Wetlands underpin the livelihoods of people and their integrity is fundamental to national development. The Uganda Wetlands Atlas, Volume II presents a comprehensive overview of the state and pressures on the wetlands in various parts of the country. Satellite and other visual presentations provide a compelling evidence of the changes taking place in the wetlands as a result of human activities. The Atlas identifies key hotspots where wetland degradation is proceeding at such a rapid pace that it now threatens to undermine the security and social fabric of communities.

The Atlas sets the context by providing an introductory overview of wetlands management in the country, as well as the institutional, policy and legal framework. The visual analysis is then clustered in seven different wetland systems and basins. The seven wetland systems are; Lake Victoria Basin, Lake Kyoga Basin, Lake Albert Basin, Lake Edward Basin, Albert Nile Basin, Achwa, and Victoria Nile. The Atlas also proposes a series of options to remedy the current degradation and ensure a sustainable use of the country's wetlands. It is envisaged that this publication will serve as an important reference tool for policy and decision makers, civil society, educators, students, and the general public.

UGANDA Wetlands Atlas Volume Two

UGANDA

WETLANDS ATLAS

Volume Two

UGANDA
WETLANDS ATLAS
Volume Two

UNITED NATIONS

ISBN: 978-9970-881-23-9

This is a Government of Uganda Publication.

For bibliographic and reference purposes this publication should be referred to as:
“MWE (2016). Uganda Wetlands Atlas – Volume Two“
Ministry of Water and Environment
P.O. Box 20026, Kampala UGANDA.

Printed by Progress Press Ltd, Malta

This report was prepared using funds provided by the Government of Uganda with technical and financial support from the United Nations Development Programme (UNDP). Technical support and additional funds were provided by United Nations Environment Programme (UNEP).

DISCLAIMER

The views expressed in this publication are not necessarily those of the agencies cooperating in this project. The designations employed and the presentations do not imply the expression of any opinion whatsoever on the part of the Ministry of Water and Environment or cooperating agencies concerning the legal status of any country, territory, city, or area of its authorities, or the delineation of its frontiers or boundaries. Mention of a commercial company or product in this report does not imply endorsement by the MWE. The use of information from this publication concerning proprietary products for publicity or advertising is not permitted. Trademark names and symbols are used in an editorial fashion with no intention of infringement on trademark or copyright laws. We regret any errors or omissions that may have been unwittingly made.

TABLE OF CONTENTS

Acknowledgements

Editorial and Production Team

Technical Coordination and Support

Government of Uganda

Paul Mafabi

Gerald Musoke Sawula

Collins Oloya

Daniel Babikwa

Arnold Waiswa Ayazika

Mike Nsereko

Joseph Ongol

UNEP

Frank Turyatunga

Charles Sebukeera

Liana Archaia-Atanasova

Stephen Ndeti

Eugene Ochieng Apindi

Anne Nyoro

USGS

James Rowland

EPI

Ashbindu Singh

Stinger Ghaffarian Technologies (SGT, Inc.)

Kimberly Giese

Bruce Pengra

Strategic Advisory Team

Government of Uganda

Ephraim Kamuntu, Minister of Water and Environment

Flavia Munaaba, Minister of State for Environment

David O. O. Obong, Permanent Secretary, Ministry of Water and Environment

Tom O. Okurut, Executive Director, National Environment Management Authority

UNEP

Juliette Biao Koudenoukpo

Munyaradzi Chenje

Mounkaila Goumandakoye

Desta Mebratu

Tessa Goverse

UNDP - Uganda

Ahunna Eziakonwa Onochie, UN Resident Coordinator

Almaz Gebru, UNDP Country Director

Onesmus Muhwezi

Daniel Omodo McMondo

Authors

Elizabeth Kironde Gowa

Charles Sebukeera

John Kitaka

George Lubega Matovu

Elizabeth Mutayanjulwa

Festus Bagoora (RIP)

Francis Ogwal

Editors

Elizabeth Kironde Gowa – Principal Editor

Charles Sebukeera – Editor

Jane Barr - Editor

Frank Turyatunga – Technical Editor

Design and layout

Elizabeth Mutayanjulwa

Kimberly Giese

GIS and Satellite Imagery

John Kitaka

Eugene Ochieng Apindi

George Lubega Matovu

Contributors

The Government of Uganda and UNEP wish to thank the following contributors:

Anita Ainomugisha, National Environment Management Authority

Christine Akello, National Environment Management Authority

Eva Wamala Mutongole, National Environment Management Authority

Festus Bagoora (RIP), National Environment Management Authority

Isaac Ntujju, National Environment Management Authority

Julius Muyizzi, National Environment Management Authority

Kato Phillip, National Environment Management Authority

Margaret Aanyu, National Environment Management Authority

Maurice Edema, National Environment Management Authority

Paul Kyazze, National Environment Management Authority

Persis Basemera, National Environment Management Authority

Richard Bidong, National Environment Management Authority

Tonny Kiwanuka, National Environment Management Authority

George Wamunga, Wetlands Management Department

Joseph Kyambadde, Wetlands Management Department

Nuubu Takuwa, Wetlands Management Department

Regina Namakula, Wetlands Management Department

Sarah Tumuhairwe, Wetlands Management Department

Simon Etimu, Ministry of Water and Environment

Vincent Barugahare, Wetlands Management Department

Deo Kabalu, Regional Wetlands Coordinator, Eastern Region

Nikolas Magara, Regional Wetland Coordinator, Western Region

Sylvano Afai, Regional Wetland Coordinator, Northern Region

Anne Nakimbugwe (RIP), Mukono District Local Government

Charles Kiyaya, Adjumani District Local Government

Clemencia Birungi, Buhweju District Local Government

Emmanuel Okalanga, Kumi District Local Government

Esau Mpoza, Wakiso District Local Government

Francisco Kisembo – Gulu District Local Government

Herbert Kamuhanda, Ntoroko District Local Government

Jamil Kiyingi, Rakai District Local Government

Joackin Andiandu, Arua District Local Government

Judith Muja, Kisoro District Local Government

Margaret Nakayima, Kayunga District Local Government

Richard Vvube, Kalungu District Local Government

Ronald Lotet, Mubende District Local Government

Samuel Bakaki, Kamuli District Local Government

Stella Nalumansi, Wakiso District Local Government

Teopista Gateese, Luweero District Local Government

Timothy Muhaire, Kabarole District Local Government

Vincent Kataate, Bushenyi District Local Government

Alfred Ahimbisibwe, Kabale Municipal Council

George Masengere, Mukono Municipal Council

Ronald Kyamanywa, Hoima Municipal Council

Josephine Asasira, Kampala Capital City Authority

Najib B. Lukooya, Kampala Capital Authority

Alfonse Opio – Gulu University

Bob Natifu, Ministry of Water and Environment

Charles Kyegonza, Uganda Bureau of Standards

E.W. Ogalo, Ministry of Lands, Housing and Urban Development

Faith Nyamwenge, Ministry of Justice and Constitutional Affairs

Gwendolyn Kyoburungi, Ministry of Water and Environment

Kassim Semanda, Ministry of Trade, Industry and Cooperatives

Leone Candia, Uganda Wildlife Authority

Taire Idwege, Uganda Police Force

Preface

Uganda is gifted by nature with a wide variety of natural resources which are the primary drivers of its economic development and transformation. They underpin the livelihoods of our people and their integrity is fundamental to national security and the fabric of society in the country. Wetlands are among the most important natural resources in Uganda. They protect our water resources and sustain agricultural productivity. During the dry seasons, they are the only places where the local communities are able to access pasture for their animals and their fringes support the production of short term crops like vegetables and potatoes for household consumption. They support artisanal fisheries and provide important breeding grounds for large scale fisheries. They also regulate flooding and remove pollutants from storm runoffs before the water enters our lakes, and play a critical role in ensuring the continuous re-charge of our ground water sources. Wetlands are therefore both the lungs and kidneys of our environment and their health is therefore crucial to our very existence. The Sustainable Development Goals, Uganda Vision 2040 and the National Development Plan will not be fully achieved without according these important ecosystems the protection they deserve.

The Government of Uganda is therefore very concerned about the rapid degradation and loss of the wetlands particularly in the areas around urban centers and in the rural areas of Busoga, Tororo, Kigezi, Bukedi and some areas of Ankole. The resulting impact of this degradation has been detrimental and even catastrophic in many areas of the country. Many areas of Eastern Uganda now experience frequent flash floods which have become more severe and destructive because there are no wetlands to hold back the massive overland flow characteristic of many rainfall events. This has led to loss of property, destruction of infrastructure and damage to crops. This has also directly undermined our long term strategy of wealth creation as such frequent destruction introduce major destabilizing factor to sustained economic growth.

