However, on ground management is mainly vested on the Regional Administration of Kagera regional authority and its structures as listed from Regional to the village structures. Minziro Forest is a Nature reserve, which has values beyond the region and

therefore managed by a manager who is directly under Tanzania Forest Services agency. Minziro Nature reserve provides a special case where the direct management of the forest is under the Central government.

In Minziro, there are four distinct ownership of resources. These are based on existing land tenure system as follows.

1. Private land This is where resources are on a private land, which can be a small holder normally between 2 to 5 acres. These are individually owned through inheritance OOR outright sale. Resources may be from both removable and non moveable. They exclude wildlife and reserved trees which are legally under the central/district government

2. Central government resources This includes the main chunk of the Minziro Nature reserve, which is under the central government and managed by Tanzania Forest Service. Resources include all forest products including tree, water and wildlife resources.

3. Communal resources These include those resources that are found on land that is does not belong to individuals, central or local governments. These include those of areas for grazing, areas that may be used for livelihood activities and some for individual benefits. These need to get a licence or a go ahead from community leadership through village authorities. These include pastoral land,

4. Local/District council resources These include resources that are under general lands, which do not fall under private, central government OR community lands. These are managed by the District Council and in order for one to access, one needs a licence or a permit from the district authorities.

Land ownership and tenure in Uganda

Most of land in Sango Bay (Uganda), 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 Kyotera District (Uganda) planning department, the peripheral areas of Sango Bay wetlands are under a mail land tenure system (a land tenure system where registered land is held in perpetuity). It was also reported that about 12,000 hectares West of Kaiso Forest Reserve is under leasehold land tenure system.

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. There is also a conflict with other pastoralists who come from outside Minziro and these come in with massive number of Ankole cows. These are mainly from neighbouring Uganda.

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. Honey gatherers and beekeepers: This group practice in all categories of lands. They are limited but share a number of lessons.

5. Fishermen: These do fishing in Lake Victoria, wetlands, rivers and tributaries.

Community based natural resources management is on good footing in Tanzania. There is a well set community involvement process since 1967 when Tanzania decided to be an African socialism country. This has hone though a good number of lessons which makes it easy for community based natural resources management in Tanzania. It is more of bottom up approach as the government has developed policy and policy instruments that support community participation. This moved further into appreciating private sector involvement and also the role of non-state actors.

Transboundary cooperation in Natural Resources Management

There are a number of good neighbourhoods' initiatives that have been going on for the last two decades. These are building on good neighbourhood of Uganda and Tanzania backed up by the East African Community. There exists a formal policy direction on management of transboundary natural resources. This falls under the Treaty that established the East African Community and the ones even before then. However, this has not been domesticated well at local cross border sites. There exists a common custom and immigration centre at the borders but

the instruments that govern natural resources and related sectors are still having a clear boundary. The major ones include immigration, customs (export and import of goods) and many others that impact the local communities during their normal lives. There has been some initiatives that brought together the Minziro Sango Bay communities together but these are yet to provide. Transboundary institutional arrangement on natural resources is fairly absent, except for project supported initiatives.

5.1 LIVELIHOOD AND ECONOMIC SYSTEM

Agriculture is the backbone of the Missenyi and Kyotera District Councils economy and most of its residents depend on it as their main source of livelihood. According to United Nations classifications, agriculture comprises of crop production, livestock, forestry and hunting sub sectors. Others are fishing and bee-keeping. In Missenyi District 87% of the population is reportedly engaged in the agricultural sector, 12% in the service sector and only 1% in industries, trade and commerce (Missenyi District Profile 2015). It is expected that similar numbers apply to Kyotera.

Analysis of poverty and livelihoods

Poverty remains widespread in most parts of Uganda as well as Tanzania, and both countries have a high Multidimensional Poverty Index (55% of the population in Tanzania and Uganda is in multidimensional poverty; UNDP 2019b). In Tanzania, the national poverty rate had declined from 34.4% in 2007 to 28.2% in 2012 and then to 26.8% in 2019 (World Bank reports, Updated April, 2019). Despite lower poverty rates, the number of poor people has stagnated due to high population growth rate. Poverty is highest in rural areas, with around 80 percent of the country's poor living in those regions. Tanzania has sustained relatively high economic growth over the last decade, averaging 6–7% a year. While the poverty rate in the country has declined, the absolute number of poor citizens has not because of the high population growth rate. The average GDP per capita in Missenyi District fluctuated between 1,100 and 1,300 USD between 2013 and 2015 (Missenyi District Profile 2015).

Uganda remains among the poorest in the world but it is one of the highest rates of poverty reduction. The number of Ugandans living below the poverty line declined from 31.1 % in 2006 to 19.7 % in 2013. 92 % of the poor live in the countryside, although only 89 % of the population is classified as rural. The discrepancy between rural and urban levels of poverty is even greater using the lower or "core" poverty line. Not only is poverty more widespread in rural areas, it is also more severe. Rural people also spend about half as much as urban dwellers. Accordingly, poverty-related indicators, such as household size, dependency ratio, and illiteracy, are higher for rural Uganda. In particular, poorer households tend to have older and less educated household heads, and are more likely to be headed by a woman. (Uganda Poverty Assessment Fact sheet, 2016).

According to the National Sample Census of Agriculture 2007/2008 (source: UroT 2012), in Missenyi District, Tanzania, crop production is the main source of income for 84% of the households, followed by formal employment (8%) and off-farm activities (5%). Fishing and livestock keeping both account as main source of income for 1% of the households (Table 8). Similar percentages are expected for Kyotera District, Uganda.

Table 8: Main source of income for Missenyi District, Tanzania (source: UroT 2012)

	% of households
Crop growing	84
Livestock keeping	1
Fishing	1
Employment	8
Off-farm activities	5

In Kyotera and Missenyi Districts, poverty is generally perceived differently by the different categories of people. For example, women in fishing communities and urban areas define poverty as the inability to spend on luxurious items. The youth on the other hand consider poverty as lack of skills that can enable them to earn a living or the inability to transform the acquired skills into practice. However, many of them perceived it as the lack of basic goods and services such as housing, clothing, land, productive assets, and markets. This condition is also associated with isolation, powerlessness, physical weakness, weak family institutions and indebtedness.

A big proportion of the population is peasants whose livelihood is basically ensured through subsistence crop farming. Majority of the population is involved in agriculture on a small scale using

labour intensive technologies, which are greatly vulnerable to the adverse effects of HIV/AIDS and other socio-economic and physical conditions. A few other households live off income generated through livestock keeping, fishing, and hiring out labour, trading and social support. For many reasons (e.g. lack of labour and the attendant reduced production, high medical and funeral costs, distress sale of assets), HIV/AIDS impacted families tend to have very few opportunities for income earning or saving. The emerging family structure distortions such as child headed and female headed households undermine family income generating mechanisms; affect the nutritional situation and food security of the families, resulting into compromised productivity capacities of the affected families. Labour intensive farming systems employed by the households, with a low level of mechanization and agricultural input are particularly vulnerable to the effects of adverse conditions.

5.2 LIVESTOCK AND AGRO-PASTORAL SYSTEM

Livestock farming is one of the major agro-economic activities in the communities of Sango Bay and Minziro, with nearly 80% of the households rearing livestock (GoU 2009) despite being the main source of income for only 1% of the households (Table 8). The median landholding size is 0.8ha of which 34.3% is used for agriculture and 61% for pasture (GoU 2009). Poultry are the most common livestock, followed by cattle, goats, sheep and pigs (Table 9). However, cattle are the most important in economic terms. There is localized nomadism during the prolonged dry periods when water and pastures are in short supply, leading to movement of cattle from place to place. In extreme cases animals are moved across inter-district and inter-national boundaries within the Sango-Bay and Minziro ecosystems. The usual international destination for cattle's from Uganda is Tanzania.

TABLE 9: LIVESTOCK STATISTICS OF FORMER RAKAI DISTRICT, NOW KYOTERA DISTRICT, UGANDA (GOU 2009)

	Cattle	Goats	Sheep	Pigs	Chickens
% of households	20.5	36.4	4.9	39.4	54
Average size	5	3	2	2	7

Table 10 shows livestock numbers for the project area in (numbers are from 2007/2008 for Tanzania and 2002 for Uganda), based on MoA 2009, UroT 2012 and GoU 2009. About 21 million cattle and 15 million goats are reported in Tanzania, compared with 11 million cattle and 12 million goats in Uganda. Pigs and chickens are not reported for Tanzania, but Uganda reports 3.2 million pigs and 37 million chickens. For Southern province in Uganda and Kagera region in Tanzania, large numbers of cattle and goats are reported and especially for Southern province large numbers of chickens as well. Zooming in to district level (Kyotera district for Uganda and Missenyi district for Tanzania), a total of about 200,000 cattle, 120,000 goats, 110,000 pigs and 510,000 chickens are reported.

TABLE 10: LIVESTOCK POPULATION NUMBERS FOR UGANDA (2002) AND TANZANIA (2007/2008) AT DIFFERENT ADMINISTRATIVE LEVELS

	Tanzania				**Uganda**			
	Cattle	*Goats*	*Pigs*	*Chickens*	*Cattle*	*Goats*	*Pigs*	*Chickens*
National	21 million	15 million			11 million	12 million	3.2 million	37 million
Region/province	840,000	820,000	38,000	1,3 million	2.5 million	1.7 million	1.3 million	11 million
District	160,000	37,000	13,000	98,000	40,000	84,000	98,000	420,000

Livestock population patterns for Uganda (MoA 2009) show 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. Livestock population patterns for Kagera province in Tanzania (UroT 2012) show a more or less steady trend for goats, a slightly increasing trend for cattle and a very large increasing trend for pigs.

Livestock production levels in 2015 for Kyotera District (Uganda) and Missenyi District (Tanzania) are shown in (Table 11).

(Source: Kyotera District Statistics and Missenyi District Statistics)

TABLE 11: LIVESTOCK PRODUCTION LEVELS

Livestock type	Kyotera District (Ug) in 2015	Missenyi District (Tz) in 2015
Cattle	132,334	88,474
Sheep	21,922	3,459
Goats	137,040	49,118
Pigs	101,805	6,895
Poultry	564,260	

(Source: Kyotera District Statistics and Missenyi District Statistics)

In this sector, dairy cattle breeding are important for production of calves and milk processing for production of milk and milk derivatives such as cheese, butter, curdam, yogurt, and ghee, are some of the products in the beef and dairy Industry. The industries for livestock products are well established in cities and towns such as Rakai, Kampala, Jinja (Uganda) and Bukoba, Mwanza and Dar Es Salaam (Tanzania). Mushrooming of milk bicycle itinerant men traders is common in rural and sub-urban centers while women sell at home stead and neighborhoods. Also the meat or beef processing is done to produce beef products such as fresh beef, sausage and corned beef. Other activities in this sector are the production of veterinary products, premixes, concentrates and animal feeds. There are some investors doing these activities and they enjoy the economies of scale in this sector and thus maximizing their profits.



FIGURE 28: TROOPS OF CATTLE BEING TAKEN FOR GRAZING (KYOTERA-KYABASIMBA ROAD)

Worm infestations are by far the most important cause of morbidity amongst livestock; for cattle it accounts for up to 74% of the death cases, largely attributed to the frequent cattle movements and physiological stress during drought. Other major diseases include foot and mouth disease (FMD), Brucellosis, Black Quarter, Trypanosomiasis, East Coast Fever and Babesiosis. Newcastle disease (NCD) is the most important diseases affecting poultry, while African swine fever periodically breaks out and kills vast numbers of pigs. Vaccination campaigns must be maintained, but these are often hindered by lack of financial resources and drugs stock-outs.

While the traditional breed of cattle kept in most of districts are better suited to the prevailing environment of pests, diseases and water stress the animals are not very productive. For instance the average daily milk yield of an Ankole cow (with big horns) is only 2 litres of milk. There is therefore need to upgrade the stock through artificial insemination technology and crossed breeding.

To regenerate the grasslands local herdsmen light the grazing lands at the end of the dry season. Albeit indeed a good solution for improving the quantity and quality of the pastures, the practices have widely been reported to increase soil erosion rates in the landscape.

5.3 CROP PRODUCTION AND FORESTRY

Crop production

The production of crops in Kyotera District (Uganda) and Missenyi District (Tanzania) is predominantly rain-fed, matched to the bi-modal rainfall pattern received over the districts. Manual irrigation is only applied in less than 2% of farming, mainly on horticultural crops such as tomatoes, onion and cabbage. The main crops – for food – include bananas, coffee, sweet potatoes, beans, maize and cassava. On average an approximate 30% of the total arable land is used for the production of these major food crops, which are primarily for own consumption. In terms of cash crops sugar cane, coffee, vanilla and tea are produced. With an area over 8100 ha in Missenyi District alone, sugar cane is ranked as the first cash crop in terms of planted area (Missenyi District Profile 2015) followed by coffee with 4500 ha. Recently some have started producing pineapples and passion fruit, both for own consumption as well as for sale.

Reliance on rainfall implies that crop productivity is badly affected by prolonged droughts. The rainy months run for an average of two months, with dry spells markedly lasting from late May to September and from January to February/March. In that respect the need for investment in water for production as well as sustainable land management technologies cannot be over emphasized. Nevertheless, crops provide the livelihoods and income to the farming population. For instance in Missenyi District in 2015, banana accounted for 35.8 percent of the average annual area of 38,497.0 ha planted with major food crops in the council and hence was the leading food crop. This was followed by beans (25.0 percent), maize (23.0 percent), cassava (9.1 percent) and sweet potatoes (7.1 percent).

TABLE 12: ESTIMATED PRODUCTION IN TONNES OF MAJOR FOOD CROPS, MISSENYI DISTRICT COUNCIL; 2011 - 2015

	2011	2012	2013	2014	2015	Total	Average	Percentage
Maize	17,571.6	17,984.1	19,150.7	17,825.0	25,123.8	97,655.2	19,531.0	13.5
Cassava	16,082.8	17,025.0	15,890.5	17,818.1	19,400.2	86,216.6	17,243.3	11.9
Sweet potatoes	11,737.8	11,754.0	7,038.2	16,648.3	12,501.7	59,680.0	11,936.0	8.3
Beans	25,209.8	24,103.8	36,525.1	59,548.7	40,932.4	186,319.8	37,264.0	25.8
Banana	88,450.4	91,192.9	12,422.1	87,614.9	12,791.6	292,471.9	58,494.4	40.5
Total	**159,052.4**	**162,059.8**	**91,026.6**	**199,455.0**	**110,749.7**	**722,343.5**	**144,468.7**	**100.0**

Source: Missenyi Executive Director's Office (Agriculture Department), Missenyi District Council, 2017

The average agricultural land per household in Missenyi District is 1.03 ha (UroT 2012). Onions (6.55 ton/ha) and cassava (4.4 ton/ha) give relatively the highest yields, while mango (0.51 ton/ha), coffee (0.54 ton/ha) and banana (0.55 ton/ha) give relatively low yields in ton/ha, but at least coffee is a good cash crop (UroT 2012). In the short rainy season, the crop production involves 6,987 ha of planted area, resulting in 9,217 ton harvested quantity. In the long rainy season, the crop production and harvested quantity are both around three times lower (Table 14).

TABLE 13: AGRICULTURAL YIELD FOR MISSENYI DISTRICT, TANZANIA (UROT 2012)

Short rainy season			Long rainy season			Total		
Planted area (ha)	Quantity harvested (tons)	Yield (tons/ha)	Planted area (ha)	Quantity harvested (tons)	Yield (tons/ha)	Planted area (ha)	Quantity harvested (tons)	Yield (tons/ha)
6,987	9,217	1.3	2,633	3,213	1.2	9,621	12,429	1.3

TABLE 14: TREND OF LEVELS OF AGRICULTURAL PRODUCTION FROM 2014 TO 2017 (KYOTERA DISTRICT)

Crop	Acreage in ha			
	2014	**2015**	**2016**	**2017**
Bananas	16,333	15,667	14,733	14,500
Cassava	8,000	9,000	9,133	10,000
Coffee	13,750	17,000	21,600	33,750
Beans	10,000	14,667	15,067	15,067
Maize	10,000	11,500	11,333	12,000
Total	**58,083**	**67,834**	**71,866**	**85,317**

Source: Production Department estimates (2017)

Crop production acreage and productivity has been increasing over the past years, but are also very unstable. Main causes of the agricultural sector's poor performance include the limited access of agricultural inputs especially to peasant farmers, low market prices of agricultural products, poor agricultural practices as well as adverse weather conditions. Soil infertility, pests and diseases, and the difficulty to contain these challenges, are amongst the major factors for highly variable production. On the Tanzanian side, Missenyi district council is sticking to Kilimo Kwanza (agriculture first), by improving extension services and attempting a more reliable supply of agricultural inputs through the National Agricultural Input Voucher Scheme (NAIVS).

Albeit positive developments in the agricultural sector have a direct positive impact on the local economy, these developments also come with disadvantages. A major issue is f.e. the need to open up and clear new lands which in combination with non-improved agricultural practices are resulting in high soil erosion rates.

Despite the challenges there are also opportunities. Although the production of meat, milk and skin industries is concentrated in cities and major towns both in Uganda and Tanzania, potential areas for investment in agriculture in Kyotera and Missenyi exist:

- production of high-yielding cash crops for regional and national market as water for irrigation is abundant;
- supply of agricultural inputs such as fertilizers, insecticides, seeds other related requirements at affordable prices;
- supply of farm implements such as power tillers, tractors and ox-cats at affordable prices;
- agro- processing industries especially sorting and packaging industry for vegetables and fruits; and irrigation by constructing irrigation schemes.

Forestry

The forestry sub sector plays an important role in maintaining ecological balance, protect soils from erosion and conserves water and wildlife. Forests are sources of domestic energy and provide industrial raw materials. Forests also provide useful non-wood products mainly honey and beeswax.

The major causes of the deterioration the quality and the quantity of the natural resource base is associated with human activity. Deforestation is a common practice in both districts. This is closely followed by wetland degradation as a result of cultivation of crops. Other threats are soil erosion whose magnitude and impact has never been quantified. There has been various strategies for Natural Resources rehabilitation and management. This has been done through strategies namely protection of the existing Natural Resources, replanting depleted trees in the Natural Resources and encouraging private tree planting. The private sector has also been encouraged and supported to; invest in natural resources put up tree nurseries on a commercial basis. The Farmers have also been encouraged to integrate tree planting into crop and animal production practices. Campaign on tree planning is an ongoing process. For instance between 2011-2015, tree seedlings amounting to 9,560,371 were raised in Missenyi District Council. The biggest number of tree seedlings of 2,190,400 (22.9 percent) was raised in 2012 while the lowest number of 1,678,090 tree seedlings (17.6 percent) was raised in 2014.

However, promotion of exotic tree species (pine and eucalyptus) in favor of indigenous species tend to change soils and micro-climate as they create their own is a challenge as these tend to destabilize the environment. This would require the ministries, natural forest agencies and CSOs to undertake comprehensive campaign for growing indigenous trees.

Bee keeping (apiculture) is a fast-growing activity in Missenyi District because of high demand for bee products and low capital outlays required. Not only that, the existing of forest in Sango-bay and Minziro is a contributing factor. For instance, there are more than 500 hives used in all of Kyotera District. Honey production today is estimated at 45,000 kg worth more than UGX 250 million. From 2011-2015, Missenyi District Council had 1,637 traditional beehives and 712 modern bee hives. As the number of traditional and modern beehives (KTB) has been increasing, there is a high expectation on the improvement of bee keeping in future due to a significant increase especially on the use of modern beehives.

Forest reserves have a very high potential for income generating investments. Logging and timber investments in the forest industry are therefore very prospective. Other related investment potentials include: Modern carpentry workshops to produce high quality furniture for local, regional and international markets; Investment in production of construction materials, charcoal, and fuel wood. Both forest reserves and game reserves have very high potential for income generating investments. Logging and timber investments in the forest industry are very prospective. During the regional workshop (Wetlands International 2019b), it was reported that indiscriminate harvesting of logging, timber, and charcoal and therefore smuggling is rampant in the area. This was confirmed during the 2019 assessment on community perception and forest disturbance in Minziro Nature Forest Reserve (Martin and Rovero, 2019). Tree bark is harvested both for medicinal purposes as well as for traditional barkcloth making (Explainer 3).

Explainer 3 – Traditional knowledge - Barkcloth making

Barkcloth making is an ancient craft of the Baganda people who live in the Buganda kingdom in southern Uganda. Nowadays, production of barkcloth is still taking place, both in Kyotera, Uganda and in Missenyi, Tanzania.

Its preparation involves one of humankind's oldest savoir-faire, a prehistoric technique that predates the invention of weaving. The inner bark of the Mutuba tree (Ficus natalensis) is harvested during the wet season and then, in a long and strenuous process, beaten with different types of wooden mallets to give it a soft and fine texture and an even terracotta colour. Craftsmen work in an open shed to protect the bark from drying out too quickly. Barkcloth is worn like a toga by both sexes, but women place a sash around the waist. While common barkcloth is terracotta in colour, barkcloth of kings and chiefs is dyed white or black and worn in a different style to underline their status. The cloth is mainly worn at coronation and healing ceremonies, funerals and cultural gatherings but is also used for curtains, mosquito screens, bedding and storage.

The production of barkcloth, which was widely spread with workshops in almost every village in the Buganda kingdom. With the introduction of cotton cloth by Arab caravan traders in the nineteenth century, production slowed and eventually faded out, limiting the use of barkcloth to cultural and spiritual functions. Nevertheless, barkcloth is still recognized among the Baganda community as a marker of specific social and cultural traditions. In recent years, the production of barkcloth has been greatly encouraged and promoted in the Buganda kingdom.



Barkcloth makers
(source: https://nl.pinterest.com/pin/411657222179860002/)



Harvesting of barkcloth
(source: https://blog.sevenponds.com/cultural-perspectives/bark-cloth-the-oldest-mourning-garment)



FIGURE 29: PROTECTED WETLAND AREA NEAR MINZIRO FOREST RESERVE SET ON FIRE, AS WAS OBSERVED ON 25 APRIL 2019

Seasonal burning of grasslands and bushes is done for clearing of agricultural lands and late burning of pastoral lands. Bush burning is a common occurrence during the dry seasons and also takes place in protected wetland area near Minziro nature forest reserve, as was observed on 25 April 2019 (Figure 29). The burning is used as a traditional method for destroying ticks and other vectors as well as stimulating fresh pastures, creating sweet young shoots for livestock, and to clear areas in advance of tilling farms. However It degrades the wetlands, and contributes to biodiversity loss and migration of wild animals.

5.4 FISHERIES AND AQUACULTURE

Lake Victoria is the most important source of fish. Victorian fishing is largely commercial and dominated by Nile perch which is certified and exported to fish processing plants and other markets in and outside Kyotera and Missenyi Districts source of livelihood. The main species of fish caught include Nile perch and Tilapia, although cat fish, Haplochromis locally known as Nkejje in Uganda and Furu in Tanzania and lungfish are often harvested on subsistence scale. Fishing is done using gill nets, long lines and scoop nets.

Fish catches indicate a notable reduction between 2016 and 2017, probably due to stock reduction in the waters, attributable to climate change effects and over fishing in previous years. However fish prices increased over the time leading to net gains in actual incomes received by fishermen. There is need to intensify fish conservation efforts through monitoring, control and surveillance exercises and also to promote good fish handling practices as well as fish culture, particularly through guided cage technology in shallower bays of the lake. Cage culture has the potential to double fish production within a few years and private investors are encouraged on the enormous opportunities available in this area.

5.4.1 Fish from Lake Victoria

Capture fisheries are one of the key natural resources that are obviously directly linked to people's minds and livelihoods for Sango Bay and Minziro FNR area and its relation to Lake Victoria. The fisheries resources of Lake Victoria contribute enormously to the regional economies of Kenya, Tanzania and Uganda, injecting about USD 840 million in 2014, with USD 540 million generated at the beach and a further USD 300 million from Nile perch exports (LVFO, 2016). This value emanates from an annual fisheries production estimate of 1 million tons, where 95% of the total catch and 90% of biomass is composed of three key commercial species: Nile perch (Lates niloticus), Nile tilapia (Oreochromis niloticus) and Dagaa (Rastrineobola argentea) (LVFO, 2016).

The Lake's fisheries employ about 800,000 people directly and indirectly and contributes to livelihoods of another 3 million. Contribution to GDPs of riparian States is about 2% for Kenya, 2.8% for Tanzania and 3% for Uganda.

The lake's production and value of the three commercial species has been varied over the years. Estimated annual production in 2014 for Dagaa was 509,598 tons valued at USD 135 million, Nile perch 198,624 tons valued at USD 545 million and Tilapia 291,778 tons (LVFO, 2016). This makes Nile perch the most commercially significant contributor in Lake Victoria. However, the threats posed to the fishery such as increasing fishing effort, inadequate enforcement of fishery regulations, growing local and regional market for small immature fish (illegal trade) has led to the riparian states developing measures to guide the management of the fishery (LVFO, 2015). Key management measures of the fishery include LVFO strategic plan (2016-2020), Lake Victoria Fisheries Management Plans; I, II and III (2016-2019), IUU-RPOA (2004) and Nile Perch Fishery Management I and II (2015-2019).

Despite all these challenges, Nile perch is still a principal economic driver of Lake and still holds potential for further development and earnings in foreign exchange. It is estimated that Nile perch is exported to over 50 countries, where European Union (EU) markets account for 45% by volume and 50% by value. The major importers of Nile Perch products in EU market include Holland, Spain, Italy and Germany (MRAG 2008 unpublished report). The most exported NP products are fresh skinless, boneless fillets, maws, headed and gutted value added. While much of information has already been collected or known about the international trade of NP, information is scanty on the regional and local market. For example, the quantities and types of products traded; handling and processing of these products; actors dealing with the products; profit margins along the chain; and regulations governing regional and local markets are largely unknown.

TABLE 15: EXAMPLE OF FISH CATCHES AND VALUE FROM LAKE VICTORIA FOR 2015 TO 2017 (KYOTERA DISTRICT)

Year	Nile Perch		Tilapia	
	Wt in Kgs	*Value in UGX'000*	*Wt in Kgs*	*Value in UGX'000*
2017	3,521,769	35,217,690	217,488	741,419
2016	3,831,196	30,648,568	51,958	602,685
2015	3,491,886	19,573,415	157,002	620,966

Fish catches indicate a notable reduction between 2016 and 2017 in Kyotera District probably due to stock reduction in the waters, attributable to climate change effects and over investment in terms of gear and people in previous years. However fish prices increased over the time leading to net gains in actual incomes received by fishermen. There is need to intensify fish conservation efforts through monitoring, control and surveillance exercises and also to promote good fish handling practices as well as fish culture, particularly through guided cage technology in shallower bays of the lake. Cage culture has the potential to double fish production within a few years and private investors are encouraged on the enormous opportunities available in this area.

The main location of fishing activities in Missenyi District Council is in Kashenye Ward. Missenyi District Council has a small share of Lake Victoria water body but has not yet utilised fully due to absence of official fish market centers and good infrastructure. By 2015, the district council had 39 fishing licenses, fishermen and 39 registered fishing vessels and 11 unregistered fishing vessels. Between 2011-2015 the average production was 48,200 kgs with average of TZS 241 million as revenue from fisheries by Missenyi District Council. Kashenye is the only ward whose performance of the sector is significantly observed. Major fishes that are found in Kashenyi include Nile Perch, Nile Tilapia, Dagaa and other indigenous species such as Clarias, Protopterus and Haplochromines.

5.4.2 Fish from wetlands, ponds and rivers

In addition to capture fisheries from Lake Victoria, significant quantities of fish are harvested from lake shore wetlands and rivers. The main fish species harvested from the wetlands and rivers include Clarias alluadi (Nsonzi) and Clarias gariepinus (Male), which are locally consumed in the area and a big number is used as bait for catching the Nile Perch (Lates niloticus) from Lake Victoria. A large number of local communities are involved in the fishery of Lake Victoria, which are dependent on baits from Sango Bay wetlands. In addition to the Clarias spp. For bait, there are huge catches of Protopterus aethiopicus (Mamba), a local delicacy, mainly from wetlands fringing the Kagera and other streams and rivers.

Over fishing is one of the serious problems – especially in wetland areas. This has resulted common cases of wetland degradation, during the harvesting of the wetland, river fisheries and bait fishes. To access the species, which burrow in the mud, the fishermen dig channels through the wetlands, which are continuously deepened and end up affecting the water levels and acting as opportunities for wetland drainage for crop farming. For instance, the economic value from wetland and river fisheries in Uganda was estimated at UGX 6,400 million (US$ 1,9 million) per year.

5.4.3 Fish from aquaculture (land and lake/ cage culture)

Fish farming / aquaculture in Kyotera District is a handy supplementary source of fisheries to the capture fisheries from natural lakes and rivers and fish farming is one of the priority enterprise that they consider, if resources were to be available but the big challenge they have faced with fish farming is that it is capital intensive with long to reap the profits. There are more than 130 fishponds in Kyotera District and two commercial fish farms have been established by the private sector to service the aquaculture sector. However, they noted that one natural challenge of aquaculture has been the frequent prolonged droughts, which reduce water supplies to ponds.

4.4.4 Marketing of fish

There is no well-organized and formal fish market, but many independent (mostly) private traders buying and processing the catch and selling it elsewhere. Nile Perch is f.e. processed at Kagera fish Company (at Kemondo bay Bukoba District), Vic fish Company (at Nyamkazi Bukoba Municipal) or transported in cold trucks to Mwanza Fish Processing factories. Sardines are often dried locally and exported to neighbouring countries. Finally, fish is obviously also for own consumption and sold in local markets.

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. Firewood is widely used in rural areas. As a case in point the 2012 Tanzania Population and Housing Census shows that in Missenyi Ditrict 92.1% of households use firewood as the main sources of energy. A similar picture most probably applies to Kyotera. Private sector and some organization such as World Vision have invested in educating the rural communities of the use of solar energy. More effort 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. The forest departments are also embarked on promotion of energy saving stoves by use of local available materials.



FIGURE 30: CHARCOAL PRODUCTION SITE INSIDE MINZIRO FOREST NATURE RESERVE (SOURCE: MARTIN AND ROVERO, 2019).

The districts have a tarmac road from Uganda to Tanzania (Mutukula) and this plays a major role in the economic status of people around the area. They use it for transportation of their produce and other products. Road network is the most common type of transport available. Electricity supply stimulates both social and economic development and improves the quality of life. However, power supply is not yet stable and faces a number of challenges such as intermittent power interruptions, low voltage, rationing, and outages. Overall, these challenges affect production of goods and services. No railway transport services were available in Kyotera and Missenyi. Although the railway transport service is needed by people in the area in order to simplify the transportation of goods and services within and outside, the service was not available. Likewise, air services were not available. The districts face moderate telecommunication services such as internet and telephone services for both cellular phones, land line-based telephone services as well as postal services. The areas have access to different providers of mobile phones.

The East African Crude Oil Pipeline

The Uganda–Tanzania Crude Oil Pipeline (UTCOP), also known as the East African Crude Oil Pipeline (EACOP), is under construction and intended to transport crude oil from Uganda's oil fields to the Port of Tanga, Tanzania on the Indian Ocean. Pipeline construction will start after the Final Investment Decision has been made and will last approximately three years. The 1443-km pipeline is planned to traverse the Sango Bay-Minziro wetland landscape along its western boundary (Explainer 4). Environmental and Social Impact Assessments (ESIAs) are undertaken for most activities and are subject to the approval of the National Environment Management Agency (NEMA) in Uganda and National Environment Management Council (NEMC) in Tanzania, who should ensure that environment and social mitigation management plans are implemented.

Explainer 4 – East African Crude Oil Pipeline

Currently, the East African Crude Oil Pipeline (EACOP) is being planned, a 1443-km pipeline transporting oil from Western Uganda to the Tanzanian coast. This pipeline is planned to traverse the Sango Bay-Minziro wetland landscape, along the western boundary of Minziro National Park and crossing the SAMUKA Ramsar wetland system.



East African Crude Oil Pipeline planned route through Uganda and Tanzania (left) and through the Sango Bay-Minziro wetland landscape (purple line; right)

Although the pipeline is expected to boost the economy of both Tanzania and Uganda at a national level, for the target area there are a number of risks. WWF and CSCO (2017) has drafted an analysis detailing the risks to water resources, wildlife and biodiversity. One of the main conclusions is that the pipeline poses a severe threat to water resources: "the probability of oil spill combined with the magnitude of the river network and tributaries to the Lake Victoria could lead to disastrous consequences by pollution and contamination of water bodies including Lake Victoria and have dramatic environmental and socio-economic consequences for the region." Moreover, they mention the Kagera river particularly being noteworthy in this context. Especially considering the seismic activity in the area, with a 5.9-magnitude earthquake hitting north-western Tanzania in 2016, the probability of oil spills seems reasonably high. Oil spill will not just affect water resources of course, the consequences are just as severe to the wildlife and biodiversity of the area.

The threats are not limited to the operational period of the pipeline, construction also poses certain threats. There is worry of drying of wetlands because of water requirements, depilation and pollution of water resources due to new settlements, increase in poaching due to easier access to natural resources and fragmentation of natural areas. Also with eventual decommissioning, the risk of pollution is considerate.

More information on the Environmental Impact Assessment can be found here
In summary: https://pau.go.ug/site/assets/files/1105/eacop_esia_summary-_oct_2019.pdf
In full: http://eacop.com/EACOP%20UGANDA%20ESIA%20REPORT.pdf

5.6 TRADE AND INDUSTRIES

Industrial growth in Sango-Bay – Minziro ecosystem is mainly agro-related and is slow hinging mainly on maize crop, coffee processing, fish processing, vegetables and fruits and sugar cane. While sugar processing company is well established in Bukoba Region (Tanzania), sugar estates in Kyotera is yet to be realized, but over 1 sq. mile of sugar plantation has been established in readiness for machinery installation. There are no fish processing factories in Missenyi but there are two factories in the Kyotera namely Oakwood Investment at Kasensero and Byansi Fisheries at Kilisizo. The presence of those factories implies the need for investment in improving the road. Two large fish processing industries (Kagera Fish Co. Ltd and Vicfish Co Ltd) are in Bukoba town.

Aquaculture is a newly established fishing industry through fish farming. In this sector, training is based on site selection, pond construction, stocking, fish feeding, record keeping and other things so that they can meet the required standards. Other food industries include dairy cattle breeding for production

of calves and milk processing for production of milk and milk derivatives such as cheese, butter, curdam, yogurt and ghees are some of the activities in the beef and dairy industry. Other activities in this sector are the production of veterinary products, premixes and animal feeds.

Both districts have good potential for beekeeping investment because of favourable climate and forests. Beekeeping is widely practiced in these areas at medium and small-scale operation. The introduction and universal use of modern beehives and modern honey harvesting and processing methods could make honey and beeswax a significant earner of income for many people in Missenyi and Kyotera. Other small-scale agro-processing industries are maize milling and packaging, bread processing, sunflower oil processing and fruit processing. Non agro-related factories are mattress factory, timber processing, furniture works and carpentry, garages, brick making and welding, among others.

Because of the districts strategic location in the East African Community and agriculturally rich land with plant of agricultural products and natural resources, investment in the area of pharmaceutical industry can be ideal as well as investment in packaging and branding can be additional industries apart from the existing agro-related processing industries. Trade volume will increase as a result of regional and cross border trade and Investments. The Agricultural and Livestock sectors will have a high demand in the cross-border trade and this will increase the volume of trade with its neighbours in Rwanda, Burundi and DRC.

The East Africa Crude Oil Pipeline (EACOP) will be laid with a route that crosses the Sango Bay Minziro wetland areas. Both the pipeline itself and its construction phase will potentially threaten the environment in general, and more specifically birds, and wildlife species that inhabit the wetland lowlands.

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 tourism. Because of its natural beauty, Sango-Bay Minziro 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.

Tourism is one of the most important and a viable economic sector in the Sango Bay-Minziro area and this has the potential of attracting investors, who can spur economic development in the region. The Sango Bay-Minziro area has a very high cultural ecosystem service value; in form of aesthetic, spiritual, recreation and ecotourism values. This includes the beautiful scenery of the different areas, including a variety of vegetation zones, Lake Victoria (the second largest fresh water lake in the world), the view of the full Kagera and Ngono Rivers, and beautiful plants and animals, that provide cultural services in the form of aesthetic values and tourism, whose potential was reported by most respondents to be still not optimally promoted. The area is also host to some historic sites such as the memorial religious buildings and monuments that are a central of tourist attraction.

In addition, a number of historical sites available in the Minziro area include a historical church at Kyaka bridge (Missenyi District, Tanzania), which is amongst the oldest in Africa to be built by the first missionaries and attracts Christian pilgrims from Africa, Europe and across the world. There are also other sites such as the Heroes Monuments at Mutukula and Missenyi and the Kagera museum at Bukoba; which are historical and archeological archives. The Chiefdom palace at Kanazi and the Buganda palace (Nang'oma) at Mikunyu/Kyebe (Kyotera, Ug) are of historic importance. The Sango Bay area also contains one of the world's Stone Age sites, which is of archaeological and religious importance, and is a significant tourist attraction. The area, internationally known as the Sangoan archaeological site, is located both in wetland and woodland forest areas and includes tools that were used approximately 200,000 years ago.

The ecosystem is also potential for forest as well as game reserves. The forests include Sango Bay forest (Kyotera), Minziro FNR (Missenyi) and Munene and Ruasina (Missenyi). Sango Bay and Minziro forests and game reserves have very high potential for income generating investments. The forests are potential for eco-tourism, block hunting, and photographing tourism. Some of the existing species are endemic which could make a very attractive tourist attraction and even call for them to be declared among the world heritage.

Another tourist site is Musambwa islands, which has a long history of cultural attachment. The Musambwa islands are some of the smallest islands located in Lake Victoria. The largest is about 5 ha in area separated by about 800m from the smaller one covering about 3 ha and between them is the smallest which are just rocks jutting out of the water with little vegetation. Despite their size, they

support large populations of congregatory breeding birds of the African race like the Grey Headed Gull, Greater Cormorant, Little Egret and the Long-Tailed Cormorant; among others. Due to the importance for birds of global significance, the Musambwa islands have been recognized as an Important Bird Area. The islands are known to be the largest breeding site in Africa for African Grey Headed Gulls. It is also considered a Sacred Island, where only men can stay overnight, and it has the Musambwa tree where the gods of the island are believed to be. Tourists visit Musambwa Island for Bird Watching and for Cultural tourism- new members are treated to an initiation dance by the community.



FIGURE 31: KASENSERO MEMORIAL SITE

During the Rwanda genocide of 1994, in which more than an estimated 800,000 people were killed; some bodies were dumped in River Kagera and floated to Lake Victoria. Some dead bodies were picked and buried at Kasensero village in Kyotera District (Figure 31), and Mpigi District which is a home to Golo Memorial site and Masaka for Lambu memorial site. These memorial mass graves have turned to be spiritual and tourist sites and are regularly visited by Rwandese who lost their relatives. It is also used for education purposes.

Water spots, beach spots and investment of recreation points along the beach of Lake Victoria are among the avenue that can be taken to boost tourism industry. Unfortunately most of these sites are not well developed. Table 16 summarizes the major sites with a short description and status.