In light of this, Government has embarked on a long term strategy to recover, restore and protect wetlands for the good of the whole country and beyond. I therefore urge all Ugandans to embrace this effort and appreciate the value of wetlands for the present and future generations. Part of Government's efforts to raise awareness on the value of wetlands is to provide access to reliable and up to date information on what is happening in our wetlands ecosystems and its implications to the economic development of the country.

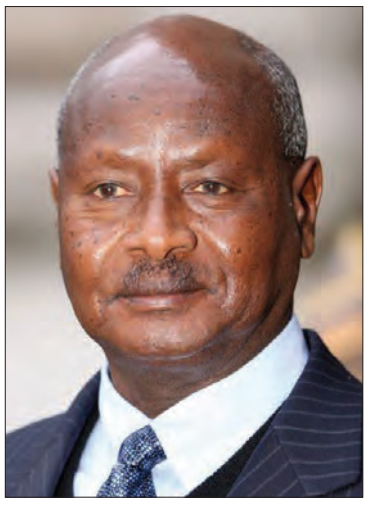
Government is therefore very pleased to release the second volume of the Uganda Wetlands Atlas which provides policy and decision-makers, implementers, and the general public with invaluable visual information about the state of our wetland resources in the country using a combination of satellite images, maps, graphics, ground photographs, and evidence based story lines supported by scientific analysis to provide a clear account of what and where in the country this strategic resource is facing challenges that need to be urgently addressed.

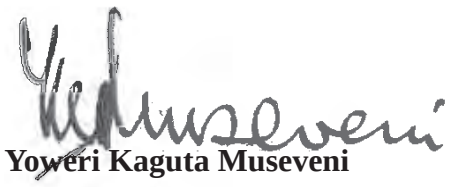
The Government is grateful to the United Nations Development Programme and the United Nations Environment Programme for the support provided in preparing this Atlas. I am also pleased to acknowledge the pledge made by the United Nations system to go even further and support the restoration of all critical wetlands in the country. I would like to pledge my full support for this initiative.

I thank all the national and international experts, national institutions and development partners whose contribution has made it possible to produce this very important publication. It is my sincere hope that the Atlas will inspire every Ugandan into action to conserve our wetlands.

I wish you an enjoyable reading.

FOR GOD AND MY COUNTRY





Yoweri Kaguta Museveni

PRESIDENT OF THE REPUBLIC OF UGANDA

Foreword

Wetlands occupy approximately 8 per cent of Uganda's land area and provide critical ecosystem services to a large number of communities, particularly in the rural areas. They are therefore pivotal to the attainment of the Sustainable Development Goals (SDGs), Africa's Agenda 2063 and the Uganda Vision 2040. Despite the critical functions wetlands provide, they are constantly under threat and many continue to be degraded and even lost. Population pressure, and in some cases greed and lack of respect for national laws, are driving this rapid change. Research now shows that the country is losing almost 500 square kilometers or 5 percent of its wetlands every year to reclamation or degradation with dire consequences to agricultural productivity and livelihoods.

Changes in climate, such as increased temperature and irregular rainfall patterns, are compounding factors that are leading to further water stress, shortage of pasture resulting in the movement of livestock. While the challenges facing wetlands management in the country are significant, there are also clear opportunities for Uganda to improve human and environmental conditions through wise use of these resources. Wetlands provide food and other agricultural products such as fuel and fiber directly through agricultural production activities, thereby presenting a unique opportunity for development and poverty eradication. The host of ecosystem services they provide can also deliver additional benefits for improved human well-being. Better farming practices within wetlands will enhance wise use and sustainability of these important ecosystems. It is therefore imperative that the functions and economic values of wetlands are considered in national planning to ensure that they are accorded commensurate protection as their integrity has a most direct impact on water quality and quantity, as well as on agricultural productivity. More than ever before, strategic planning underpinned by timely and evidence based scientific information is now very crucial for Uganda's wetlands, especially in light of the challenges paused by increasing demand for land and the impact of climate change.

The Uganda Wetlands Atlas, Volume II provides visual evidence of the extent and severity of the changes taking place in the country's wetlands spanning a period of some thirty years. The Atlas is among the recent major publications depicting the dynamics in Uganda's wetlands using satellite imagery. The site-specific, side-by-side display of "before and after" satellite images show different kinds of changes in wetlands ecosystems all over the country such as: agricultural encroachment; urban growth into wetland areas; altered hydrology (river diversions, and drained wetlands); and the impacts of climate change. The satellite images and the story lines are supported by graphs, maps, and photographs to provide complete and compelling scientific evidence. It is important to note that different sites highlighted by the change pairs in the Atlas are only selected samples to help in providing a better understanding that changes in Uganda's wetland ecosystems constitute a widespread problem being driven by different factors.

The visual story told by these images should be an encouragement to the general public to support Government efforts in remedial actions to redeem the wetlands. It, among others seeks to;

- provide scientific evidence of environmental change in Uganda's wetlands and raise public awareness about its causes and effects;
- depict the links between the wetlands ecosystems and people by showing where and how human populations have interacted with the wetlands and how they may be affected by the changes that have occurred;
- provide resource materials for awareness and educational purposes.

Through the Atlas, my Ministry is providing support and guidance for the development of a national wetlands restoration programme, supported by H.E Yoweri Kaguta Museveni, the President of the Republic of Uganda, to fast track the process of securing critical wetlands in the country, whose integrity has a bearing on national development.

I would like to express the gratitude of the Government of Uganda to our partners in the preparation of this Atlas, especially the United Nations System in Uganda, including the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP); and the United States Government through its technical agencies, particularly USGS/EROS, whose support made the availability and analysis of satellite data possible. I am confident that this Atlas will provide a solid foundation for improved wetlands management for the present and future generations.

Prof. Ephraim Kamuntu

MINISTER OF WATER AND ENVIRONMENT

Kalagala Falls, a tourist attraction on the Victoria Nile

Photo credit: George Lubega

Chapter 1

BACKGROUND

INTRODUCTION

Uganda is well endowed with abundant natural resources which if well managed have the capacity to sustain the physical environment and support socio-economic development while self-replenishing. The entire country presents considerable physiographic features that are of interest to nature lovers from mountains, highlands, plateaus, hills, plains, rivers, lakes and wetlands.

Hydrological ecosystems such as riverbanks, lakeshores and wetlands together with mountainous and hilly areas have been recognised as fragile ecosystems. This is because they embody the water catchments and water bodies, which are a key life support system and resource base for development. Wetlands are under serious pressure from the increasing population and associated livelihood activities. Once degraded, they are almost impossible to restore. Hence, the Government has accorded high priority to their protection.

Key messages

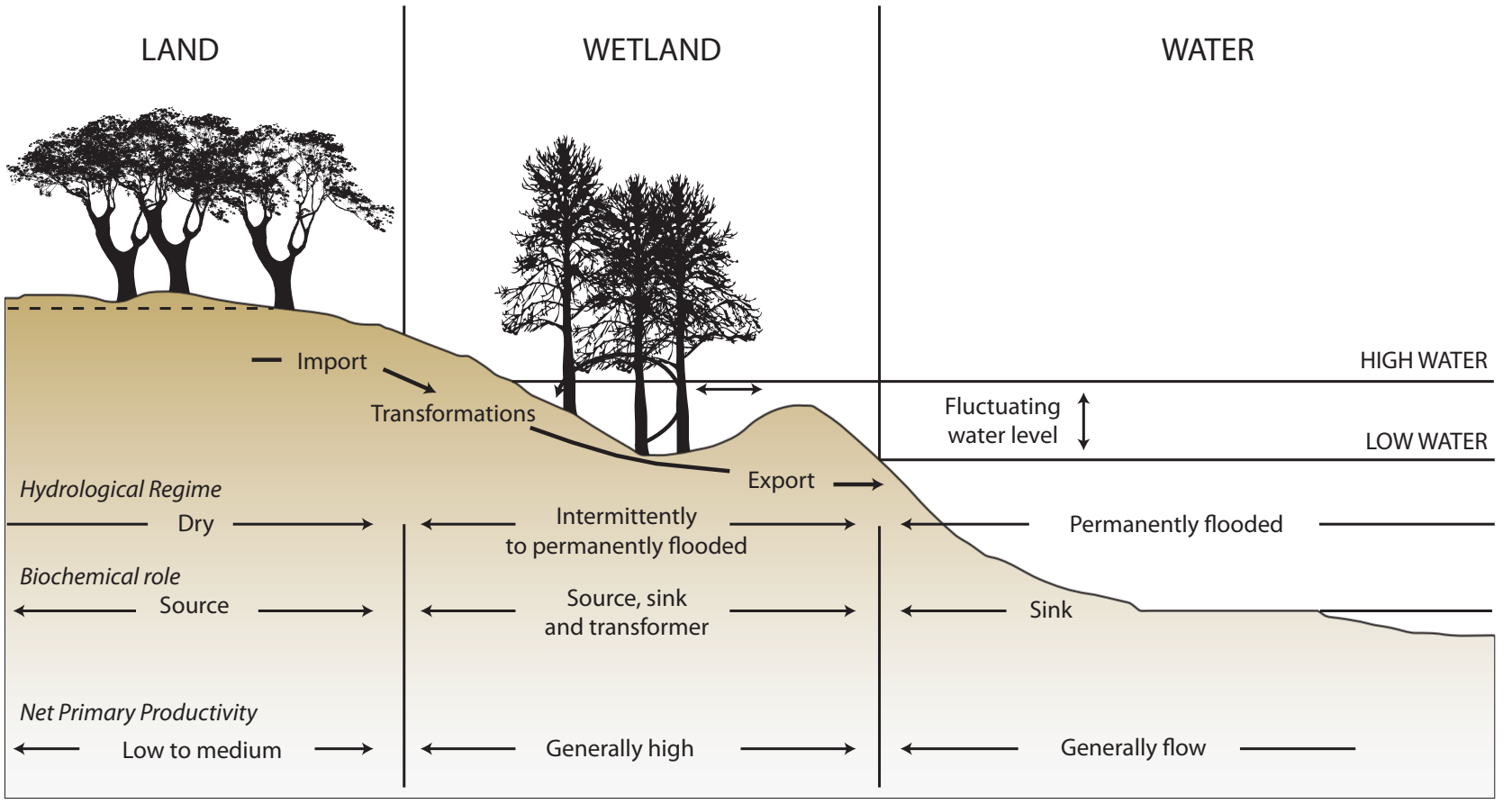
The integrity of Uganda's water resources, agricultural productivity and the welfare of its people are sustained by wetlands.