TABLE 16: SITES WITH ECO-TOURISM POTENTIAL IN THE SANGO-BAY AND MINZIRO WETLAND LANDSCAPE

Site / Location	Status and description
Church at Kyaka Bridge & Heroes Monuments at Mutukula (Missenyi District) as a result of the Uganda-Tanzania war (1978-1979)	Not very well developed
Sangoan archaeological site	One of the world's Stone Age sites, which is of archaeological and religious importance, and is a significant tourist attraction
The Chiefdom palace at Kanazi (Missenyi, Tz)	Not well developed
King of Buganda palace at Nang'oma, at Mikunyu/Kyebe (Kyotera, Ug)	Building idle
The 'Mafiga matatu' tourist site where the borders of the three countries convene (Missenyi, Tz)	Not well developed
Kasensero Genocide memorial site (Kyotera, Ug)	Developed – The mass graves contain thousands of victims who were killed and thrown into rivers in Rwanda and bodies ended up on the shores of Lake Victoria at the Kagera River mouth
Wajinja Rocks (Kibonzi/Nabigasa) – Kyotera, Ug	Not developed
Colonial war bunkers at Katongero hill – Ssimba village/Kakuuto (Kyotera)	Not developed
Lake Victoria – second largest lake globally (Kyotera & Missenyi) own some proportion	Open for public use/open access
Musambwa Islands (Lake Victoria) – Kyotera	CBOs formed. Open for public use with support from Fauna and Flora International (FFI) and Nature Uganda
Kyasango wonder tree (Kyotera)	Not developed, believed to have 140 years, used as landmark for fishermen. Can be seen over 40 Kms; site for making local brew and cultural tales
Kakuuto Ostrich farm (Kyotera)	One of the developed area, One of the few ostrich farm in Uganda which involves ostrich watching and riding, Agri-tourism is also done, Fish farming, orange farms, piggery, poultry farm, Tourist accommodation in bandas/huts (double, single, groups), Craft shops, horse riding, community walks, study center, soft drink and meals
Community tourisms (Kyotera and Missenyi)	Developed, Handcraft making, Souvenir
Bark cloth making (Kyotera and Missenyi)	Not developed, Small homestead workshop
Kagera river meanders (Missenyi and Kyotera)	Main river, Has crocodiles, Hippos and birds which sail to Lake Victoria, Breeding ground for fish, Harbors traditional & indigenous fish species, Main water supply to Lake Victoria, Site for living colonial history – the bunkers
Kihilila at Gera Waterfalls (Missenyi)	Not well developed
Ruiga forest reserves and Minziro forest reserves (Missenyi)	Not well developed
Malamagambo forest canopy (Kyotera & Missenyi)	One of the rain forest in Uganda with a number of endemic species of trees and famous for its *Podocapus* species, Important bird area and part of SAMUKA Ramsar site, Transboundary resource, Good site for bird watching with over 250 species of birds and outstanding for its butterfly species, Supports 36% of Uganda bird species and 50% of diurnal primates, elephants, buffalos, and bush pigs
Sango bay steep edge forest	Clear 90 degrees of demarcation between the grassland and the forest, Characterized by unique forest mosaic within swamps – sharp edged, Scenic and they are worth memory to remember, Has elephants, buffalos and sitatunga etc, Host 75% of the total global population of the blue swallow
John speke Lake Victoria site (Kyotera)	Not developed
Kasensero rocks (Kyotera)	Not developed
Community visits for HIV/Aids tales	Not well developed

The aesthetic value and nature based tourism in Sango Bay-Minziro area was as estimated at US$ 14.3 million per year; with a habitat value of US$ 360 per hectare per year (USAID 2016). Respondents from district authorities reported that they have been trying to link up with the Uganda Tourist Board to market the Sango Bay area as an important tourist destination, which could be included in the existing tourist circuits. In addition to government efforts, it was reported that other actors are coming in to develop the tourist potential for the area. For example, one innovative private entrepreneur has set up an ostrich centre in Kakuuto sub-county, which was reported to be attracting some tourists (USAID 2016).

In all potential tourist sites mentioned (Table 16), improvement of road infrastructures as well as financial and accommodation facilities are important for tourism growth. All these can well be achieved through Public Private Partnership (PPP) and proper engagement of local people.

6.1 HUMAN DEMOGRAPHY

Missenyi and Kyotera Districts are among the fastest growing districts in Tanzania and Uganda, both as a result of high birth rates and migration.

Demography Missenyi District, Tanzania

The 2012 Population and Housing Census shows that at Missenyi the population stood at 202,632, out of which, females accounted for 52 percent and males accounted for 48 percent of the population. Population in Missenyi District increased by 32.6 percent (49,846 people) between 2002 (152,786) and 2012 (202,632), according to the socio-economic profile of 2015 (Missenyi District 2018). Missenyi District had an average population density of 51.9 people per sq. km in 2002, which increased to 75.9 people per sq. km in 2012. Migration contributed to population increase in Missenyi with Haya's, Ha's (from Kigoma) and Sukuma's (from Mwanza) being the main migrant ethnic groups. A main reason for incoming migration is the presence of industries such as Kagera Sugar Company, OLAM Coffee Processing Industry and Missenyi Ranch (Missenyi District 2018).

Household size is another key indicator used to measure the quality of households and examine the burden experienced by bread winners in their households. In 2012, the population of Missenyi District Council was found to have 202,632 people in 48,104 private households. Despite the population increase, the household size decreased slightly to 4.2 persons per household. The 2012 Population and Housing Census results show that the population of Kagera Region will almost double after 25.5 years (Missenyi District 2018).

TABLE 17: POPULATION DISTRIBUTION BY WARD AND WITH SEX RATIO, MISSENYI DISTRICT (TANZANIA), 2002 AND 2012

	2002			2012		
Ward	Male	Female	Sex ratio	Male	Female	Sex ratio
Kakunyu	6,996	6,692	105	10,267	9,866	104
Nsunga	5,539	5,026	110	10,159	8,842	115
Mutukula	4,071	3,445	118	7,735	7,764	100
Kasambya	8,948	8,985	100	13,055	13,578	96
Minziro	4,077	4,238	96	4,828	5,123	94
Ruzinga	1,846	1,975	94	1,549	1,744	89
Kashenye	1,846	1,975	94	2,740	2,917	94
Kanyigo	5,028	5,028	100	4,954	5,214	95
Ishunju	1,474	1,702	87	1,635	1,844	89
Buyango	3,648	4,096	89	4,273	4,605	93
Bwanjai	3,434	3,903	88	3,990	4,308	93
Ishozi	3,348	3,792	88	3,517	3,677	96
Gera	2,094	2,243	93	2,341	2,490	94
Bugandika	3,967	4,508	88	4,478	4,966	90
Kitobo	3,216	3,581	90	3,531	3,796	93
Bugorora	2,790	2,842	98	3,366	3,539	95
Kyaka	4,312	4,340	99	6,437	6,753	95
Mushasha	8,345	8,536	98	2,496	2,587	97
Kilimilile	4,383	4,545	96	5,652	5,804	97
Mabale	2,516	2,654	95	3,082	3,130	99
Total	**81,878**	**84,106**	**97**	**100,085**	**102,547**	**98**

Demography Kyotera District, Uganda

The 2017 Population and Housing Census shows that at Kyotera District, Uganda, the population stood at 253,538, out of which females accounted for 51 percent and males accounted for 49 percent of the population. About 68% of the population of former Rakai is in what is now Kyotera district at the time of reformation (GoU 2009). Average population density in Kyotera District is 147 people per sq. km. The population growth rate was 2.06 by 2017. In Kyotera, about 78% of the population is rural, a situation which reflects the basically agricultural nature of the district economy. In this rural environment, settlement pattern vary, depending on a number of factors such as climate, vegetation, water supply, terrain, soil

fertility, disease agents etc. Kakuuto County is the least densely populated with about 60 people per sq km. The low population in Kakuuto can be attributed in part to the fact that the low-lying areas bordering the Lake (the Sango Bay, which seasonally floods making it un-conducive to permanent settlement, covers much of the County and the acute shortage of water (Kyotera District 2017).

TABLE 18: POPULATION TREND IN KYOTERA DISTRICT (UGANDA), BY 2014 AND 2017 (SOURCE: KYOTERA DISTRICT, 2017)

Administrative Unit		Households		2014			2017
County	Sub County	Number	Average Size	Total	Males	Female	Total
Kakuuto	Kakuuto	9,366	4.1	39,827	21,037	21,302	42,339
Kakuuto	Kasasa	3,925	4.3	17,187	8,884	9,387	18,271
Kakuuto	Kyebe (Incl. Nangoma)	5,507	3.7	20,613	11,067	10,847	21,913
Kyotera	Kabira	6,738	4.5	30,994	16,598	16,351	32,949
Kyotera	Kalisizo	4,095	4.3	17,975	9,359	9,750	19,109
Kyotera	Kirumba	5,852	4.2	24,822	12,696	13,691	26,388
Kyotera	Lwankoni	3,397	4.3	14,893	7,767	8,066	15,832
Kyotera	Nabigasa	4,715	4.3	20,616	10,691	11,225	21,916
Kyotera	Kyotera Tc	1,645	4.2	12,789	5,782	7,271	13,052
	Kalisizo Tc	3,589	3.6	13,464	6,236	7,505	13,741
	Kasaali T/C	6,224	4.1	26,365	13,841	14,187	28,028
Total		**55,053**	**4.0**	**239,545**	**123,958**	**129,582**	**253,538**

Albeit migration plays an important role in population growth, it is difficult to accurately estimate. Unlike birth and death (the other two factors that affect the population size of a country) migration, especially emigration has been difficult to monitor.

Overall demography figures Sango Bay-Minziro

The total population in Sango Bay – Minziro wetland landscape in 2019 was calculated from census data (UN 2019; UBS 2017; NBS 2013). In Table 19 population estimates for 2019 are shown, from national level to project area level. In Tanzania, about 58 million people live and in Uganda about 44 million. In Missenyi district in Tanzania and Kyotera district in Uganda, about 0.23 million and 0.27 million live respectively. Serving as proxies for the population in the Sango Bay – Minziro wetland landscape, that makes for a total of about 0.5 million people.

The same census data (UN 2019; UBS 2017; NBS 2013) was also used to forecast the total population in Sango Bay – Minziro wetland landscape until the year 2030, as shown in (Figure 32), which is expected to rise from the current 498.000 (2019) to 563.000 in 2025 and 622.000 in 2030 with a population growth rate of 2.04.

TABLE 19: 2019 POPULATION ESTIMATES AT DIFFERENT ADMINISTRATIVE LEVELS

	Tanzanian side		Ugandan side		Sango Bay-Minziro total	
	Population (million)	Growth rate (%)	Population (million)	Growth rate (%)	Population (million)	Growth rate (%)
Country level	58	2.97	44	3.59		
District level	0.23	2.02	0.27	2.06		
Project area level	~ 0.23	~ 2.02	~ 0.27	~ 2.06	~ 0.5	~ 2.04

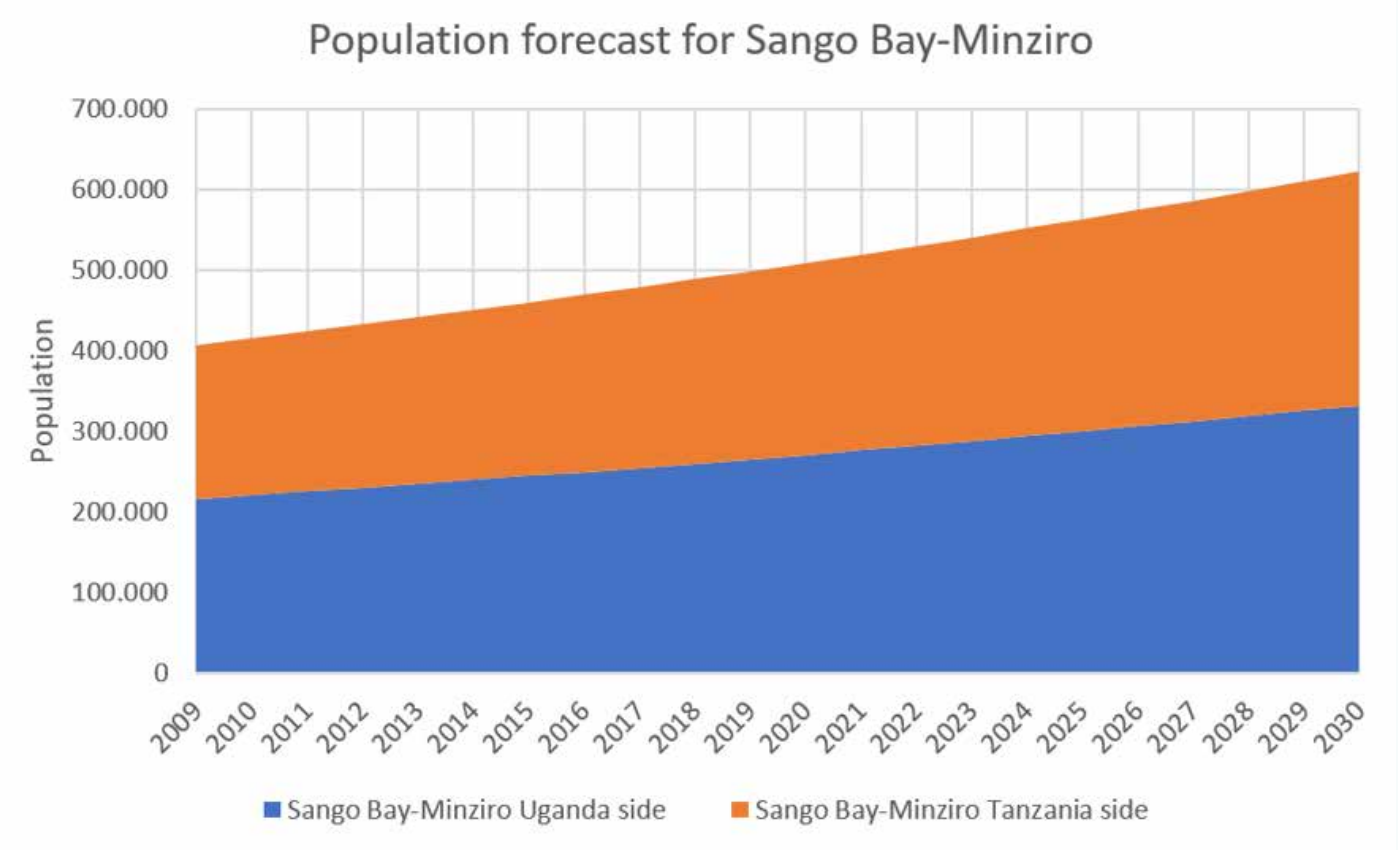


FIGURE 32: POPULATION FORECAST OF SANGO BAY - MINZIRO WETLAND LANDSCAPE

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 include the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) and the Dairy Development Authority (DDA) in Uganda, and the Ministry of Agriculture, Livestock and Fisheries (MALF) in Tanzania. On a local level, the livestock production departments of Missenyi (Tanzania) and Kyotera (Uganda) are active. Besides, there is PENHA, 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. Also active in Sango Bay is Twezimbe Farmers' Group Gwanda and village councils.

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. National parks are managed by the Tanzania National Park Authority (TANAPA); game reserves and game controlled areas are managed by the Tanzania Wildlife Management Authority (TAWA); and Wildlife Management Areas (WMAs) are managed by communities through Authorised Associations, which, except for the secretary and trustee of each Authorised Association, are democratically elected community-based organisations (CBO's). On a local level, the Districts Environment officer, Forest officer, Land officer, Entomologist, Natural resource officer, as well as LUMA, BUDA, BUMASI and Beach Management Units (BMU's) and CBO's are recognized in Uganda and Tanzania.

Two NGOs, Kolping (working under the same Euregio programme as this survey) and Biodiversity Project (no longer active) have recently being conducting environmental conservation activities such as providing environmental education, advocating for the use of energy saving stoves, tree nurseries establishment, agroforestry among other activities in the area. However, some of these activities lack sustainability and coordination with TFS. Hence assessing the impact of these activities on environmental conservation remains difficult (Martin and Rovero, 2019).

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). Tanzania Forest Services Agency (TFS) is a semi-autonomous government Executive Agency. The Agency is mandated to sustainably undertake conservation, development and utilization of national forest and bee resources so that they contribute to the social, economic, ecological and cultural needs of present and future generations. Local actors recognized in forestry management of Sango Bay – Minziro are the Uganda Forest office, Nature Uganda, Community, LVFO, NEMA, MAAIF, MoF, NFA, UWA, LVBC, District Authorities, Sub County officials, LC II, LC I, LUMA, BUMASI, BUTA (all Uganda) and RUWASA and Nature Tanzania in Tanzania.

6.2.4 Fisheries management

Local actors recognized in fisheries management of Sango Bay – Minziro are WRUAs, Community BMUs (in Tanzania), MAAIF, NaFIRRI, LVFO, LUMA, BMUs BUMASI, BUDA (in Uganda).

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 Health and Social Welfare (MHSW) in Tanzania are the key institution responsible for the water sector. In Tanzania, the Ministry of Education and Vocational Training (MEVT) is responsible for coordinating sanitation and hygiene in schools, while the Prime Minister's Office leads the implementation of school sanitation and hygiene activities. On local level, some Community Based Organisations (CBO's) are involved in the water and sanitation sector such as KAKUUTO, 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 Tanzania, Water User Associations (rural areas) and Water Service Providers (urban area) act as commercially oriented public enterprises responsible for water and sanitation services. Besides local governments, also active are NGO's such as World Vision, KADETF and CHEMA).

6.3 WATER SUPPLY AND SANITATION

6.3.1 Water supply

From the community- and district level meetings (see meeting reports Wetlands International 2019b and 2019c) and field surveys performed in April 2019 (see Appendix B) it becomes clear that especially during the dry season water shortage is experienced in Sango Bay-Minziro wetland area, both for animals (grazing) 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 Sango Bay – Minziro are favourable for groundwater exploitation and in addition huge reserves of fresh water are available such as River Kagera and Lake Victoria.

As per June 2019, the rate of access to a safe source of water (safe water coverage) in Kyotera District, Uganda, was estimated at 64%, with a functionality of 67%. The current strategic directive by the Uganda government is to ensure provision of at least one improved water source per village. In Kyotera District, a total of 167 villages (78%) are with a source of safe water, against a total of 47 villages (22%) that are still without a source of safe water supply (MWE 2019).

According to the Uganda Water Supply Atlas 2017, Kyotera District (back then Rakai District) has a total population of 550,000 of which only 46% have access to safe water. Access rates vary widely, from 6% in Kagamba to 95% in Kasaali subcounty (Figure 33). The towns located near the forest reserves and

protected wetland area of Sango Bay, like Minziro, have an access rate of around 30% (Kyebe subcounty). The subcounties of Kakuuto, Kasasa, Kalisizo TC, Kyotera TC and Nabigasa are served by the National Water and Sewerage Corporation (NWSC), the public utility in Uganda that provide water and sewerage services to major cities and towns, but in recent years started serving some of Uganda's rural areas as well.

There are almost 2000 domestic water points and 6 piped water schemes in the district. The overall source functionality in the district is 78% in rural areas and 42% in urban areas. Around 450 domestic water points have been non functional for over 5 years

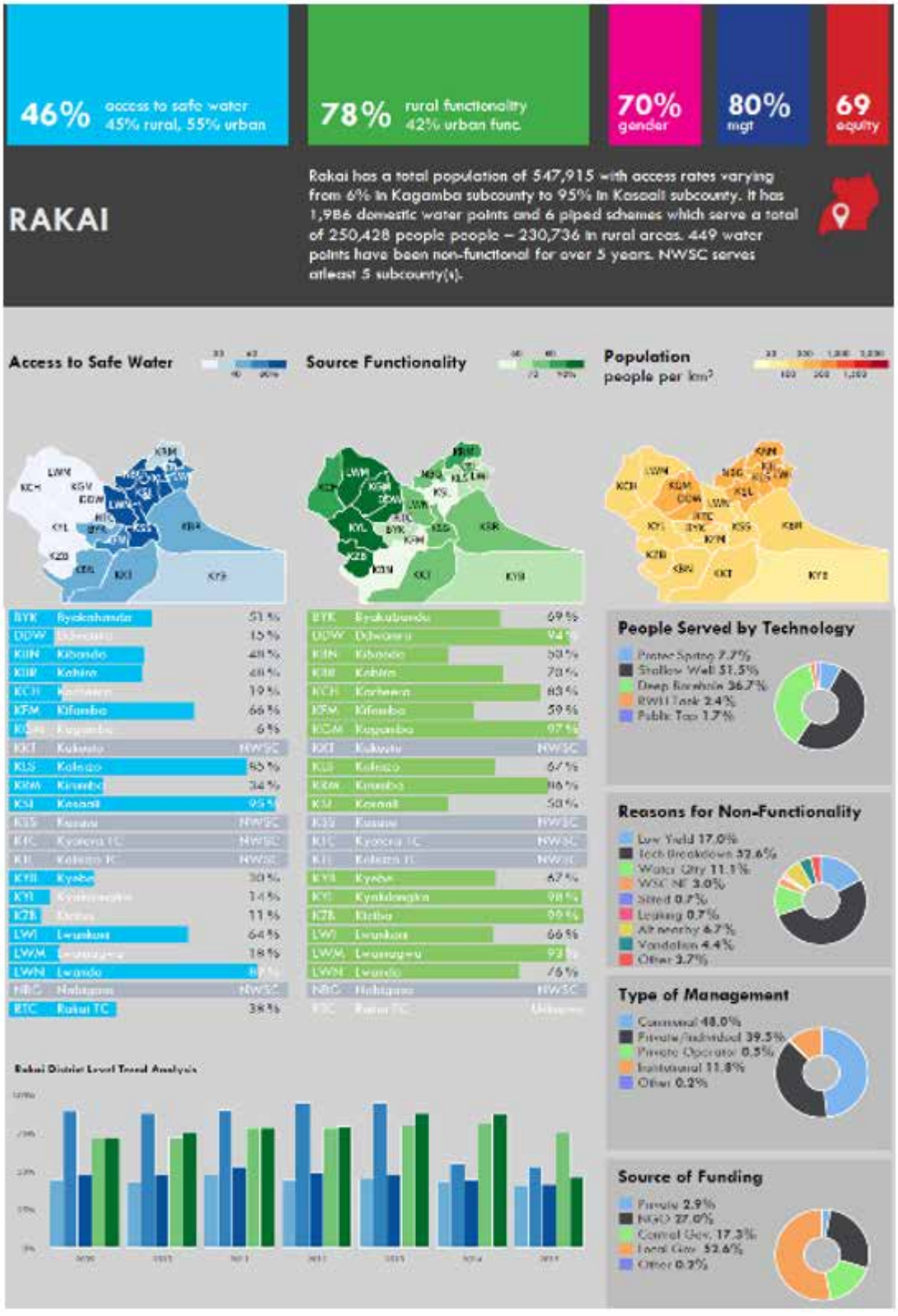


FIGURE 33: INFOGRAPHIC SHOWING THE ACCESS TO SAFE WATER AND WATER SOURCE FUNCTIONALITY (AS OF JUNE 2017) IN THE FORMER DISTRICT OF RAKAI (NOW KYOTERA DISTRICT), UGANDA. SOURCE: UGANDA WATER SUPPLY ATLAS, 2017

and are considered abandoned. Reasons for non-functionality are reported to be technical breakdown in most cases (52,6%), sometimes related to low yield (17,0%) or water quality (11,1%). However, during the field mission of April 2019 no cases of low yield or bad water quality were found.

The map of Kyotera District (former Rakai District; Figure 34) shows that protected springs as point water sources are mainly located west of the road between Kyotera TC and Mutukula road, as was also observed in the field (Appendix C – Field observations). Along this road, a lot of functional and non-functional shallow wells are located, with deep boreholes in the major towns. Within the forest reserves and protected wetland area of Sango Bay the main point water sources are deep boreholes and rain water harvesting.

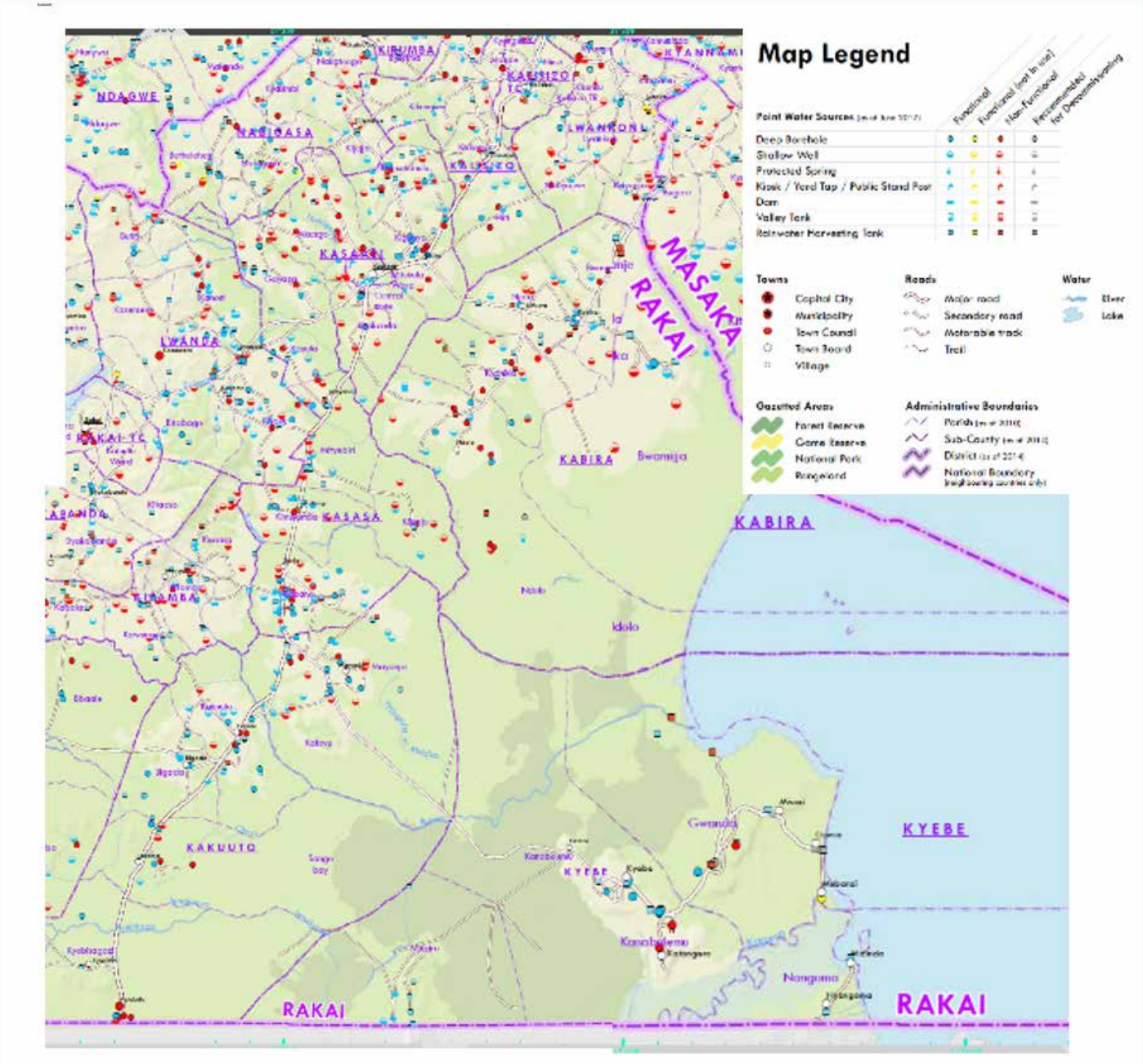


FIGURE 34: MAP SHOWING THE LOCATION AND FUNCTIONALITY OF DIFFERENT POINT WATER SOURCES (AS OF JUNE 2017) IN THE FORMER DISTRICT OF RAKAI (NOW KYOTERA DISTRICT), UGANDA. SOURCE: UGANDA WATER SUPPLY ATLAS, 2017

According to the Uganda Water Supply Atlas 2017, people are served mainly by shallow wells (51,5%) and deep boreholes (36,7%) in Kyotera District. Only 7.7% of the people are served by protected springs, 2,4% by roof water harvesting and public tap comprises only 1.7% (Figure 33). However, during the field mission of April 2019 it was found that roof water harvesting is an important source of protected water outside the major towns.

During the field survey in April 2019 it was found that Kyotera town council is served by a piped water system (source: three high yielding boreholes). In Kakuuto county people are served by boreholes and there is one piped water system (source: protected spring). Most springs are located in Kyotera county. Boreholes in the district normally don't dry, but during the dry periods in 2007-2009 and 2011-2012 some boreholes dried, according to the District Water Officer.

Kyotera District is not supporting the use of shallow wells since 2011, because of challenges with drying and contamination. Instead the extension of piped water network is encouraged. Challenges with single water points are also lack of ownership, no maintenance and water quality issues.

In Kasensero Landing Site (fishing village), people get water from the water kiosk (50 UGX per jerrycan). Kasensero has a piped water system (installed by Min of W&E), with the protected spring in Ssekaningo Forest Reserve as source (Figure 4 and Figure 36). From there water is pumped to elevated tank at Magoa (on top of hill) and distributed from there. In Kasensero, shallow wells are discouraged by the district because of risk of contamination. Roof Water Harvesting is also observed in the village.

In Minziro town (both UG and TZ side) they have boreholes for water supply, no springs or open wells (according to District Water Officer). In Ssange town there is piped water system, with water coming from two production wells (12 m3/hr and 18 m3/hr / 85 and 90 m deep). Piped water system will be extended to a third production borehole soon. In Kyotera town there is piped water system with water from three production wells (22 m3/hr, 22 m3/hr and 12 m3/hr). Water is distributed from a large 220 m3 elevated tank. Depth of BH's unknown, well completion reports could not be obtained. UN Habitat did drilling & distribution system. Pumps are powered by the net. At schools, rainwater harvesting tanks are installed.



FIGURE 35: POLY-GLU DRINKING WATER KYAKA TOWN, WATER TREATMENT PLANT NEAR RIVER KAGERA. PHOTO TAKEN ON 24 APRIL 2019 AT LAT: 1°15'04.80"S / LON: 31°25'07.96"E.

However, although the water yields of most boreholes are satisfactory they are not especially high, and sustainability is not assured, partly due to unprofessional borehole siting, drilling and construction practices and a lack of experienced supervision. During the transboundary meeting of 25 April 2019 (see meeting report Wetlands International 2019b) it was noted that in Missenyi District (Tanzania), there are many boreholes with mechanical breakdown that require rehabilitation. In Kyaka Town, there is a water treatment plant near River Kagera (Figure 35), where the river water is turned into drinking water by removing the high sediment load of the water using a flocculant and by disinfecting the water with a disinfectant powder.

Missenyi District is characterized by several protected and unprotected springs, that generally are a reliable source of potable water. Also several boreholes and wells were visited, both protected and unprotected and both with handpump and with electric pump. Because of differences in elevation, many times the villages are located on hills and ridges while the springs and high yielding boreholes are down in the valley. This requires a distribution system, sometimes costly due to the elevation difference to overcome. During the field survey it was observed that along Lake Victoria, most of the fishing villages depend on lake water with occasional use of boreholes where they are available.

According to the 2012 Population and Housing Census only 32% had access to a safe sources of water in 2012, while the Missenyi District Plan reports 62% for 2019. Whether the improvements can be fully attributed to new infrastructure is unknow; it could also be that the survey method differed. Safe water supply is provided by means of public taps,



FIGURE 36: PROTECTED SPRING IN SSEKANINGO FOREST RESERVE, PROVIDING WATER FOR KASENSERO AND MAGOA. PHOTO TAKEN ON 26 APRIL 2019 AT LAT: 0°54'07.81"S / LON: 31°44'16.90"E.

boreholes, shallow wells, piped water supplies, protected springs, rain water facilities and small dams. The district plan shows that most of the rural population continues to walk long distances to fetch water from natural springs and ponds, which places a large burden on women and children. Approximately 75% of the population gets water from natural sources (streams, rivers and Lake Victoria), and at an average price of TShs 4,000 per cubic metre (USAID 2016).

Water for Livestock

Most livestock farmers use natural sources (streams, rivers and Lake Victoria), as they are preferred due to their convenience of access during the time when livestock are out grazing. Also, watering from natural sources does not attract a cost, while a fee is charged for the use of most of the protected sources. Reports from Missenyi District indicate that at least 75% of the total 160,545 cattle (120,409) are watered from natural sources (USAID 2016).

Water for Irrigation

Missenyi District also has a large span of tributaries and vast groundwater potential that feed the Kagera and Ngono Rivers, which hold water even during the dry seasons. This provides an enormous potential area for irrigation in the Minziro area. However, during this study, respondents reported that crop irrigation potential is not optimally used, apart from a few cases of watering horticultural crops during the dry season. Although this has resulted in Missenyi ranking as one of the key producers of tomatoes and cabbages in the Kagera region, the only significant level of irrigation that has been carried out is at Kagera Sugar Company, to enhance the production of sugar cane (USAID 2016).

Water supply constraints

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

From the community- and district level meetings (see meeting reports Wetlands International 2019b and 2019c) and field surveys performed in April 2019 (see Appendix B) it becomes clear that there is limited access to adequate sanitation in most of Sango Bay-Minziro wetland area, especially at the landing sites and associated fishing villages.

Most of the landing sites and associated fishing villages lack adequate sanitation facilities, they are not being used or in some cases they are entirely absent. With the growing population there is an ever-increasing quantity of untreated sewage directly or indirectly entering Lake Victoria or River Kagera. There is also an absence of disposal facilities for fish waste along Lake Victoria and this is generally thrown straight back into the lake. In combination with inadequate garbage disposal facilities throughout Sango Bay-Minziro, the sanitation and hygiene conditions are worsening. In addition to the lack of access to sanitation facilities, poor construction and unprotected water supply facilities, poor rehabilitation and maintenance of wash facilities and a weak local private sector and local institutions with insufficient funding are worsening the problem, constraining the performance of the sanitation and hygiene sector.

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 the rural parts of Sango Bay Minziro, open defecation is a common practise where sanitation infrastructure and services are not available, which is especially the case in the landing sites along the Lake Victoria shoreline, like Kansesere. In the major towns latrine coverage is higher but also here untreated urban and industrial sewage is a risk. 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 garbage disposal facilities, the population in Sango Bay Minziro is susceptible to faecal contamination that can cause infections and waterborne diseases like cholera 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. Outbreaks of cholera happened historically, but are rare these days.

In Kigenya parish, Kasali Town council, Kakuto

County, Kyotera District, Uganda a new faecal sludge treatment plant (FSTP; Figure 37) was constructed and is operational since January 2019. They have a truck (8 m3) to dislodge septic tanks and lined pit latrines, mainly from schools and hotels but also smaller ones of individuals. The treatment consists of various steps, including an 'artificial wetland' where papyrus plants clean the sludge. After all steps, the remaining water is discharge in the wetland nearby. Desludging costs 150.000-200.000 UGX (EUR 36,- to 48,-) depending on the distance (fuel). Desludging is still much cheaper than construction a new latrine, after the old one got full, which used to be the normal procedure. Constructing a new latrine costs around 500.000 to 1.000.000 UGX (EUR 120,- to 240,-) for individuals, and around 2.000.000 to 2.500.000 UGX (EUR 480,- to 600,-).

During the field visit by the Consultant in April 2019 it became clear that they have received only 15 truckloads (120 m3) so far while the capacity of the treatment plant is 2 million m3/year. The FSTP was funded by EU, but now it has to sustain itself (M&O costs). More public awareness is needed in order to get a higher demand.



FIGURE 37: THE KASAALI FAECAL SLUDGE TREATMENT PLANT, A BRAND NEW FACILITY FOR THE EMPTYING TRANSPORTATION AND TREATMENT OF FAECAL MATTERS FROM SEPTIC TANKS AND LINED PIT LATRINES. THE TREATMENT PROCESS CONSISTS OF VARIOUS STEPS, INCLUDING AN 'ARTIFICIAL WETLAND' WHERE PAPYRUS PLANTS TREAT THE SLUDGE (PHOTO LEFT). HOWEVER, MOST OF THE CAPACITY OF 2 MILLION M3/YEAR REMAINS UNUSED SO FAR DUE TO VERY LOW DEMAND (PHOTO RIGHT). PHOTOS TAKEN ON 27 APRIL 2019 AT LAT: 0°38'34.71"S / LON: 31°30'17.43"E.

The Sector Performance Report 2019 of the Ministry of Water and Environment of Uganda is referring to these other activities that are required to generate and sustain demand for the FSM service as well as maintain the functionality of the FSTP (MWE 2019). During the Financial Year 2018/2019, MWE handed over the newly constructed FSTP of Kasali to Umbrella of Water and Sanitation – Central, for operation and maintenance, as well as four Cesspool Trucks to support the feacal sludge emptying and transportation system in the central region. A case study is drawn from the operation and maintenance of Kasali FSTP in Kyotera. The plant was constructed by the Water and Sanitation Development Facility-South West and its operation commenced in January 2019. Kasali FSTP is located approximately 7 km away from Kyotera town and currently receives sludge from Kyotera Town Council, Kasali Town Council, Bethlehem, Mutukula, Sanje, Kasasa, Kakuto (along mutukula road), Kalisizo, Bukunda, Kabiira, Bulindo (along Masaka – Kyotera Road), Lwanda, Kanoni (Kyotera-Rakai Road) and Rakai town. At the inception of their operations, the UWS-C established sustainable systems to aid the operation and maintenance of this FSTP and these included:



FIGURE 38: CONSTRUCTION OF A NEW 5 STAR VIP PUBLIC TOILET AT KASENSERO LANDING SITE. PHOTO TAKEN ON 27 APRIL 2019 AT LAT: 0°52'39.05"S / LON: 31°45'53.51"E.

- setting of emptying and disposal tariffs with reference to the available market;

- hire of staff; and

- sensitization/promotion and marketing activities within the potential catchment area of the FSTP.

The UWS-C employed the following approaches to carry out sanitation marketing:

- identification of potential clients and institutions with emptiable facilities;

- dissemination of brochures about the plant, charges and how to access the service / contacts;

- use of public announcements on community radios and talk shows on local FM stations; partnering with area NWSC offices to disseminate the information about the plant while issuing the water bill; and

- collaboration with the District and Town Council Health Inspectorate officers to ensure harmony.

During the operation, the UWS-C noted a strong correlation between the increase in clientele and increased

community sensitization/sanitation marketing activities across the catchment area of the FSTP. The lesson learned here is that construction of FSTPs is not enough to solve the FSM challenge but must be supported by other activities to generate and sustain demand for the FSM service as well as maintain the functionality of the FSTP (MWE 2019).

In Kasensero Landing Site (fishing village), there used to be one public toilet (old). A new public toilet has been constructed recently as part of the Lake Victoria Environmental Project. This is a so called 5star VIP toilet (for 5x40 people). Also at Kyabasimba Landing Site (fishing village with 700 adult inhabitants), there used to be one public toilet (old) and a new public toilet is under construction. This is going to be a 5star VIP toilet (for 5x40 people), same as in Kasensero Landing Site. It was reported that "people have to pay UGX 200 to use the toilet" (for maintenance and operation).

However, people will likely not use these public toilets. The men are fishing during the day and will use the open water. They don't like the smell of such a toilet. The women and children will use the grass (open defecation). "The construction is only for the inspector, not for the people" one villager said. Life is hard in a fishing village with big families in one small shack. Everything is temporal, buildings and facilities are not permanent: if the fishing sites are not good anymore they will move to a next one. Therefore,

investments in good water supply and sanitation are low. As a result, open defecation is taking place. There is high need for more sensitization and education in WASH. According to the District Water Officer, each year there is a 'sanitation week'. The District receives grant from Ministry of Water & Environment to implement projects in 25 villages. There are projects on 1) sensitisation, 2) triggering people to construct latrines, 3) open defecation free villages.

Overall, the sanitation and hygiene conditions in Sango Bay Minziro 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 Kyabasimba landing site in Uganda

6.4 PUBLIC HEALTH

6.4.1 Public health facilities

Missenyi and Kyotera Districts, 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.

In Tanzania, health strategy policy requires each village to have a dispensary and each Ward should have a health center. According to the District Executive Director's Office (District Medical Office) of Missenyi District (2019), among the 20 wards in Missenyi, only 4 wards have health centers and out of 77 villages only 32 (41%) have dispensaries. The availability of health facilities in Missenyi District Council falls below WHO standards. The average coverage of the population by a health facility in the district increased from 1.7 facilities per 10,000 people in 2002 to 1.8 facilities per 10,000 people in 2012. Overall the provision of health services in Missenyi District is still insufficient. The number and quality of facilities, practitioners, medical equipment and availability of medicines is insufficient. The number of specialized doctors is limited, especially because they are not motivated to work in rural areas.

Kyotera District in Uganda has 75 Health facilities. Some of the Health facilities are Government hospitals while others are owned by Non-Government Organizations (NGOs) and Private for Profit (PFP). The distribution is fair, but some of them lack the basic equipment to offer reasonable services. Many rural units require rehabilitation and equipment. Besides diseases, poor nutrition has contributed to worrying situation. Because of cross cutting nature of health issues, there is need for an integrated approach to health. There are various NGOs both local and international that are involved in AIDS prevention and control in the district. Such activities include blood screening and counseling, medical treatment, home care, pastoral education, health education, AIDS research and orphan support.

Underfunding: The per capita cost for providing the current Uganda minimum Health care package has been estimated at USD 41.2 in 2008/09, rising to USD 47.9 in the fiscal year 2011/12. However, in 2008/09 the per capita health cost was only USD 10.4.The shortfall is significant. This has affected all inputs in the sector. For instance, current annual per capita expenditure on essential medicines is only USD 0.87 against an estimated requirement of USD 2.4 per capita (excluding ARTs, ACT's ITNs and the pentavalent vaccine). The scaling up of programmes and expansion of the health facility network has meant that more staff, equipment and medicines are required to run the operations of the health facilities of the District. Shortage of health workers: The sector has experienced unprecedented problems related to low motivation, labour migration and retention of

professional workers, both in the Government and PNFP subsectors, as both employers have been unable to offer attractive employment packages. Despite the existing four medical schools in Uganda, there is an alarming doctor to patient ratio of 1:24,725 and nurse/midwife to patient ratio of1:11,000. The WHO recommended norm of doctor-patient ratio is 1:800. The health worker to population ratio of 1:2,298 as compared to the WHO standard of 1:439. At regional and international levels, the remuneration of health workers in Uganda is much lower than that of his /her counterpart abroad. On average, a doctor (medical officer) in UK earns 12 times more while one in Kenya earns 4 times more than his counterpart in Uganda (MoH 2009 Motivation and Retention strategy). Low motivation of workers is partly due to insufficient career development opportunities. The above analysis has made the rural poor even to suffer more as the few health workers available don't want to work in remote areas for which Kyotera is one of them (Kyotera District, 2017).

6.4.2 Health issues

The national health indicators for Tanzania and Uganda are shown in Table 20 (source: WHO 2018a and WHO 2018b). On a national level, diarrhoea has the highest disability-adjusted life years (DALYs) per 1000 capita in both Uganda and Tanzania, followed by Respiratory infections and Malaria (Table 20).

TABLE 20: HEALTH INDICATORS AT NATIONAL LEVEL

	Uganda	Tanzania
Child health		
Infants exclusively breastfed for the first six months of life (%) (2011)	63.2	41.1
DTP3 immunization coverage among 1-year-olds (%) (2016)	78	97
Demographic and socio-economic statistics		
Life expectancy at birth (years) (2015)	62.3 (Both sexes)	61.8
	64.3 (Female)	63.8
	60.3 (Male)	59.9
% population under 15 (2015)	48.1	45.2
% population over 60 (2015)	3.8	4.8
Multidimensional Poverty Index (population in multidimensional poverty) – (2019)	0.269 (55.1%)	0.273 (55.4%)
Literacy rate among adult aged >= 15 years (%) (2007-2012)	73	73
Gender Inequality Index rank and value (2018)	127 (0.531)	130 (0.539)
Human Development Index rank (2018)	159	159
Health systems		
Total expenditure on health as a percentage of gross domestic product (2014)	7.22	5.58
Private expenditure on health as a percentage of total expenditure on health (2014)	75.06	53.59
General government expenditure on health as a percentage of total government expenditure (2014)	10.97	12.31
Physicians density (per 1000 population) (2015)	0.093	0.022
Nursing and midwifery personnel density (per 1000 population) (2015)	0.648	0.416
Mortality and global health statistics		
Neonatal mortality rate (per 1000 live births) (2016)	21.4	25
Under-five mortality rate (probability of dying by age 5 per 1000 live births) (2016)	53	67
Maternal mortality ratio (per 100,000 live births) (2015)	343	556
Births attended by skilled health personnel (%) (2011)	57.4	64
Public health and environment		
Population using safely managed sanitation services (%)		19
Population using safely managed drinking water services (Urban) (2015)	18	34

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, diarrhoea has the highest disability-adjusted life years (DALYs) per 1000 capita in both Uganda and Tanzania, followed by Malaria and Respiratory infections (Table 21; source WHO 2009).

The main health issues in Kyotera District in Uganda include malaria, childhood malnutrition, diarrheal diseases, HIV/AIDS, obstetric complications, respiratory infections, and skin diseases (Joyce, 2006). In Missenyi District (Tanzania) in 2015, out of 11,288 reported in-patients, 96.5% were suffering from one of the first five illnesses (Table 23). Malaria has by far the highest number of

TABLE 21: ENVIRONMENTAL BURDEN BY DISEASE CATEGORY [DALYS/1000 CAPITA], PER YEAR

Disease	World's lowest country rate	Uganda	Tanzania	World's highest country rate
Diarrhoea	0.2	35	29	107
Respiratory infections	0.1	19	16	71
Malaria	0	22	18	34
Other vector-borne diseases	0	1.1	2.5	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	2.8	14
COPD	0	0.6	0.8	4.6
Asthma	0.3	1.8	1	2.8
Musculoskeletal diseases	0.5	0.5	0.6	1.5
Road traffic injuries	0.3	4.7	3.9	15
Other unintentional injuries	0.6	10	8.2	30
Intentional injuries	0	2	1.8	7.5

reported cases (61.8%) and was followed at distance by other diagnosis (15.7%), pneumonia (8.0%), anaemia (6.2%) and diarrhoea (4.7%). Noticeable is that clinical AIDS, cardiovascular diseases and tuberculosis showed a 50% decrease in percent cages between 2013 and 2015.

TABLE 22: MAJOR ILLNESSES REPORTED IN KYOTERA DISTRICT (UGANDA) IN THE LAST TWO YEARS 2013/2014

Category of Illness	Male	Female	Total	% coverage on OPD
Malaria	93263	126601	219864	**52.3**
Cough/cold	41923	53815	95738	**22.9**
Intestinal worms	8500	10258	18758	**5.3**
Eyes	4161	4851	9012	**2.1**
Diarrhea diseases	5811	6619	12430	**2.8**
Pneumonia	5418	6218	11636	**3.7**
Skin diseases	6866	7818	14684	**3.4**
Injuries(Trauma)	5269	4542	9811	**2.2**
Oral diseases	4610	5544	10154	**2.5**
Gastro intestinal diseases	4609	7611	12220	**2.8**
Total	**180430**	**233877**	**414307**	**100**

Source: Kyotera District, 2017

TABLE 23: TEN MOST REPORTED CAUSES OF MORBIDITY (IN PATIENTS), MISSENYI DISTRICT (TANZANIA); 2013 AND 2015

	2013			2015		
S/N	Disease	No of Cases	Percent cases	Disease	No of cases	Percent cases
1	Malaria	4,656	65.7	Malaria	6,973	61.8
2	Pneumonia	627	8.8	Other diagnosis	1,774	15.7
3	Other diagnosis	544	7.7	Pneumonia	908	8.0
4	Anaemia	390	5.5	Anaemia	698	6.2
5	Diarrhoea	241	3.4	Diarrhoea	535	4.7
	Sub total	**6,458**	**91.1**	**Sub total**	**10,888**	**96.5**
6	Clinical AIDS	215	3.0	Clinical AIDS	156	1.4
7	Prematurity	210	3.0	Tuberculosis	87	0.8
8	Tuberculosis	121	1.7	Burns	65	0.6
9	Cardiovascular	80	1.1	Cardiovascular	49	0.4
10	Neonatal sepsis	8	0.1	Poisoning	43	0.4
	Total	**7,092**	**100**	**Total**	**11,288**	**100**

Source: District Executive Director's Office (District Medical's Office), Missenyi District (2017)

In Kyotera District, the directorate of Health and development partner's implements a number of activities aimed at promoting improve health. In Kagera Region, Tanzania, the vaccination coverage (BCG, polio & DTP) is 88% (MoHCDGEC 2016).

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 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 similar in Tanzania, as can be seen mental health atlas of Tanzania (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 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. For instance at Missenyi District, this is evidenced by the decline of mortality rates relating to mothers and children by 2015. Medical records released by district medical office show that Infant Mortality Rate has reached 9 per 1,000 infants, under five years mortality rate was estimated at 3 per 1,000 live births and the estimated maternal mortality rate was 167 per 100,000 live births. Reduction of deaths among children and their mothers is attributed to the wide coverages of immunisation campaigns in the district.

Data from the District Executive Director's Office (District Medical's Office) of Missenyi District (2017) shows that as much as 44.5% of expectant mothers were vaccinated with TT2 in 2013 and 51.2% in 2015. At Missenyi, the trend of BCG vaccination for children under one year increased both in the number and proportion for children who were vaccinated. They increased from 97.1 percent in 2011 to 98 percent in 2013 but decreased slightly to 97.7 in 2015. The overall percentages of targeted children under one year who were vaccinated decreased from 98 percent in 2013 to 97.3 percent in 2015. With regards to DPT3,

the coverage of immunisation in Missenyi was good. The proportion of vaccinated children increased from 85.2 percent of 7,701 targeted children in 2013 to 85.2 percent of 8,240 children in 2015.

Immunization and Integrated Management of Childhood illnesses (IMCI in Kyotera district is faced with low funding, fluctuations in gas supply, aging vehicles, fridges and poor use of data for planning. In regard to IMC, there is shortage of HRH including requisite skills and the general lack of funding.

Constraints to the performance of Health and Nutrition sector in Missenyi and Kyotera Districts:

Mother and Child health:

- Inadequate capacity to deliver, Minimum Health care package specifically mother and child health, communicable, Non- Communicable Disease and Nutrition.

- Inadequate skilled personnel for deliveries.

- Inadequate provision of emergency and basic obstetric care.

- Limited access to contraceptives (low family planning uptake).

Limited and inappropriate adolescent sexual and reproductive health services:

- Shortage of HRH including requisite skills and the general lack of funding for integrated maternal and childhood illness (IMCI).

- Inadequate funding for the immunization programmes to support provision to supplies, equipment and transport.

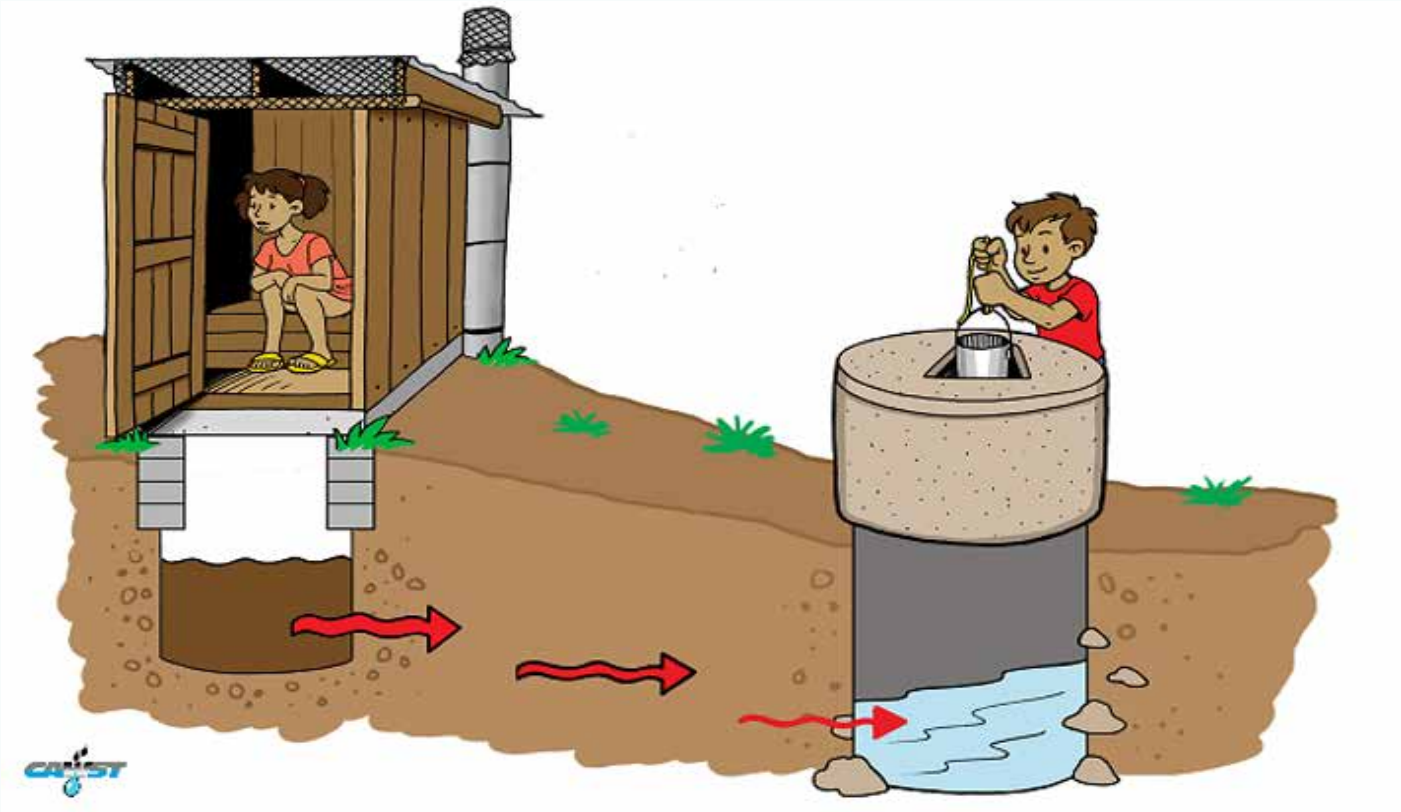
- Limited use of data for planning.

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, Hepatitus 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 Sango Bay-Minziro, 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 faecal pathogens from pit latrines (Figure 39), and as a result cholera and diarrhoea are common amongst communities around the lake.

FIGURE 39: WATERBORNE DISEASES CAN BE SPREAD VIA GROUNDWATER WHICH IS CONTAMINATED WITH FECAL PATHOGENS FROM PIT LATRINES. SOURCE: CENTRE FOR AFFORDABLE WATER AND SANITATION TECHNOLOGY



In Kagera region, Tanzania, no cholera cases have been reported between 2011-2014 (MoHCDGEC 2016). Since 1994, cholera is reported annually in Uganda (Figure 40), fluctuating between 250 and 5,000 cases per year with the exception of a large outbreak in 1998 with almost 50,000 cases. In former Rakai district, now Kyotera District, less than 15 people per 100,000 hospitalized with cholera between 2005-2010 (Bwire 2013).

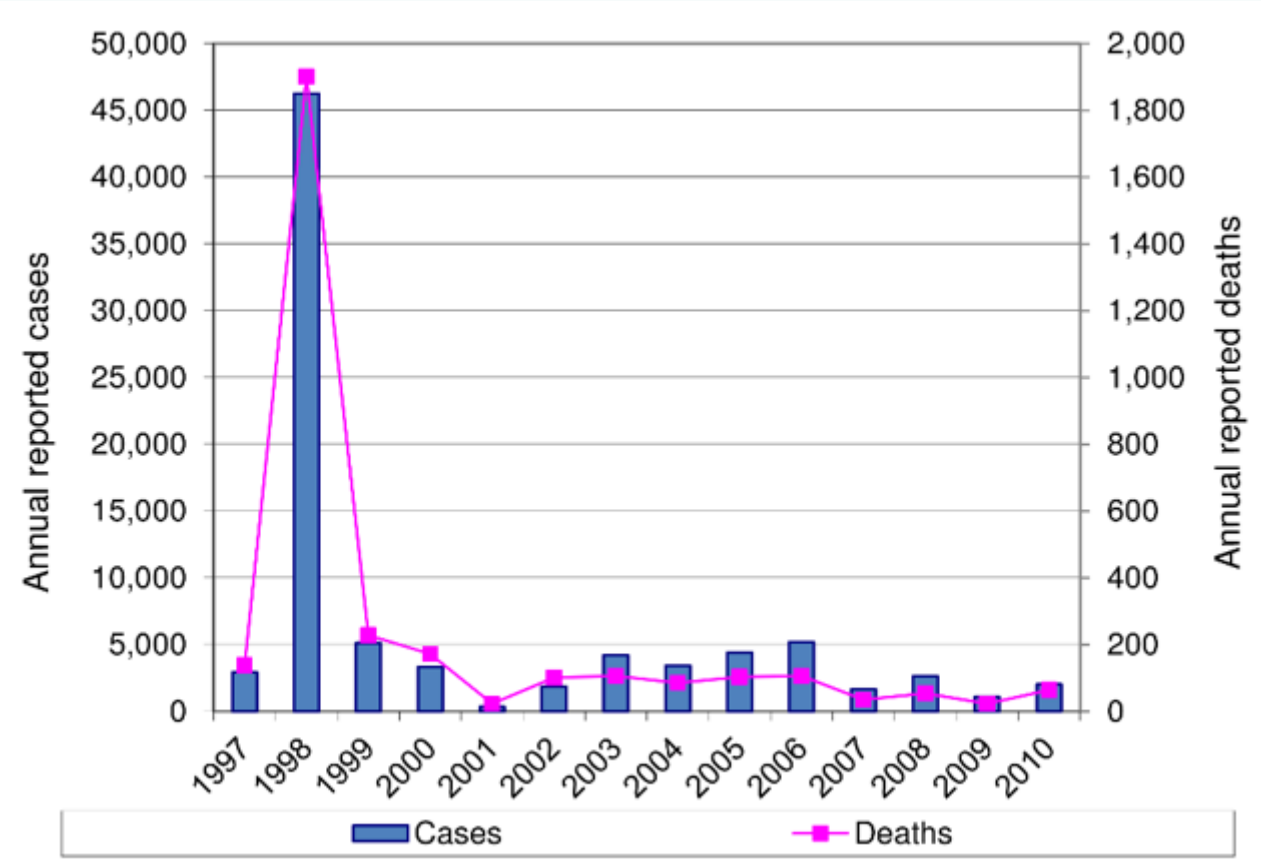


FIGURE 40: ANNUAL NUMBER OF CHOLERA CASES AND DEATHS REPORTED IN UGANDA 1997-2010.

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).

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 constrains 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

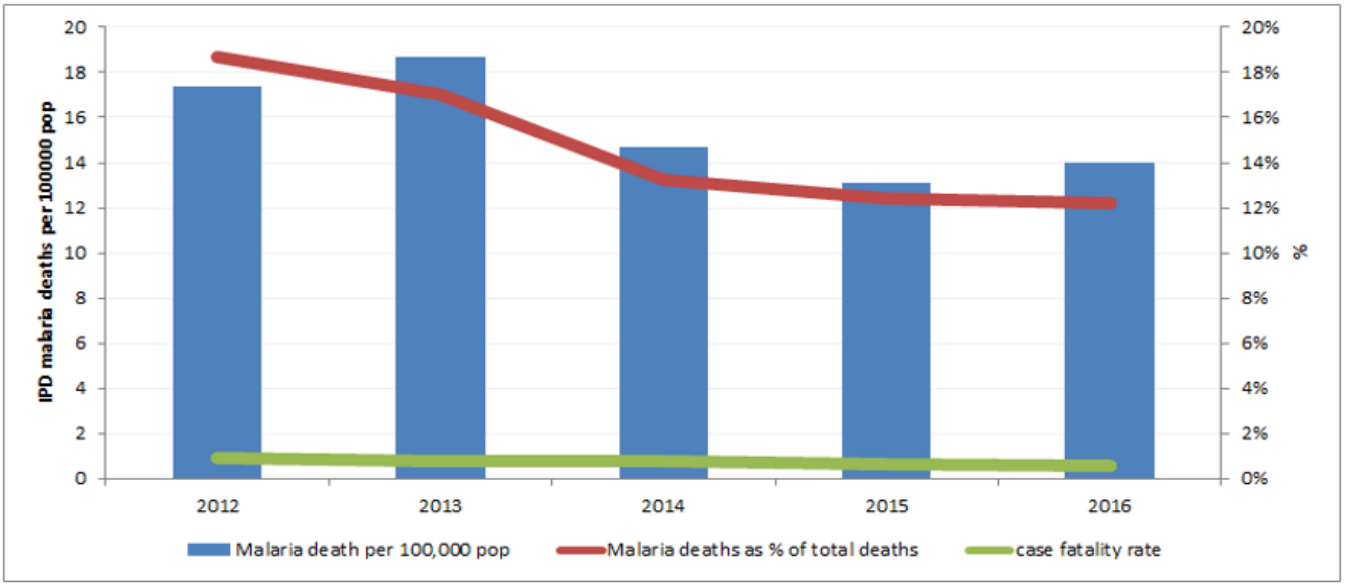
Malaria

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. 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%.

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 41), with a case fatality rate of circa 0.5%.

FIGURE 41: 2012-2016 TREND IN DEATHS IN UGANDA DUE TO MALARIA



In Kagera Region, Tanzania, malaria prevalence is 41%, the highest in Tanzania (MoHCDGEC 2016). The high incidence of malaria could be explained by recent increased rainfall, low coverage of mosquito nets or probably failure by the communities to maintain clean environment. During the field mission it was reported that mosquito nets are used for fishing or keeping poultry.

Constrains on Malaria prevention

- Weaknesses in the procurement which lead to delayed delivery of malaria commodities especially Coartem.

- Inadequate trained workers.

- Inadequate laboratory infrastructure for malaria diagnosis.

- Weak malaria partnership forum.

- Weak implementation of a comprehensive policy on malaria and diagnostics treatment.

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 Sango Bay-Minziro, 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.

The first recorded case of HIV/AIDS in Uganda, was at Kasensero Landing Site, on the shores of Lake Victoria, in Kyotera District (back then Rakai District) (Namubiru, 2007). The disease has ravaged the district population, where prevalence rates were as high as 12 percent, as recently as 2014 (Mutyaba, 2014). In Missenyi District the extent and trend of HIV prevalence among the people are testing family blood donors, prevalence among Voluntary Counseling and Testing (VCT) volunteers and expected mothers who were attending Prevention Mother to Child Transmission (PMTCT) service. Data from the District Executive Director's Office (District Medical Office), Missenyi District (2017) shows a slight increase of prevalence rate of persons with HIV from 3.5 percent in 2013 to 9.4 percent in 2015.

HIV statistics for Uganda and Tanzania (UNAIDS 2018a and UNAIDS 2018c) show that each year a total of 53.000 and 72.000 people get newly infected with HIV in Uganda and Tanzania respectively each year. The number of deaths from an AIDS-related illness is 23.000 (Uga) and 24.000 (Tan) people per year (Table 24).

TABLE 24: NATIONAL HIV STATISTICS FOR UGANDA AND TANZANIA

	Uganda	Tanzania
Number of people with HIV	1,400,000	1,600,000
HIV incidence (%)	1.4	1.41
HIV prevalence (%)	5.7	4.6
Number of people newly infected with HIV	53,000	72,000
Number of deaths from an AIDS-related illness	23,000	24,000
Percentage of people with HIV aware of their status	84	78
Percentage of people with HIV receiving treatment	72	71

In former Rakai district, 3.9% of people tested were suffering from HIV, and 90% of people with HIV receive treatment (Uganda AIDS Commission 2017). In Kagera region, HIV prevalence is reported at 3.7% (MoHSW 2015).

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.

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 Tanzania are ranking #127 and #130 respectively (out of 189 countries) on the Gender Inequality Index rank of 2018 (Table 20; UNDP 2019). The Gender Inequality Index is 0.531 for Uganda and 0.539 for Tanzania, where a value of 0 expresses perfect equality, while a value of one represents perfect inequality. Within Sango Bay-Minziro 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).

In both Kyotera District (Uganda) and Missenyi District (Tanzania), the Social Development Sectors such as Community Development, Community, elderly, children and women welfare departments, cooperative societies, youth organizations foster the rights of the vulnerable population, addresses gender inequalities, labour and employment as well as community mobilization and empowerment. Addressing the rights and needs of the vulnerable and disadvantaged populations such as People with Disabilities (PWDs), older persons, youth, women, orphans and other vulnerable children and the chronically poor underpins the core concerns of governments, donor agencies through projects and programs, NGOs and development partners. For instance in Tanzania, TASAF – Tanzania Social Action Fund has been established to help poor and elderly people. Likewise in Uganda, NUSAF – Northern Uganda Social Action Fund has been established to help local communities from Northern Uganda who have been ravaged by conflict over the years.

Not only that, various measures are taken to minimize time spent by women and girls in attending to home activities and thus give them more time to be used in the above-mentioned activities. These measures include the use of family planning, opening and operating of day care centres, establishment of women economic groups and participation in Savings and Credit Cooperatives (SACCOs), Community Based Organizations (CBOs), Village Community Banks (VICOBA) and other cooperative activities. Based on personal communication of the Consultant (field inquiries), these initiatives are also implemented in both districts. Running of day care centres enables mothers to participate in various economic activities which contribute significantly to the household socioeconomic growth. Day care centres are meant for children of age three to four years. For instance, Missenyi District had 21 day care centres in 2013 with 552 pupils.

Collaborative partners and stakeholders who include Government agencies, development partners, private sector and Civil Society Organizations (CSOs) are critical to the fulfilment of the mission. Specific departments have been set in Ministries as well as local governments with the mandate to empower communities to harness their potential through cultural growth, decision-making processes, skills development and labour productivity for sustainable and gender responsive development. In order to realize gender equality, the government departments carries out the following activities under the following sub-sectors: (a) Children and Youth (b) Gender (c) Labour and employment (d) Community mobilization and empowerment (c) social protection (OVC, PWDs, low paid workers such as domestic workers, displaced person, victims of disaster etc) and (d) Culture, among others.

The issue of gender equity is well built under the normal cultural practices of the local tribes across the borders. The practices are almost similar. However, there has been a good number of initiatives that tried to bring into balance socio economic and gender issues onto normal planning of community based activities. There is more awareness of women and men improved contribution to livelihood activities.

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.

This monograph describes the historical and current situation of the Sango Bay-Minziro 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.

7.1 MAIN CHALLENGES

7.1.1 Destruction of the wetland

The wetlands are being degraded by human activities (e.g. opening up of land for crop cultivation, grazing of livestock, land clearing for settlements, sand mining, clay brick making, charcoal production). 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 Sango Bay Minziro 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 Sango Bay Minziro, with more and more informal settlements originating along the banks of River Kagera (Figure 21). At these settlements, natural vegetation is being replaced by cultivated land used for construction of houses and for agriculture. Besides leading loss of important vegetation and biodiversity, these pressures are aggravating soil erosion, causing greater siltation of River Kagera and Lake Victoria and fuelling conflicts amongst the different user groups. Sango Bay Minziro is a hotspot for biodiversity, but the habitat of these species is being degraded, and their future in Sango Bay Minziro wetland is no longer certain. The fragmentation of the natural vegetation, intensification of natural resources use by humankind and increasing invasive species (e.g. Iguana spp, water hyacinth and Kariba dam weed) entering the ecosystem, which tend to suppress native species, have resulted in declining species populations. Sewage, animal waste, agricultural waste and solid waste has resulted in pollution of water and environment.

Seasonal burning of grasslands and bushes is a common occurrence during the dry seasons, and was observed to take place inside protected area near Minziro nature forest reserve (Figure 29). The burning is used as a traditional method for destroying ticks and other vectors as well as stimulating fresh pastures, creating sweet young shoots for livestock, and to clear areas in advance of tilling farms. The illegal hunters also burn wetlands to scare animals so that they can easily hunt them, which is a big problem to the biodiversity and ecosystem at large. Bush burning degrades the wetlands, and contributes to biodiversity loss and migration of wild animals. Community sensitization must be intensified to educate the people about the dangers of bush burning.

The peatlands around the meandering River Kagera can be seen as one of the most important carbon sinks in the Nile Equatorial Lakes region. The other way around can deterioration of these peatlands (f.e. through drainage) enhance national carbon emissions at a significant scale, as explained in the NBI Carbon Study 2019. The total amount of carbon in the Sango Bay Minziro area peatlands is estimated around 0.25 billion tonnes (Figure 20). The unsustainable use of Sango Bay Minziro wetlands for water supply, agriculture or energy generation, can turn these peatlands from a carbon sink to a huge carbon source. Accelerating land-use change under the business-as-usual scenario are observed, and give cause for alarm.

7.1.2 Overexploitation of natural resources

Products like papyrus, wild game, wood and fish are being overharvested. Also unregulated and indiscriminate harvesting of logging, timber, and charcoal and therefore smuggling is rampant in the area. The endemic forest hardwood tree species Podocarpus has been virtually wiped out, and a number of trees with medicinal value, such as Phoenix reclinata, Prunus Africana, Rytigynia beniensis, “Omunyabuliko” and “Olikwatango”, are seriously declining. An assessment on the levels of human disturbances in Minziro Nature Forest Reserve (Martin and Rovero, 2019) shows that communities rely largely on the reserve for various natural resources such as firewood, medicinal plants and thatching grasses. Disturbance transects revealed that the reserve suffers from human disturbances in terms of illegal poles extraction, human paths, charcoal burning and illegal hunting for bushmeat, with the western area of the reserve being relatively more affected than the eastern part. Limited access to alternative sources of heating energy leading to dependence wood fuel. In Missenyi District (Tz) 92.1% of households use firewood as the main sources of energy. A similar picture most probably applies to Kyotera District (Ug). Electricity supply and distribution is still very limited and tariffs remain unaffordable by the majority of the population. Especially at fish landing sites, the local communities require a lot of firewood for cooking and smoking fish. Overfishing, increased competition 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. Fish species such as Ningu (Labeo spp), "Enkuyu" spp., Endera (Barbus spp), tilapia, and Ngege (Oreochromis esculentus) have continued to disappear. Game meat from animals such as monkeys and antelopes is acquired through illegal hunting. Wild animals populations, including elephants and buffaloes, are going down due to illegal hunting both for domestic consumption as well as wildlife trades across borders, poaching and encroachment into the forest-wetland areas that have for centuries been a great refuge and across man migratory routes.

7.1.3 Unsustainable resource management practices in upstream areas of Kagera river basin

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 Kagera Catchment can drastically affect crucial ecological functions in the Sango Bay Minziro downstream. Some of the 'external factors' of activities taking place within the catchment of River Kagera and ultimately affecting the status of Sango Bay Minziro '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 Kagera flows into Lake Victoria

- Soil degradation. Over time and because of poor farming practices, soils are gradually losing their vitality. Basic good agricultural practices, such as mulching, soil and water conservation, crop rotation and application of fertilizers are insufficiently applied. Due to soil degradation, farmers continue looking for new farm lands (wetland encroachment). The unsustainable land use practices are also enhancing river bank, lakeshore and wetland degradation, soil erosion and landslide risk. The detached soil material is transported downstream by streams and rivers resulting in a high sediment load of rivers (like River Kagera) and siltation of Lake Victoria.

- Land cover changes upstream (like deforestation and wetland encroachment) can have a negative effect on:

o Flood control, water buffering and drought mitigating capacity of Sango Bay Minziro wetlands

o Water purification and filtration, deterioration of water quality in Sango Bay Minziro wetlands

o Soil loss, removal of vegetated buffer strips, resulting in siltation of Sango Bay Minziro wetlands

7.1.4 Crop productivity and livestock productivity are low

Crop productivity and marketing prices are suboptimal. Crop diseases particularly the epidemics of Banana Bacterial Wilt (BBW), Coffee Bacterial Wilt (CBW) and cassava disease are a major threat to crop production. The major pest is the black coffee twig borer (BCTB). These diseases and pests have destroyed large areas of bananas and coffee in most farms causing the greatest ever threat to food security and household incomes. Sensitization and training of farmers on control of these menaces is important including multiplication and provision of improved varieties for farm revitalization. Due to low shelf life and seasonal harvesting crop prices fluctuate heavily; prices tend to go down at the peak of the harvesting season and rise to a peak at planting time. At present shelf life of maize is enhanced by numerous maize milling plants producing maize flour and bran. However, there is need for more investment in storage infrastructure and agro-processing so that crop shelf life and market value of other crops is also enhanced.

Also, livestock productivity is low. Due to shortages of water and pastures during droughts, high pest and animal disease incidence (including foot and mouth disease), and limited vaccination campaigns as these are hindered by a lack of resources and drug stock-outs. To raise productivity the effectiveness and efficiency of extension services needs to improve, more water storage infrastructure in terms of valley dams and tanks as well as growing of improved fodder crops for livestock are needed and modern techniques such as artificial insemination and cross breeding should be made available

7.1.5 Conflict between different wetland resource user groups.

An increasing number of conflicts has been reported between the National Forest Association and internal migrants (settlers) that enter into the protected areas. As land is becoming scarce little land is left for free grazing of livestock, which has led to an increase in conflicts between herders and farmers. The scramble for land has led to encroachment on wetlands and is compromising its ecological functioning.

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. 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.

7.2 ROOT CAUSES

7.2.1 Widespread poverty

Widespread poverty (55% of the population in both Tanzania and 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 Sango Bay Minziro 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

High population growth rates in the area is a threat for all natural resources. There is a significant population increase both due to high birth rates as well as migration which comes in with a broad range of demands with a natural resource base and land. With a population growth rate of 2.04% per year (Table 19) the current population number in Sango Bay-Minziro wetland landscape is expected to increase from 498.000 in 2019 to 622.000 in 2030 (Figure 32). In combination with widespread poverty and the huge dependency of the population of natural resources this expected to increase the pressure on the landscape. 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.

Weak implementation of a (land use) policy and plans, and environmental protection protocols, such as non-implementation of the land use policy to mitigate the encroachment on forests and wetlands and inadequate physical planning has resulted in improper land usage. There are a number of land use plans but need to be reviewed and put in place. Unfortunately, these plans have not been provided with sufficient resources, community perception on conservation of wetland resources remains poor, and inconsistencies remain in the legal and policy frameworks. Overstocking of cattle/animals is one of the major challenge that needs proper land use plans. After crop production it is the most important economic sector in the landscape and the number of livestock heads is ever increasing. Though local communities are not pastoralists per se, this now a growing practice and will need to be addressed. Cattle from across the border are a growing major problem as the numbers grow without control during dry seasons. The sector is almost entirely dependent on donor and private investment, which is by no means sufficient to address the challenges. International, national and regional policies need to be better accommodated at local levels.

Lack of facilities for fisheries monitoring, control and surveillance. The fisheries department does not have the required outfit of patrol vessels, safety gear and engines to enable movement on water for collection of data and enforcement of fisheries regulations and to ensure that the quality of the landed fish is good. This area needs to be addressed if efforts to conserve the fisheries resources are to be realized.

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 it's ecosystem services. For many years, Ugandans and Tanzanians have taken water and environment resources for granted, expecting these resources to always be available. The continuous striving 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 Sango Bay Minziro 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

A shortage of water for domestic consumption, livestock watering and irrigation is experienced especially during the dry season in Sango Bay-Minziro wetland area. This can be explained in terms of inadequate water resources exploitation and poor technology rather than resource scarcity, as sufficient water resources are available; both groundwater and surface water. In addition, water quality is poor because of faecal contamination due to inadequate sanitation and low latrine coverage. Open defecation is especially a problem close to fish landing sites. The need for investment in technologies that promote water efficiency has to be particularly emphasized. Many communities do not have access to clean and safe water for domestic use.

7.2.6 Climate change

Climate change already has, and is expected to continue presenting an additional stress on development in the Sango Bay Minziro region, especially with its high dependency on rain-fed agriculture and cattle grazing. The climate is changing and for Sango Bay-Minziro area continued warming is projected. The temperature is projected to increase by about 1.5 °C by 2050 (Figure 19). As a result there is a potential for an increase in the frequency and intensity of extreme events (e.g. heavy rainstorms, flooding, droughts). As a consequence:

i. Water resources are likely to be increasingly strained in the future climate of the wider Sango Bay-Minziro area. While it is projected that the total rainfall will increase, warmer temperatures will accelerate evapotranspiration, reducing the benefits of increased rainfall. With more frequent and severe droughts, the River Kagera basin will likely experience negative impacts on water supply and biodiversity. 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.

ii. 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 Sango Bay-Minziro. The expected increase in rain during the dry season (June-September and December-mid March) 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 in the Sango Bay-Minziro wetland system.

iii. Climate change will likely cause loss of, or reduction in, the total wetland area Sango Bay-Minziro 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.

7.3 THREATS AND PRESSURES

The East African Crude Oil Pipeline (EACOP) is under construction, a 1443-km pipeline transporting oil from Western Uganda to the Tanzanian coast. This pipeline is planned to traverse the Sango Bay-Minziro wetland landscape, along the western boundary of Minziro National Park and crossing the SAMUKA Ramsar wetland system (Explainer 4 in chapter 5.5). The pipeline poses a severe threat to water resources, wildlife and biodiversity. The oil pipeline could have adverse impacts on biodiversity and ecosystem services during construction and if oil spills occur. Addressing the possible impacts of oil transportation 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.

8.1 PHYSICAL LANDSCAPE

8.1.1 Location and delineation

The Sango Bay-Minziro wetland landscape is located west of Lake Victoria and lies within Uganda (Kyotera and Kakuuto counties in Kyotera district) and Tanzania (mainly Missenyi district). The boundaries of the wetland landscape are based on a combination of existing protected areas and topography.

Topography, geology and soils

The general elevation varies between 1,134 and 1,180 meter above mean sea level with some rocky hills rising up to elevations of 1,350 m amsl. The geology is characterized by crystalline basement rock (granites and gneiss), covered by thick layers of sedimentary rocks (sandstones and siltstones) that form the hills in the area. In the valleys, the sedimentary rocks are covered by unconsolidated sediments (sands and clays).