Wetlands can only fulfill their ecological, social and economic functions if they are healthy.

Uganda is a signatory to many international and regional laws on wetlands.

The legal framework for the management of wetlands is provided for under the National Environment Act Cap 153, which is amenable to domesticating all regional and international laws.

Figure 1.1: Transect of a wetland



(Mitsch & Gosselink, 1993)

Wetlands have critical ecosystem functions: they act as a buffer, protecting against the impacts of the strong seasonal variations in rainfall patterns, store floodwaters and help to maintain river flows even during dry spells. They also trap sediments and purify agricultural, industrial and urban wastewater. When very large such as in the case of the Sango Bay wetlands, they can influence local microclimates.

This atlas is designed to document the knowledge base of wetlands and in so doing provide information for decision and policy making.

DEFINITION OF WETLANDS

Wetlands can be defined as land where saturation with water is the dominant factor determining the nature of soil development and the various organisms living in the soil and on its surface. Wetlands are thus the transitional ecosystems situated between terrestrial and aquatic systems as shown in Figure 1.1. They form the changeover between land and water and despite the vast differences between these ecosystems, there is also a high level of mutual interdependence between the two (Mitsch & Gosselink, 1993).

The definition of wetlands found in the Ramsar Convention underpins most descriptions of wetlands. The Convention defines wetlands as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres" (Ramsar 1971).

The Uganda National Environment Act Cap 153 categorises a wetland as an 'area that is either permanently or seasonally flooded by water and where plants and animals have become adapted' (GOU, 1995). The Regulations on Wetlands, Riverbanks and Lakeshores further defines a wetland as 'an area that is permanently or seasonally flooded by water where plants and animals have become adapted; and include swamps, dambos, areas of march, peat land, mountain bogs, banks of rivers, vegetation, areas of impeded drainage, or blackish salt' (GOU, 2000).

DEFINING CHARACTERISTICS

Soils

Wetland soils or hydric soils are formed under water logged conditions and are able to support the growth and regeneration of hydrophytic vegetation. During the vegetative season, the soil must remain waterlogged long enough to allow for anaerobic conditions to develop in the upper part of the soil (NRCS, undated). These soils have unique biological, chemical and physical properties.

Uganda's wetland have varying soils with changing vegetation types as the soils become drier (see figure 1.2). For example most of the soils in the River Rwizi catchment in the Lake Victoria basin belong to the oldest soil type that dominates in Uganda known as ferrasols. Soil types include sandy loams, sands and sandy clays and clays. In the Lake Kyoga Basin around Awoja wetland the soils are alluvial clays known as vertisols or black cotton sandy clays and clays. They shrink and develop extensive cracks when dry. During the rains, they absorb a lot of water and expand closing the cracks.

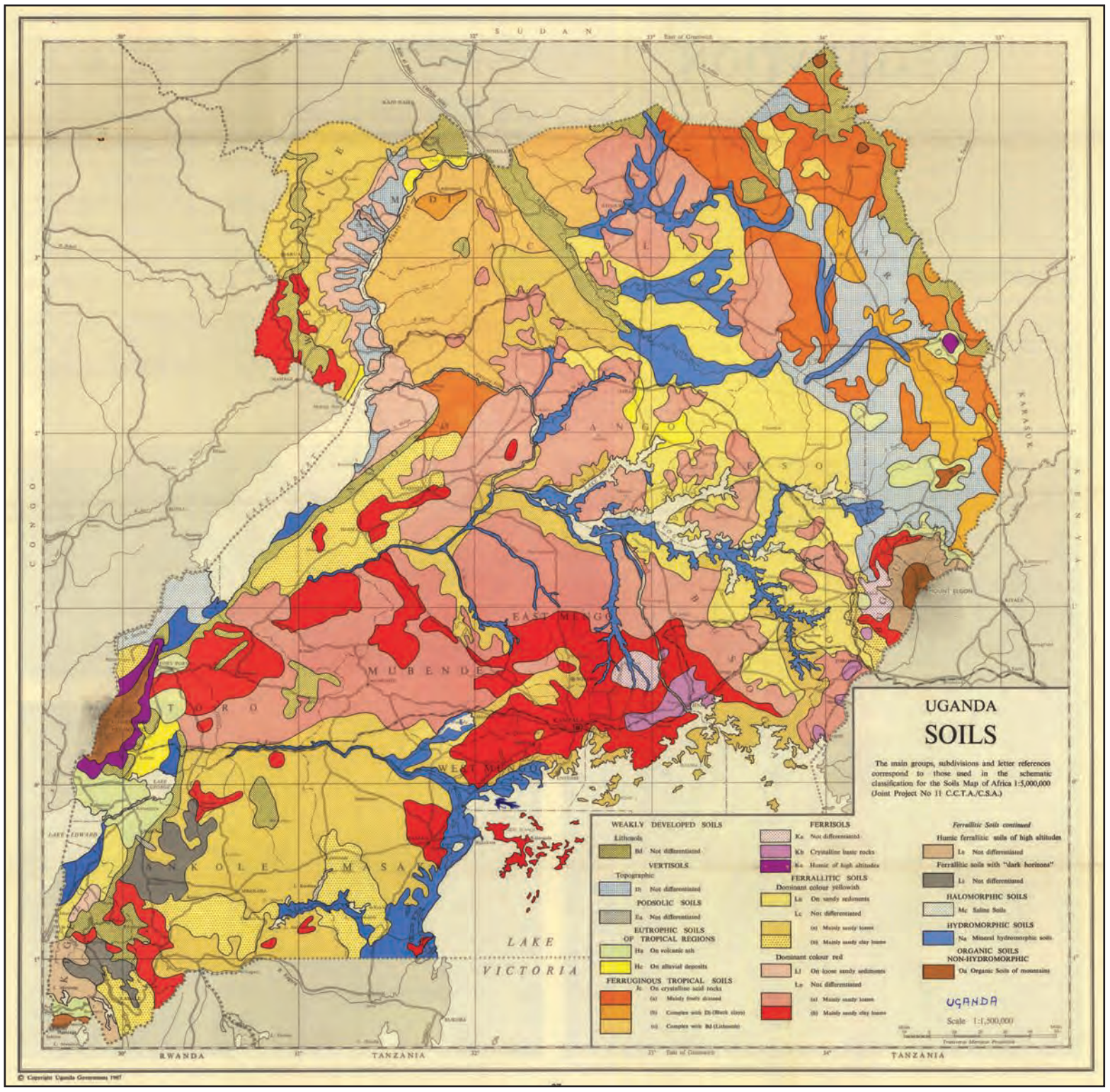
The soils covering Semliki flats are dominantly deep and poorly drained clays, classified as Semliki Series with some variations caused by small sand leeves along the meanders of the old Semliki River. These soils tend to be saline (pH 8.0-10.0) and the sodium contained may make plant growth difficult (Harrop, 1960). According to the FAO classification system (FAO, 1993), such soils are classified as Solonetz, and are not good for agriculture without undertaking expensive soil desalinization as a necessary amendment procedure.