Hydrology and water resources

There is a strong spatial variation in rainfall (mean annual rainfall is around 1,400 mm per year), with the long rains falling in mid-March to May and the short rains in October to November. The River Kagera flows in an incised channel across an extensive seasonal flood plain, heavy meandering and with many sharp curves, before entering Lake Victoria. In the study area, the discharge of the Kagera is approximately 40% higher in June and July than during the low flow season between November and February. During the long rains in mid-March to May the groundwater table rises in the flat lowlands that surrounds the Kagera floodplain, followed by a peak flow in River Kagera during the months June-August. As a result, several feet of water covers the floor of most of the low-lying landscape of the Sango Bay-Minziro wetlands each year for four to eight months. Other perennial rivers include River Ngono and River Bukoola. Groundwater resources can mainly be found in the thick layers of consolidated sedimentary rocks that cover the basement rocks and in sandy aquifers along Kagera. Often springs can be found on the slope or the foot of sandstone ridges.

Water quality and hydrological functions of wetland system

River Kagera has a high sediment load (turbidity, used as indicative proxy for sediment load, was measured at 85 NTU), due to unsustainable land use practices that enhance river bank, lakeshore and wetland degradation and soil erosion, resulting in siltation of Lake Victoria. Faecal contamination due to inadequate sanitation and low latrine coverage is also a major health concern. The Sango Bay-Minziro 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 Victoria, 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 Sango Bay-Minziro area. Overall, precipitation is not projected to change significantly by 2050, though it is expected to increase by 5–8% in the period November–February. This means that significant increases or decreases in precipitation are possible. Temperatures are expected to rise by up to 2 °C by 2050. Rising temperatures may 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. 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 Sango Bay-Minziro wetland landscape needs better protection from human disturbance and warming, to avoid the release of major heat-trapping greenhouse gases, including carbon dioxide.

Wetlands are an effective sink for carbon, playing a key role in buffering the effects of climate change, thereby supporting climate adaptation and resiliency. The peatlands of Kagera River within Sango Bay-Minziro contain the highest carbon stock of the Nile Equatorial Lakes region. Therefore, the Sango Bay-Minziro wetland landscape needs better protection from human disturbance and increasing temperatures, to avoid the release of carbon dioxide. The unsustainable use of Sango Bay Minziro peatlands could turn these peatlands from a carbon sink to a huge carbon source (NBI Carbon Study; Elsehawi et al. 2019).

Land use

The land use in the area has changed over recent decades. A rapidly growing population has led to a sharp increase in agricultural land and residential areas, resulting in encroachment along River Kagera and large-scale deforestation in the project area. Based on the Land cover dataset of the European Space Agency, built up area including settlements and residential areas tripled between 1995 and 2015. Increasingly, settlements and croplands are located on steep slopes, which increases the risk of landslides and erosion.

BIODIVERSITY AND ECOSYSTEM SERVICES

Biodiversity

The Sango Bay and Minziro wetland areas are considered to be of high bio-geographic importance; because they are located in the transition zone between the East and West African vegetation zones. They are home to rare and endemic forest swamp tree species, where over 300 species of birds, globally endangered mammals and a variety of amphibians and reptiles. The Sango Bay-Minziro wetland landscape is an important habitat for fish, which are found mainly in Lake Victoria, rivers, and floodplains.

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 Sango Bay-Minziro 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 23.

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 Sango Bay-Minziro wetland system provides for a call of a multi-layered participatory approach which should carefully be linked to the transboundary conservation interests.

Protected areas

Sango Bay is connected with SAMUKA Ramsar site no. 1641 and an Important Bird Area (IBA). Minziro Forest Reserve is one of the 20 Important Bird Areas of Tanzania. In total, these and other smaller protected areas cover nearly 75% of the study area. In fact, the transboundary Sango Bay-Minziro wetland system, encompassing the seasonal and permanent wetlands, grasslands and thickets and forest reserves is earmarked to be designed as a Ramsar site. Here fore, the Wildlife division of the Ministry of Natural resources and Tourism is the focal point for the Ramsar convention.

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-ECONOMIC SYSTEM

Livelihood and socio-economic system

Agriculture is the backbone of the Missenyi and Kyotera District Councils economy and most of its residents depend on it as their main source of livelihood. A big proportion of the population is peasants whose livelihood is basically ensured through subsistence crop farming. Crop production is the main source of income for 84% of the households, followed by formal employment (8%) and off-farm activities (5%). Fishing and livestock keeping both account as main source of income for 1% of the households (Table 8). Poverty remains widespread in most parts of Uganda and Tanzania, with a high Multidimensional Poverty Index (55% of the population in Tanzania and Uganda is in multidimensional poverty; UNDP 2019b), and is generally perceived differently by the different categories of people.

Livestock and agro-pastoralism

Livestock farming is one of the major agro-economic activities in the communities of Sango Bay and Minziro of which cattle is the most important in economic terms. There is localized nomadism during the prolonged dry periods when water and pastures are in short supply, leading to movement of cattle from place to place. In extreme cases animals are moved across inter-district and inter-national boundaries within the Sango-Bay and Minziro ecosystems.

Crop production and forestry

The production of crops in is predominantly rain-fed, with manual irrigation only applied in less than 2% of farming, mainly on horticultural crops such as tomatoes and vegetables. The main crops include bananas, coffee, beans, maize and cassava. Pineapples, tomatoes, cabbages and passion fruits

are more recent and progressing additions. Coffee is the conventional cash crop, while all other crops provide both food and cash.

During the regional workshop it was reported that indiscriminate harvesting of logging, timber, and charcoal and therefore smuggling is rampant in the area. Bee keeping (apiculture) is a fast growing activity in Missenyi District.

Fisheries and aquaculture

Lake Victoria is the most important source of fish and the economic value of fisheries is high. Victorian fishing is largely commercial and dominated by Nile perch and Tilapia which is certified and exported to fish processing plants and other markets in and outside Kyotera and Missenyi Districts source of livelihood. Overfishing is one of the serious problems, especially in wetland areas, which has resulted in common cases of wetland degradation. There is need to intensify fish conservation efforts through monitoring, control and surveillance exercises and also to promote good fish handling practices and fish culture.

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.

Trade and industries

Industrial growth in Sango Bay-Minziro ecosystem is mainly agro-related and is slow hinging mainly on maize crop, coffee processing, fish processing, vegetables and fruits and sugar cane. The East Africa Crude Oil Pipeline (EACOP) currently planned will be laid with a route that crosses the Sango Bay Minziro wetland areas. Both the pipeline itself and its construction phase phase will potentially threaten the environment in general, and more specifically birds, and wildlife species that inhabit the wetland lowlands.

Eco-tourism

Because of its rich and relatively undisturbed natural areas, Sango Bay-Minziro wetland landscape has a high yet underdeveloped potential for eco-tourism. The ecosystem harbours many potential tourist attractions such as the biological diversity, scenery, cultural tourism, community tourism, historical sites, forests and game reserves. More efforts are needed to promote community based low-impact eco-tourism, combining both income generation and nature conservation.

SOCIAL DIMENSION

Human demography

Missenyi and Kyotera Districts are among the fastest growing districts both due to high birth rates and migration. The Population and Housing Census shows that at Missenyi District the population stood at 202,632 in 2012, and at Kyotera District the population stood at 253,538 in 2017. The total population in Sango Bay - Minziro wetland landscape is calculated to be currently 498.000 (2019) and is expected to rise to 563.000 in 2025 and 622.000 in 2030 (Figure 32) with a population growth rate of 2.04% per year (Table 19).

Water supply and sanitation

As per June 2019, the rate of access to a safe source of water (safe water coverage) in Kyotera District, Uganda, was estimated at 64%, with a functionality of 67% and a total of 47 villages (22%) 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 Sango Bay-Minziro 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. There is limited access to adequate sanitation in most of Sango Bay-Minziro wetland area, especially at the landing sites and associated fishing villages.

Public health and diseases

Missenyi and Kyotera Districts has been experiencing shortage of health facilities, medical personnel as well as medical equipment and medicines. The main health issues include malaria, childhood malnutrition, diarrheal diseases, HIV/AIDS, obstetric complications, respiratory infections, and skin disease. The first recorded case of HIV/AIDS in Uganda, was at Kasensero Landing Site. The disease has ravaged the district population, where prevalence rates were as high as 12 percent, as recently as 2014. In Kagera region, HIV prevalence is reported at 3.7%. The total malaria deaths in Uganda has gradually decreased between 2012 and 2016 (Figure 36), with a case fatality rate of circa 0.5%. In Kagera Region, Tanzania, malaria prevalence is 41%, the highest in Tanzania.

Equity and gender

Uganda and Tanzania are ranking #122 and #125

respectively on the Gender Inequality Index rank of 2014 (Table 20). The Social Development Sectors in both districts foster the rights of the vulnerable population, addresses gender inequalities, labour and employment as well as community mobilization and empowerment. However, the districts still experience difficulties/challenges in enhancing gender mainstreaming.

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 Sango Bay Minziro wetlands. The peatlands of Kagera River within Sango Bay-Minziro contain the highest carbon stock of the Nile Equatorial Lakes region, but the unsustainable use of the peatlands can turn the Sango Bay Minziro wetland from a huge carbon sink into a 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. Seasonal burning of grasslands and bushes is a common occurrence during the dry seasons and is used as traditional method to stimulate fresh pastures, creating sweet young shoots for livestock, to clear areas in advance of tilling farms, and used for hunting. Burning degrades the wetlands, and contributes to biodiversity loss and migration of wild animals. Poor agricultural practices, unsustainable land use management, deforestation, encroachment and river bank degradation in upstream areas of the Kagera river basin results in adverse effects on Sango Bay Minziro area downstream.

Crop productivity and marketing prices are suboptimal, diseases and pests have destroyed large areas of crops (f.e. bananas and coffee) and also livestock productivity is low, all putting more pressure on natural resources. As land is becoming scarce little land is left for free grazing of livestock, which has led to an increase in conflicts between herders and farmers. The scramble for land has led to encroachment on wetlands and is compromising its ecological functioning. 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. Conflicts arise between different users as land tenure is unclear or not respected.

Root causes, threats and pressures

The continuous striving for a better life has put unprecedented pressure on water and environment resources in the Sango Bay Minziro 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 Sango Bay Minziro region, especially with its high dependency on rain-fed agriculture and cattle grazing. The East African Crude Oil Pipeline (EACOP) is under construction, planning to traverse the Sango Bay-Minziro wetland landscape, along the western boundary of Minziro National Park and crossing the SAMUKA Ramsar wetland system (Explainer 4 in chapter 5.5). The pipeline poses a severe threat to water resources, wildlife and biodiversity, during construction and if oil spills occur.

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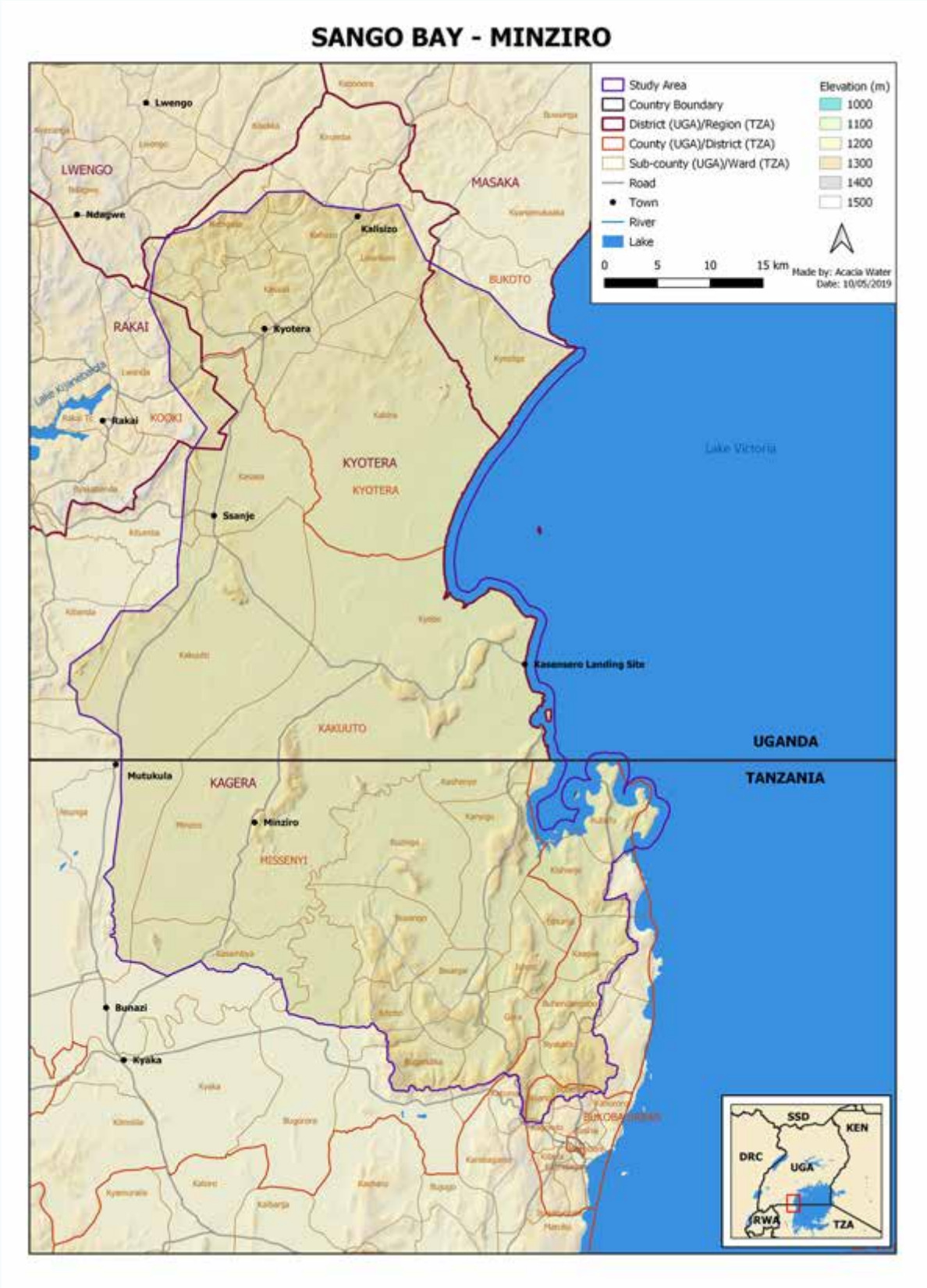
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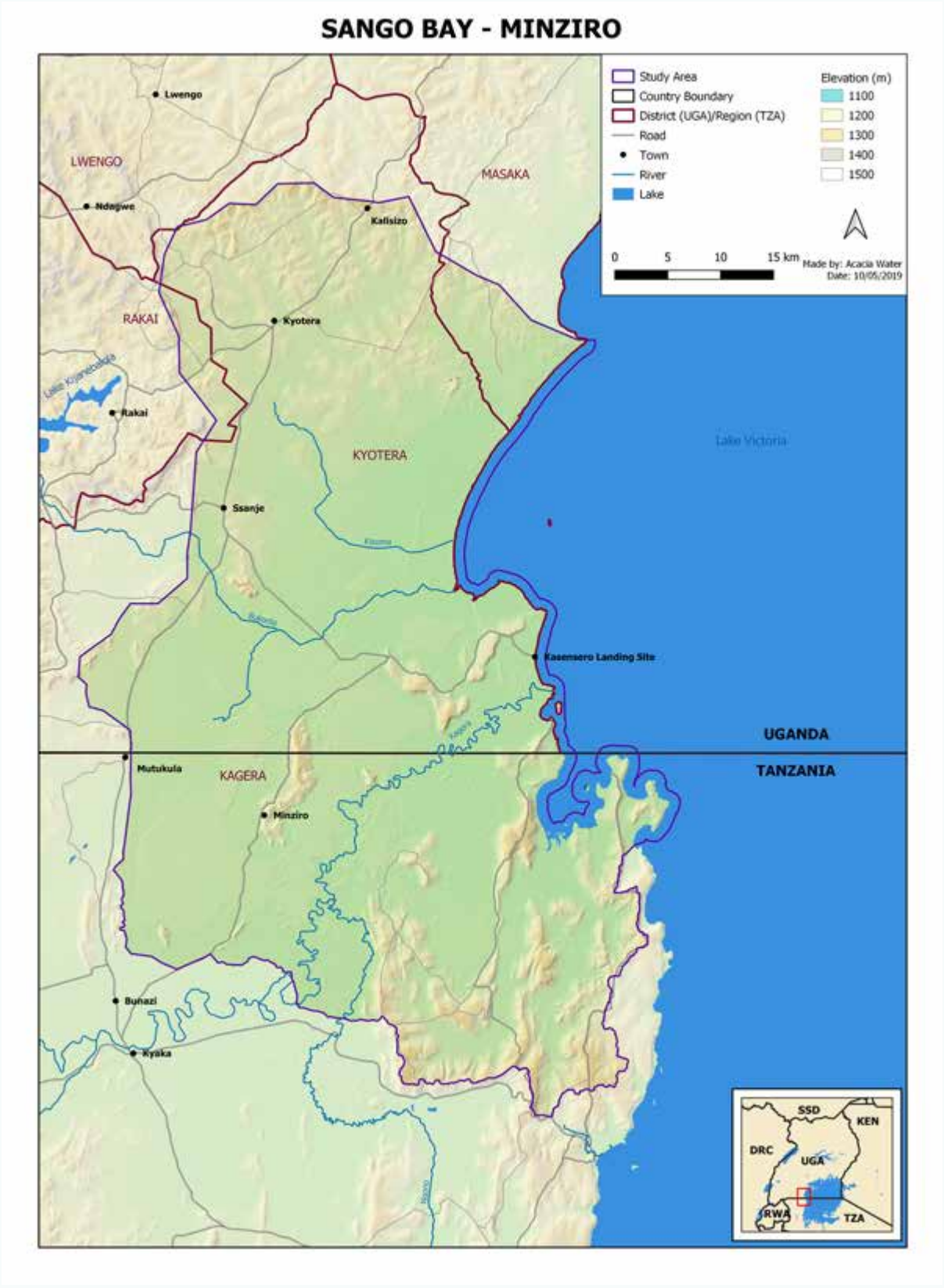
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Appendix A MAPS

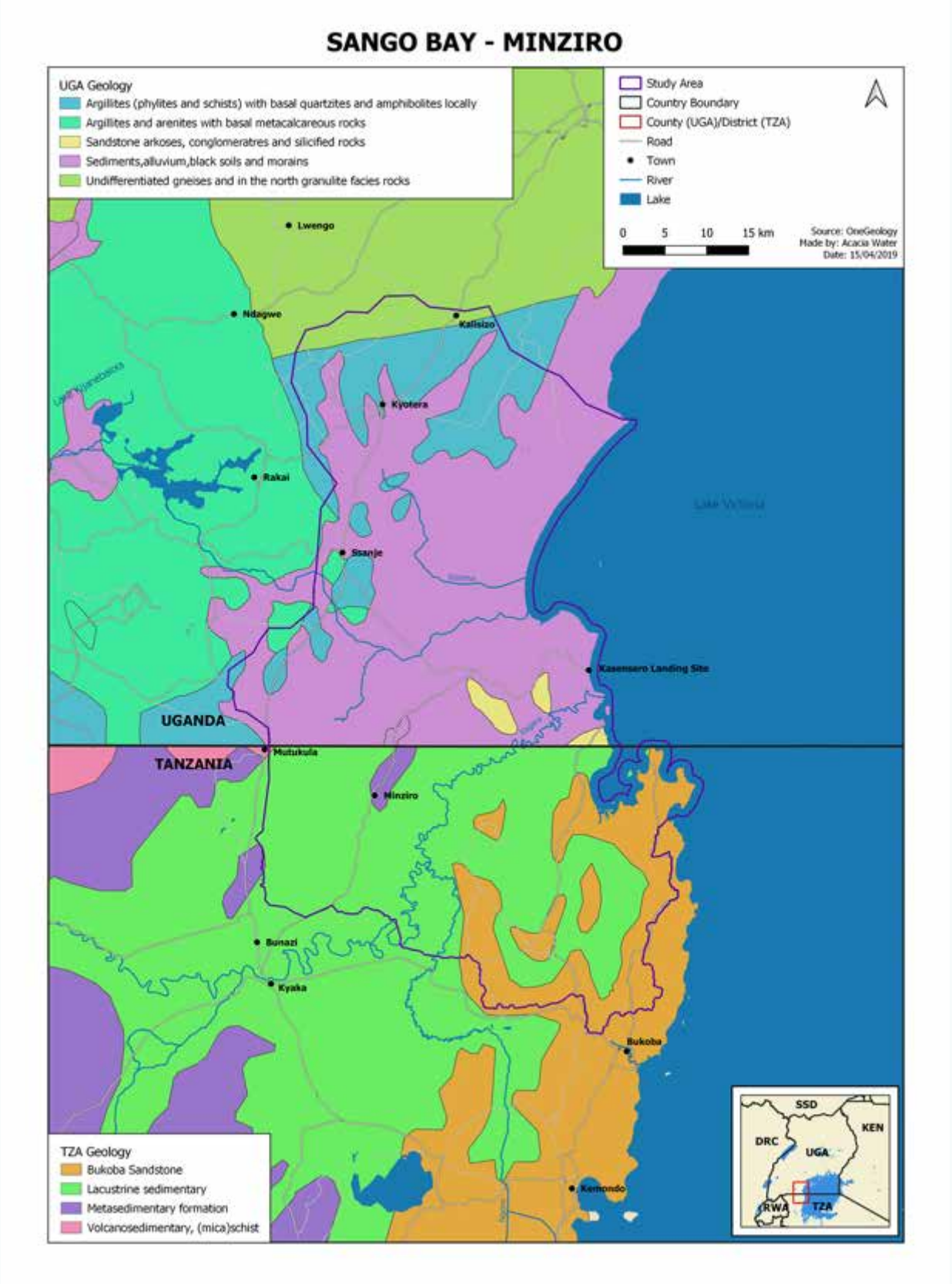
A1. Sango Bay-Minziro - Administrative boundaries



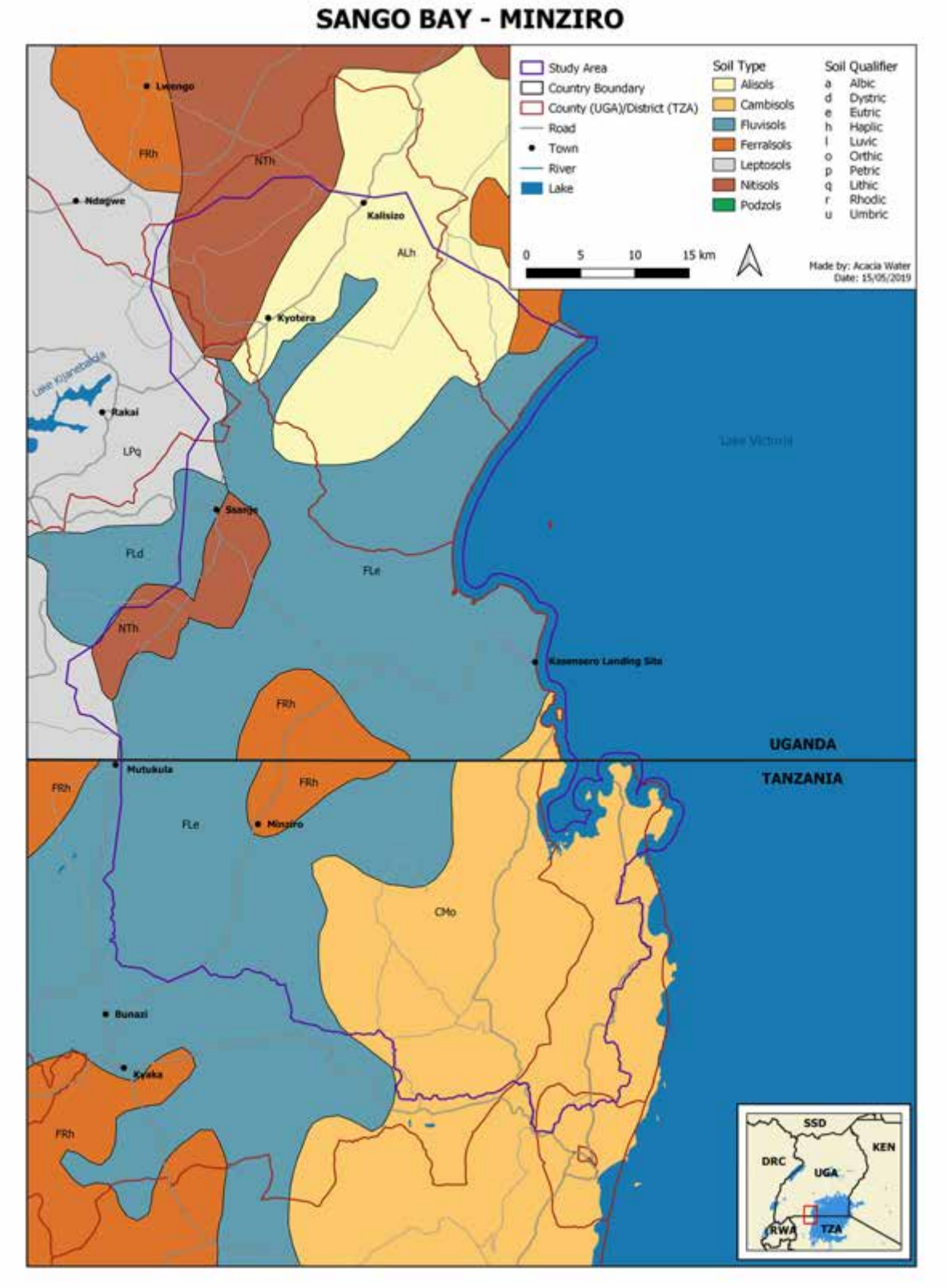
A2. Sango Bay-Minziro - Elevation



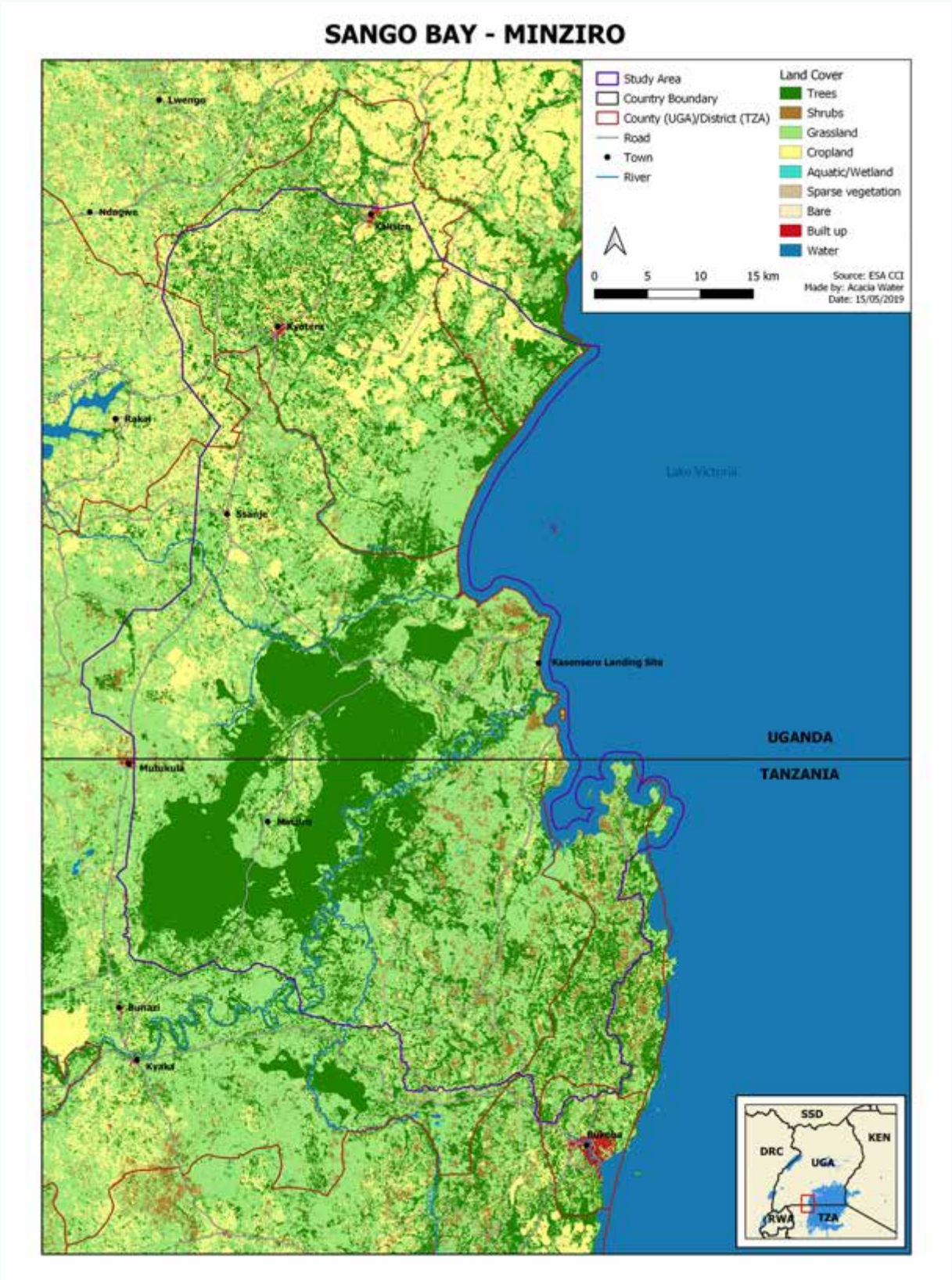
A3. Sango Bay-Minziro - Geology



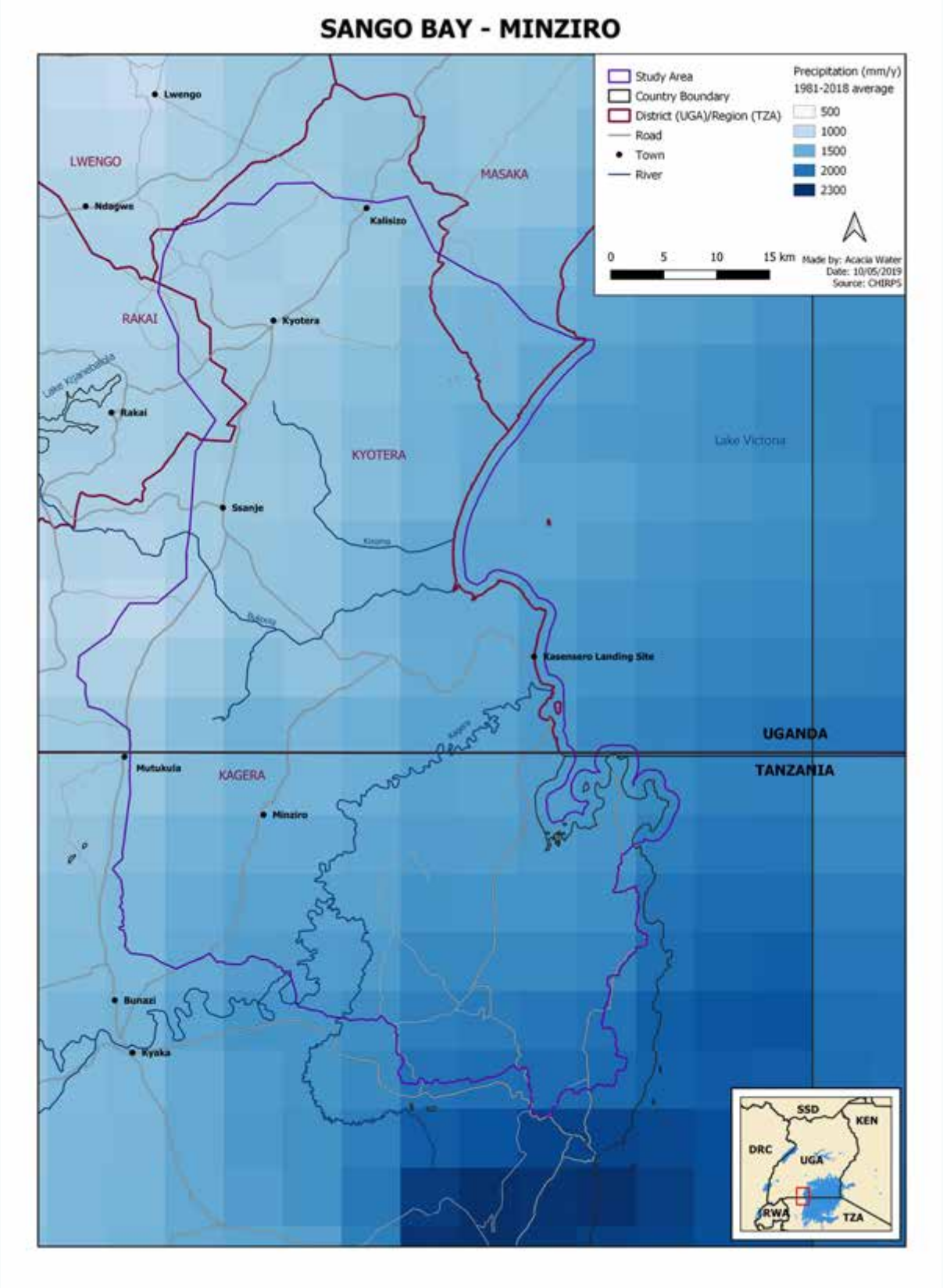
A4. Sango Bay-Minziro - Soils



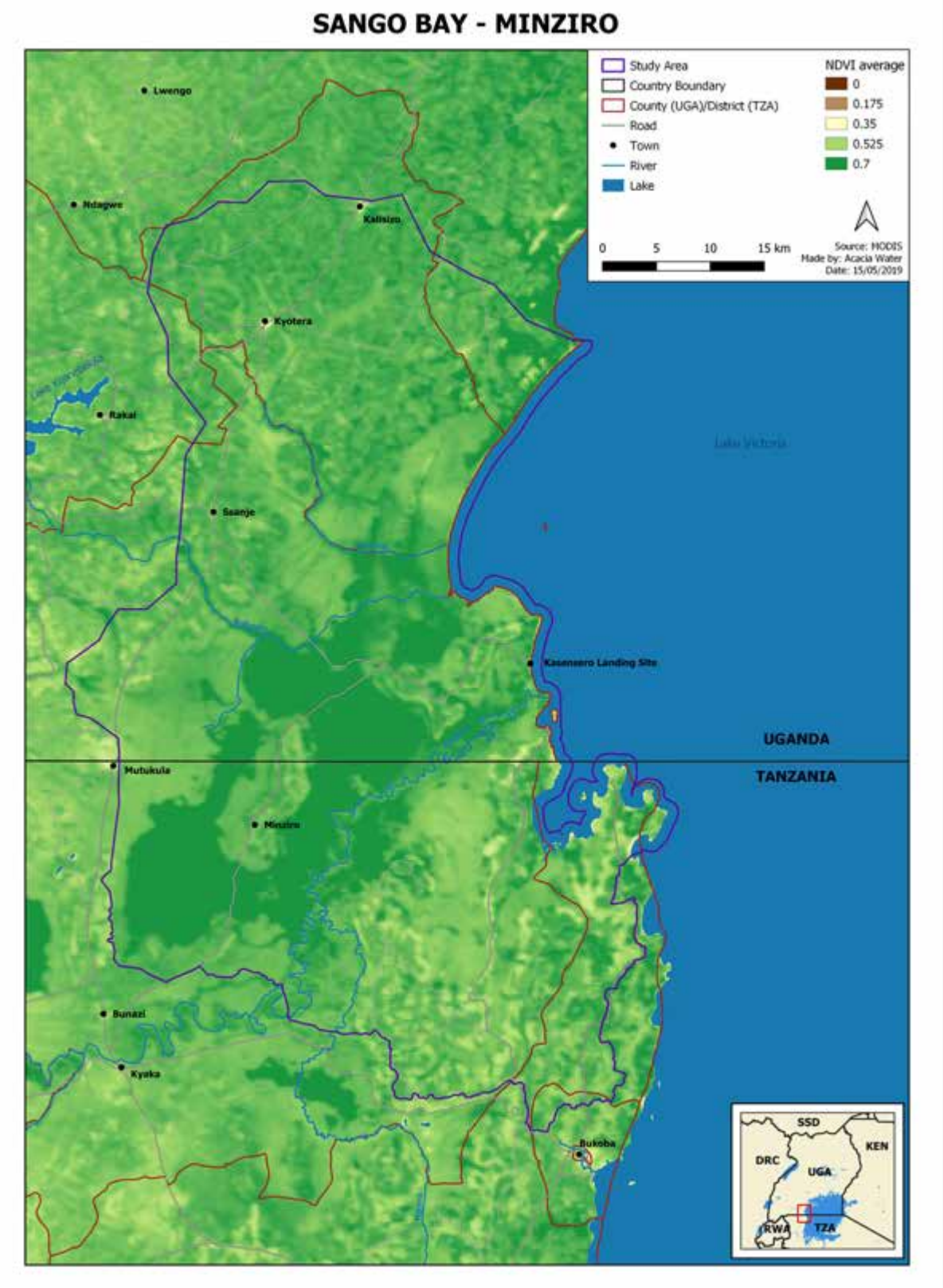
A5. Sango Bay-Minziro - Land cover



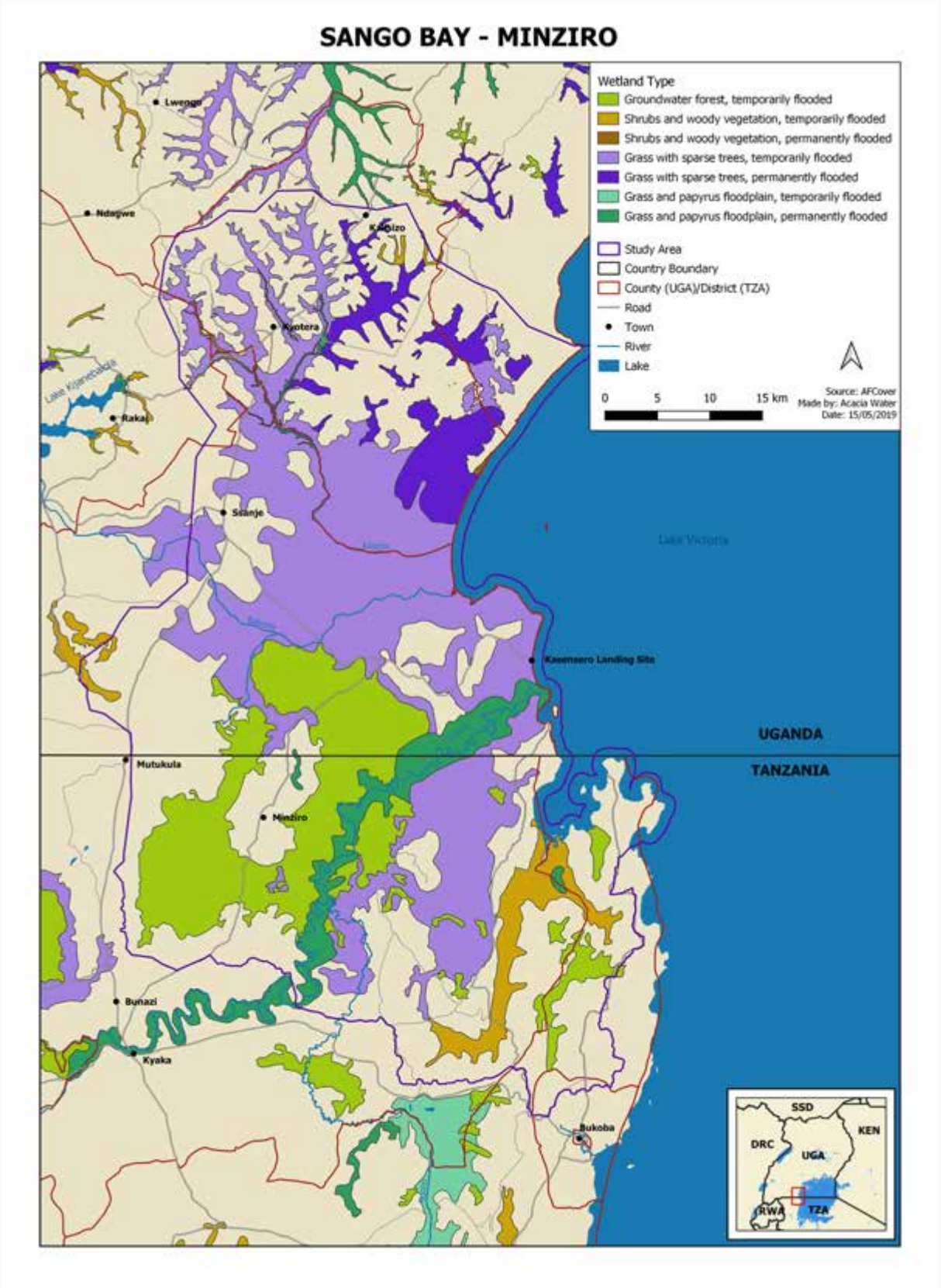
A6. Sango Bay-Minziro - Precipitation



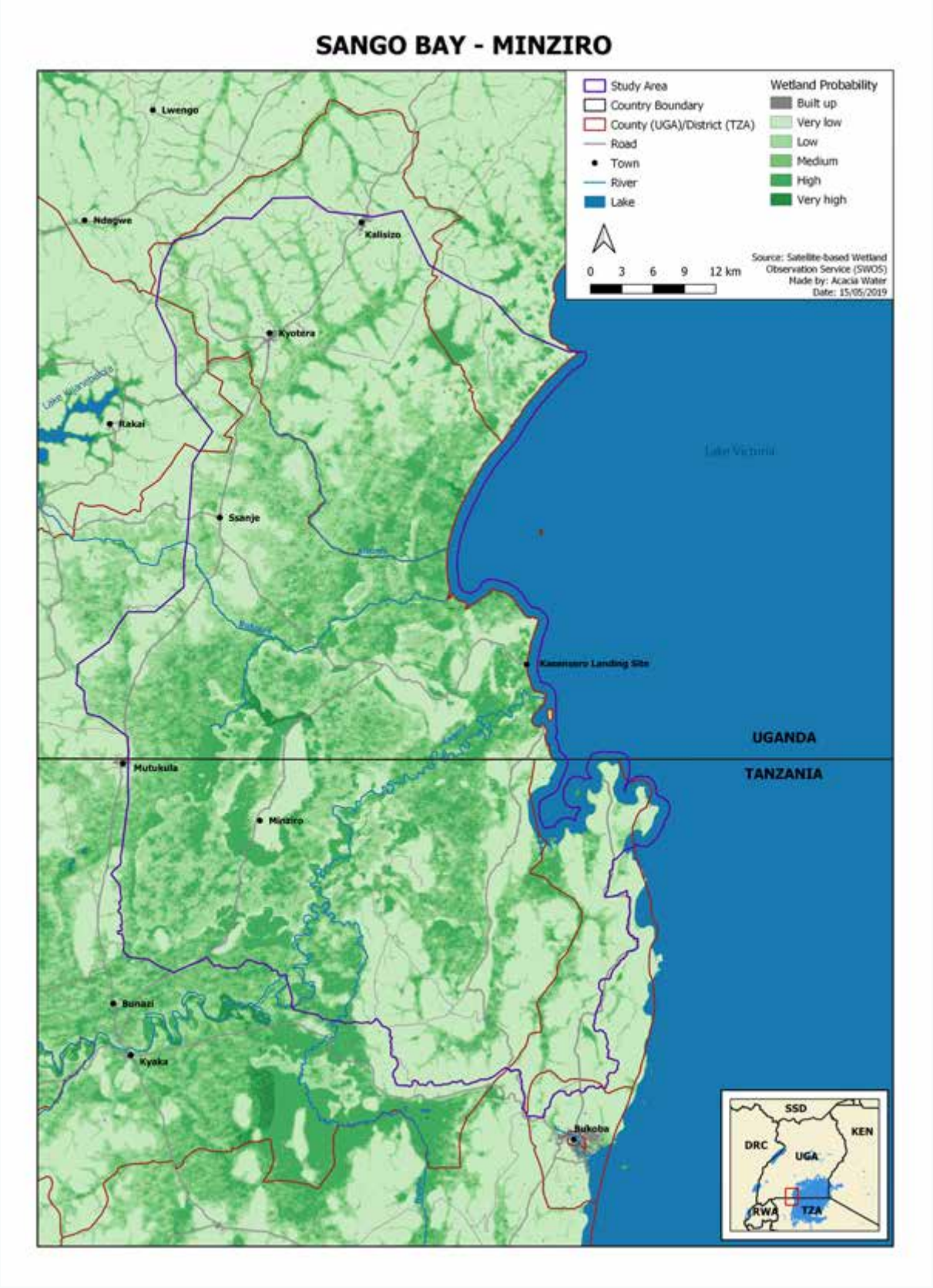
A7. Sango Bay-Minziro - Vegetation greenness (NDVI)