Red sandy-clay soils of the Kiamara Series are found along River Mpanga in the Lake Edward basin in Mwenge, Kibaale, Burahya and Bunyangabo Counties. There are also peaty clays which are the most productive soils in the region.

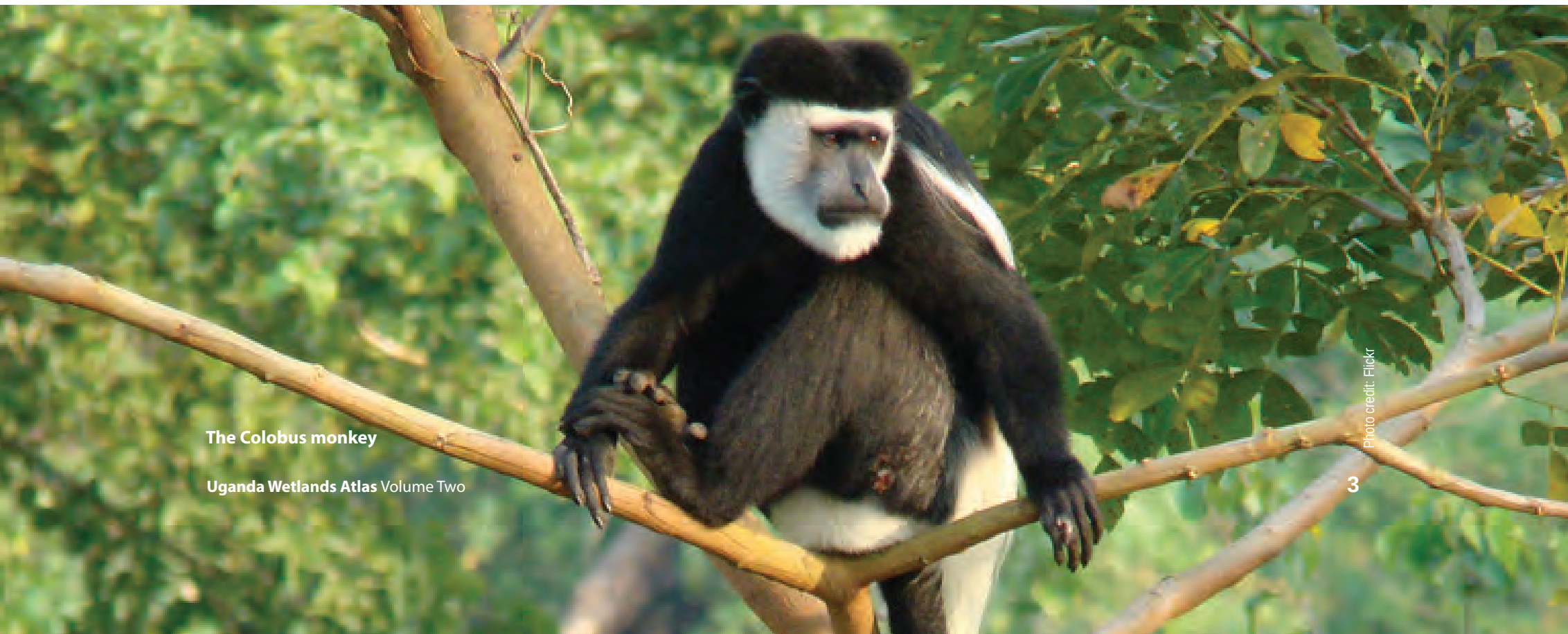
A typical permanent wetland in Ugandan dominated by *Cyperus papyrus*

Photo credit: George Lubega

Figure 1.2: Wetland Soils in Uganda



(Uganda Atlas, 1967)



The Colobus monkey

Photo credit: Flickr

Table 1.1: Wetlands coverage by water regime

Water regime	Area (km²)		% of Surface area		Loss	
	1994	2008	1994	2008	km²	% loss
Permanent	10390.9	5867.1	4.3	2.4	4523.8	43.5
Seasonal	27184.5	20440.7	11.3	8.5	6743.9	24.8
Total	**37575.4**	**26307.7**	**15.6**	**10.9**	**11267.7**	**30.0**

(WMD, 2008)

Hydrology

The main hydrological feature of wetlands is the presence of flooding; and in Uganda this is driven mainly by precipitation. The wetlands in Uganda are defined by two hydro-periods or water regimes. In permanent wetlands water remains above the land surface throughout the year; whereas in seasonal wetlands water covers the soil surface for only parts of the year and usually in the wet season. During the dry season, the water remains below the surface creating waterlogged conditions beneath the soil surface (NWP 2001). Table 1.1 shows the extent of wetlands as defined by their water regime. In 2008 permanent wetlands covered an area of 5,867 km^2 while seasonal wetlands covered 20,440 km^2. Figure 1.4 shows the wetlands of Uganda.

Wetlands flora and fauna

Wetland vegetation or hydrophytes have special features allowing them to live in the waterlogged type of environment. These features include morphological adaptations (for example the presence of aerial root tips), physiological adaptations (such as anaerobic respiration to enable the plants withstand the absence of atmospheric oxygen) and reproductive adaptations (for instance viviparous seeds which germinate within the fruit) to specifically tolerate partial or complete inundations for short or prolonged periods of time (Tiner, 2012). The vegetation found in wetlands will vary depending on how waterlogged the ground is as shown in figure 1.3.

Wetlands fauna range from protozoa, invertebrates to small and large vertebrates. Together with the plants they combine to form an elaborate food web which ensures a thriving interdependent habitat. There is a high level of endemism in wetlands because the aquatic factor acts as a physical impediment to some species.

Figure 1.3: Diagrammatic representation of the various wetland vegetation types as one moves towards the dryland

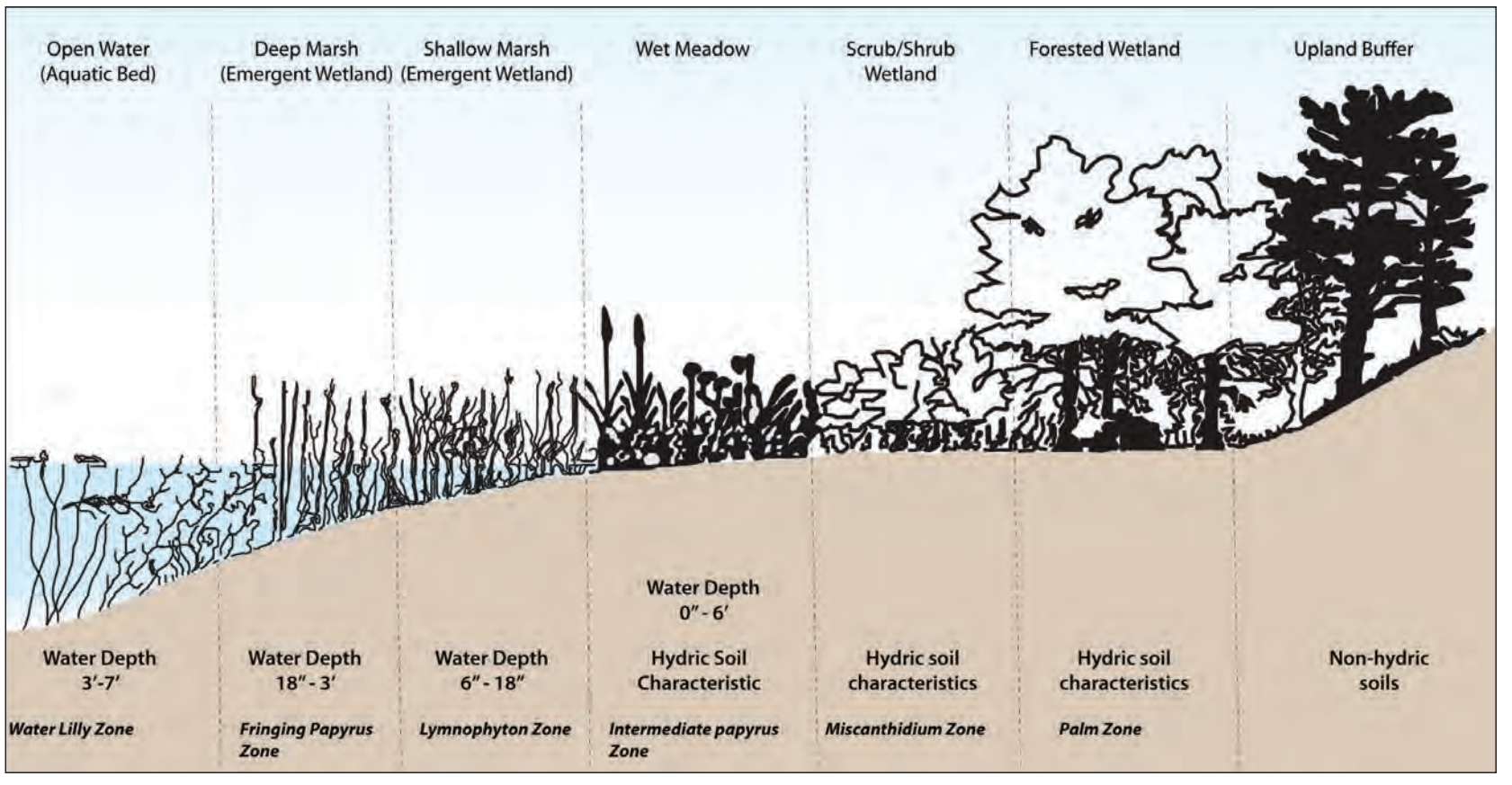


Figure 1.4: Wetland distribution in Uganda

(WMD, 2008)