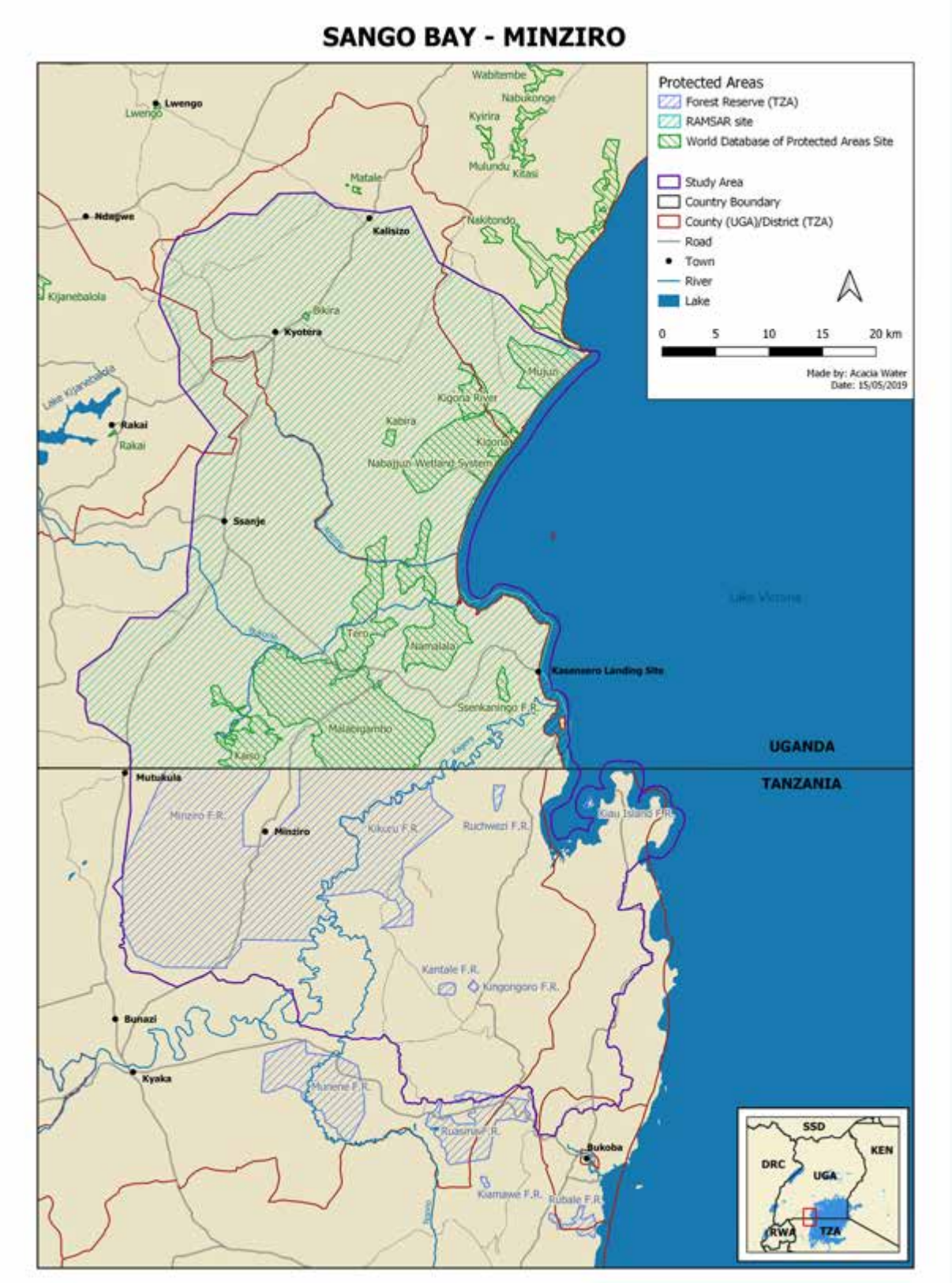
A8. Sango Bay-Minziro - Wetland types



A9. Sango Bay-Minziro - Probability of wetland cover



A10. Sango Bay-Minziro - Protected areas



Appendix B MAIN FINDINGS FIELD VISITS

Observations and notes field visit Kyabasimba fish landing site in Kyotera District, Uganda on April 26th 2019

The Kyabasimba fish landing site in Kyotera, Uganda is highly concentrated with about 800+ people. The main fish being landed in this beach are Lung fish, Tilapia and Catfish. Average of number of boat landed was between 120-150. The organization of fishing is diverse. Some fishers and crew stay with their families (wife and children) while others stay alone and travel home for their family from time to time. Fishing is done by crewmembers. Some crews have organised themselves in form of camp. They hire rooms and someone cooks for them. They are those who cook for themselves and those who have their family at the landing site.

The landing site is divided in two sections: Tilapia and lungfish/catfish landing site and the one for Nile Perch which is a bit isolated. In each boat, averages of two crewmembers work for boat owners. If they get say 10 kilogram of fish, 7Kgs are taken by owner of the boat and 3 Kgs are taken by boat crew who divide the proceeds after sale. The average catch for Tilapia is about 40 to 50 Kgs per boat which was indicated to be low catches compared to 10 years ago. Crew who rent boats also pay UGX 10,000 to the owner of the boat on a daily basis as beach landing fee. In this year, the government of Uganda has decided to set some days off (Saturday and Sunday) to reduce fishing pressure but it is not practically working. Nile Perch fishers normally go out fishing in deeper waters while for Tilapia, catfish and lung fish they go in shallow waters. Prices for Tilapia was about 6,000 to 7,000 UGX per kilo while Nile Perch was 7,000 to UGX 15,000.- The two fish species were more commercial and bought by various traders mainly agents of Nile Perch export processing factors who use insulated trucks to collect fish from different fish landing sites. Fish buyers come to Kyabasimba beach daily. Majority come from Kyotera, Kakuuto, Saneje and Kampala.

The following were mentioned as peak fishing seasons (Jan-Feb) and gillnet fishing gear are favourable during this period. In July-August it is windy and the lake is so rough. Water mixing his high and the best gear for Nile Perch is long lines. For Tilapia gill net is the only gear used. Fishing for Nile Perch is done at night. Fishers go out fishing from 2-3pm and return from 6-11am. It takes about 3-5 years to reach the fishing ground. For Tilapia, lung fish and cat fish fishing is done morning and early in the morning, day time and even evening time.

Being a concentrated landing site the sanitary condition at Kyabasimba was so poor. The beach had one public toilet (pit latrine) which was full. People paid UGX 200.- to get access to it. Lack of public and private toilets caused serious problem in the area and defecating in bushes was a common phenomenon. During the visit, a huge pit hole was being built for communal toilets and drug shops and HIV/Aids counseling services were available. Lake water was the only source of water for all uses. Washing, drinking, bathing, cleaning, construction and so on.

Photographs from Kyabasimba fish landing site (Kyotera) and Bukoba Police station (Tanzania)



Juvenile Nile Perch confiscated at Bukoba Police station



Gill net for catching Tilapia



Nile Perch in insulated truck



Tilapia fishing boats at Kyabasimba Landing site (Uganda)

(Photographs taken by Modesta Medar

Waypoint	Lat	Lon	Elevation	Type	Status	Name	Wadi / sub-county	EC	T	NO3	Turbidity (NTU)	Yield (estimated)
830	0343790	9862966	1136	River	perennial	Ngono river		17	22	0	<5	20 m3/s
831	0340728	9864643	1145	Borehole	functional	Bugorora Primary School	Bugorora	64	24	0		
832				Crop								
833				Water treatment plant	Since 2017	Kyaka town	Kyaka	282	29	0		?
834	0324038	9861714	1145	River	perennial	Kagera River		133	23	0	80-95	200 m3/s
690				valley/culvert			Minziro					
689				valley/culvert			Minziro					
688				valley/culvert			Minziro					
841	0345578	9866521	1135	River	perennial	Ngono river		17	23	0	<5	

Borehole number	Borehole placement	Borehole depth	depth to GW (m)	Geology	Activities	Vegetation	Animals	Wetland Services	Comments
				sandstones and mudstones, low grade metamorphic, dipping with 30 degrees in ESE direction			birds & butterflies	household water	Water has a very low EC, colour is brown but turbidity low, small side valley with papyrus connects with river immediately after bridge, waterlevel according to scale is 2,24 m, in total there are 8 scales of 1m each (highest waterlevel recorded = +7m?), according to locals the yearly high flow mark is +2,5 m, river profile: width=9m, depth = 2m, floating stick method (14, 13 and 13 sec for 15m) --> velocity = 1 m/s --> Q = 20 m3/s; old small bridge and new higher bridge
		around 45 m				school garden	no		
									New agricultural project with large scale sunflower crops starting
									Water treatment plant, Installed by JICA in 2016/2017, Kagera River intake, sand filtration+carbon+chlorination, some kind of powder ("poly-glu"?) added to remove turbidity, water is sold in Kyaka for 100 Tsh per 20L jerrycan. Note that EC goes up from 133 to 282 uS/cm after treatment
				big stones (outcrop?) of metasediments / quartzites	washing clothes, motorcycle, waste disposal	water hyacinth floating in the water + big floating mats of grass			Floating water hyacint and big mats of grass (due to heavy debugging / erosion upstream), water scale gauging station has been washed aside and not relocated, 46 cm it reads, river profile: width = 60m, depth = 3m?, velocity = 1 m/s (not measured) --> Q = 180 m3/s. Note: in March 2019 Q was measured as 182 m3/s by Lake Victoria Watershed (v=1.1m/s, width=50.2; depth (along the side) = 2.2m
									WP of Jan 2019; riverbed still dry, landscape: high grass & acacia trees
									WP of Jan 2019; riverbed some stagnant water, not flowing, landscape: natural forest (Minziro Forest) with mosses in the trees (capturing fog?!)
									WP of Jan 2019; riverbed some stagnant water, not flowing, lot of stagnant water along the sides of the road
				outcrops of metasedimentary rocks (low grade M sandstones & mudstones; foliated)		very mixed, different types of trees and bushes and reeds	According to guide: hippo's in the river but far from here, and crocs		

Waypoint	Lat	Lon	Elevation	Type	Status	Name	Wadi / sub-county	EC	T	NO3	Turbidity (NTU)	Yield (estimated)
842				Viewpoint								
843				Rock								
844	0347933	9875285	1147	Protected well	non-functional, handpump removed							
845				Spring/open well (unprotected)	perennial			38	23	2		
846A	0351286	988434	1150	Borehole (electric pump)	Since 2017	Ruzinga town	Ruzinga					5 m3/hr
846B	0351260	9878452	1148	Spring (protected)	perennial	Ruzinga town	Ruzinga	50	23	10		?
847	0349527	9872711	1164	Stream	seasonal	Buyango stream	Buyango (?)	13	20	0	<5	20 L/s
848				valley/culvert								
849				valley/culvert								
850	0355328	9866271	1206	Stream		Chabazaire	Bwanyi	48	24	5	<5	10 L/s
851				Observation								

Borehole number	Borehole placement	Borehole depth	depth to GW (m)	Geology	Activities	Vegetation	Animals	Wetland Services	Comments
				outcrops/blocks of meta-sandstone/quartzite		pine tree plantation	1 black/white hornbill		View on grass with scattered trees (seasonal flooded according to wetland type map)
				outcrops/blocks of meta-sandstone/quartzite everywhere					
		around 10 m	1,03 m below rim; rim = +0,45m						
				quartzite (many lichens!) outcrops on the hills nearby; no outcrops in valley; soil is grey and sandy		lush vegetation with trees, palms in the valley; grass on the hills			
		around 100 m			crunching big rocks for gravel production; brick making	lush vegetation with many trees, palms, bamboo, pines	3 velvet monkeys		Water supply for Ruzinga town (on top of hill) consists of 1 HY BH + 2 springs; water is collected in 1 tank and pumped to storage tank on top of hill. BH water could not be sampled, but water from 60m3 collection tank (mixed with spring water) = EC 171 uS/cm, T = 23,9; NO3 = 10 mg/l --> EC BH = 200-300? Collection tank has a lot of iron flogs/precipitation. 10mg/l NO3 suggests faecal contamination might be present. Advisable to use chlorine for desinfection
						lush vegetation with many trees, palms, bamboo		Vegetation in valley for natural treatment of spring water; potable water	Water supply for Ruzinga town (on top of hill) consists of 1 HY BH + 2 springs; 1 spring visisted (near BH), water is collected in 1 tank and pumped to storage tank on top of hill. Ruzing town it self has no boreholes for water supply, only spring
						Papyrus			Small valley with papyrus, water flow directly into Kagera, during dry season the stream dries (3-4 months)
									Wide valley with papyrus, small culverts
									Smal valley with some stagnant water
				outcrops of metasedimentary rocks (low grade M sandstones & mudstones; foliated)	car wash in stream	bamboo, eucalyptus, other trees and bushes			Small fast flowing stream, car and motorbike parked in the stream for washing (soap) --> contamination. Erosion on the nearby roads due to surface runoff
				outcrops of metasedimentary rocks (low grade M sandstones & mudstones; foliated)		Pine trees, palms and down in the valley wide plain with grasses (seasonally			Groundwater seepage/springs causing wet spots in the rocks/landscape surrounding the road, combining to small streams, not many people in this area

Waypoint	Lat	Lon	Elevation	Type	Status	Name	Wadi / sub-county	EC	T	NO3	Turbidity (NTU)	Yield (estimated)	Borehole number
852				Observation		Kanyigo							
853				Viewpoint									
854				Observation									
855	0365102	9889485	1139	Lake		Lake Victoria	Kasheny e	102	29	0	<5		
856	0360839	9882071	1279	Stream	perennial	Kishaba	Kanyego	29	22	0	<5	5 L/s	
857	0358498	9877427	1159	Borehole (electric pump)	functional	Kikukwe dispensery	Kanyego					25 m3/hr	
858	0359116	9864493	1151	Swamp	perennial; almost no flow	Kadia swamp	Gera	14	24				
859	0360952	9860733	1262	Spring (unprotected)	perennial	Bwenoni spring	Kashamb ia village	13	23	0	<5	3 L/s (constant whole year)	
860	0336679	9924835	1169	River	seasonal	River Kisoma		292	19	0		stagnant	
861	0342310	9900584	1143	River	perennial	River Bukoola (Kibaale)		370	19	0	<5	450 L/s	
862	0349934	9897841	1152	Borehole (handpump)	functional	Mutegombu ra village	Kyebe	44	24	35			DWD 53586

Borehole placement	Borehole depth	depth to GW (m)	Geology	Activities	Vegetation	Animals	Wetland Services	Comments
					flooded; protected status)			
								Many new houses being build here on the edge of Kanyigo town; school also
								Viewpoint on edge of escarpment. High side is 1296m
					a lot of pine trees and eucalyptus planted here			In village here water from springs and lake water is used
			outcrops of quartzites / sandstones nearby	Fishing boats				Kabindi town, fishing village (big boats, some with engines + fishing nets), no boreholes, Lake Victoria water used as potable water,
			outcrops of quartzites/sandstones		Mix of pines, palms, eucalypt, shrubs, banana, "Muamra tree"		water from stream used for drinking	
	50m		no outcrops (almost down in valley) dark red/brown soils, clayey		many pine trees planted; crops: mais and cassava	'Hamerkop' bird around here		Pump test was performed recently (25 m3/hr) but no pump report yet. BH with electric pump, water pumped to 10 m3 elevated tank, tap where water can be. fetched is locked, tank is empty currently. Water used by community (500 TZS per month), secondary school and dispensery. Termite mounds grow well on red clayey soils. Rain Water Harvesting at roof of building
					papyrus swamp, with high grass and reeds			Papyrus swamp; Water is brown/yellow but very clear; seems to be stagnant water but is flowing into lake Victoria
			outcrops of meta sedimentary rock + blocks of quartzite; in the surroundings are ridges of white coloured low-grade quartzite (or meta-sandstone)	no encroachment observed here	bamboo, eucalyptus, other trees and bushes			In the region are two of these springs (we visit only 1), with a constant rate throughout the year
			no outcrops	encroachment upstream	Papyrus swamp			Seasonal river, stagnant right now, culvert = 2x2 m
			no outcrops		papyrus			Perennial river, bridge flooded one time (1999?), around 1.5 m wide, 0.4 m deep, v = 0,75 m/s --> Q = 450 L/s
17-12-17	(check well completion report)				grass (football field) and eucalypt			Settlement around 100 m away, might be source of contamination (high NO3)

Waypoint	Lat	Lon	Elevation	Type	Status	Name	Wadi / sub-county	EC	T	NO3	Turbidity (NTU)	Yield (estimated)	Borehole number
863	0353567	9895556	1144	Borehole (handpump)	functional	Kibumbe village	Kyebe	148	23	0			DWD 25512
864				Viewpoint									
865				River	perennial	River Kagera		155	23	0	75-90	not estimated	
867				Shallow well	non-functional, 'fietspomp' pump still there								
868													
869				Water supply		Kasensero Landing Site							
870	0359113	9900260	1152	Spring (protected)	functional	Ssekaningo Forest Reserve Production spring		34	22	5 to 10		12 m3/hr for 12 hours per day	
871				Borehole 879									
872				Borehole									

Borehole placement	Borehole depth	depth to GW (m)	Geology	Activities	Vegetation	Animals	Wetland Services	Comments
06-10-07	depth unknown			BH in town, houses & latrines nearby (20-30m)	horticulture, coffee plants			
								Viewpoint on escarpment & Ssekaningo Forest Reserve
			no outcrops	transport by boats, fishing	papyrus on one side, grass on other side, floating island (grass and water hyacint) in the water	according to fishermen: crocs and hippo's are there		River Kagera, almost at the outlet, boats used for fishing and crossing the river, fishermen are afraid for crocs and hippo's, they eat them but only when opportunity is there, dredging machines were used some time ago to clear the water from vegetation, funded by Egyptians, the water way was obstructed with water hyacinth, high water level is only 0,5 m higher than current level, scales in river read 0,88 m, there is only 1 higher scale (1m) so waterlevel does not get very high here. River bankd degredation
1995								Also elevated tank nearby, with electric pump + high yielding borehole (no well report), problems with distribution
								Water supply in Kasensero Landing Site (fishing village) is coming from water kiosks, which are supplied by piped water system (Min. of W&E), source of water is a protected spring in Ssekaningo Forest Reserve (waypoint...)
			spring at foot of escarpment (quartzite)					Water from this protected spring is pumped to reservoir 2,1 km away and from there distributed to Kasensero town. Water intake for 12 hours a day with 12 m3/hr (144 m3/day production). Two pumps, meters read 25934 m3 and 3975 m3. Pumping since 2015 (note: 30.000 m3 with 144 m3/day is only 207 days...) The spring is well protected and the site is fenced, has a generator (in case of electricity failure), concrete buildings, guard etc. Before 2015 the spring was used by local communities; they can not access the spring anymore (and there is no tap for them outside the fence!), according to the district water officer "they have other sources". Water can be bought from the kiosk for 100 UGX/jerrycan. "The only spring in the area"
						velvet monkey		coordinates are estimate; we did not stop here

Waypoint	Lat	Lon	Elevation	Type	Status	Name	Wadi / sub-county	EC	T	NO3	Turbidity (NTU)	Yield (estimated)	Borehole number
873				POI									
874				Sign									
875	0362616	9903230	1123	Lake Victoria - Landing Site				105	25	5	<5		
876				Toilet									
877				School									
878				Water kiosk									
879	0356422	9898132	1157	Borehole	functional	Mirugwe village	Kasenseso Town Council (?)	58	25	0			DWD 49030
880	0354529	9895695	1140	Shallow well (handpump)	functional	Kasuli village / Kasuli forest		31	23	0			
881				RWH									
882				RWH									
883				Observation									
884				Observation									
885	0331275	9913175	1160	Spring (protected)	perennial	Buvango village	Kasese sub-county	48	24	5		1 L/s	

Borehole placement	Borehole depth	depth to GW (m)	Geology	Activities	Vegetation	Animals	Wetland Services	Comments
								Rwanda Genocide mass grave, the remains of 2783 victims are burried here (from Kagera River)
				Charcoal production				Charcoal production. Sign about "free family planning services available" --> important services as all pressure on wetlands is the result of high population pressure
			banks of meta-sandstone / conglomerates near the beach, heavily jointed and weathered (almost like 'elephant skin'		inundated trees (acacias?) along the shore of Lake Victoria			Kyabasimba Landing Site - around 700 people (adults) living here, around 120 boats for fishing, all registered and licensed, Lake Victoria is only source of (potable) water. Inundation of trees is seasonal, when the water level in Lake Victoria is high ("in may")
			4m deep hole with blocks of weathered red/white sandstone					New toilet block in construction, hole is 4 m deep
								nearby school for Landing Sites where kids (possibly) go
								One of the water kiosk selling water from the protected spring (wp870)
2015	unknown				On the side of a grassfield, near school, in village			Near Mirigwe Primary School. "Funded by Egyptian Support"
			outcrops of red sandstones on the road side; shallow well located 20m down the road; soils are red and clayey		Forest vegetation		Timber from forest (man taking out logs)	Shallow well (big diameter) protected and with handpump, located on foot of hill (road) in the Kasuli Forest
								School with Rain Water Harvesting
								School with Rain Water Harvesting, also gravel making (crushing bick rocks) and brick making
								Pastoralists living around here in round houses, near the forest
								Pastoralists living around here in round houses, near the forest
					plantation of pine trees	Many weaver birds in big tree near spring		This is the only spring left in this area, used to be several springs but they have dried due to cultivation. Spring was renovated in 2018. Water used for washing and drinking

Appendix C SPECIES LIST SANGO BAY-MINZIRO

Birds of Sangobay-Minziro area, Rakai

(Source:- Avibase Online Bird Checklists of the World, Last modified: 2019-05-05)

SANGOBAY-MINZIRO		
ANSERIFORMES: Anatidae		
White-faced Whistling-Duck	*Dendrocygna viduata*	
Fulvous Whistling-Duck	*Dendrocygna bicolor*	
White-backed Duck	*Thalassornis leuconotus*	
Knob-billed Duck	*Sarkidiornis melanotos*	
Egyptian Goose	*Alopochen aegyptiaca*	
Spur-winged Goose	*Plectropterus gambensis*	
African Pygmy-Goose	*Nettapus auritus*	
Garganey	*Spatula querquedula*	
Hottentot Teal	*Spatula hottentota*	
Northern Shoveler	*Spatula clypeata*	
Eurasian Wigeon	*Mareca penelope*	Rare/Accidental
African Black Duck	*Anas sparsa*	
Yellow-billed Duck	*Anas undulata*	
Red-billed Duck	*Anas erythrorhyncha*	
Northern Pintail	*Anas acuta*	
Green-winged Teal	*Anas crecca*	
Southern Pochard	*Netta erythrophthalma*	
GALLIFORMES: Numididae		
Helmeted Guineafowl	*Numida meleagris*	
Crested Guineafowl	*Guttera pucherani*	
GALLIFORMES: Phasianidae		
Blue Quail	*Synoicus adansonii*	
Harlequin Quail	*Coturnix delegorguei*	
Heuglin's Francolin	*Pternistis icterorhynchus*	
Scaly Francolin	*Pternistis squamatus*	
Red-necked Francolin	*Pternistis afer*	
Crested Francolin	*Dendroperdix sephaena*	
Coqui Francolin	*Peliperdix coqui*	
Red-winged Francolin	*Scleroptila levaillantii*	
PHOENICOPTERIFORMES: Phoenicopteridae		
Lesser Flamingo	*Phoeniconaias minor*	Near-threatened
PODICIPEDIFORMES: Podicipedidae		
Little Grebe	*Tachybaptus ruficollis*	
COLUMBIFORMES: Columbidae		
Speckled Pigeon	*Columba guinea*	
Afep Pigeon	*Columba unicincta*	
Rameron Pigeon	*Columba arquatrix*	
Bronze-naped Pigeon	*Columba iriditorques*	
Lemon Dove	*Columba larvata*	

Mourning Collared-Dove	*Streptopelia decipiens*	
Red-eyed Dove	*Streptopelia semitorquata*	
Ring-necked Dove	*Streptopelia capicola*	
Laughing Dove	*Streptopelia senegalensis*	
Blue-spotted Wood-Dove	*Turtur afer*	
Tambourine Dove	*Turtur tympanistria*	
Namaqua Dove	*Oena capensis*	
African Green-Pigeon	*Treron calvus*	
OTIDIFORMES: Otididae		
Denham's Bustard	*Neotis denhami*	Near-threatened
Black-bellied Bustard	*Lissotis melanogaster*	
MUSOPHAGIFORMES: Musophagidae		
Black-billed Turaco	*Tauraco schuettii*	
White-crested Turaco	*Tauraco leucolophus*	
Ross's Turaco	*Musophaga rossae*	
Bare-faced Go-away-bird	*Corythaixoides personatus*	
Eastern Plantain-eater	*Crinifer zonurus*	
CUCULIFORMES: Cuculidae		
Senegal Coucal	*Centropus senegalensis*	
Blue-headed Coucal	*Centropus monachus*	
White-browed Coucal	*Centropus superciliosus*	
Blue Malkoha	*Ceuthmochares aereus*	
Great Spotted Cuckoo	*Clamator glandarius*	
Levaillant's Cuckoo	*Clamator levaillantii*	
Pied Cuckoo	*Clamator jacobinus*	
Dideric Cuckoo	*Chrysococcyx caprius*	
Klaas's Cuckoo	*Chrysococcyx klaas*	
African Emerald Cuckoo	*Chrysococcyx cupreus*	
Dusky Long-tailed Cuckoo	*Cercococcyx mechowi*	
Black Cuckoo	*Cuculus clamosus*	
Red-chested Cuckoo	*Cuculus solitarius*	
African Cuckoo	*Cuculus gularis*	
Madagascar Cuckoo	*Cuculus rochii*	Rare/Accidental
Common Cuckoo	*Cuculus canorus*	
CAPRIMULGIFORMES: Caprimulgidae		
Pennant-winged Nightjar	*Caprimulgus vexillarius*	
Standard-winged Nightjar	*Caprimulgus longipennis*	
Eurasian Nightjar	*Caprimulgus europaeus*	
Swamp Nightjar	*Caprimulgus natalensis*	
Plain Nightjar	*Caprimulgus inornatus*	
Freckled Nightjar	*Caprimulgus tristigma*	
Slender-tailed Nightjar	*Caprimulgus clarus*	
Square-tailed Nightjar	*Caprimulgus fossii*	
CAPRIMULGIFORMES: Apodidae		
Sabine's Spinetail	*Rhaphidura sabini*	
Scarce Swift	*Schoutedenapus myoptilus*	
Alpine Swift	*Apus melba*	
Common Swift	*Apus apus*	
Little Swift	*Apus affinis*	

White-rumped Swift	*Apus caffer*	
African Palm-Swift	*Cypsiurus parvus*	
GRUIFORMES: Sarothruridae		
White-spotted Flufftail	*Sarothrura pulchra*	
Buff-spotted Flufftail	*Sarothrura elegans*	
Red-chested Flufftail	*Sarothrura rufa*	
GRUIFORMES: Rallidae		
African Rail	*Rallus caerulescens*	
Corn Crake	*Crex crex*	
African Crake	*Crex egregia*	
Spotted Crake	*Porzana porzana*	Rare/Accidental
Lesser Moorhen	*Paragallinula angulata*	
Eurasian Moorhen	*Gallinula chloropus*	
Allen's Gallinule	*Porphyrio alleni*	
African Swamphen	*Porphyrio madagascariensis*	
Striped Crake	*Amaurornis marginalis*	Rare/Accidental
Black Crake	*Zapornia flavirostra*	
Baillon's Crake	*Zapornia pusilla*	Rare/Accidental
GRUIFORMES: Heliornithidae		
African Finfoot	*Podica senegalensis*	
GRUIFORMES: Gruidae		
Gray Crowned-Crane	*Balearica regulorum*	Endangered
CHARADRIIFORMES: Burhinidae		
Water Thick-knee	*Burhinus vermiculatus*	
CHARADRIIFORMES: Recurvirostridae		
Black-winged Stilt	*Himantopus himantopus*	
Pied Avocet	*Recurvirostra avosetta*	
CHARADRIIFORMES: Charadriidae		
Long-toed Lapwing	*Vanellus crassirostris*	
Spur-winged Lapwing	*Vanellus spinosus*	
Senegal Lapwing	*Vanellus lugubris*	
Crowned Lapwing	*Vanellus coronatus*	
Wattled Lapwing	*Vanellus senegallus*	
Brown-chested Lapwing	*Vanellus superciliosus*	
Caspian Plover	*Charadrius asiaticus*	
Kittlitz's Plover	*Charadrius pecuarius*	
Common Ringed Plover	*Charadrius hiaticula*	
Little Ringed Plover	*Charadrius dubius*	
Three-banded Plover	*Charadrius tricollaris*	
CHARADRIIFORMES: Rostratulidae		
Greater Painted-Snipe	*Rostratula benghalensis*	
CHARADRIIFORMES: Jacanidae		
African Jacana	*Actophilornis africanus*	

CHARADRIIFORMES: Scolopacidae		
Whimbrel	*Numenius phaeopus*	
Eurasian Curlew	*Numenius arquata*	Near-threatened
Black-tailed Godwit	*Limosa limosa*	Near-threatened
Ruff	*Calidris pugnax*	
Temminck's Stint	*Calidris temminckii*	
Little Stint	*Calidris minuta*	
Jack Snipe	*Lymnocryptes minimus*	
Great Snipe	*Gallinago media*	Near-threatened
Common Snipe	*Gallinago gallinago*	
African Snipe	*Gallinago nigripennis*	
Common Sandpiper	*Actitis hypoleucos*	
Green Sandpiper	*Tringa ochropus*	
Spotted Redshank	*Tringa erythropus*	
Common Greenshank	*Tringa nebularia*	
Marsh Sandpiper	*Tringa stagnatilis*	
Wood Sandpiper	*Tringa glareola*	
Common Redshank	*Tringa totanus*	
CHARADRIIFORMES: Turnicidae		
Small Buttonquail	*Turnix sylvaticus*	
Black-rumped Buttonquail	*Turnix nanus*	
CHARADRIIFORMES: Glareolidae		
Temminck's Courser	*Cursorius temminckii*	
Bronze-winged Courser	*Rhinoptilus chalcopterus*	
Collared Pratincole	*Glareola pratincola*	
Black-winged Pratincole	*Glareola nordmanni*	Near-threatened
CHARADRIIFORMES: Laridae		
Gray-hooded Gull	*Chroicocephalus cirrocephalus*	
Black-headed Gull	*Chroicocephalus ridibundus*	
Lesser Black-backed Gull	*Larus fuscus*	
Gull-billed Tern	*Gelochelidon nilotica*	
White-winged Tern	*Chlidonias leucopterus*	
Whiskered Tern	*Chlidonias hybrida*	
African Skimmer	*Rynchops flavirostris*	Near-threatened
CICONIIFORMES: Ciconiidae		
African Openbill	*Anastomus lamelligerus*	
Black Stork	*Ciconia nigra*	
Abdim's Stork	*Ciconia abdimii*	
Woolly-necked Stork	*Ciconia episcopus*	
White Stork	*Ciconia ciconia*	
Saddle-billed Stork	*Ephippiorhynchus senegalensis*	
Marabou Stork	*Leptoptilos crumenifer*	
Yellow-billed Stork	*Mycteria ibis*	
SULIFORMES: Anhingidae		
African Darter	*Anhinga rufa*	

SULIFORMES: Phalacrocoracidae		
Long-tailed Cormorant	*Microcarbo africanus*	
Great Cormorant	*Phalacrocorax carbo*	
PELECANIFORMES: Pelecanidae		
Great White Pelican	*Pelecanus onocrotalus*	
Pink-backed Pelican	*Pelecanus rufescens*	
PELECANIFORMES: Balaenicipitidae		
Shoebill	*Balaeniceps rex*	Vulnerable
PELECANIFORMES: Scopidae		
Hamerkop	*Scopus umbretta*	
PELECANIFORMES: Ardeidae		
Little Bittern	*Ixobrychus minutus*	
Dwarf Bittern	*Ixobrychus sturmii*	
Gray Heron	*Ardea cinerea*	
Black-headed Heron	*Ardea melanocephala*	
Goliath Heron	*Ardea goliath*	
Purple Heron	*Ardea purpurea*	
Great Egret	*Ardea alba*	
Intermediate Egret	*Ardea intermedia*	
Little Egret	*Egretta garzetta*	
Black Heron	*Egretta ardesiaca*	
Cattle Egret	*Bubulcus ibis*	
Squacco Heron	*Ardeola ralloides*	
Madagascar Pond-Heron	*Ardeola idae*	Rare/Accidental Endangered
Rufous-bellied Heron	*Ardeola rufiventris*	
Striated Heron	*Butorides striata*	
Black-crowned Night-Heron	*Nycticorax nycticorax*	
White-backed Night-Heron	*Gorsachius leuconotus*	
PELECANIFORMES: Threskiornithidae		
Glossy Ibis	*Plegadis falcinellus*	
African Sacred Ibis	*Threskiornis aethiopicus*	
Hadada Ibis	*Bostrychia hagedash*	
African Spoonbill	*Platalea alba*	
ACCIPITRIFORMES: Sagittariidae		
Secretarybird	*Sagittarius serpentarius*	Vulnerable
ACCIPITRIFORMES: Pandionidae		
Osprey	*Pandion haliaetus*	
ACCIPITRIFORMES: Accipitridae		
Black-winged Kite	*Elanus caeruleus*	
African Harrier-Hawk	*Polyboroides typus*	
Palm-nut Vulture	*Gypohierax angolensis*	