WETLANDS IN UGANDA

Overview

Uganda's wetlands are fed and maintained by a climate of high rainfall and the general topography of the country. They occur at a range of altitudes from those bordering the Equatorial lakes at around 1,130 masl to those higher up at 4,000 masl, for instance on the mountains of Elgon and the Rwenzori's.

Wetlands have been defined as one of Uganda's main land cover classes. They include swamps, marshes, seasonally inundated grasslands, swamp forests, floodplains and riparian wetlands or those that occur at the edges of lakes and rivers. The coverage of each of these elements of the wetlands land classification is shown in Table 1.2 and it is clear from this data that the area under wetlands classes are changing. In 1994 wetlands were estimated to cover an area of 37,575 km² declining to 26,308 km² in 2008 and increasing slightly to 26,315.1 km² in 2014 (MWE, 2014). Much of this decline has been due to human activity and the consequent encroachment and degradation that this entails. Human activities contributing to this decline include over-extraction of water for domestic and commercial use especially in the central region; over-harvesting of materials for construction and handicrafts, over-fishing; and reclamation for agriculture. For instance wetlands are extensively used to support rice fields in eastern Uganda and vegetable growing in the southwest. These uses lead to environmental complications such as siltation of wetlands and associated water bodies in turn forcing people ever deeper into the wetlands.

Table 1.2: Wetlands coverage by land cover class

Class	Area 1994 (km²)	Area 2008 (km²)	Loss (km²)	% loss
Woodland	5932.3	4598.1	1334.2	22.5
Palms and thickets	1149.1	609.6	539.5	47.0
Grassland	20793.3	15745.3	5048.0	24.3
Sedges	232.8	7.7	225.1	96.7
Papyrus	6403.8	3607.7	2796.1	43.7
Floating vegetation	309.6	1.2	308.4	99.6
Farmland (converted)	2754.4	1738.2	1016.2	36.9
Totals	**37575.4**	**26307.7**	**11267.7**	**30.0**

(NFA, 2008)

Limoto Wetland in Pallisa District. It is permanently flooded due to large volumes of water from the catchment. The wetland is recovering after eviction of the encroachers.

Photo credit: George Lubega

Categories of wetlands

There is a wide range of differing categorization systems for wetlands worldwide. Generally, a categorization system helps provide a structure for the purpose of inventories, wetlands assessments and to guide other management purposes. Developing an appropriate categorization system is an arduous task and Uganda has been unable to do so to date. The wide regional and local differences in the soils, topography, climate, hydrology, water chemistry and vegetation have previously resulted in numerous systems with a myriad of categories. Other reasons include the limited number of experts to carry out categorization, insufficient tools and laboratories to ascertain productivity and ensure sustainability and the diversity of wetland types in the country (BakamaNume, 2010) (FAO, 1998). Some of these classification systems are described in the paragraphs that follow. However there is need to consolidate the different classification systems in use in the country.

In 1991, the Wetlands Management Department adopted two major categories: lacustrine and riverine wetlands (BakamaNume, 2010). Lacustrine wetlands are those associated with lakes such as Lakes Albert, George, Edward and the Kyoga/Kwania complex; while riverine wetlands are those connected with rivers such as Rivers Kafu or Okole (BakamaNume, 2010). Another categorization based on altitude defines mountainous bogs above 3,000m such as those on Mounts Rwenzori and Elgon; Permanent swamps in the low altitude and permanently flooded areas such as in central Uganda; and seasonal swamps found in the drier areas in the north and east of the country (BakamaNume, 2010).

The Mbeiza and Mutekanga categorization system identifies 12 classes primarily based on the dominant vegetation (BakamaNume, 2010). These include:

1. Freshwater emergent reed swamps
2. Freshwater floating leaved by rooted vegetation
3. Freshwater submerged and rooted macrophytes
4. Freshwater submerged but not rooted vegetation
5. Freshwater floating communities
6. Seasonally flooded herbaceous wetlands
7. Seasonally flooded woodland grasslands
8. Freshwater palustrine forests
9. Freshwater riverine forests
10. Freshwater montane wetlands
11. Permanent saline wetlands
12. Seasonally flooded saline herbaceous wetlands

Other categorization systems that have been developed include the regional categories for East African wetlands developed by the Regional Wetland Biodiversity Group, in May 1996 (Table 1.3).

Table 1.3:Wetland classification system for East Africa (Agreed by Regional Wetland Biodiversity Group at Mbale, Uganda, in May 1996)

1.	**SODIC AND/OR SALINE WATER**		
1.1	Lacustrine	Permanent	Sodic lakes, salt lakes
		Seasonal	Seasonally/occasionally inundated depressions, salt pans
1.2	Palustrine	Permanent	Sodic and salt marshes and swamps
			Springs, soaks and resultant pools
2.	**FRESHWATER**		
2.1	Riverine	Permanent	Edges of perennial rivers, streams and waterfalls
			Inland deltas (including deltas in lakes)
		Seasonal	Seasonal/occasional rivers, streams and waterfalls
			Riverine floodplains, river flats, deltaic plains, riverine grass lands, mbugas
2.2	Lacustrine	Permanent	Freshwater lakes (> 10 ha) including shores subject to seasonal or irregular inundation (drawdown floodplains)
			Freshwater ponds, pools (< 10 ha)
		Seasonal	Seasonal lakes (> 10 ha)
			Seasonal ponds, pools (< 10 ha)
2.3	Palustrine	Herbaceous	Permanent swamps, marshes, dambos
			Seasonal/occasional swamps, marshes, dambos
			Peatlands, fens
			Montane wetlands (including bogs)
			Springs, soaks
		Woody	Shrub swamps, thicket wetlands
			Swamp forests
3.	**MAN-MADE WETLANDS**		
3.1	Aquaculture/mariculture		Fish ponds, prawn farms
3.2	Agriculture		Farm ponds and dams
			Irrigated lands, rice paddy, channels, canals, ditches
			Seasonally flooded arable land
3.3	Salt production		Salt evaporation pans
3.4	Urban/industrial		Borrow pits, brick pits, mining pools, road impoundments, quarries
			Wastewater treatment facilities
3.5	Water storage		Ponds, dams, reservoirs

Wetland drainage basins in Uganda

Wetlands in Uganda have been grouped into eight catchment systems or drainage basins (Figure 1.5). These are Albert Nile, Achwa, Kidepo, Lake Albert, Lake Edward, Lake Kyoga, Lake Victoria and the Victoria Nile. These, apart from Kidepo will be discussed in the chapters that follow. The wetlands in each of the catchments have undergone a lot of changes primarily due to pressures from the growing population. Changes in the coverage of wetlands by drainage basin is shown in Table 1.4. For instance the wetland catchment area around Lake Victoria alone has shrunk by more than 50% in 14 years - from 7,167.6 km² in 1994 to 3,310 km² in 2008. The wetland catchment of Lake Kyoga has also reduced in size from 15,008.3 to 11,028.5 km² between 1994 and in 2008 respectively (NFA, 2008).