Egyptian Vulture	*Neophron percnopterus*	Endangered
European Honey-buzzard	*Pernis apivorus*	
African Cuckoo-Hawk	*Aviceda cuculoides*	
White-headed Vulture	*Trigonoceps occipitalis*	Critically endangered
Lappet-faced Vulture	*Torgos tracheliotos*	Endangered
Hooded Vulture	*Necrosyrtes monachus*	Critically endangered
White-backed Vulture	*Gyps africanus*	Critically endangered
Rüppell's Griffon	*Gyps rueppelli*	Critically endangered
Bateleur	*Terathopius ecaudatus*	Near-threatened
Black-chested Snake-Eagle	*Circaetus pectoralis*	
Brown Snake-Eagle	*Circaetus cinereus*	
Banded Snake-Eagle	*Circaetus cinerascens*	
Bat Hawk	*Macheiramphus alcinus*	
Crowned Eagle	*Stephanoaetus coronatus*	Near-threatened
Martial Eagle	*Polemaetus bellicosus*	Vulnerable
Long-crested Eagle	*Lophaetus occipitalis*	
Lesser Spotted Eagle	*Clanga pomarina*	
Wahlberg's Eagle	*Hieraaetus wahlbergi*	
Booted Eagle	*Hieraaetus pennatus*	
Ayres's Hawk-Eagle	*Hieraaetus ayresii*	
Tawny Eagle	*Aquila rapax*	Vulnerable
Steppe Eagle	*Aquila nipalensis*	Endangered
African Hawk-Eagle	*Aquila spilogaster*	
Lizard Buzzard	*Kaupifalco monogrammicus*	
Gabar Goshawk	*Micronisus gabar*	
Grasshopper Buzzard	*Butastur rufipennis*	
Eurasian Marsh-Harrier	*Circus aeruginosus*	
African Marsh-Harrier	*Circus ranivorus*	
Pallid Harrier	*Circus macrourus*	Near-threatened
Montagu's Harrier	*Circus pygargus*	
African Goshawk	*Accipiter tachiro*	
Little Sparrowhawk	*Accipiter minullus*	
Ovambo Sparrowhawk	*Accipiter ovampensis*	
Black Goshawk	*Accipiter melanoleucus*	
Black Kite	*Milvus migrans*	
African Fish-Eagle	*Haliaeetus vocifer*	
Common Buzzard	*Buteo buteo*	
Augur Buzzard	*Buteo augur*	
STRIGIFORMES: Tytonidae		
Barn Owl	*Tyto alba*	
STRIGIFORMES: Strigidae		
African Scops-Owl	*Otus senegalensis*	
Southern White-faced Owl	*Ptilopsis granti*	
Spotted Eagle-Owl	*Bubo africanus*	
Verreaux's Eagle-Owl	*Bubo lacteus*	
Pearl-spotted Owlet	*Glaucidium perlatum*	
African Wood-Owl	*Strix woodfordii*	
Marsh Owl	*Asio capensis*	
COLIIFORMES: Coliidae		
Speckled Mousebird	*Colius striatus*	
Blue-naped Mousebird	*Urocolius macrourus*	
TROGONIFORMES: Trogonidae		

Narina Trogon	*Apaloderma narina*	
BUCEROTIFORMES: Upupidae		
Eurasian Hoopoe	*Upupa epops*	
BUCEROTIFORMES: Phoeniculidae		
Green Woodhoopoe	*Phoeniculus purpureus*	
White-headed Woodhoopoe	*Phoeniculus bollei*	
Forest Woodhoopoe	*Phoeniculus castaneiceps*	
Common Scimitarbill	*Rhinopomastus cyanomelas*	
BUCEROTIFORMES: Bucerotidae		
Crowned Hornbill	*Lophoceros alboterminatus*	
African Pied Hornbill	*Lophoceros fasciatus*	
African Gray Hornbill	*Lophoceros nasutus*	
Black-and-white-casqued Hornbill	*Bycanistes subcylindricus*	
CORACIIFORMES: Alcedinidae		
Shining-blue Kingfisher	*Alcedo quadribrachys*	
Malachite Kingfisher	*Corythornis cristatus*	
White-bellied Kingfisher	*Corythornis leucogaster*	
African Pygmy-Kingfisher	*Ispidina picta*	
African Dwarf Kingfisher	*Ispidina lecontei*	
Gray-headed Kingfisher	*Halcyon leucocephala*	
Woodland Kingfisher	*Halcyon senegalensis*	
Blue-breasted Kingfisher	*Halcyon malimbica*	
Striped Kingfisher	*Halcyon chelicuti*	
Giant Kingfisher	*Megaceryle maxima*	
Pied Kingfisher	*Ceryle rudis*	
CORACIIFORMES: Meropidae		
Little Bee-eater	*Merops pusillus*	
Blue-breasted Bee-eater	*Merops variegatus*	
White-throated Bee-eater	*Merops albicollis*	
Blue-cheeked Bee-eater	*Merops persicus*	
Madagascar Bee-eater	*Merops superciliosus*	
CORACIIFORMES: Coraciidae		
European Roller	*Coracias garrulus*	
Lilac-breasted Roller	*Coracias caudatus*	
Broad-billed Roller	*Eurystomus glaucurus*	
PICIFORMES: Lybiidae		
Yellow-billed Barbet	*Trachyphonus purpuratus*	
Gray-throated Barbet	*Gymnobucco bonapartei*	
Speckled Tinkerbird	*Pogoniulus scolopaceus*	
Yellow-throated Tinkerbird	*Pogoniulus subsulphureus*	
Yellow-rumped Tinkerbird	*Pogoniulus bilineatus*	
Yellow-fronted Tinkerbird	*Pogoniulus chrysoconus*	
Yellow-spotted Barbet	*Buccanodon duchaillui*	
Hairy-breasted Barbet	*Tricholaema hirsuta*	

Spot-flanked Barbet	*Tricholaema lacrymosa*	
White-headed Barbet	*Lybius leucocephalus*	
Red-faced Barbet	*Lybius rubrifacies*	Near-threatened
PICIFORMES: Indicatoridae		
Wahlberg's Honeyguide	*Prodotiscus regulus*	
Least Honeyguide	*Indicator exilis*	
Lesser Honeyguide	*Indicator minor*	
Scaly-throated Honeyguide	*Indicator variegatus*	
Greater Honeyguide	*Indicator indicator*	
PICIFORMES: Picidae		
Rufous-necked Wryneck	*Jynx ruficollis*	
Speckle-breasted Woodpecker	*Chloropicus poecilolaemus*	
Cardinal Woodpecker	*Chloropicus fuscescens*	
Bearded Woodpecker	*Chloropicus namaquus*	
Golden-crowned Woodpecker	*Chloropicus xantholophus*	
African Gray Woodpecker	*Chloropicus goertae*	
Brown-eared Woodpecker	*Campethera caroli*	
Buff-spotted Woodpecker	*Campethera nivosa*	
Nubian Woodpecker	*Campethera nubica*	
FALCONIFORMES: Falconidae		
Lesser Kestrel	*Falco naumanni*	
Eurasian Kestrel	*Falco tinnunculus*	
Gray Kestrel	*Falco ardosiaceus*	
Red-necked Falcon	*Falco chicquera*	
Red-footed Falcon	*Falco vespertinus*	Rare/Accidental Near-threatened
Amur Falcon	*Falco amurensis*	Rare/Accidental
Eurasian Hobby	*Falco subbuteo*	
African Hobby	*Falco cuvierii*	
Lanner Falcon	*Falco biarmicus*	
Peregrine Falcon	*Falco peregrinus*	
PSITTACIFORMES: Psittaculidae		
Red-headed Lovebird	*Agapornis pullarius*	
PSITTACIFORMES: Psittacidae		
Gray Parrot	*Psittacus erithacus*	
Meyer's Parrot	*Poicephalus meyeri*	
PASSERIFORMES: Calyptomenidae		
African Broadbill	*Smithornis capensis*	
PASSERIFORMES: Pittidae		
African Pitta	*Pitta angolensis*	
Green-breasted Pitta	*Pitta reichenowi*	
PASSERIFORMES: Campephagidae		
Black Cuckooshrike	*Campephaga flava*	
Red-shouldered Cuckooshrike	*Campephaga phoenicea*	
Purple-throated Cuckooshrike	*Campephaga quiscalina*	

PASSERIFORMES: Oriolidae		
Eurasian Golden Oriole	*Oriolus oriolus*	
African Golden Oriole	*Oriolus auratus*	
Western Black-headed Oriole	*Oriolus brachyrynchus*	
African Black-headed Oriole	*Oriolus larvatus*	
PASSERIFORMES: Platysteiridae		
Brown-throated Wattle-eye	*Platysteira cyanea*	
Black-throated Wattle-eye	*Platysteira peltata*	
Chestnut Wattle-eye	*Platysteira castanea*	
Jameson's Wattle-eye	*Platysteira jamesoni*	
Yellow-bellied Wattle-eye	*Platysteira concreta*	
Chinspot Batis	*Batis molitor*	
Western Black-headed Batis	*Batis erlangeri*	
PASSERIFORMES: Vangidae		
White Helmetshrike	*Prionops plumatus*	
African Shrike-flycatcher	*Megabyas flammulatus*	
Black-and-white Shrike-flycatcher	*Bias musicus*	
PASSERIFORMES: Malaconotidae		
Brubru	*Nilaus afer*	
Northern Puffback	*Dryoscopus gambensis*	
Pink-footed Puffback	*Dryoscopus angolensis*	
Marsh Tchagra	*Tchagra minutus*	
Black-crowned Tchagra	*Tchagra senegalus*	
Brown-crowned Tchagra	*Tchagra australis*	
Lühder's Bushshrike	*Laniarius luehderi*	
Tropical Boubou	*Laniarius major*	
Black-headed Gonolek	*Laniarius erythrogaster*	
Papyrus Gonolek	*Laniarius mufumbiri*	Near-threatened
Slate-colored Boubou	*Laniarius funebris*	
Sulphur-breasted Bushshrike	*Telophorus sulfureopectus*	
PASSERIFORMES: Dicruridae		
Velvet-mantled Drongo	*Dicrurus modestus*	
PASSERIFORMES: Monarchidae		
Blue-headed Crested-Flycatcher	*Trochocercus nitens*	
African Crested-Flycatcher	*Trochocercus cyanomelas*	
Black-headed Paradise-Flycatcher	*Terpsiphone rufiventer*	
African Paradise-Flycatcher	*Terpsiphone viridis*	
PASSERIFORMES: Laniidae		
Red-backed Shrike	*Lanius collurio*	
Red-tailed Shrike	*Lanius phoenicuroides*	
Isabelline Shrike	*Lanius isabellinus*	
Gray-backed Fiscal	*Lanius excubitoroides*	
Mackinnon's Shrike	*Lanius mackinnoni*	

Northern Fiscal	*Lanius humeralis*	
PASSERIFORMES: Corvidae		
Pied Crow	*Corvus albus*	
White-necked Raven	*Corvus albicollis*	
PASSERIFORMES: Hyliotidae		
Yellow-bellied Hyliota	*Hyliota flavigaster*	
PASSERIFORMES: Stenostiridae		
African Blue Flycatcher	*Elminia longicauda*	
Dusky Crested-Flycatcher	*Elminia nigromitrata*	
PASSERIFORMES: Paridae		
White-shouldered Black-Tit	*Melaniparus guineensis*	
White-winged Black-Tit	*Melaniparus leucomelas*	
Dusky Tit	*Melaniparus funereus*	
PASSERIFORMES: Remizidae		
African Penduline-Tit	*Anthoscopus caroli*	
PASSERIFORMES: Alaudidae		
Rufous-naped Lark	*Mirafra africana*	
Flappet Lark	*Mirafra rufocinnamomea*	
Red-capped Lark	*Calandrella cinerea*	
PASSERIFORMES: Nicatoridae		
Western Nicator	*Nicator chloris*	
PASSERIFORMES: Macrosphenidae		
Green Crombec	*Sylvietta virens*	
Northern Crombec	*Sylvietta brachyura*	
Red-faced Crombec	*Sylvietta whytii*	
Moustached Grass-Warbler	*Melocichla mentalis*	
Yellow Longbill	*Macrosphenus flavicans*	
Gray Longbill	*Macrosphenus concolor*	
Green Hylia	*Hylia prasina*	
PASSERIFORMES: Cisticolidae		
Greencap Eremomela	*Eremomela scotops*	
White-chinned Prinia	*Schistolais leucopogon*	
Miombo Wren-Warbler	*Calamonastes undosus*	
Green-backed Camaroptera	*Camaroptera brachyura*	
Olive-green Camaroptera	*Camaroptera chloronota*	
Buff-bellied Warbler	*Phyllolais pulchella*	
Black-capped Apalis	*Apalis nigriceps*	
Black-throated Apalis	*Apalis jacksoni*	
Masked Apalis	*Apalis binotata*	
Yellow-breasted Apalis	*Apalis flavida*	
Buff-throated Apalis	*Apalis rufogularis*	
Gray Apalis	*Apalis cinerea*	

Tawny-flanked Prinia	*Prinia subflava*	
Banded Prinia	*Prinia bairdii*	
Black-faced Rufous-Warbler	*Bathmocercus rufus*	
Gray-capped Warbler	*Eminia lepida*	
Red-faced Cisticola	*Cisticola erythrops*	
Singing Cisticola	*Cisticola cantans*	
Whistling Cisticola	*Cisticola lateralis*	
Trilling Cisticola	*Cisticola woosnami*	
Chubb's Cisticola	*Cisticola chubbi*	
Winding Cisticola	*Cisticola marginatus*	
Carruthers's Cisticola	*Cisticola carruthersi*	
Stout Cisticola	*Cisticola robustus*	
Croaking Cisticola	*Cisticola natalensis*	
Tabora Cisticola	*Cisticola angusticauda*	
Siffling Cisticola	*Cisticola brachypterus*	
Zitting Cisticola	*Cisticola juncidis*	
Wing-snapping Cisticola	*Cisticola ayresii*	
PASSERIFORMES: Acrocephalidae		
Papyrus Yellow-Warbler	*Calamonastides gracilirostris*	Introduced species
Eastern Olivaceous Warbler	*Iduna pallida*	
African Yellow-Warbler	*Iduna natalensis*	
Icterine Warbler	*Hippolais icterina*	
Sedge Warbler	*Acrocephalus schoenobaenus*	
Eurasian Reed Warbler	*Acrocephalus scirpaceus*	
Lesser Swamp Warbler	*Acrocephalus gracilirostris*	
Greater Swamp Warbler	*Acrocephalus rufescens*	
Great Reed Warbler	*Acrocephalus arundinaceus*	
PASSERIFORMES: Locustellidae		
Fan-tailed Grassbird	*Schoenicola brevirostris*	
River Warbler	*Locustella fluviatilis*	Rare/Accidental
PASSERIFORMES: Hirundinidae		
Plain Martin	*Riparia paludicola*	
Bank Swallow	*Riparia riparia*	
Banded Martin	*Riparia cincta*	
Rock Martin	*Ptyonoprogne fuligula*	
Barn Swallow	*Hirundo rustica*	
Angola Swallow	*Hirundo angolensis*	
Wire-tailed Swallow	*Hirundo smithii*	
Montane Blue Swallow	*Hirundo atrocaerulea*	Vulnerable
Red-rumped Swallow	*Cecropis daurica*	
Lesser Striped Swallow	*Cecropis abyssinica*	
Rufous-chested Swallow	*Cecropis semirufa*	
Mosque Swallow	*Cecropis senegalensis*	
Common House-Martin	*Delichon urbicum*	
White-headed Sawwing	*Psalidoprocne albiceps*	
Black Sawwing	*Psalidoprocne pristoptera*	
Gray-rumped Swallow	*Pseudhirundo griseopyga*	
PASSERIFORMES: Pycnonotidae		
Slender-billed Greenbul	*Stelgidillas gracilirostris*	
Red-tailed Bristlebill	*Bleda syndactylus*	

Lesser Bristlebill	*Bleda notatus*	
Honeyguide Greenbul	*Baeopogon indicator*	
Yellow-throated Greenbul	*Atimastillas flavicollis*	
Spotted Greenbul	*Ixonotus guttatus*	
Red-tailed Greenbul	*Criniger calurus*	
Gray Greenbul	*Eurillas gracilis*	
Plain Greenbul	*Eurillas curvirostris*	
Yellow-whiskered Greenbul	*Eurillas latirostris*	
Little Greenbul	*Eurillas virens*	
Toro Olive-Greenbul	*Phyllastrephus hypochloris*	
Icterine Greenbul	*Phyllastrephus icterinus*	
Xavier's Greenbul	*Phyllastrephus xavieri*	
Common Bulbul	*Pycnonotus barbatus*	
PASSERIFORMES: Phylloscopidae		
Wood Warbler	*Phylloscopus sibilatrix*	
Willow Warbler	*Phylloscopus trochilus*	
PASSERIFORMES: Sylviidae		
Garden Warbler	*Sylvia borin*	
PASSERIFORMES: Zosteropidae		
African Yellow White-eye	*Zosterops senegalensis*	
PASSERIFORMES: Pellorneidae		
Brown Illadopsis	*Illadopsis fulvescens*	
Pale-breasted Illadopsis	*Illadopsis rufipennis*	
Scaly-breasted Illadopsis	*Illadopsis albipectus*	
PASSERIFORMES: Leiothrichidae		
Black-lored Babbler	*Turdoides sharpei*	
Brown Babbler	*Turdoides plebejus*	
Arrow-marked Babbler	*Turdoides jardineii*	
PASSERIFORMES: Sturnidae		
Wattled Starling	*Creatophora cinerea*	
Violet-backed Starling	*Cinnyricinclus leucogaster*	
Chestnut-winged Starling	*Onychognathus fulgidus*	
Purple-headed Starling	*Hylopsar purpureiceps*	
Rüppell's Starling	*Lamprotornis purpuroptera*	
Splendid Starling	*Lamprotornis splendidus*	
Lesser Blue-eared Starling	*Lamprotornis chloropterus*	
Greater Blue-eared Starling	*Lamprotornis chalybaeus*	
Purple Starling	*Lamprotornis purpureus*	
PASSERIFORMES: Turdidae		
Rufous Flycatcher-Thrush	*Neocossyphus fraseri*	
White-tailed Ant-Thrush	*Neocossyphus poensis*	
Abyssinian Thrush	*Turdus abyssinicus*	
African Thrush	*Turdus pelios*	

PASSERIFORMES: Muscicapidae		
African Dusky Flycatcher	*Muscicapa adusta*	
Spotted Flycatcher	*Muscicapa striata*	
Swamp Flycatcher	*Muscicapa aquatica*	
Dusky-blue Flycatcher	*Bradornis comitatus*	
Pale Flycatcher	*Agricola pallidus*	
Gray-throated Tit-Flycatcher	*Fraseria griseigularis*	
Gray Tit-Flycatcher	*Fraseria plumbea*	
Ashy Flycatcher	*Fraseria caerulescens*	
Northern Black-Flycatcher	*Melaenornis edolioides*	
Fire-crested Alethe	*Alethe castanea*	
Brown-backed Scrub-Robin	*Cercotrichas hartlaubi*	
Red-backed Scrub-Robin	*Cercotrichas leucophrys*	
Blue-shouldered Robin-Chat	*Cossypha cyanocampter*	
Gray-winged Robin-Chat	*Cossypha polioptera*	
White-browed Robin-Chat	*Cossypha heuglini*	
Red-capped Robin-Chat	*Cossypha natalensis*	
Snowy-crowned Robin-Chat	*Cossypha niveicapilla*	
Brown-chested Alethe	*Chamaetylas poliocephala*	
Forest Robin	*Stiphrornis erythrothorax*	
Lowland Akalat	*Sheppardia cyornithopsis*	
Semicollared Flycatcher	*Ficedula semitorquata*	
Common Redstart	*Phoenicurus phoenicurus*	
Whinchat	*Saxicola rubetra*	
African Stonechat	*Saxicola torquatus*	
Mocking Cliff-Chat	*Thamnolaea cinnamomeiventris*	
Sooty Chat	*Myrmecocichla nigra*	
Northern Wheatear	*Oenanthe oenanthe*	
Familiar Chat	*Oenanthe familiaris*	
PASSERIFORMES: Nectariniidae		
Gray-headed Sunbird	*Deleornis axillaris*	
Little Green Sunbird	*Anthreptes seimundi*	
Green Sunbird	*Anthreptes rectirostris*	
Collared Sunbird	*Hedydipna collaris*	
Green-headed Sunbird	*Cyanomitra verticalis*	
Blue-throated Brown Sunbird	*Cyanomitra cyanolaema*	
Blue-headed Sunbird	*Cyanomitra alinae*	
Olive Sunbird	*Cyanomitra olivacea*	
Green-throated Sunbird	*Chalcomitra rubescens*	
Scarlet-chested Sunbird	*Chalcomitra senegalensis*	
Bronze Sunbird	*Nectarinia kilimensis*	
Olive-bellied Sunbird	*Cinnyris chloropygius*	
Beautiful Sunbird	*Cinnyris pulchellus*	
Mariqua Sunbird	*Cinnyris mariquensis*	
Red-chested Sunbird	*Cinnyris erythrocercus*	
Purple-banded Sunbird	*Cinnyris bifasciatus*	
Orange-tufted Sunbird	*Cinnyris bouvieri*	
Superb Sunbird	*Cinnyris superbus*	
Variable Sunbird	*Cinnyris venustus*	
Copper Sunbird	*Cinnyris cupreus*	
PASSERIFORMES: Ploceidae		

Crested Malimbe	*Malimbus malimbicus*	
Red-headed Malimbe	*Malimbus rubricollis*	
Red-headed Weaver	*Anaplectes rubriceps*	
Baglafecht Weaver	*Ploceus baglafecht*	
Little Weaver	*Ploceus luteolus*	
Slender-billed Weaver	*Ploceus pelzelni*	
Black-necked Weaver	*Ploceus nigricollis*	
Spectacled Weaver	*Ploceus ocularis*	
Holub's Golden-Weaver	*Ploceus xanthops*	
Orange Weaver	*Ploceus aurantius*	
Northern Brown-throated Weaver	*Ploceus castanops*	
Lesser Masked-Weaver	*Ploceus intermedius*	
Vieillot's Weaver	*Ploceus nigerrimus*	
Village Weaver	*Ploceus cucullatus*	
Weyns's Weaver	*Ploceus weynsi*	
Black-headed Weaver	*Ploceus melanocephalus*	
Golden-backed Weaver	*Ploceus jacksoni*	
Yellow-mantled Weaver	*Ploceus tricolor*	
Compact Weaver	*Pachyphantes superciliosus*	
Cardinal Quelea	*Quelea cardinalis*	
Red-headed Quelea	*Quelea erythrops*	
Red-billed Quelea	*Quelea quelea*	
Southern Red Bishop	*Euplectes orix*	
Black-winged Bishop	*Euplectes hordeaceus*	
Yellow Bishop	*Euplectes capensis*	
White-winged Widowbird	*Euplectes albonotatus*	
Yellow-mantled Widowbird	*Euplectes macroura*	
Red-collared Widowbird	*Euplectes ardens*	
Fan-tailed Widowbird	*Euplectes axillaris*	
Grosbeak Weaver	*Amblyospiza albifrons*	
PASSERIFORMES: Estrildidae		
Gray-headed Nigrita	*Nigrita canicapillus*	
White-breasted Nigrita	*Nigrita fusconotus*	
Jameson's Antpecker	*Parmoptila jamesoni*	
White-collared Oliveback	*Nesocharis ansorgei*	
Yellow-bellied Waxbill	*Coccopygia quartinia*	
Green-backed Twinspot	*Mandingoa nitidula*	
Fawn-breasted Waxbill	*Estrilda paludicola*	
Crimson-rumped Waxbill	*Estrilda rhodopyga*	
Common Waxbill	*Estrilda astrild*	
Black-crowned Waxbill	*Estrilda nonnula*	
Red-headed Bluebill	*Spermophaga ruficapilla*	
Black-bellied Seedcracker	*Pyrenestes ostrinus*	
Red-cheeked Cordonbleu	*Uraeginthus bengalus*	
Green-winged Pytilia	*Pytilia melba*	
Red-billed Firefinch	*Lagonosticta senegala*	
African Firefinch	*Lagonosticta rubricata*	
Zebra Waxbill	*Sporaeginthus subflavus*	
Quailfinch	*Ortygospiza atricollis*	
Bronze Mannikin	*Spermestes cucullata*	
Black-and-white Mannikin	*Spermestes bicolor*	
PASSERIFORMES: Viduidae		

Pin-tailed Whydah	*Vidua macroura*	
Village Indigobird	*Vidua chalybeata*	
PASSERIFORMES: Passeridae		
House Sparrow	*Passer domesticus*	
Northern Gray-headed Sparrow	*Passer griseus*	
PASSERIFORMES: Motacillidae		
Western Yellow Wagtail	*Motacilla flava*	
African Pied Wagtail	*Motacilla aguimp*	
African Pipit	*Anthus cinnamomeus*	
Long-billed Pipit	*Anthus similis*	
Plain-backed Pipit	*Anthus leucophrys*	
Tree Pipit	*Anthus trivialis*	
Red-throated Pipit	*Anthus cervinus*	
Short-tailed Pipit	*Anthus brachyurus*	
Yellow-throated Longclaw	*Macronyx croceus*	
PASSERIFORMES: Fringillidae		
Yellow-fronted Canary	*Crithagra mozambica*	
Western Citril	*Crithagra frontalis*	
Black-throated Canary	*Crithagra atrogularis*	
Brimstone Canary	*Crithagra sulphurata*	
PASSERIFORMES: Emberizidae		
Golden-breasted Bunting	*Emberiza flaviventris*	
Cinnamon-breasted Bunting	*Emberiza tahapisi*	

Amphibians of Sango Bay – Minziro

Family	Species	Common name	IUCN Status
Bufonidae	*Afrixalus quadrivittatus*	Four-lined Spiny Reed Frog	Least Concern
Ranidae	*Amietia nutti*	Nutt's River Frog	Least Concern
Ranidae	*Amnirana albolabris*	White-lipped Frog	Least Concern
Ranidae	*Amnirana galamensis*	Galama White-lipped Frog	Least Concern / NT
Dicroglossidae	*Hoplobatrachus occipitalis*	Crowned Bullfrog	Least Concern
Hyperoliidae	*Hyperolius acuticeps*	Sharp-headed Long Reed Frog	Least Concern
Hyperoliidae	*Hyperolius cf castaneus*	Ahl's reed frog	Least Concern
Hyperoliidae	*Hyperolius cinnamomeoventris*	Cinnamon-bellied Reed Frog	Least Concern
Hyperoliidae	*Hyperolius kivuensis*	Kivu Reed Frog	Least Concern
Hyperoliidae	*Hyperolius langi*	Langi's Reed Frog	Least Concern
Hyperoliidae	*Hyperolius lateralis*	Side-striped Tree Frog	Least Concern
Hyperoliidae	*Hyperolius parralellus argentovittis*	Ahl's Reed Frog	Least Concern
Hyperoliidae	*Hyperolius sp*		
Hyperoliidae	*Hyperolius viridiflavus bayoni*	Bayoni's Reed Frog	Least Concern
Hyperoliidae	*Hyperolius viridiflavus variabilis*	Variable Reed Frog	Least Concern
Hyperoliidae	*Hyperolius viridiflavus viridiflavus*	Common Reed Frog	Least Concern
Hyperoliidae	*Hyperololius nasutus*	Long-nosed Reed frog	Least Concern
Hyperoliidae	*Kassina senegalensis*	Senegal Land Frog	Least Concern
Leptopelidae	*Leptopelis bocagei*	Bocage's Tree Frog	Least Concern
Leptopelidae	*Leptopelis sp1*		
Leptopelidae	*Leptopelis sp2 (Nabugabo North)*		
Phrynobatrachidae	*Phrynobatrachus acridoides*	East African Puddle Frog	Least Concern
Phrynobatrachidae	*Phrynobatrachus cf rouxi*	Roux's River Frog	DD/CR
Phrynobatrachidae	*Phrynobatrachus dendrobates*		Least Concern
Phrynobatrachidae	*Phrynobatrachus mababiensis*	Mababe Puddle Frog	Least Concern
Phrynobatrachidae	*Phrynobatrachus natalensis*	Natal Dwarf Puddle Frog	Least Concern
Phrynobatrachidae	*Phrynobatrachus sp1*		
Phrynobatrachidae	*Phrynobatrachus sp2*		
Ptychadenidae	*Ptychadena chrysogaster*	Yellow-bellied Ridged Frog	Least Concern
Ptychadenidae	*Ptychadena nilotica*	Nile Grassland Frog	Least Concern
Ptychadenidae	*Ptychadena oxyrhynchus*	Sharp-nosed Frog	Least Concern
Ptychadenidae	*Ptychadena porosissima*	Grassland Ridged Frog	Least Concern
Ptychadenidae	*Ptychadena sp (airstrip)*		
Bufonidae	*Sclerophrys gutturalis*	Guttural Toad	Least Concern
Bufonidae	*Sclerophrys regularis*	Common Toad	Least Concern
Bufonidae	*Sclerophrys sp*		
Bufonidae	*Sclerophrys steindachneri*	Steindachner's Toad	Least Concern
Bufonidae	*Sclerophrys vittatus*	Lake Victoria Toad	Data Deficient/Least Concern
Pipidae	*Xenopus victorianus*	Lake Victoria Toad	Data Deficient/Least Concern

Reptiles of Sango Bay - Minziro wetland

Order	Family	Species	Common name	IUCN Status
Chelonia	Pelomedusidae	*Pelomedusa subrufa*	Marsh terrapin	NE/LC
Sauria	Agamidae	*Acanthocercus atricollis*	Blue-headedTree Agama	LC/LC
Sauria	Scincidae	*Trachylepis megalura*	Grass-top Skink	NE/NT
Sauria	Scincidae	*Trachylepis maculilabris*	Speckle-lipped Skink	NE/LC
Sauria	Scincidae	*Trachylepis striata*	Common Striped Skink	NE/LC
Sauria	Gekkonidae	*Hemidactylus brookii*	Brook's House Gecko	NE/LC
Sauria	Gekkonidae	*Hemidactylus mabouia*	Tropical House Gecko	NE/LC
Sauria	Chamaeleonidae	*Chamaeleo gracilis*	Graceful Chameleon	NE/LC
Sauria	Chamaelionidae	*Chamaeleo laevigatus*	Smooth Chameleon	NE/LC
Sauria	Chameleonidae	*Trieceros ellioti*	Elliot's Groove-throated Chameleon	LC/LC
Sauria	Lacertidae	*Lacerta jacksonii*	Jackson's Forest Lizard	NE/LC
Sauria	Cordylidae	*Chamaesaura anguina tenuior*	East African Highland Grass Lizard	NE/NT
Sauria	Varanidae	*Varanus niloticus*	Nile Monitor	NE/LC
Crocodylia	Crocodylidae	*Crocodylus niloticus*	Nile Crocodile	LC/LC
Serpentes	Typhlopidae	*Typhlops lineolatus*	Lineolate Blind-snake	NE/LC
Serpentes	Colubridae	*Naticitires olivaceous*	Olive Marsh Snake	LC/DD
Serpentes	Colubridae	*Lamprophis fuliginosus*	Common House-snake	NE/LC
Serpentes	Colubridae	*Dasypeltis scabra*	Common Egg-eater	LC/LC
Serpentes	Colubridae	*Bothropthalmus lineatus*	Red and Black Striped Snake	NE/LC
Serpentes	Colubridae	*Philopthamnus angolensis*	Angola Green Snake	NE/DD
Serpentes	Colubridae	*Philopthamnus heterolepidotus*	Slender Green Snake	NE/LC
Serpentes	Colubridae	*Philopthamnus cf ruadae*	Rwandan Green Snake	NE/LC
Serpentes	Colubridae	*Philopthmnus semivariegatus*	Variegated Bush Snake	NE/LC
Serpentes	Colubridae	*Crotaphopeltis hotamboeia*	White-lipped Herald Snake	NE/LC
Serpentes	Colubridae	*Thrasops jacksonii*	Jackson's Tree Snake	NE/LC
Serpentes	Colubridae	*Psammophis lineatus*	Lined Olympic Sand Snake	NE/LC
Serpentes	Colubridae	*Psammophis mossambicus*	Olive Sand Snake	NE/LC
Serpentes	Pythonidae	*Python sebae*	African Rock Python	NE/LC
Serpentes	Atractaspididae	*Atractaspis irregularis*	Variable Stiletto Snake	LC/DD
Serpentes	Viperidae	*Bitis arietans*	Puffadder	NE/LC
Serpentes	Viperidae	*Bitis gabonica*	Gaboon Viper	NE/LC
Serpentes	Viperidae	*Bitis nasicornis*	Rhinocerous Viper	NE/LC
Serpentes	Elapidae	*Dendroaspis jamesonii*	Jameson's Mamba	NE/LC
Serpentes	Elapidae	*Naja melanoleuca*	Forest Cobra	NE/LC

Plant species of Sango Bay-Minziro

Species	Family	Habit	Habitat	Conservation status (IUCN)	Uses
Acacia brevispica	Fabaceae	Shrub	Bushland	LC	
Acacia hockii De Wild.	Fabaceae	Shrub	Grassland		Medicinal
Acacia kirkii	Fabaceae	Tree	Wetland	LC	
Acacia sieberiana	Fabaceae	Tree	Forest, Woodland, Grassland		
Acalypha neptunica	Euphorbiaceae	Shrub	Forest, Woodland, Grassland		
Acalypha villicaulis A. Rich.	Euphorbiaceae	Shrub	Grassland		Medicinal
Acanthus arborescens	Acanthaceae	Shrub	Forest		
Acanthus pubescens (T. Thoms.) Engl.	Acanthaceae	Shrub	Forest		Medicinal
Achyranthes aspera	Amaranthaceae	Herb	Woodland, Grassland		
Aeolanthus repens Oliv.	Lamiaceae	Herb	Grassland		Medicinal
Aerva lanata (L.) Schulles	Amaranthaceae	Herb	Grassland		Medicinal
Afrocarpus gracilior (Pilg.) C. N. Page	Podocarpaceae	Tree	Forest	LC	
Afrocarpus usambarensis (Pilg.) C. N. Page	Podocarpaceae	Tree	Forest, Woodland, Grassland	EN	
Aidia micrantha	Rubiaceae	Shrub	Forest, Woodland, Grassland		
Alangium chinense (Lour) Harms.	Alangiaceae	Tree	Forest		Medicinal
Albizia coriaria	Fabaceae	Tree	Forest, Woodland, Grassland	LC	Medicinal
Albizia glaberrima	Fabaceae	Tree	Forest	LC	
Albizia gummifera	Fabaceae	Tree	Forest		
Albizia zygia	Fabaceae	Tree	Forest, Woodland, Grassland		
Alchornea cordifolia (Schum & Thonn.) Muell. Arg.	Euphorbiaceae	Shrub	Forest, Bushaland	LC	Medicinal
Alchornea floribunda	Euphorbiaceae	Shrub	Forest	LC	
Alchornea hirtella	Euphorbiaceae	Shrub	Forest, Woodland, Grassland		
Alchornea laxiflora	Euphorbiaceae	Shrub	Forest, Woodland, Grassland		
Allophylus africanus	Sapindaceae	Shrub	Woodland	LC	
Allophylus dummeri	Sapindaceae	Tree	Forest		
Allophylus macrobotrys	Sapindaceae	Tree	Forest, Woodland, Grassland		
Alloteropsis angusta	Poaceae	Herb	Grassland		
Aloe volkensii Engl.	Xanthorrhoeaceae	Herb	Grassland	LC	Medicinal
Alstonia boonei	Apocynaceae	Tree	Forest		

Amaranthus dubius	Amaranthaceae	Herb	Woodland, Grassland		
Aningeria altissima	Sapotaceae	Tree	Forest		
Anisopappus africanus (Hook. F.) Oliv. & Hiern.	Asteraceae	Herb	Grassland		Medicinal
Annona senegalensis	Annonaceae	Tree	Grassland	LC	
Anthocleista schweinfurthii	Gentianaceae	Tree	Forest		
Antiaris toxicaria	Moraceae	Tree	Forest, Woodland, Grassland		
Antidesma membranaceum	Euphorbiaceae	Tree	Forest, Woodland, Grassland		
Apodytes dimidiata	Icacinaceae	Shrub	Forest		
Argomuellera macrophylla	Euphorbiaceae	Shrub	Forest	LC	
Aspilia africana (Pers.) C.D. Adams (not	Asteraceae	Herb	Grassland, Bushland		Medicinal
Asystasia gangetica	Acanthaceae	Herb	Woodland, Grassland		
Baikiaea insignis	Fabaceae	Tree	Forest	LC	
Balanites wilsoniana	Zygophyllaceae	Tree	Forest		
Baphiopsis parviflora	Fabaceae	Shrub	Forest, Woodland, Grassland	LC	
Barteria nigritana	Passifloraceae	Shrub	Forest		
Basella alba	Basellaceae	Herb	Woodland, Grassland		
Beilschmiedia ugandensis	Lauraceae	Tree	Forest, Woodland, Grassland	VU	
Belonophora hypoglauca	Rubiaceae	Shrub	Forest, Woodland, Grassland		
Bersama abyssinica	Melianthaceae	Tree	Forest, Woodland, Grassland		
Bertiera racemosa	Rubiaceae	Tree	Forest		
Bidens grantii (Oliv.) Sherff.	Asteraceae	Herb	Grassland		Medicinal
Bidens kilimandscharica (O. Hoffm) Sherff.	Asteraceae	Herb	Grassland		Medicinal
Bidens pilosa	Asteraceae	Herb	Woodland, Grassland		
Blighia unijugata	Sapindaceae	Tree	Forest		Medicinal
Blighia welwitschii	Sapindaceae	Tree	Forest		
Blumea perottetiana DC	Asteraceae	Herb	Grassland		Medicinal
Bothriocline bagshawei	Asteraceae	Herb	Grassland		
Brachiaria jubata	Poaceae	Herb	Wetland		
Bridelia brideliifolia	Euphorbiaceae	Tree	Forest, Woodland, Grassland		
Bridelia micrantha (Hochst) Baill.	Euphorbiaceae	Shrub	Forest, Woodland, Grassland		Medicinal
Canarium schweinfurthii Engl.	Burseraceae	Tree	Forest, Grassland		Medicinal
Canthium vulgare	Rubiaceae	Shrub	Forest		

Capparis tomentosa	Capparaceae	Shrub	Forest, Woodland, Grassland		
Carapa grandiflora	Meliaceae	Tree	Forest		
Carissa spinarum L.	Apocynaceae	Shrub	Woodland, Grassland		Medicinal
Casearia runssorica	Salicaceae	Tree	Forest, Woodland, Grassland		
Cassia didymobotrya	Fabaceae	Shrub	Forest, Woodland, Grassland		Medicinal
Cassine aethiopica	Celastraceae	Shrub	Forest, Woodland, Grassland	LC	
Cassipourea gummiflua	Rhizophoraceae	Tree	Forest, Woodland, Grassland	LC	
Cassipourea malosana	Rhizophoraceae	Tree	Forest		
Cassipourea ruwensorensis	Rhizophoraceae	Tree	Forest		
Cayratia ibuensis	Vitaceae	Herb	Forest, Wetland, Grassland		
Celosia anthelminthica	Amaranthaceae	Herb	Grassland, Woodland		
Chaetacme aristata	Ulmaceae	Shrub	Forest		
Chenopodium opulifolium Koch & Ziz.	Chenopodiaceae	Herb	Grassland		Medicinal
Chionanthus africanus (Welw. ex Knobl.) Stearn	Oleaceae	Shrub	Forest		
Chrysophyllum albidum	Sapotaceae	Tree	Forest		
Chrysophyllum delevoyi	Sapotaceae	Tree	Forest		
Cissampelos mucronata A. Rich.	Menispermaceae	Herb	Grassland		Medicinal
Cissus adenocaulis Steud ex A. Rich	Vitaceae	Herb	Grassland, Bushland		Medicinal
Citropsis articulata (Spreng.) Swingle & Kellerm.	Rutaceae	Tree	Forest		Medicinal
Clausena anisata	Rutaceae	Tree	Forest, Woodland, Grassland		
Cleistanthus polystachyus	Phyllanthaceae	Tree	Forest	LC	
Cleome gynandra	Capparaceae	Herb	Grassland		
Cleome monophylla L.	Capparaceae	Herb	Grassland		Medicinal
Clerodendrum capitatum (Willd.) Schum. & Thonn.	Lamiaceae	Shrub	Forest		Medicinal
Clerodendrum cordifolium	Lamiaceae	Shrub	Woodland		
Clerodendrum myricoides (Hochst.)	Lamiaceae	Shrub	Grassland		Medicinal
Coffea canephora	Rubiaceae	Shrub	Forest	LC	
Coffea eugenioides	Rubiaceae	Shrub	Forest	LC	
Commelina diffusa	Commelinaceae	Herb	Grassland	LC	
Commelina zambesica	Commelinaceae	Herb	Grassland		
Connarus longistipitatus	Connaraceae	Shrub	Forest	LC	

Conyza adolfi-fridericii (Musch.) H. Wild.	Asteraceae	Herb	Grassland		Medicinal
Cordia africana	Boraginaceae	Tree	Forest, Woodland, Grassland		
Cordia millenii	Boraginaceae	Tree	Forest	LC	
Crassocephalum sp.	Asteraceae	Herb	Grassland		Medicinal
Craterispermum schweinfurthii	Rubiaceae	Tree	Forest, Woodland, Grassland	LC	Medicinal
Crotalaria agathiflora Scheinf.	Fabaceae	Shrub	Grassland	LC	Medicinal
Crotalaria incana L.	Fabaceae	Herb	Grassland		Medicinal
Crotalaria mesopontica Taub.	Fabaceae	Herb	Grassland	LC	Medicinal
Crotalaria natalitia Meissn.	Fabaceae	Herb	Grassland		Medicinal
Croton macrostachyus	Euphorbiaceae	Tree	Forest	LC	
Croton megalocarpus	Euphorbiaceae	Tree	Forest		
Croton sylvaticus	Euphorbiaceae	Shrub	Forest		
Cymbopogon nardus (L.) Rendle	Poaceae	Herb	Grassland		Medicinal
Cynodon dactylon	Poaceae	Herb	Grassland, Woodland		
Cyperus maculatus	Cyperaceae	Herb	Wetland		
Cyperus papyrus	Cyperaceae	Herb	Wetland	LC	
Cyperus sphacelatus	Cyperaceae	Herb	Wetland		
Cyphostemma adenocaule (A. Rich) Wild & Drummond	Vitaceae	Herb	Grassland, Forest		Medicinal
Dalbergia lactea	Fabaceae	Shrub	Forest, Woodland, Grassland		
Dasylepsis eggelingii	Flacourtiaceae	Shrub	Forest		
Desmodium adscendens (Sw.) DC	Fabaceae	Herb	Grassland	LC	Medicinal
Dichrocephala integrifolia O. Ktze	Asteraceae	Herb	Grassland, Forest		Medicinal
Dichrostachys cinerea	Fabaceae	Shrub	Woodland, Grassland, Bushland	LC	
Dicliptera laxata C. B. Cl.	Acanthaceae	Herb	Grassland		Medicinal
Dictyandra arborescens	Rubiaceae	Shrub	Forest		
Diospyros abyssinica	Ebeneceae	Tree	Forest		
Discopodium penninervium Hochst.	Solanaceae	Herb	Grassland		Medicinal
Dombeya bagshawei	Malvaceae	Shrub	Woodland		
Dovyalis abyssinica	Salicaceae	Shrub	Forest, Woodland, Grassland		
Dovyalis macrocalyx	Salicaceae	Shrub	Forest, Woodland, Grassland		
Dracaena fragrans	Asparagaceae	Shrub	Woodland, Bushland	LC	
Dracaena laxissima	Asparagaceae	Shrub	Wetland		
Dracaena steudneri	Asparagaceae	Tree	Forest	LC	
Dyschoriste magchana (Nees.) Bennet	Acanthaceae	Herb	Grassland		Medicinal

Echinochloa pyramidalis	Poaceae	Herb	Wetland	LC	
Ehretia cymosa	Boraginaceae	Shrub	Forest, Woodland, Grassland		
Eichhornia crassipes	Pontederiaceae	Herb	Wetland		
Ekebergia capensis	Meliaceae	Tree	Forest	LC	
Ekebergia senegalensis	Meliaceae	Tree	Forest		
Eleusine indica	Poaceae	Herb	Woodland, Grassland	LC	
Enhydra fluctuans	Asteraceae	Herb	Wetland		
Entada abyssininca	Fabaceae	Tree	Woodland, Grassland	LC	Medicinal
Entandrophragma angolense	Meliaceae	Tree	Forest	VU	
Entandrophragma excelsum	Meliaceae	Tree	Forest	LC	
Eragrostis olivaceae	Poaceae	Herb	Grassland		
Eriosema stanerianum Hauman	Fabaceae	Shrub	Grassland		Medicinal
Erlangea tomentosa S. Moore	Asteraceae	Herb	Grassland		Medicinal
Erucastrum arabicum Fisch & C. A. Mey.	Cruciferae	Herb	Grassland		Medicinal
Erythrina abyssinica	Fabaceae	Tree	Forest, Woodland, Grassland	LC	Medicinal
Erythrina excelsa	Fabaceae	Tree	Forest		
Erythroxylum fischeri	Erythroxylaceae	Shrub	Forest, Woodland, Grassland		
Euclea divinorum	Ebeneceae	Shrub	Grassland		
Eugenia bukobensis	Myrtaceae	Tree	Wetland, Bushland, Woodland		
Euphorbia grantii	Euphorbiaceae	Shrub	Woodland, Grassland, Bushland		Medicinal
Euphorbia teke	Euphorbiaceae	Tree	Forest, Woodland, Grassland		
Euphorbia tirucalli L.	Euphorbiaceae	Herb	Grassland	LC	Medicinal
Fagaropsis angolensis	Rutaceae	Tree	Forest		
Ficus asperifolia	Moraceae	Shrub	Forest, Woodland, Grassland	LC	
Ficus barteri	Moraceae	Shrub	Forest	LC	
Ficus conraui	Moraceae	Tree	Forest	LC	
Ficus craterostoma	Moraceae	Shrub	Forest		
Ficus cyathistipula	Moraceae	Tree	Forest, Woodland, Grassland	LC	
Ficus lingua	Moraceae	Tree	Forest	LC	
Ficus mucuso	Moraceae	Tree	Forest	LC	
Ficus natalensis	Moraceae	Tree	Forest, Woodland, Grassland	LC	
Ficus ottoniifolia	Moraceae	Shrub	Forest		

Ficus ovata	Moraceae	Tree	Forest, Woodland, Grassland		
Ficus pseudomangifera	Moraceae	Tree	Forest		
Ficus saussureana	Moraceae	Tree	Forest	LC	
Ficus sur	Moraceae	Tree	Forest, Woodland, Grassland		
Ficus sycomorus	Moraceae	Tree	Forest, Woodland, Grassland	LC	
Ficus thonningii	Moraceae	Tree	Forest, Woodland, Grassland	LC	
Ficus trichopoda	Moraceae	Tree	Wetland	LC	
Ficus vogeliana	Moraceae	Tree	Wetland	LC	
Fimbristylis dichotoma	Cyperaceae	Herb	Wetland, Grassland		
Flueggea virosa	Phyllanthaceae	Shrub	Forest, Woodland, Grassland	LC	Medicinal
Funtumia africana	Apocynaceae	Tree	Forest		
Funtumia elastica	Apocynaceae	Tree	Forest	LC	
Glyphaea brevis	Malvaceae	Shrub	Forest		
Gnaphalium purpureum L.	Asteraceae	Herb	Forest		Medicinal
Gomphrena pungens	Amaranthaceae	Herb	Grassland		
Greenwayodendron suaveolens	Annonaceae	Tree	Forest	LC	
Grewia floribunda	Malvaceae	Shrub	Forest, Woodland, Grassland		
Grewia trichocarpa	Malvaceae	Shrub	Woodland		
Guarea cedrata	Meliaceae	Tree	Forest		
Gymnosporia gracilipes	Celastraceae	Shrub	Forest, Wetland, Bushland		
Gymnosporia senegalensis	Celastraceae	Tree	Woodland, Bushland	LC	
Hallea rubrostipulata (K. Schum.) J-F. Leroyr	Rubiaceae	Tree	Forest		Medicinal
Harpachne schimperi	Poaceae	Herb	Grassland		
Harungana madagascariensis Poir.	Hypericaceae	Tree	Forest, Grassland	LC	Medicinal
Heisteria parvifolia	Olacaceae	Shrub	Forest	LC	
Helichrysum sp.	Asteraceae	Herb	Grassland		Medicinal
Herichrysum panduratum O. Hoffm.	Asteraceae	Herb	Grassland		Medicinal
Hewittia sublobata (L.) O. Ktze.	Convolvulaceae	Herb	Grassland		Medicinal
Hibiscus acetosella Welw ex Hiern.	Malvaceae	Herb	Grassland		Medicinal
Hibiscus calphyllus Cav.	Malvaceae	Herb	Wetland		Medicinal
Hibiscus diversifolius	Malvaceae	Shrub	Grassland, Woodland		
Hibiscus fuscus Garke	Malvaceae	Shrub	Woodland, Grassland, Bushland		Medicinal
Hoslundia opposita Vahl.	Lamiaceae	Shrub	Grassland, Bushland		Medicinal

Hyparrhenia papillipes	Poaceae	Herb	Grassland		
Hyparrhenia rufa	Poaceae	Herb	Grassland		
Ilex mitis	Aquifoliaceae	Shrub	Forest, Woodland, Grassland	LC	
Indigofera arrecta A. Rich.	Fabaceae	Herb	Grassland		Medicinal
Indigofera congesta Welw. ex Bak. f.	Fabaceae	Herb	Grassland		Medicinal
Indigofera drepanocarpa Taub.	Fabaceae	Herb	Grassland		Medicinal
Indigofera emarginella A. Rich.	Fabaceae	Shrub	Grassland		Medicinal
Indigofera spicata Forsk.	Fabaceae	Herb	Grassland		Medicinal
Ipomoea cairica (L.) Sweet.	Convolvulaceae	Herb	Grassland	LC	Medicinal
Ipomoea rubens	Convolvulaceae	Herb	Wetland		
Irvingia gabonensis	Irvingiaceae	Tree	Forest	NT	
Justicia heterocarpa T. Anderson	Acanthaceae	Herb	Grassland		Medicinal
Kalanchoe marmorata Bak.	Crassulaceae	Herb	Grassland, Forest		Medicinal
Kalanchoe tubiflora (Harvey) Hamet	Crassulaceae	Herb	Grassland		Medicinal
Kigelia africana (Lam.) Benth.	Bignoniaceae	Tree	Forest, Woodland, Grassland	LC	Medicinal
Klainedoxa gabonensis	Irvingiaceae	Tree	Forest, Woodland, Grassland	LC	
Kosteletzkya begoniifolia	Malvaceae	Herb	Wetland		
Kotschya africana	Fabaceae	Shrub	Forest, Woodland, Grassland, Wetland	LC	Medicinal
Lagenaria siceraria	Cucurbitaceae	Herb	Grassland, Bushland		
Lagenaria sphaerica	Cucurbitaceae	Herb	Wetland, Bushland		
Lannea edulis (Sonder) Engl.	Anacardiaceae	Shrub	Grassland		Medicinal
Lannea welwitschii	Anacardiaceae	Tree	Forest		
Lantana trifolia L.	Lamiaceae	Shrub	Grassland, Bushland		Medicinal
Lasiodiscus mildbraedii	Rhamnaceae	Shrub	Forest		
Lecaniodiscus fraxinifolius	Sapindaceae	Tree	Forest		
Leersia hexandra	Poaceae	Herb	Wetland		
Leonotis nepetifolia	Lamiaceae	Herb	Woodland, Grassland		
Lepidotrichilia volkensii	Meliaceae	Tree	Forest		
Leptaulus daphnoides	Icacinaceae	Shrub	Forest	LC	
Leptaulus holstii	Icacinaceae	Shrub	Forest		
Lijndenia jasminoides	Melastomataceae	Shrub	Forest, Woodland, Grassland		
Lindackeria bukobensis	Achariaceae	Shrub	Forest		
Loudetia kagerensis	Poaceae	Herb	Grassland		
Lovoa trichilioides	Meliaceae	Tree	Forest	LC	

Ludwigia abyssinica	Onagraceae	Herb	Wetland	LC	
Ludwigia leptocarpa	Onagraceae	Herb	Wetland	LC	
Lychnodiscus cerospermus	Sapindaceae	Tree	Forest		
Macaranga barteri	Euphorbiaceae	Tree	Forest	LC	
Macaranga kilimandscharica	Euphorbiaceae	Tree	Forest		
Macaranga monandra	Euphorbiaceae	Tree	Forest, Woodland, Grassland	LC	
Macaranga schweinfurthii	Euphorbiaceae	Tree	Forest	LC	
Macaranga spinosa	Euphorbiaceae	Tree	Forest	LC	
Maerua duchesnei	Capparaceae	Shrub	Forest	LC	
Maesa lanceolata	Primulaceae	Shrub	Forest, Woodland, Grassland, Bushland	LC	Medicinal
Maesopsis eminii Engl.	Rhamnaceae	Tree	Forest	LC	Medicinal
Majidea fosteri	Sapindaceae	Tree	Forest		
Mallotus oppositifolius	Euphorbiaceae	Shrub	Forest, Woodland, Grassland		
Mangifera indica L.	Anacardiaceae	Tree	Bushland		Medicinal, Food
Manilkara obovata (Sabine & G. Don) J.H. Hemsl.	Sapotaceae	Tree	Forest		Medicinal
Margaritaria discoideus (Baill.) Webster	Phyllanthaceae	Shrub	Forest, Woodland, Grassland	LC	Medicinal
Markhamia lutea	Bignoniaceae	Tree	Forest	LC	
Maytenus acuminata	Celastraceae	Tree	Forest	LC	
Maytenus senegalensis (Lam.) Exell.	Celastraceae	Tree	Grassland		Medicinal
Maytenus undata	Celastraceae	Tree	Forest	LC	
Meineckia phyllanthoides Baill.	Euphorbiaceae	Herb	Grassland		Medicinal
Melanthera scandens	Asteraceae	Herb	Forest, Wetland		
Memecylon myrianthum	Melastomataceae	Tree	Forest		
Micrococca mercurialis (L.) Benth.	Euphorbiaceae	Herb	Grassland		Medicinal
Microglossa pyrifolia (Lam.) O. Ktze	Asteraceae	Shrub	Grassland		Medicinal
Mimosa pigra L.	Fabaceae	Shrub	Wetland		Medicinal
Mimosa pudica L.	Fabaceae	Herb	Wetland	LC	Medicinal
Mimusops bagshawei	Sapotaceae	Tree	Forest		
Momordica foetida Schumach.	Cucurbitaceae	Herb	Bushland		Medicinal
Mondia whitei (Hook. f.) Skeels	Asclepiadaceae	Herb	Bushland, Forest		Medicinal
Monodora myristica	Annonaceae	Tree	Forest		
Mundulea sericea (Wild.) A. Chev.	Fabaceae	Shrub	Forest	LC	Medicinal
Murdannia simplex	Commelinaceae	Herb	Grassland		
Mussaenda arcuata Poir.	Rubiaceae	Shrub	Forest		Medicinal
Myrica kandtiana Engl.	Myricaceae	Tree	Forest		Medicinal

Neoboutonia macrocalyx	Euphorbiaceae	Tree	Forest	LC	
Neoboutonia melleri	Euphorbiaceae	Tree	Forest	LC	
Nephrolepis biserrata	Nephrolepidaceae	Herb	Wetland		
Ochna afzelii	Ochnaceae	Tree	Forest	LC	
Ochna membranacea	Ochnaceae	Tree	Forest		
Ocimum gratissimum L.	Lamiaceae	Shrub	Woodland, Grassland, Bushland, Forest		Medicinal
Ocimum kilimandscharicum Gurke	Lamiaceae	Herb	Grassland		Medicinal
Oenanthe palustris (Chiov.) Norman	Apiaceae	Herb	Wetland		Medicinal
Olea chrysophylla	Oleaceae	Tree	Forest, Woodland, Grassland		
Olea welwitschii	Oleaceae	Tree	Forest		
Oncoba spinosa	Salicaceae	Tree	Forest, Woodland, Grassland	LC	
Oreobambos buchwaldii	Poaceae	Shrub	Forest, Woodland, Grassland		
Ouratea densiflora	Ochnaceae	Tree	Forest		
Ouratea hiernii	Ochnaceae	Tree	Forest		
Oxalis corniculata L.	Oxalidaceae	Herb	Grassland		Medicinal
Oxyanthus speciosus	Rubiaceae	Shrub	Forest		
Oxygonum sinuatum (Meisn.) Dammer	Polygonaceae	Herb	Grassland		Medicinal
Pachystela brevipes	Sapotaceae	Tree	Forest		
Pallaea adiantoides (Wild) J. Smith	Adiantaceae	Herb	Grassland, Bushland		Medicinal
Pancovia sp nr turbinata	Sapindaceae	Tree	Forest		
Parinari curatellifolia Planch.	Chrysobalanaceae	Tree	Woodland, Grassland, Bushland	LC	Medicinal
Parinari excelsa	Chrysobalanaceae	Tree	Forest	LC	
Parkia filicoidea	Fabaceae	Tree	Forest	LC	
Pauridiantha viridiflora	Rubiaceae	Tree	Forest		
Peddiea fischeri	Tymelaeceae	Shrub	Forest, Woodland, Grassland	LC	
Pennisetum purpureum Schumach. (not	Poaceae	Herb	Bushland		Medicinal
Pentodon pentandrus	Rubiaceae	Herb	Wetland	LC	
Persicaria madagascariensis	Polygonaceae	Herb	Wetland		
Persicaria setosula	Polygonaceae	Herb	Wetland		
Phaseolus lunatus	Fabaceae	Herb	Grassland		
Phoenix reclinata	Arecaceae	Tree	Forest, Woodland, Grassland	LC	Crafts, Food
Phyllanthus nummularifolius Poir.	Phyllanthaceae	Herb	Forest		Medicinal
Phyllanthus ovalifolius Forsk.	Phyllanthaceae	Herb	Grassland		Medicinal
Phyllanthus pseudo-niruri	Phyllanthaceae	Herb	Grassland		

Physalis micrantha Link.	Solanaceae	Herb	Grassland		Medicinal
Piptadeniastrum africanum (Hook. f.)	Fabaceae	Tree	Forest		Medicinal
Pistia stratiotes	Araceae	Herb	Wetland	LC	
Pittosporum mannii	Pittosporaceae	Tree	Forest, Woodland, Grassland		
Plantago palmata Hook. f.	Plantaginaceae	Herb	Forest		Medicinal
Pleiocarpa pycnantha	Apocynaceae	Tree	Forest	LC	
Pleurostylia capensis Loes.	Celastraceae	Tree	Grassland	LC	Medicinal
Podocarpus latifolius (Thunb.) R. Br. ex Mirb.	Podocarpaceae	Tree	Forest	LC	
Polyscias fulva	Araliaceae	Tree	Forest, Woodland, Grassland	LC	
Premna angolensis	Lamiaceae	Tree	Forest		
Priva adhaerens (Forssk.) Chiov.	Verbenaceae	Herb	Grassland		Medicinal
Priva cordifolia (L.f.) Druce	Verbenaceae	Herb	Grassland		Medicinal
Prunus africana	Rosaceae	Tree	Forest, Woodland, Grassland	VU	Medicinal
Pseudagrostistachys ugandensis	Euphorbiaceae	Tree	Forest, Woodland, Grassland		
Pseudarthria confertiflora (A. Rich) Bak	Fabaceae	Shrub	Grassland		Medicinal
Pseudarthria hookeri Wight & Arn	Fabaceae	Shrub	Grassland		Medicinal
Pseudospondias microcarpa (A. Rich.)	Anacardiaceae	Tree	Forest, Woodland, Grassland		Medicinal
Psilotrichum elliotii Bak.	Amaranthaceae	Herb	Grassland, Forest		
Psorospernum febrifugum	Clusiaceae	Shrub	Woodland, Grassland	LC	Medicinal
Psychotria mahonii	Rubiaceae	Shrub	Forest, Woodland, Grassland		
Pterygota mildbraedii	Malvaceae	Tree	Forest		
Pycnanthus angolensis	Myristicaceae	Tree	Forest		
Pycnostachys eminii Gurke	Lamiaceae	Shrub	Grassland		Medicinal
Raphia farinifera	Arecaceae	Tree	Forest, Woodland, Grassland	LC	
Rauvolfia oxyphylla	Apocynaceae	Tree	Forest		
Rauvolfia vomitoria	Apocynaceae	Tree	Forest	LC	
Rhus natalensis Krauss.	Anacardiaceae	Tree	Forest, Woodland, Grassland, Bushland		Medicinal
Rhus ruspolii	Anacardiaceae	Shrub	Forest		
Rhus vulgaris Meikle.	Anacardiaceae	Shrub	Forest, Woodland, Grassland, Bushland		Medicinal
Rhynchosia resinosa (A. Rich) Bak.	Fabaceae	Herb	Grassland		Medicinal

Rhynchosia sp.	Fabaceae	Herb	Grassland		Medicinal
Rinorea brachypetala	Violaceae	Shrub	Forest		
Rinorea dentata	Violaceae	Shrub	Forest, Woodland, Grassland		
Rinorea ilicifolia	Violaceae	Shrub	Forest		
Ritchiea albersii	Capparaceae	Shrub	Forest, Woodland, Grassland	LC	
Rothmannia urcelliformis	Rubiaceae	Shrub	Forest		
Rubia cordifolia L.	Rubiaceae	Herb	Forest		Medicinal
Rubus apetalus Poir.	Rosaceae	Shrub	Forest		Medicinal
Rumex usambarensis (Dammer) Dammer.	Polygonaceae	Herb	Grassland		Medicinal
Rytigynia beniensis (De Wild) Robyns.	Rubiaceae	Tree	Forest	NT	Medicinal
Sacciolepis indica	Poaceae	Herb	Wetland		
Schefflera barteri	Araliaceae	Shrub	Forest		
Schizachyrium sanguineum	Poaceae	Herb	Grassland		
Schrebera arborea	Oleaceae	Tree	Forest		
Scolopia rhamniphylla	Salicaceae	Tree	Forest, Woodland, Grassland		
Scutia myrtina	Rhamnaceae	Shrub	Forest, Woodland, Grassland	LC	
Senencio nandensis S. Moore	Asteraceae	Herb	Grassland		Medicinal
Senencio petitianus A. Rich.	Asteraceae	Herb	Grassland		Medicinal
Senna obtusifolia L.	Fabaceae	Shrub	Grassland	LC	Medicinal
Senna occidentalis L.	Fabaceae	Herb	Grassland		Medicinal
Sesbania sesban (L.) Merr.	Fabaceae	Tree	Wetland		Medicinal
Setaria sphacelata	Poaceae	Herb	Wetland, Grassland		
Shirakiopsis elliptica	Euphorbiaceae	Tree	Forest, Bushland		Medicinal
Sida cuneifolia Roxb.	Malvaceae	Herb	Grassland		Medicinal
Sida rhombifolia L.	Malvaceae	Shrub	Bushland, Forest		Medicinal
Siegesbeckia orientalis L.	Asteraceae	Herb	Grassland		Medicinal
Solanecio manii (Hook.f.) C.Jeffrey	Asteraceae	Herb	Grassland	LC	Medicinal
Solanum campylacanthum Hochst.	Solanaceae	Shrub	Woodland, Grassland, Bushland		Medicinal
Solanum indicum	Solanaceae	Shrub	Forest		
Sorghastrum stipoides	Poaceae	Herb	Wetland		
Solenostemon latifolius (Benth.) J. K.	Lamiaceae	Herb	Bushland, Forest		Medicinal
Spathodea campanulata	Bignoniaceae	Tree	Forest	LC	
Spondianthus preussii	Phyllanthaceae	Tree	Forest, Woodland, Grassland		
Sporobolus pyramidalis	Poaceae	Herb	Grassland		
Steganotaenia araliacea Hochst.	Apiaceae	Tree	Grassland	LC	Medicinal

Strombosia scheffleri	Strombosiaceae	Tree	Forest		
Strychnos mitis	Loganiaceae	Tree	Forest		
Suregada procera	Euphorbiaceae	Tree	Forest		
Symphonia globulifera Linn.f.	Clusiaceae	Tree	Forest	LC	Medicinal
Syzygium cordatum Sond.	Myrtaceae	Tree	Forest, Woodland, Grassland	LC	Medicinal
Syzygium guineense (Willd.) D.C.	Myrtaceae	Tree	Forest	LC	Medicinal
Tabernaemontana holstii (K. Schum) Stapf.	Apocynaceae	Tree	Forest		Medicinal
Tabernaemontana usambarensis	Apocynaceae	Tree	Forest		
Tagetes minuta L.	Asteraceae	Herb	Grassland		Medicinal
Talinum paniculatum (Jacq.) Gaertn.	Portulacaceae	Herb	Grassland		Medicinal
Tarenna pavettoides	Ribiaceae	Shrub	Forest, Woodland, Grassland		
Tephrosia linearis (Willd.) Pers.	Fabaceae	Shrub	Grassland		Medicinal
Tetradenia riparia (Hochst) Codd.	Lamiaceae	Shrub	Grassland	LC	Medicinal
Tetrapleura tetraptera	Fabaceae	Tree	Forest	LC	
Tetrorchidium didymonstemon (Baill.) Pax & K. Hoffm.	Euphorbiaceae	Shrub	Forest, Wetland, Bushland	LC	Medicinal
Toddalia asiatica Lam.	Rutaceae	Shrub	Forest, Woodland, Grassland		Medicinal
Treculia africana	Moraceae	Tree	Forest		
Trema orientalis	Cannabaceae	Shrub	Forest	LC	
Trichilia dregeana	Meliaceae	Tree	Forest	LC	
Trichilia rubescens	Meliaceae	Tree	Forest	LC	
Trichocladus ellipticus	Hamamelidaceae	Shrub	Forest, Woodland, Grassland		
Trilepisium madagascariensis	Moraceae	Tree	Forest		
Trimeria grandifolia	Salicaceae	Shrub	Forest, Woodland, Grassland		
Tristemma mauritianum J.F. Gmel.	Melastomataceae	Herb	Wetland		Medicinal
Triumfetta annua L.	Malvaceae	Shrub	Grassland		Medicinal
Triumfetta brachyceras	Malvaceae	Shrub	Forest, Wetland		
Triumfetta cordifolia	Malvaceae	Shrub	Forest, Wetland, Woodland		
Triumfetta macrophylla	Malvaceae	Shrub	Forest, Woodland, Grassland		
Turraea robusta	Meliaceae	Tree	Forest, Wetland	LC	
Turraea vogelioides	Meliaceae	Shrub	Wetland		
Uapaca paludosa	Phyllanthaceae	Tree	Forest, Woodland, Grassland		
Vangueria apiculata	Rubiaceae	Shrub	Forest		

Vepris nobilis (Delile) Mziray	Rutaceae	Tree	Forest, Woodland, Grassland		
Vernonia amygdalina	Asteraceae	Shrub	Forest, Woodland, Grassland, Bushland		
Vernonia campanea S. Moore	Asteraceae	Shrub	Grassland		Medicinal
Vernonia cinerea L.	Asteraceae	Herb	Grassland		Medicinal
Vernonia lasiopus O. Hoffn.	Asteraceae	Shrub	Grassland		Medicinal
Vernonia stenocephala Oliv.	Asteraceae	Shrub	Grassland		Medicinal
Vigna luteola var. *luteola*	Fabaceae	Herb	Grassland		
Vitex amboniensis	Lamiaceae	Tree	Forest		
Voacanga thouarsii	Apocynaceae	Tree	Wetland		
Vossia cuspidata	Poaceae	Herb	wetland	LC	
Warburgia ugandensis	Canellaceae	Tree	Forest		
Xylopia aethiopica	Annonaceae	Tree	Forest, Woodland, Grassland	LC	
Xymalos monospora	Monimiaceae	Tree	Forest		
Zanha golungensis	Sapindaceae	Tree	Forest	LC	
Zanthoxylum chalybeum Engl.	Rutaceae	Tree	Forest	LC	Medicinal
Zanthoxylum gilletii	Rutaceae	Tree	Forest		
Zanthoxylum leprieurii	Rutaceae	Tree	Forest		
Zanthoxylum rubescens	Rutaceae	Tree	Forest		
Zehneria capillacea	Cucurbitaceae	Herb	Forest, Woodland, Wetland		

Insects of Sango Bay-Minziro

Family	Genus	Species		IUCN/Africa/EA	Uganda status
			SANGO-BAY		
HESPERIIDAE	*Acleros*	*mackenii*		NE	NT
HESPERIIDAE	*Acleros*	*neavei*		NE	VU
HESPERIIDAE	*Acleros*	*ploetzi*		NE	NT
HESPERIIDAE	*Afrogegenes*	*niso*		NE	LC
HESPERIIDAE	*Andronymus*	*neander*		NE	NE
HESPERIIDAE	*Andronymus*	*helles*	1	NE	EN
HESPERIIDAE	*Borbo*	*borbonica*		NE	LC
HESPERIIDAE	*Borbo*	*fallax*		NE	LC
HESPERIIDAE	*Borbo*	*fatuellus*		NE	LC
HESPERIIDAE	*Borbo*	*lugens*		NE	LC
HESPERIIDAE	*Calleagris*	*lacteus*		NE	NE
HESPERIIDAE	*Celaenorrhinus*	*galenus*		NE	LC
HESPERIIDAE	*Coeliades*	*libeon*		NE	LC
HESPERIIDAE	*Eagris*	*nottoana*	1	NE	LC
HESPERIIDAE	*Eretis*	*lugens*		NE	LC
HESPERIIDAE	*Gorgyra*	*bibulus*	1	NE	LC
HESPERIIDAE	*Kedestes*	*brunneostriga*		NE	NT
HESPERIIDAE	*Lepella*	*lepeletier*		NE	NT
HESPERIIDAE	*Metisella*	*midas*	1	NE	LC
HESPERIIDAE	*Meza*	*cybeutes*		NE	VU
HESPERIIDAE	*Pardaleodes*	*incerta*		NE	LC
HESPERIIDAE	*Pelopidas*	*thrax*		NE	LC
HESPERIIDAE	*Prosopalpus*	*saga*		NE	DD
HESPERIIDAE	*Prosopalpus*	*styla*		NE	NT
HESPERIIDAE	*Sarangesa*	*bouvieri*		NE	NT
HESPERIIDAE	*Sarangesa*	*haplopa*		NE	VU
HESPERIIDAE	*Spialia*	*diomus*		NE	LC
HESPERIIDAE	*Tagiades*	*flesus*		NE	LC
HESPERIIDAE	*Teniorhinus*	*ignita*		NE	LC
HESPERIIDAE	*Teniorhinus*	*watsoni*		NE	CR
HESPERIIDAE	*Xanthodisca*	*vibius*		NE	EN
LYCAENIDAE	*Actizera*	*lucida*	1	NE	LC
LYCAENIDAE	*Anthene*	*amarah*		NE	LC
LYCAENIDAE	*Anthene*	*crawshayi*		NE	LC
LYCAENIDAE	*Anthene*	*definita*		NE	LC
LYCAENIDAE	*Anthene*	*indefinita*		NE	LC
LYCAENIDAE	*Anthene*	*ituria*		NE	VU
LYCAENIDAE	*Anthene*	*larydas*	1	NE	LC
LYCAENIDAE	*Anthene*	*lasti*	1	NE	DD
LYCAENIDAE	*Anthene*	*lingures*	1	NE	LC
LYCAENIDAE	*Anthene*	*liodes*	1	NE	VU
LYCAENIDAE	*Anthene*	*princeps*	1	NE	LC
LYCAENIDAE	*Anthene*	*rubricinctus*	1	NE	VU
LYCAENIDAE	*Anthene*	*schoutedeni*	1	NE	LC

LYCAENIDAE	*Anthene*	*scintillula*	1	NE	VU
LYCAENIDAE	*Anthene*	*suquala*	1	NE	VU
LYCAENIDAE	*Aphnaeus*	*chapini*		NE	CR
LYCAENIDAE	*Aphnaeus*	*nyanzae*		NE	CR
LYCAENIDAE	*Aphnaeus*	*orcas*	1	NE	VU
LYCAENIDAE	*Argyrocheila*	*wadifera*	1	NE	CR
LYCAENIDAE	*Axiocerces*	*bambana*		NE	DD
LYCAENIDAE	*Axiocerces*	*harpax*	1	NE	LC
LYCAENIDAE	*Azanus*	*isis*		NE	LC
LYCAENIDAE	*Azanus*	*jesous*		NE	LC
LYCAENIDAE	*Azanus*	*mirza*		NE	LC
LYCAENIDAE	*Azanus*	*moriqua*	1	NE	LC
LYCAENIDAE	*Azanus*	*natalensis*	1	NE	LC
LYCAENIDAE	*Cacyreus*	*audeoudi*	1	NE	VU
LYCAENIDAE	*Cacyreus*	*lingeus*	1	NE	LC
LYCAENIDAE	*Cacyreus*	*virilis*	1	NE	LC
LYCAENIDAE	*Citrinophila*	*erastus*	1	NE	DD
LYCAENIDAE	*Cupidopsis*	*cissus*	1	NE	LC
LYCAENIDAE	*Cupidopsis*	*jobates*	1	NE	LC
LYCAENIDAE	*Chloroselas*	*sp*	1	NE	
LYCAENIDAE	*Eicochrysops*	*hippocrates*	1	NE	LC
LYCAENIDAE	*Eicochrysops*	*messapus*	1	NE	VU
LYCAENIDAE	*Eresina*	*masaka*	1	NE	DD
LYCAENIDAE	*Euchrysops*	*albistriata*		NE	DD
LYCAENIDAE	*Euchrysops*	*barkeri*		NE	LC
LYCAENIDAE	*Euchrysops*	*malathana*		NE	LC
LYCAENIDAE	*Euchrysops*	*osiris*	1	NE	LC
LYCAENIDAE	*Euchrysops*	*subpallida*	1	NE	LC
LYCAENIDAE	*Falcuna*	*orientalis*	1	NE	VU
LYCAENIDAE	*Hypolycaena*	*antifaunus*	1	NE	LC
LYCAENIDAE	*Hypolycaena*	*hatita*	1	NE	LC
LYCAENIDAE	*Hypolycaena*	*pachalica*	1	NE	LC
LYCAENIDAE	*Hypolycaena*	*philippus*	1	NE	LC
LYCAENIDAE	*Iolaus (Epamera)*	*pollux*	1	NE	DD
LYCAENIDAE	*Iolaus (Tanuatheira)*	*timon*	1	NE	EN
LYCAENIDAE	*Lachnocnema*	*bibulus*	1	NE	LC
LYCAENIDAE	*Lachnocnema*	*durbani*	1	NE	LC
LYCAENIDAE	*Lampides*	*boeticus*	1	NE	LC
LYCAENIDAE	*Larinopoda*	*tera*	1	NE	LC
LYCAENIDAE	*Lepidochrysops*	*neonegus*	1	NE	LC
LYCAENIDAE	*Lepidochrysops*	*parsimon*	1	NE	LC
LYCAENIDAE	*Leptotes*	*pirithous*		NE	LC
LYCAENIDAE	*Leptotes*	*sp.*	1	NE	
LYCAENIDAE	*Lipaphnaeus*	*leonina*		NE	VU
LYCAENIDAE	*Lipaphaeus*	*loxura*	1	NE	VU
LYCAENIDAE	*Kakumia*	*ideoides*	1	NE	EN
LYCAENIDAE	*Liptena*	*xanthostola*	1	NE	VU

LYCAENIDAE	*Megalopalpus*	*zymna*	1	NE	LC
LYCAENIDAE	*Micropentila*	*chevereti*	1	NE	VU
LYCAENIDAE	*Micropentila*	*fontainei*		NE	VU
LYCAENIDAE	*Micropentila*	*jacksoni*	1	NE	CR
LYCAENIDAE	*Micropentila*	*katera*	1	NE	CR
LYCAENIDAE	*Mimacraea*	*landbecki*	1	NE	CR
LYCAENIDAE	*Mimacraea*	*krausei*	1	NE	EN
LYCAENIDAE	*Mimacraea*	*marshalli*	1	NE	VU
LYCAENIDAE	*Mimeresia*	*drucei*		NE	DD
LYCAENIDAE	*Mimeresia*	*moreelsi*		NE	DD
LYCAENIDAE	*Mimeresia*	*neavei*	1	NE	DD
LYCAENIDAE	*Neaveia*	*lamborni*	1	NE	CR
LYCAENIDAE	*Neoepitola*	*barombiensis*		NE	DD
LYCAENIDAE	*Anthene*	*chryseostictus*	1	NE	NT
LYCAENIDAE	*Anthene*	*luzones*	1	NE	CR
LYCAENIDAE	*Anthene*	*staudingeri*		NE	VU
LYCAENIDAE	*Neurypexina*	*kalinzu*	1	NE	DD
LYCAENIDAE	*Oboronia*	*guszfeldti*		NE	VU
LYCAENIDAE	*Oboronia*	*punctatus*	1	NE	LC
LYCAENIDAE	*Ornipholidotos*	*jacksoni*	1	NE	VU
LYCAENIDAE	*Ornipholidotos*	*katangae*	1	NE	VU
LYCAENIDAE	*Ornipholidotos*	*emarginata*	1	NE	DD
LYCAENIDAE	*Ornipholidotos*	*latimargo*	1	NE	DD
LYCAENIDAE	*Ornipholidotos*	*overlaeti*	1	NE	NT
LYCAENIDAE	*Ornipholidotos*	*paradoxa*	1	NE	DD
LYCAENIDAE	*Ornipholidotos*	*peucetia*	1	NE	DD
LYCAENIDAE	*Ornipholidotos*	*teroensis*	1	NE	DD
LYCAENIDAE	*Ornipholidotos*	*ugandae*	1	NE	DD
LYCAENIDAE	*Oxylides*	*faunus*		LC	DD
LYCAENIDAE	*Pentila*	*alba*		NE	DD
LYCAENIDAE	*Pentila*	*inconspicua*	1	NE	VU
LYCAENIDAE	*Pentila*	*pauli*	1	NE	LC
LYCAENIDAE	*Pentila*	*tachyroides*	1	NE	CR
LYCAENIDAE	*Pentila*	*umangiana*		NE	LC
LYCAENIDAE	*Phlyaria*	*cyara*	1	NE	VU
LYCAENIDAE	*Phytala*	*elais*		NE	EN
LYCAENIDAE	*Pseudonacaduba*	*aethiops*		NE	LC
LYCAENIDAE	*Pseudonacaduba*	*sichela*	1	NE	LC
LYCAENIDAE	*Ptelina*	*carnuta*	1	NE	LC
LYCAENIDAE	*Spalgis*	*lemolea*	1	NE	LC
LYCAENIDAE	*Tarucus*	*grammicus*	1	NE	DD
LYCAENIDAE	*Telipna*	*aurivillii*		NE	EN
LYCAENIDAE	*Telipna*	*erica*		NE	EN
LYCAENIDAE	*Telipna*	*consanguinea*		NE	DD
LYCAENIDAE	*Tetrarhanis*	*ilma*	1	NE	LC
LYCAENIDAE	*Thermoniphas*	*distincta*	1	NE	EN
LYCAENIDAE	*Thermoniphas*	*plurilimbata*	1	NE	VU
LYCAENIDAE	*Thermoniphas*	*togara*	1	NE	EN