Table 1.4: Changes to wetlands coverage by drainage basin between 1994 and 2008

Drainage basin	1994 (Area km²)	%	2008 (Area km²)	%
Albert Nile	1,736.3	6.21	1,255.2	4.71
Achwa	3,028.0	10.83	2,168.9	8.24
Kidepo	168.1	0.60	197.2	0.74
Lake Albert	2,838.6	10.15	2,421.7	9.20
Lake Edward	1,671.1	5.97	1,096.3	4.16
Lake Kyoga	15,008.3	53.67	11,028.5	41.92
Lake Victoria	7,167.6	25.63	3,310.2	12.58
Victoria Nile	5,786.3	20.69	4,829.4	18.35

(MWE, 2011)

Figure 1.5: Wetland drainage basins in Uganda

(Uganda Atlas, 1967)

IMPORTANCE OF WETLANDS IN UGANDA

Wetlands provide an abundance of benefits to people in both urban and rural settings. As such, their destruction affects livelihoods of people as well as the national economy. It is estimated that about 15% of GDP is lost through the destruction of natural resource including wetlands. The loss of wetlands alone costs the country nearly Ug.Shs 2 billion annually and contamination of water resources which is partly caused by reduced buffering capacity of open water bodies costs the country not less than Ug.Shs 38 billion shillings annually (Emerton & Muramira, 1999).

The benefits provided by wetlands can be put into four groups: provisioning, regulating, cultural and supporting functions as highlighted in Table 1.5 (MEA, 2005). Figure 1.6 highlights economic values also provided by wetlands.

Table 1.5: Ecosystems services provided by or derived from wetlands

PROVISIONING	
Food	production of fish, wild game, fruits, and grains
Fresh water	storage and retention of water for domestic, industrial, and agricultural use
Fiber and fuel	production of logs, fuel wood, peat, fodder
Biochemical	extraction of medicines and other materials from biota
Genetic materials	genes for resistance to plant pathogens, ornamental species, and so on
REGULATING	
Climate regulation	source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes
Water regulation (hydrological flows)	groundwater recharge/discharge
Water purification and waste treatment Erosion regulation	retention, recovery, and removal of excess nutrients and other pollutants retention of soils and sediments
Natural hazard regulation	flood control, storm protection
Pollination	habitat for pollinators
CULTURAL	
Spiritual and inspirational	source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems
Recreational	opportunities for recreational activities
Aesthetic	many people find beauty or aesthetic value in aspects of wetland ecosystems
Educational	opportunities for formal and informal education and training
SUPPORTING	
Soil formation	sediment retention and accumulation of organic matter
Nutrient cycling	Storage, recycling, processing, and acquisition of nutrients

(MEA, 2005)

The *Sitatunga* (Marshbuck) is one of the rare animals found in wetlands

Provisioning functions

This the most important function of wetlands as they are crucial for livelihood and the development of the economy. They supply families with basic needs such as water, construction material, and fuel. Over 80% of the population is thought to depend on wetlands for domestic water valued at US$34 million per annum (Kakuru, Turyahabwe, & Mugisha, 2013). Bee keeping occurs in about 11% of all wetlands and is concentrated in Nakaseke, Luwero and in parts of Apac and Lira Districts. Fishing and cultivation occurs in about 35 and 37% of all wetlands respectively and are both clustered around Jinja, Kayunga and Kamuli (World Resources Institute, 2009). Both uses are extensively practiced in wetlands in Bushenyi and Ntungamo Districts in southwestern Uganda and in communities northeast of Lake Kyoga. In 2014, fish exports in Uganda were worth US$134.8 million (UBOS, 2015). Hunting occurs in 42% of all wetlands including Jinja, Kayunga, and Kamuli districts and also in seasonal wetlands around Lake Kyoga (World Resources Institute, 2009).

Regulating functions

These include climate regulation, water purification, soil erosion control, habitat for pollinators and hydrological services (MEA, 2005). The entire wetland and hydrological system of Uganda is central to the sustainability of the Nile River. At a national and local level, the system of interconnected wetlands plays a crucial role filtering pollutants and regulating water flows (influencing groundwater recharge, flood impacts, and water availability during the dry season). The ability of wetlands to act as natural sponges, storing water and slowly releasing it reduces the water's momentum and erosive potential, reduces flood heights, and allows for ground water and aquifer recharge, which in turn contributes base flow to surface water systems during dry periods. Although a small wetland might not store much water, a network of many small wetlands can store an enormous amount. The ability of wetlands to store flood waters reduces the risk of costly property damage and loss of life - benefits that have immense economic value.

Wetlands are central to improving water quality. After being slowed by a wetland, water moves around plants, allowing the suspended sediment to drop out and settle to the wetland floor. Nutrients from fertilizer application, manure, leaking septic tanks, and municipal sewage that may be dissolved in the water are often absorbed by plant roots and micro-organisms in the soil. Other pollutants stick to soil particles. In many cases, this filtration process removes much of the excess nutrient and pollutant load by the time the water is ready to leave the wetland. Some types of wetlands are so good at this filtration function that environmental managers construct similar artificial wetlands to treat storm and wastewater.

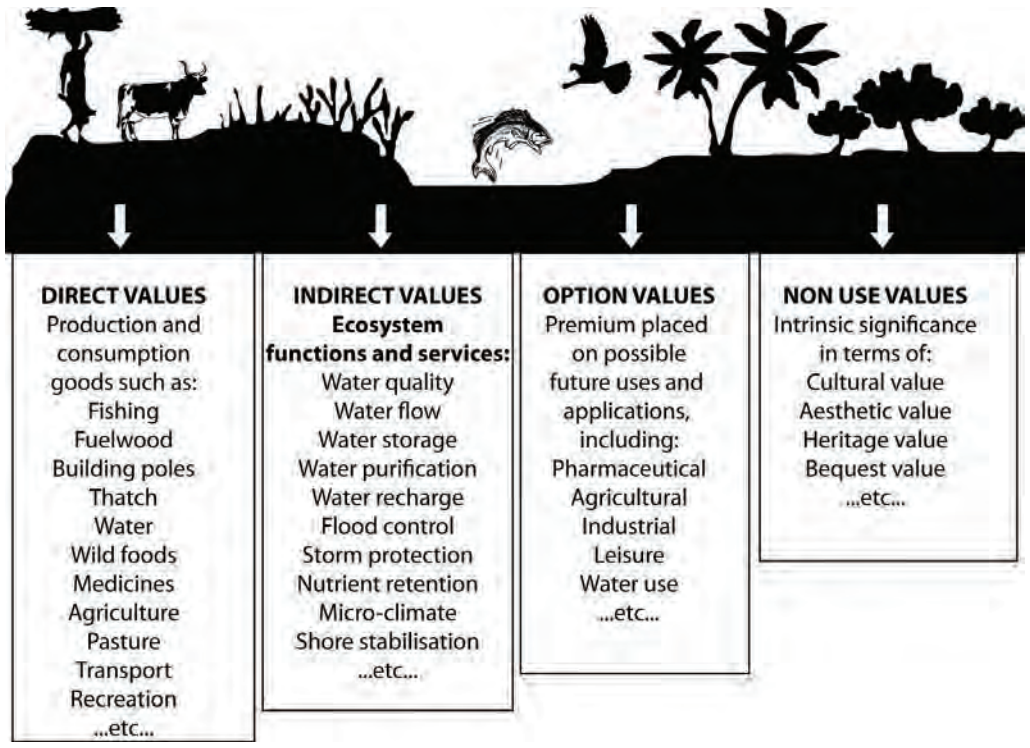
Many wetlands are also important stopovers for numerous migratory water birds. They are a major habitat for birds including the globally endangered birds - the Shoebill (*Balaeniceps rex*) and Fox's weaver (*Ploceus spekeoides*) and certain fish species of the *Cichlidae* family. They are also habitat for fish adapted to living under low oxygen conditions such as the Lung fish. Lakeside wetlands support large numbers of insects, worms and shrimps that are important as food for the fish. They are nursery grounds for many species of fish and provide shelter and protection to the young fish from predators. The Kasa Mabamba wetland located west of Entebbe International Airport in Kasanje subcounty,

A man checks on his salt pans in Lake Katwe. Salt extraction from the lake is the main source of livelihood among the surrounding communities.

Wakiso District supports a lucrative fish industry and is a well known stop over for migrant birds such as the Blue swallow, White-winged tern, Gull-billed tern, Papyrus Gonolek and Papyrus Yellow warbler among others (Byaruhanga & Kigoolo, 2005).

In addition wetlands provide a stabilizing service for rivers used to generate hydropower by maintaining constant recharge for the reservoirs. The current location of the mini-hydropower plants, are associated with the existence of permanent wetlands in their catchments (Figure 1.7).