LYCAENIDAE	*Toxochitona*	*sankuru*		NE	EN
LYCAENIDAE	*Zizeeria*	*knysna*	1	NE	LC
LYCAENIDAE	*Zizina*	*antanossa*	1	NE	LC
LYCAENIDAE	*Zizula*	*hylax*	1	NE	LC
RIODINIDAE	*Abisara*	*neavei*	1	NE	LC
NYMPHALIDAE	*Acraea*	*anemosa*	1	NE	DD
NYMPHALIDAE	*Acraea*	*aganice*	1	NE	LC
NYMPHALIDAE	*Acraea*	*alcinoe*		NE	LC
NYMPHALIDAE	*Acraea*	*aurivilli*		NE	LC
NYMPHALIDAE	*Acraea*	*cinera*	1	NE	LC
NYMPHALIDAE	*Acraea*	*consanguinea*	1	NE	LC
NYMPHALIDAE	*Acraea*	*egina*	1	NE	LC
NYMPHALIDAE	*Acraea*	*elgonense*	1	NE	LC
NYMPHALIDAE	*Acraea*	*epaea*		NE	LC
NYMPHALIDAE	*Acraea*	*insignis*	1	NE	VU
NYMPHALIDAE	*Acraea*	*kraka*	1	NE	VU
NYMPHALIDAE	*Acraea*	*leucographa*		NE	VU
NYMPHALIDAE	*Acraea*	*macaria*	1	NE	LC
NYMPHALIDAE	*Acraea*	*macarista*	1	NE	NT
NYMPHALIDAE	*Acraea*	*natalica*	1	NE	NT
NYMPHALIDAE	*Acraea*	*neobule*	1	NE	LC
NYMPHALIDAE	*Acraea*	*poggei*	1	NE	LC
NYMPHALIDAE	*Acraea*	*pseudegina*	1	NE	LC
NYMPHALIDAE	*Acraea*	*quirina*	1	NE	LC
NYMPHALIDAE	*Acraea*	*quirina*	1	NE	LC
NYMPHALIDAE	*Acraea*	*rogersi*	1	NE	VU
NYMPHALIDAE	*Acraea*	*tellus*	1	NE	LC
NYMPHALIDAE	*Actinote*	*acerata*		NE	LC
NYMPHALIDAE	*Actinote*	*alciope*	1	NE	EN
NYMPHALIDAE	*Actinote*	*alcipioides*		NE	VU
NYMPHALIDAE	*Actinote*	*alicia*	1	NE	LC
NYMPHALIDAE	*Actinote*	*bonasia*		NE	LC
NYMPHALIDAE	*Actinote*	*cabira*	1	NE	LC
NYMPHALIDAE	*Actinote*	*encedana*	1	NE	LC
NYMPHALIDAE	*Actinote*	*encedon*	1	NE	LC
NYMPHALIDAE	*Actinote*	*esebria*	1	NE	LC
NYMPHALIDAE	*Actinote*	*humilis*	1	NE	DD
NYMPHALIDAE	*Actinote*	*iturina*		NE	LC
NYMPHALIDAE	*Actinote*	*jodutta*	1	NE	LC
NYMPHALIDAE	*Actinote*	*johnstoni*	1	NE	LC
NYMPHALIDAE	*Actinote*	*lycoa*	1	NE	LC
NYMPHALIDAE	*Actinote*	*orinata*	1	NE	NT
NYMPHALIDAE	*Actinote*	*parrhasia*	1	NE	VU
NYMPHALIDAE	*Actinote*	*peneleos*	1	NE	LC
NYMPHALIDAE	*Actinote*	*penelope*	1	NE	LC
NYMPHALIDAE	*Actinote*	*perenna*	1	NE	LC

NYMPHALIDAE	*Actinote*	*pharsalus*	1	NE	VU
NYMPHALIDAE	*Actinote*	*quirinalis*	1	NE	LC
NYMPHALIDAE	*Actinote*	*rahira*	1	NE	VU
NYMPHALIDAE	*Actinote*	*semivitrea*	1	NE	LC
NYMPHALIDAE	*Actinote*	*sotikensis*	1	NE	LC
NYMPHALIDAE	*Actinote*	*ventura*	1	NE	LC
NYMPHALIDAE	*Actinote*	*viviana*	1	NE	NT
NYMPHALIDAE	*Amauris*	*albimaculata*	1	NE	LC
NYMPHALIDAE	*Amauris*	*hecate*	1	NE	LC
NYMPHALIDAE	*Amauris*	*niavius*	1	NE	LC
NYMPHALIDAE	*Amauris*	*oscarus*	1	NE	LC
NYMPHALIDAE	*Amauris*	*tartarea*	1	NE	LC
NYMPHALIDAE	*Ariadne*	*enotrea*	1	NE	LC
NYMPHALIDAE	*Ariadne*	*pagenstecheri*	1	NE	LC
NYMPHALIDAE	*Aterica*	*galene*	1	NE	LC
NYMPHALIDAE	*Bebearia (Apectinaria)*	*abesa*		NE	DD
NYMPHALIDAE	*Bebearia (Apectinaria)*	*absolon*		NE	LC
NYMPHALIDAE	*Bebearia (Apectinaria)*	*barce*		NE	VU
NYMPHALIDAE	*Bebearia (Apectinaria)*	*carshena*		NE	DD
NYMPHALIDAE	*Bebearia (Apectinaria)*	*cocalia*	1	NE	LC
NYMPHALIDAE	*Bebearia (Apectinaria)*	*partita*		NE	VU
NYMPHALIDAE	*Bebearia (Apectinaria)*	*sophus*	1	NE	LC
NYMPHALIDAE	*Bebearia (Apectinaria)*	*tentyris*		NE	VU
NYMPHALIDAE	*Bebearia (Apectinaria)*	*zonara*		NE	NT
NYMPHALIDAE	*Bebearia*	*brunhilda*		NE	DD
NYMPHALIDAE	*Bebearia*	*laetitioides*		NE	VU
NYMPHALIDAE	*Bebearia*	*phantasiella*	1	NE	EN
NYMPHALIDAE	*Bicyclus*	*alboplagus*	1	NE	VU
NYMPHALIDAE	*Bicyclus*	*angulosus*		NE	LC
NYMPHALIDAE	*Bicyclus*	*angynana*		NE	LC
NYMPHALIDAE	*Bicyclus*	*auricrudus*		NE	LC
NYMPHALIDAE	*Bicyclus*	*buea*	1	NE	LC
NYMPHALIDAE	*Bicyclus*	*campinus*		NE	NT
NYMPHALIDAE	*Bicyclus*	*dentatus*		NE	LC
NYMPHALIDAE	*Bicyclus*	*funebris*	1	NE	LC
NYMPHALIDAE	*Bicyclus*	*golo*	1	NE	LC
NYMPHALIDAE	*Bicyclus*	*graueri*	1	NE	LC
NYMPHALIDAE	*Bicyclus*	*istaris*	1	NE	VU
NYMPHALIDAE	*Bicyclus*	*jefferyi*	1	NE	NT
NYMPHALIDAE	*Bicyclus*	*mandanes*	1	NE	LC
NYMPHALIDAE	*Bicyclus*	*mesogena*	1	NE	LC
NYMPHALIDAE	*Bicyclus*	*milyas*	1	NE	LC
NYMPHALIDAE	*Bicyclus*	*mollitia*	1	NE	LC
NYMPHALIDAE	*Bicyclus*	*procora*		NE	EN
NYMPHALIDAE	*Bicyclus*	*safitza*	1	NE	LC

NYMPHALIDAE	*Bicyclus*	*sambulos*	1	NE	LC
NYMPHALIDAE	*Bicyclus*	*sanaos*	1	NE	NT
NYMPHALIDAE	*Bicyclus*	*sandace*	1	NE	LC
NYMPHALIDAE	*Bicyclus*	*saussurei*	1	NE	LC
NYMPHALIDAE	*Bicyclus*	*sebetus*	1	NE	LC
NYMPHALIDAE	*Bicyclus*	*smithi*	1	NE	LC
NYMPHALIDAE	*Bicyclus*	*sophrosyne*	1	NE	NT
NYMPHALIDAE	*Bicyclus*	*vulgaris*	1	NE	LC
NYMPHALIDAE	*Byblia*	*anvatara*	1	NE	LC
NYMPHALIDAE	*Byblia*	*ilithyia*	1	NE	LC
NYMPHALIDAE	*Catacroptera*	*cloanthe*	1	NE	LC
NYMPHALIDAE	*Catuna*	*angustatum*		NE	DD
NYMPHALIDAE	*Catuna*	*crithea*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*ameliae*		NE	VU
NYMPHALIDAE	*Charaxes*	*ansorgei*		NE	NT
NYMPHALIDAE	*Charaxes*	*anticlea*		NE	NT
NYMPHALIDAE	*Charaxes*	*bipunctatus*		NE	LC
NYMPHALIDAE	*Charaxes*	*brutus*		NE	NT
NYMPHALIDAE	*Charaxes*	*castor*		NE	LC
NYMPHALIDAE	*Charaxes*	*catachrous*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*cedreatis*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*cynthia*		NE	LC
NYMPHALIDAE	*Charaxes*	*etesipe*		NE	LC
NYMPHALIDAE	*Charaxes*	*etheocles*		NE	LC
NYMPHALIDAE	*Charaxes*	*eudoxus*		NE	LC
NYMPHALIDAE	*Charaxes*	*eupale*		NE	LC
NYMPHALIDAE	*Charaxes*	*fulvescens*		NE	LC
NYMPHALIDAE	*Charaxes*	*hadrianus*	1	NE	DD
NYMPHALIDAE	*Charaxes*	*imperialis*	1	NE	NT
NYMPHALIDAE	*Charaxes*	*jasius*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*kahldeni*		NE	LC
NYMPHALIDAE	*Charaxes*	*lucretius*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*lycurgus*	1	NE	NT
NYMPHALIDAE	*Charaxes*	*nobilis*	1	NE	DD
NYMPHALIDAE	*Charaxes*	*numenes*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*paphianus*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*pleione*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*pollux*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*porthos*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*protoclea*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*pythodoris*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*smaragdilis*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*subornatus*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*tiridates*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*varanes*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*virilis*		NE	LC
NYMPHALIDAE	*Charaxes*	*zingha*	1	NE	LC
NYMPHALIDAE	*Charaxes*	*zoolina*	1	NE	LC

NYMPHALIDAE	*Cymothoe*	*coccinata*		NE	EN
NYMPHALIDAE	*Cymothoe*	*cyclades*		NE	EN
NYMPHALIDAE	*Cymothoe*	*egesta*		NE	EN
NYMPHALIDAE	*Cymothoe*	*hobarti*	1	NE	NT
NYMPHALIDAE	*Cymothoe*	*jodutta*		NE	VU
NYMPHALIDAE	*Cymothoe*	*lurida*	1	NE	LC
NYMPHALIDAE	*Cymothoe*	*ochreata*		NE	NT
NYMPHALIDAE	*Cymothoe*	*reginaeelisabethae*		NE	VU
NYMPHALIDAE	*Cymothoe*	*sangaris*		NE	EN
NYMPHALIDAE	*Cynandra*	*opis*	1	NE	VU
NYMPHALIDAE	*Cyrestis*	*camillus*	1	NE	LC
NYMPHALIDAE	*Danaus*	*chrysippus*	1	NE	LC
NYMPHALIDAE	*Elymnias*	*bammakoo*	1	NE	LC
NYMPHALIDAE	*Euphaedra*	*alacris*		NE	DD
NYMPHALIDAE	*Euphaedra (Euphaedrana)*	*edwardsii*		NE	LC
NYMPHALIDAE	*Euphaedra*	*eleus*		NE	LC
NYMPHALIDAE	*Euphaedra*	*harpalyce*		NE	LC
NYMPHALIDAE	*Euphaedra*	*hollandi*		NE	LC
NYMPHALIDAE	*Euphaedra*	*medon*	1	NE	LC
NYMPHALIDAE	*Euphaedra*	*rex*	1	NE	LC
NYMPHALIDAE	*Euphaedra (Euphaedrana)*	*preussi*		NE	LC
NYMPHALIDAE	*Euphaedra*	*ruspina*	1	NE	LC
NYMPHALIDAE	*Euphaedra*	*viridicaerulea*	1	NE	DD
NYMPHALIDAE	*Euriphene*	*atossa*		NE	VU
NYMPHALIDAE	*Euriphene*	*conjugens*	1	NE	DD
NYMPHALIDAE	*Euriphene*	*ribensis*	1	NE	DD
NYMPHALIDAE	*Euriphene*	*saphirina*	1	NE	LC
NYMPHALIDAE	*Euryphura*	*plautilla*	1	NE	DD
NYMPHALIDAE	*Eurytela*	*dryope*	1	NE	LC
NYMPHALIDAE	*Eurytela*	*hiarbas*	1	NE	LC
NYMPHALIDAE	*Euxanthe*	*eurinome*	1	NE	LC
NYMPHALIDAE	*Gnophodes*	*betsimena*	1	NE	LC
NYMPHALIDAE	*Gnophodes*	*chelys*	1	NE	LC
NYMPHALIDAE	*Hamanumida*	*daedalus*		NE	LC
NYMPHALIDAE	*Harma*	*theobene*	1	NE	LC
NYMPHALIDAE	*Heteropsis*	*peitho*	1	NE	LC
NYMPHALIDAE	*Heteropsis*	*perspicua*	1	NE	LC
NYMPHALIDAE	*Heteropsis*	*phaea*	1	NE	LC
NYMPHALIDAE	*Hypolimnas*	*anthedon*	1	NE	LC
NYMPHALIDAE	*Hypolimnas*	*dinarcha*	1	NE	LC
NYMPHALIDAE	*Hypolimnas*	*misippus*	1	NE	LC
NYMPHALIDAE	*Hypolimnas*	*monteironis*	1	NE	LC
NYMPHALIDAE	*Hypolimnas*	*salmacis*	1	NE	LC
NYMPHALIDAE	*Junonia*	*chorimene*	1	NE	LC
NYMPHALIDAE	*Junonia*	*hierta*	1	NE	LC
NYMPHALIDAE	*Junonia*	*oenone*	1	NE	LC
NYMPHALIDAE	*Junonia*	*sophia*	1	NE	LC
NYMPHALIDAE	*Junonia*	*gregorii*	1	NE	LC

NYMPHALIDAE	*Junonia*	*terea*	1	NE	LC
NYMPHALIDAE	*Junonia*	*westermanni*	1	NE	LC
NYMPHALIDAE	*Melanitis*	*leda*	1	NE	LC
NYMPHALIDAE	*Neptidopsis*	*ophione*	1	NE	NT
NYMPHALIDAE	*Neptis*	*carpenteri*		NE	VU
NYMPHALIDAE	*Neptis*	*conspicua*		NE	LC
NYMPHALIDAE	*Neptis*	*continuata*		NE	DD
NYMPHALIDAE	*Neptis*	*kiriakoffi*		NE	LC
NYMPHALIDAE	*Neptis*	*laeta*	1	NE	LC
NYMPHALIDAE	*Neptis*	*melicerta*	1	NE	LC
NYMPHALIDAE	*Neptis*	*metella*	1	NE	NT
NYMPHALIDAE	*Neptis*	*morosa*	1	NE	IC
NYMPHALIDAE	*Neptis*	*nemetes*	1	NE	NT
NYMPHALIDAE	*Neptis*	*nicomedes*	1	NE	VU
NYMPHALIDAE	*Neptis*	*ochracea*	1	NE	VU
NYMPHALIDAE	*Neptis*	*puella*	1	NE	VU
NYMPHALIDAE	*Neptis*	*saclava*	1	NE	LC
NYMPHALIDAE	*Neptis*	*serena*	1	NE	LC
NYMPHALIDAE	*Neptis*	*strigata*	1	NE	LC
NYMPHALIDAE	*Palla*	*violinitens*		LC	EN
NYMPHALIDAE	*Pardopsis*	*punctatissima*		NE	LC
NYMPHALIDAE	*Phalanta*	*eurytis*	1	NE	LC
NYMPHALIDAE	*Phalanta*	*phalanta*	1	NE	LC
NYMPHALIDAE	*Precis*	*antilope*		NE	LC
NYMPHALIDAE	*Precis*	*archesia*		NE	LC
NYMPHALIDAE	*Precis*	*ceryne*	1	NE	LC
NYMPHALIDAE	*Precis*	*pelarga*	1	NE	NT
NYMPHALIDAE	*Precis*	*sinuata*	1	NE	LC
NYMPHALIDAE	*Precis*	*tugela*	1	NE	NT
NYMPHALIDAE	*Pseudacraea*	*eurytus*	1	NE	LC
NYMPHALIDAE	*Pseudacraea*	*kuenowi*	1	NE	LC
NYMPHALIDAE	*Pseudacraea*	*lucretia*	1	NE	LC
NYMPHALIDAE	*Pseudargynnis*	*hegemone*	1	NE	LC
NYMPHALIDAE	*Pseudoneptis*	*bugandensis*		NE	LC
NYMPHALIDAE	*Protogoniomorpha*	*anacardii*		NE	LC
NYMPHALIDAE	*Salamis*	*cacta*		NE	LC
NYMPHALIDAE	*Protogoniomorpha*	*parhassus*	1	NE	LC
NYMPHALIDAE	*Protogoniomorpha*	*temora*	1	NE	LC
NYMPHALIDAE	*Sevenia*	*boisduvali*	1	NE	LC
NYMPHALIDAE	*Sevenia*	*garega*	1	NE	LC
NYMPHALIDAE	*Sevenia*	*occidentalium*	1	NE	LC
NYMPHALIDAE	*Sevenia*	*umbrina*	1	NE	LC
NYMPHALIDAE	*Telchinia*	*serena*	1	NE	LC
NYMPHALIDAE	*Tirumala*	*formosa*	1	NE	LC
NYMPHALIDAE	*Tirumala*	*petiverana*	1	NE	LC
NYMPHALIDAE	*Vanessula*	*milca*	1	NE	LC
NYMPHALIDAE	*Ypthima*	*albida*	1	NE	LC
NYMPHALIDAE	*Ypthima*	*asterope*	1	NE	LC

NYMPHALIDAE	*Ypthima*	*doleta*	1	NE	LC
NYMPHALIDAE	*Ypthima*	*granulosa*	1	NE	LC
NYMPHALIDAE	*Ypthima*	*pupillaris*	1	NE	LC
NYMPHALIDAE	*Ypthima*	*sp.*	1	NE	LC
NYMPHALIDAE	*Ypthimomorpha*	*itonia*	1	NE	LC
PAPILIONIDAE	*Graphium*	*almansor*	1	NE	LC
PAPILIONIDAE	*Graphium*	*angolanus*		NE	LC
PAPILIONIDAE	*Graphium*	*antheus*		NE	LC
PAPILIONINAE	*Graphium*	*leonidas*	1	NE	LC
PAPILIONIDAE	*Papilio*	*charopus*		NE	LC
PAPILIONIDAE	*Papilio*	*chrapkowskoides*	1	NE	LC
PAPILIONINAE	*Papilio*	*constantinus*		NE	DD
PAPILIONIDAE	*Papilio*	*cynorta*	1	NE	NT
PAPILIONINAE	*Papilio*	*dardanus*	1	NE	LC
PAPILIONIDAE	*Papilio*	*demodocus*	1	NE	LC
PAPILIONIDAE	*Papilio*	*echerioides*	1	NE	NT
PAPILIONINAE	*Papilio*	*hespreus*	1	NE	NT
PAPILIONINAE	*Papilio*	*lormieri*	1	NE	NT
PAPILIONINAE	*Papilio*	*mackinnoni*		NE	NT
PAPILIONIDAE	*Papilio*	*mechowi*	1	NE	NT
PAPILIONINAE	*Papilio*	*nireus*	1	NE	NT
PAPILIONINAE	*Papilio*	*nobilis*		NE	NT
PAPILIONIDAE	*Papilio*	*phorcas*	1	NE	LC
PAPILIONIDAE	*Papilio*	*rex*	1	NE	LC
PAPILIONIDAE	*Papilio*	*sosia*	1	NE	NT
PAPILIONIDAE	*Papilio*	*zenobia*	1	NE	VU
PIERIDAE	*Afrodryas*	*leda*	1	NE	LC
PIERIDAE	*Appias*	*epaphia*		NE	LC
PIERIDAE	*Appias*	*sabina*	1	NE	LC
PIERIDAE	*Appias*	*sylvia*	1	NE	LC
PIERIDAE	*Belenois*	*aurota*	1	NE	LC
PIERIDAE	*Belenois*	*calypso*		NE	LC
PIERIDAE	*Belenois*	*crawshayi*		NE	LC
PIERIDAE	*Belenois*	*creona*	1	NE	LC
PIERIDAE	*Belenois*	*gidica*	1	NE	LC
PIERIDAE	*Belenois*	*solilucis*	1	NE	VU
PIERIDAE	*Belenois*	*subeida*	1	NE	LC
PIERIDAE	*Belenois*	*sudanensis*	1	NE	VU
PIERIDAE	*Belenois*	*theora*	1	NE	LC
PIERIDAE	*Belenois*	*theusis*	1	NE	EN
PIERIDAE	*Belenois*	*thysa*	1	NE	LC
PIERIDAE	*Catopsilia*	*florella*	1	NE	LC
PIERIDAE	*Colotis*	*antevippe*	1	NE	LC
PIERIDAE	*Colotis*	*aurigineus*		NE	LC
PIERIDAE	*Colotis*	*danae*		NE	LC
PIERIDAE	*Colotis*	*elgonensis*		NE	NT

PIERIDAE	*Colotis*	*eucharis*		NE	LC
PIERIDAE	*Colotis*	*euippe*		NE	LC
PIERIDAE	*Colotis*	*evagore*	1	NE	LC
PIERIDAE	*Colotis*	*hetaera*	1	NE	LC
PIERIDAE	*Colotis*	*rogersi*	1	NE	LC
PIERIDAE	*Colotis*	*vesta*	1	NE	LC
PIERIDAE	*Dixeia*	*charina*		NE	LC
PIERIDAE	*Dixeia*	*dixeyi*		NE	VU
PIERIDAE	*Dixeia*	*doxo*		NE	LC
PIERIDAE	*Dixeia*	*orbona*	1	NE	LC
PIERIDAE	*Dixeia*	*pigea*	1	NE	LC
PIERIDAE	*Eronia*	*cleodora*		NE	LC
PIERIDAE	*Eurema*	*brigitta*	1	NE	LC
PIERIDAE	*Eurema*	*desjardinsi*	1	NE	LC
PIERIDAE	*Eurema*	*floricola*	1	NE	LC
PIERIDAE	*Eurema*	*hapale*	1	NE	LC
PIERIDAE	*Eurema*	*hecabe*	1	NE	LC
PIERIDAE	*Eurema*	*regularis*	1	NE	LC
PIERIDAE	*Eurema*	*senegalensis*	1	NE	LC
PIERIDAE	*Leptosia*	*alcesta*		NE	LC
PIERIDAE	*Leptosia*	*hybrida*	1	NE	LC
PIERIDAE	*Leptosia*	*nupta*	1	NE	LC
PIERIDAE	*Leptosia*	*wigginsi*	1	NE	LC
PIERIDAE	*Mylothris*	*agathina*	1	NE	LC
PIERIDAE	*Mylothris*	*chloris*	1	NE	LC
PIERIDAE	*Mylothris*	*continua*	1	NE	LC
PIERIDAE	*Mylothris*	*hilara*	1	NE	LC
PIERIDAE	*Mylothris*	*kiwuensis*	1	NE	EN
PIERIDAE	*Mylothris*	*rubricosta*	1	NE	VU
PIERIDAE	*Mylothris*	*yulei*	1	NE	VU
PIERIDAE	*Nepheronia*	*buquetti*		NE	LC
PIERIDAE	*Nepheronia*	*pharis*		NE	LC
PIERIDAE	*Nepheronia*	*thalassina*		NE	LC
PIERIDAE	*Pseudopontia*	*mabira*		NE	VU

Mammals of Sango Bay-Minziro

Order	Family	Species	Sango-Bay	Semliki	Sio-Siteko	IUCN	Uganda Listing
Artiodactyla	Bovidae	White-bellied Duiker *Cephalophus leucogaster*		p		LC	NA
		Waterbuck *Kobus ellipsiprymnus*		p	p	LC	LC
		Uganda Kob *Kobus kob*		P		NE	LC
		Pygmy Antelope *Neotragus batesi*		p		LC	EN B2ab(iii)
		Bohor Reedbuck *Reduna redunca*	p	p	p	LC	EN C1
		Common Bush Duiker *Sylivicapra grimmia*	P	p	p	LC	LC
		Blue Duiker *Cephalophus monticola*	p	P		LC	LC
		Buffalo *Syncerus caffer*	p	p		LC	LC
		Bushbuck *Tragelaphus scriptus*	p	p	p	LC	LC
		Sitatunga *Tragelaphus spekei*		p	p	LC	VU B1b(i)c(i)
		Bongo *Tragelaphus eurycerus*		p		**NT**	**NA**
	Swidae	Red river Hog *Potamochoerus porcus*	p	p	p	LC	DD
		Giant Forest Hog *Hylochoerus meinertzhageni*		P		LC	EN B1ab(iii)
	Hipopotamidae	Hipopotamus *Hipopotamus amphibius*	p	p	p	VU	VU B2b(iii)c(iv)
	Tragulidae	Water Chevrotain *Hyemoschus aquaticus*		p		LC	DD
Pholidota	Manidae	Tree Pangolin *Manis tricupsis*	p	p		VU (A4d)	EN B2ab(iii,v)

Lagomorpha	Leporidae	Bunyoro Rabbit *Poelagus marjorita*		p		LC	VU B1ab(i,ii)
		Cape Hare *Lepus capensis*	p			LC	LC
		Savanna Hare *Lepus victoriae*	p			LC	LC
	Canidae	Side-striped Jackal *Canis adustus*		p	p	LC	LC
Carnivora	Felidae	Leopard *Panthera pardus*	p	p	p	NT	VU C1+2(i)
		Serval *Leptailurus serval*	p	p	p	LC	NT
	Herpestidae	*Marsh Mongoose Atilax paludinosus*	P	P	p	LC	LC
		Egyptian Mongoose *Herpestes ichneumon*	P	P	p	LC	LC
		Banded Mongoose *Mungos mungos*		p	P	LC	LC
		Slender Mongoose *Herpestes sanguineus*	p	p	p	LC	LC
		White-tailed Mongoose *Ichneumia albicauda*		p	p	LC	LC
	Mustelidae	African Spot-necked Otter *Hydrictis maculicollis*	p		p	NT	EN C1
		East African Stripped Weasel *Poecilogale albinuca*		p		LC	NA
	Viveridae	African Civet *Civettictis civetta*	p	p	p	LC	LC
		African Palm Civet *Nandinia binotata*		p		LC	NA
		Rusty nosed Genet *Geneta tigrina*	p			LC	LC
		Servaline Genet *geneta servalina*		p		LC	LC
		Small-spotted Genet *Geneta genetta*		p	p	LC	LC

	Hyenidae	Spotted Hyena *Crocuta crocuta*		p	p	LC	CR C1
Mega-Chiroptera	Macroglosinae	Nector bat *Megaloglossus woermanni*		p		LC	NA
	Pteropodidae	Little Epauletted Fruit bat *Epomophorus labiatus*	p	p	p	LC	LC
		Epomophorus minimus	p	p		LC	LC
		Hammerhead Fruit Bat Hypsignathus *monstrosus*	p	p		LC	LC
		Franquet's Fruit Bat *Epomops frangueti*	p	p		LC	LC
		Egyptian Fruit bat *Rousettus aegyptiacus*	p	p		LC	LC
		Bocage's Fruit bat *Rousettus angolensis*	p	p		LC	LC
		Common Dwarf Epauletted Fruit Bat *Micropteropus pusillus*	p	p		LC	LC
		Common Collared Fruit Bat *Myonycteris torquata*		p		LC	NA
	Embalonuridae	Tomb bat *Taphozous mauritianus*		p		LC	NA
Micro - Chiroptera	Hiposideridae	Aba Leaf-nosed Bat *Hipposideros abae*		p		LC	VU D2
		Cyclops Leaf-nosed Bat *Hipposideros cyclops*	p	p		LC	VU C1
		Sundevall's Leaf-nosed Bat *Hipposideros caffer*		p		LC	LC
		Noack's Leaf-nosed Bat *Hipposideros ruber*		p		LC	LC

	Rhinolophidae	East African Horseshoe Bat *Rhinolophus eloquens*	p			LC	LC
		Rueppell's Horseshoe Bat *Rhinolophus fumigatus*	p			LC	LC
		Savanna Woodland Horseshoe Bat *Rhinolophus simulator*	p			LC	LC
	Megadermatidae	Yellow winged bat *Lavia frons*	*p*	p		LC	LC
	Molosidae	Little Free-tailed bat *Chaerophon pumila*	*p*	p		LC	LC
		Angolan Free-tailed Bat *Mops condylurus*		p		LC	LC
		Trevor's Free-tailed Bat *Mops trevoli*		p		DD	EN B2b(iii) c(ii)
	Nycteridae	Bate's Slit-faced Bat *Nycteris arge*	*p*	p		LC	LC
		Hairy Slit-faced Bat *Nycteris hispida*	*p*	p		LC	LC
		Large-eared Slit faced Bat *Nycteris macrotis*	p			LC	LC
	Verspertilionidae	White-winged Serotine *Eptesicus tenuipinnis*	*p*	p		LC	LC
		Cape Serotine *Eptesicus capensis*		p		LC	LC
		Bibundi Butterfly Bat *Glauconycteris egeria*	*p*			LC	LC
		Variegated butterfly bat *Glauconycteris variegata*	*p*			LC	LC
		Banana Bat *Pipistrellus nanus*		p		LC	LC
		Rueppell's Bat *Pipistrellus rueppellii*	p	p		LC	LC

		Rufous Mouse-eared Bat *Myotis bocagei*	p			LC	LC
		Scoteocus albofuscus		p		LC	LC
		Forest Brown House Bat *Scotophilus nux*	p			LC	LC
		Scotophilus leucogaster		p		LC	LC
	Chrysocloridae	Stuhlmann's golden Mole *Chrysochloris stuhlmanni*		P		LC	NA
Insectivora	Soricidae	Long-tailed Musk Shrew *Crocidura dolichura*		p		LC	LC
		Tiny Musk Shrew *Crocidura fuscomurina*	*p*	p		LC	LC
		Peter's Musk Shrew *Crocidura gracilipes*	*p*	p		LC	NA
		Hildegarde's Musk Shrew *Crocidura hildegardeae*	p			LC	LC
		Jackson's Musk Shrew *Crocidura jacksoni*		p		LC	LC
		Musk Shrew *Crocidura ludia*		p		LC	LC
		Greater Grey-brown Musk Shrew *Crocidura luna*		P		LC	LC
		Dwarf Musk Shrew *Crocidura nanilla*		P		LC	LC
		Uganda Forest Musk Shrew *Crocidura selina*		P		LC	LC
		Musk Shrew *Crocidura denti*		P		LC	LC
		Uganda Musk Shrew *Crocidura tarella*		P		LC	LC
		Butiab Musk Shrew *Crocidura littolaris*	p			LC	LC
		Greater Grey-brown Musk Shrew *Croociduara luna*	p			LC	LC

		Dwarf Musk Shrew *Crocidura nanilla*	p	p		LC	LC
		Matschie's Musk Shrew *Crocidura nigrofusca*	p			LC	LC
		Northern Swamp Musk Shrew *Crocidura maurisca*	p			LC	VU D2
		Olivier's Musk Shrew *Crocidura olivieri*	p	p		LC	LC
		Small-footed Musk Shrew *Crocidura parvipes*	p			LC	LC
		Southern Woodland Musk shrew *Crocidura turba*	p	p		LC	LC
		Hero Shrew *Scutisorex somereni*		p		LC	NA
		Suncus infinitesimus	p	p		LC	NA
		Climbing Forest Shrew *Sylvisorex megalura*	p	p		LC	LC
		Least Long-tailed Forest Shrew *Sylvisorex granti*	p	p		LC	LC
		Pygmy Forest Shrew *Sylvisorex johnstoni*	p	p		LC	LC
Primates	Pongidae	Common Chimpanzee *Pan troglodytes*		p		EN	ENA4c
Primates	Cercopithecidae	Red-tailed Monkey *Cercopithecus ascanius*	p	p		LC	LC
		Vervet Monkey *Cercopithecus aethiops*	p	p	p	LC	LC
		Blue Monkey *Cercopithecus mitis*	p	p		LC	LC
		DeBrazza's Monkey *Cercopithecus neglectus*		p		LC	VU D2
		Uganda Mangabey Lophocebus ugandai	p	p		LC	VU A2c

		Olive Baboon *Papio anubis*	p	p	p	LC	LC
		Black and White Colobus *Colobus guereza*		p		LC	LC
		Angola Colobus *Colobus angolensis*	p			LC	VU D2
	Galagonidae	Spectacled Galago *Galago matschiei*		p		LC	DD
Proboscidea	Elephantidae	African Elephant *Loxodonta africana*	p	p		VU	CR A4a
Procavidae	Hyracoidea	Southern Tree Hyrax *Dendrohyrax arboreus*	p			LC	LC
Tubulidentata	Tubulidentidae	Aardvark *Orycteropus afer*	p	P		LC	LC
Rodentia	Anomaluridae	Lord Berdy's Flying Squirrel *Anomalurus beecrofti*		p		LC	LC
		African Dwarf Flying Squirrel *Idiurus zenkeri*		p		LC	LC
	Cricetidae	Savannah Pouched Rat *Cricetomys emini*	p	p		LC	LC
		Grey Climbing Mouse *Dendromus melanotis*	p	p		LC	LC
		Brant's Climbing Mouse *Dendromus mesorius*		p		LC	LC
		Chestnut Climbing Mouse *Dendromus mystacalis*	p			LC	LC
		Congo Forest Mouse *Deomys ferrugineus*	p	p		LC	LC
		Montane groove-toothed Rat *Otomys denti*		p		LC	LC
		Tropical Groove-toothed Rat *Otomys tropicalis*	p			LC	LC
	Hystricidae	Crested Porcupine *Hystrix cristata*	p		p	LC	LC

		Northern Bush Rat *Aethomys hindei*		P		LC	LC
		Kaiser's Bush rat *Aethomys kaiseri*	p			LC	LC
		Nile Grass Rat *Arvicanthis niloticus*	p	p		LC	LC
		White-bellied Unstriped Grass Mouse *Arvicanthis testicularis*		P		LC	LC
	Muridae	Peter's Striped Mouse *Hybomys univittatus*	p	p		LC	LC
		Common Brush-furred Rat *Lophuromys sikapusi*	p	p		LC	LC
		Eastern Brush-furred Rat *Lophuromys flavopunctatus*	p	p	p	LC	LC
		Velvet Rat *Colomys goslingi*		p		LC	NT
		Shaggy Swamp Rat *Dasymys incomtus*	p	p		LC	LC
		Common Thicket Rat *Grammomys dolichurus*	p	p		LC	LC
		Macmillan's Thicket Rat *Grammomys macmillani*	p			LC	DD
		Arboreal Thicket Rat *Grammomys rutilans*	p			LC	LC
		Stella Wood Mouse *Hylomyscus stella*	p	p		LC	LC
		Common Striped Grass Rat *Lemniscomys striatus*	p	p		LC	LC
		Peter's Stripped Mouse Hybomys univittatus	p	P		LC	LC

		Long footed Rat *Malacomys longipes*	p	p		LC	LC
		Northern Savanna Multimammate rat *Mastomys natalensis*	p	p		LC	LC
		Western Rift Pygmy Mouse *Mus bufo*		P		LC	LC
		Pygmy Mouse *Mus minutoides*	p	p		LC	LC
		Mus musculoides	p			LC	LC
		Grey-bellied Pygmy Mouse *Mus triton*	p			LC	LC
		Three-toed Grass Rat *Mylomys dybwskyii*	P				
		Rusty-nosed Rat *Oenomys hypoxanthus*	p	p		LC	LC
		Montane Groove-toothed Rat Otomys denti		p		LC	LC
		Tropical Groove-toothed Rat *Otomys tropicalis*	p			LC	LC
		Papyrus Rat *Pelomys hopkinsi*	p			DD	LC
		Jackson's Soft-furred Rat *Praomys jacksoni*	p	p		LC	LC
		Black Rat *Rattus rattus*	p			LC	LC
		Long-tailed Forest Rat *Stochomys longicaudatus*		p		LC	LC
	Myoxidae	African Common Dormouse *Graphiurus murinus*	p	p		LC	LC
	Rhizomyidae	Rueppell's Mole-ra *Tachyoryctes splendens*			p	LC	LC
	Scuiridae	Cuvier's Fire-footed Squirrel *Funisciurus pyrrhopus*	p	p		LC	LC

		Red-legged Sun Squirrel *Heliosciurus rufobrachium*		p		LC	LC
		Alexander's Bush Squirrel *Paraxerus alexandri*	p			LC	LC
		Boehm's Bush Squirrel *Paraxerus boehmi*	p			LC	LC
		Giant Forest Sguirrel *Protoxerus stangeri*	P			LC	LC
		Geoffrey's Ground Squirrel *Xerus erythropus*	p		p	LC	LC
	Thryonomidae	Lesser Cane Rat *Thryonomys gregorianus*	p	p	p	LC	LC
		Common Cane Rat *Thryonomys swinderianus*	p	p		LC	LC
	Gerbillidae	Savanna Woodland Gerbil *Tatera leucogaster*	P	P		LC	LC
		Northern Savanna Gerbil *Tatera valida*	p	P		LC	LC
	Myoxidae	African Common Dormouse *Graphiurus murinus*		p		LC	LC
		Grand Total	93	122	26		

Family	**Species**	**Sango Bay-Minziro**	**IUCN**	**Uganda listing**
Bovidae	Sitatunga *Tragelaphus spekei*	P	LC	VU B1b(i)c(i)
Swidae	Red river Hog Potamochoerus porcus	P	LC	DD
Hipopotamidae	Hipopotamus *Hipopotamus amphibius*	P	VU	VU B2b(iii)c(iv)
Manidae	Tree *Pangolin Manis tricupsis*	P	VU (A4d)	EN B2ab(iii,v)
Felidae	Leopard *Panthera pardus*	P	NT	VU C1+2(i)
	Cyclops Leaf-nosed Bat *Hipposideros cyclops*	P	LC	VU C1
Soridae	Northern Swamp Musk Shrew *Crocidura maurisca*	P	LC	VU D2
Cercophithecidae	Angola Colobus Colobus angolensis	P	LC	VU D2
Elephantidae	African Elephant *Loxodonta africana*	P	VU	CR A4a
Muridae	Macmillan's Thicket Rat Grammomys macmillani	P	LC	DD



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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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