Figure 1.6: Wetlands provide many benefits



(Adapted from Emerton, 2001)

Supporting functions

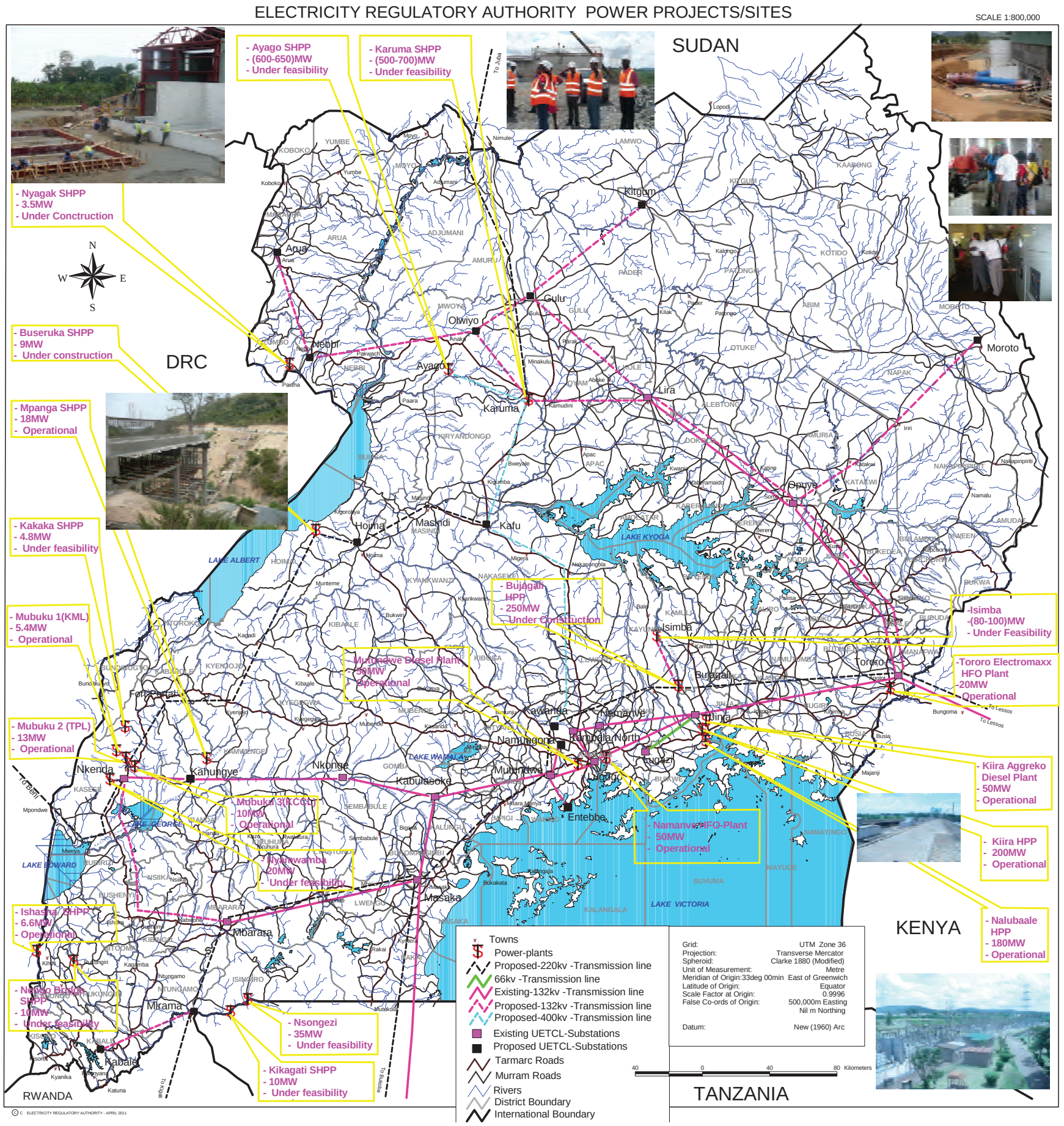
Wetlands play a key role in soil formation and nutrient recycling. Their intermediate location between water and land gives them a special place in the environment. The varying water levels control the oxidation-reduction conditions that are common in wetlands permitting nutrient recycling, sediment and organic matter accumulation, among others (NCSU Water Quality Group). For instance, as a sink for nutrients and other organic compounds, wetlands are important in the global carbon, nitrogen and sulphur cycles (NCSU Water Quality Group). Furthermore they also play a role in transforming nutrients, organic compounds and metals.

Cultural functions

These include the aesthetic, recreational and spiritual aspects. Some wetlands are tourist attractions and provide opportunities for education. Makanaga wetland in Bussi Subcounty, Wakiso District has significant cultural and socio-economic values. It is host for the Wanema cultural site of the Genet cat (*Kasimba*) clan found at Buyembe village on Zzinga Island (UWEC, 2014). Uganda's tourism products include bird and butterfly watching, gorilla tracking, nature and village walks. The most popularly visited national parks are Murchison Falls (33%), Queen Elizabeth (29%) and Lake Mburo (13%) National Parks which contain extensive wetland systems (UBOS, 2015). These three all have designated Ramsar sites in them. Another Ramsar site popular with tourists is the Rwenzori mountain bogs (located in the Mount Rwenzori National Park).

Wetlands provide habitat to large mammals

Figure 1.7: Map showing location of mini hydro power plants



The integrity of wetlands has a direct implication on the productivity of existing and proposed hydro power facilities in the country. Their conservation should be integral to the power development strategy.

KEY THREATS TO UGANDA'S WETLANDS

As clear from the foregoing discussions, the array of functions provided by wetlands is quite extensive. As a result they are under threat for the very reasons that make them key to people's wellbeing. Their provisioning services have led to severe encroachment, over exploitation and degradation. This consequently affects the regulating, supporting and cultural functions that the wetlands perform. Some of the threats affecting wetlands around the country are discussed below.

Drainage of wetlands

In the 1950s, drainage of wetlands in the southwestern part of the country was actively promoted by the Government (see Chapter 5). These days, it is driven by commercial interests and it is common to find wetlands that have been leased for up to 99 years to rich farmers. The result has not only been the degradation of former wetland areas but also the denial of local populations of the benefits from these wetlands.

Introduction of new crops

Rice was introduced on a large scale in the 1960's as a wetland-based crop. Kibimba Irrigation Scheme in Eastern Uganda was established for this purpose. The crop has now spread into a number of different wetlands and is a major crop in that region. The clearing of wetlands for rice has resulted in the loss of biodiversity and a number of their functions (see Chapter 3).

Pollution

Wetlands are being polluted from various sources. Those that are located near urban areas are under threat from sewage and other municipal waste. Pollution from industry located close to wetlands is another threat. For instance in western Uganda, mine tailings from the Kilembe copper mines has affected wetlands associated with Lakes George and Edwards (see Chapter 5).

Over-harvesting

Some of the wetlands have faced the problem of overexploitation of some of the plants and animals found in them. The most affected parts of wetlands are the seasonal ones which fringe the edges and form an interface between land and the wetland proper. Biomass and papyrus harvesting are some of the resources that are frequently overharvested. Nearer to the major towns, the principal problem has been the extensive exploitation of clays for brick making. This has not only meant the exposure of these areas to flooding and erosion, but also the creation of huge and deep holes that portend danger to man, livestock and wildlife.

Reclamation for settlements and industrial developments

The unclear land tenure regime in the wetlands has also attracted the emergence of unplanned settlements. The driving force behind this growth includes the high cost of land, inadequate supply of affordable housing and high rates of poverty. Further, although some of the urban areas have development plans, there is no linkage between the urban plans and their implementation. For instance despite the existence of a Physical Development Plan for Kampala City, residential, commercial and industrial infrastructure is being erected in areas not planned for them. Furthermore, the 1972 Kampala Development Plan requires that wetlands be left as green areas, however ineffective law enforcement has led to the growth of slums especially in the areas of Bwaise, Kalerwe and Natete. The impeded drainage and regular flooding leads to poor sanitation, water borne diseases and possibility of conflict since at times housing is built in road reserves hindering access for other planned developments (Nyakaana, Sengendo, & Lwasa, 2007). These issues are discussed further in Chapter 2.

Migingo island, rich fishing ground in Lake Victoria

Photo credit: Flickr

Crested cranes

UGANDA'S POLICY AND LEGAL FRAMEWORK FOR WETLANDS

Although Uganda has, since 1995, had a clear policy and legal framework to regulate the management of wetlands. There have been challenges, some stemming from historical policy decisions. For example during the 1900s the country's natural resources were protected through a system of customary rules and practices in the form of hunting, cultural and spiritual grounds. Box 1.1 gives a chronology of how policy related to wetlands management has developed. With the advent of colonisation, the community protected areas were converted into parks and reserves governed under various pieces of legislation. Wetlands at this time were managed as common property under customary norms and traditions. This method of management was feasible at that time when the population was small and the resources were not under pressure from commercial and population forces.

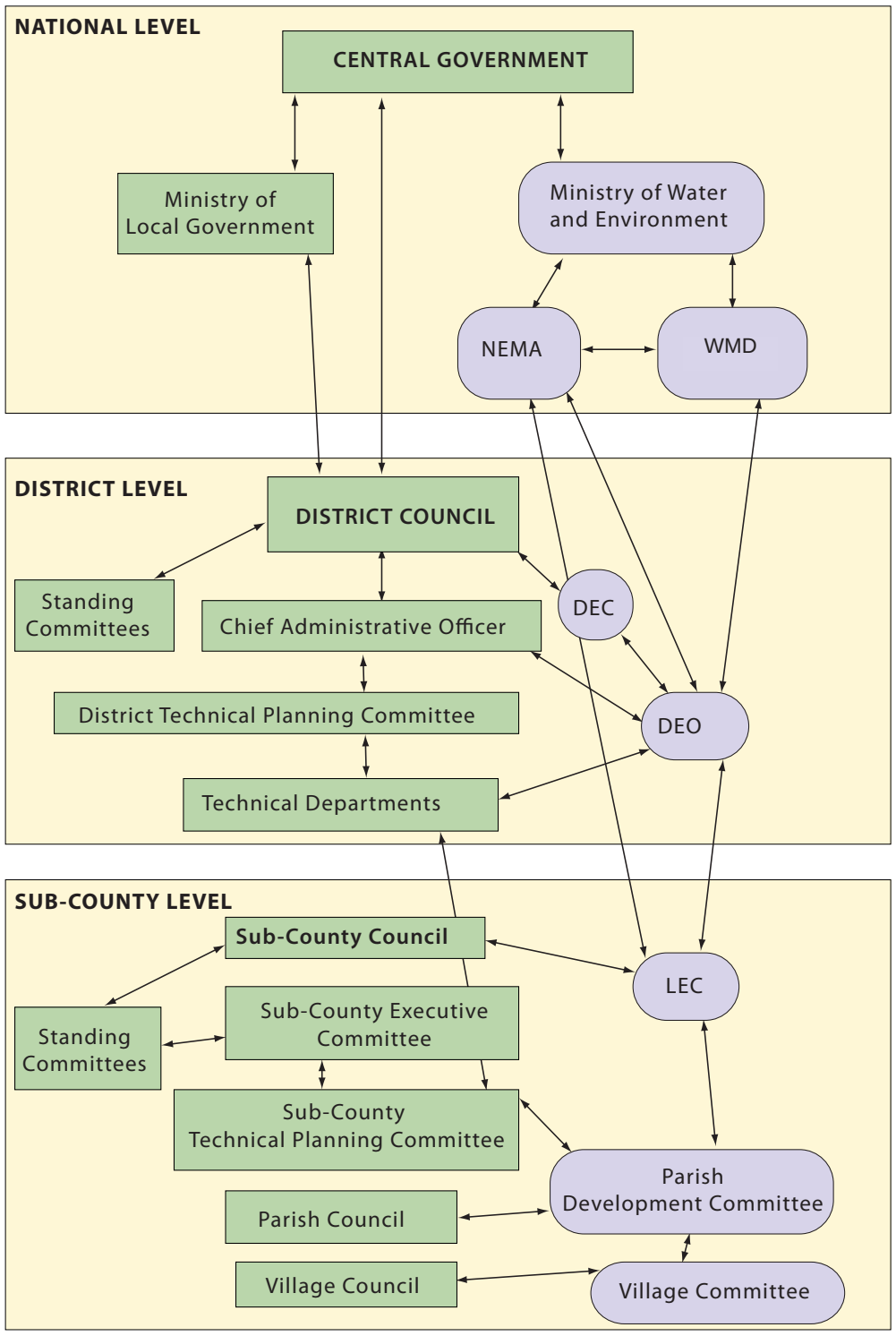
A subsequent policy recommendation in 1955 to allow the drainage of wetlands for agriculture in areas where the population had increased tremendously such as in the districts of Kabale, Rukingiri, Kisoro and Bushenyi led to mass encroachment and degradation of wetlands (Gibb, 1955), (Kabagambirwe, 1972). Rich and progressive farmers acquired leaseholds upon these wetlands and commenced the programme of draining and converting them into dairy farms.

In 1986, the Government banned further large scale drainage of wetlands and set up the National Conservation and Management Programme within the newly created Ministry of Environment Protection to ensure conservation of Uganda's wetlands. However, despite this all indications are that elements of the destructive practices of the 1950's continue even today, and it is this that has prompted the current government to intervene with a new policy and approach to wetlands management.

Box. 1.1: Historical review of legal, policy and institutional mechanisms for wetlands management

1902	Uganda Order in Council establishes land tenure and ownership
1954	Gibb study recommends drainage of wetlands for agriculture land to be managed by Uganda Land Commission
1986	Government (stop gap) policy to stop large scale draining of wetlands
1988	Ramsar Convention entered into force in Uganda
1989	Establishment of the National Wetlands Conservation and Management Programme
1991	National Environment Action Plan Process
1994	National Environment Management Policy
1995	National Environment Management Act
1995	National Policy for the Conservation and Management of Wetlands
1995	New Constitution (that provided for protection of wetlands)
1997	Local Governments Act that gave districts authority to manage wetlands
2000	National Environment (Wetlands, River Banks and Lake Shores Management) Regulations

Figure. 1.8: Institutional structure for wetlands management in Uganda



INSTITUTIONAL FRAMEWORK

The National Environment Management Authority (NEMA)

The National Environment Management Authority (NEMA) is the principal regulator for environmental issues including wetlands. NEMA is charged with the responsibility to monitor, supervise and coordinate all aspects of the environment. In fulfilling this mandate, NEMA works with other Lead Agencies, Government departments and Local Governments as provided for in the National Environment Act Cap 153 and the Local Government Act.

In addition, NEMA is empowered to gazette qualified and certified government officials as Environmental Inspectors to perform its duties including management of wetlands. Each gazetted Environmental Inspector is empowered to stop any wetlands degradation, issue an Environmental Improvement Notice and cause arrest and prosecution of any wetland violator.

Wetlands Management Department

The Wetlands Management Department in the Ministry of Water and Environment is the core department charged with the responsibility to manage wetlands. The department assists Central and Local Governments to apply the National Policy for the Conservation and Management of Wetland Resources to ensure sustainable conservation and management of wetlands so as to optimize socio-economic and ecological benefits to local, national and international communities. The details of how this works is discussed in the section titled “Wetlands Management in Uganda”.

District Local Governments

The management of wetlands and other natural resources in Uganda is a decentralized function of Local Governments (Figure 1.8). The District Environment Committee is the sub-committee of the District Council that provides policy guidance on the management of wetlands. In undertaking this mandate, the Local Governments are guided by the Wetlands Management Department and NEMA. Local Governments also liaise with the Civil Society Organizations to strengthen and speedup community outreach. Each District Local Government has a District Environment Officer (DEO), who is the key technical person responsible for the environment and wetlands related issued as stipulated in Section 15 of the National Environment Act Cap 153.

At subcounty level (third administrative unit to the central government), the Local Environment Committees (LECs) were appointed under the Section 16 of the National Environment Act of 1995. They are mandated to: prepare local environment work plans; mobilize the people to conserve natural resources through voluntary self help such as planting trees, and monitor all environmental activities in the community. Although Parish and Village level structures have been put in place; they have not been fully operationalized. It is also important to note that the county level is not an administrative structure for wetland governance.

POLICY FRAMEWORK

In 1995 Uganda became the first African country and only second country in the world (after Canada) to adopt a National Policy for the Conservation and Management of Wetland Resources. The National Wetlands Policy is based on five goals:

1. to establish the principles by which wetland resources can be optimally used now and in the future;
2. to end practices which reduce wetland productivity;
3. to maintain the biological diversity of natural or semi-natural wetlands;
4. to maintain wetland functions and values; and,
5. to integrate wetland concerns into the planning and decision making of other sectors.

In order to achieve these goals, the WMD realizes that wetland resources form an integral part of the environment and their management must be pursued in the context of an interaction between conservation and the national development strategies and activities. Secondly, that wetland conservation can only be achieved through a coordinated and cooperative approach involving all the concerned people and organizations in the country including the local communities. Lastly, for sustainability, the attitude of the public towards wetlands must be changed.

LEGAL FRAMEWORK

The Constitution of Uganda 1995

The Constitution, the supreme law of Uganda, has specific provisions for the management and protection of natural and environmental resources and specifically mentions wetlands as part of these. The Constitution starts by affirming in Objective XIII of its national objectives and directive principles of state policy that the government shall protect important natural resources including land, water, wetlands, minerals, oil, flora and fauna. Objective XXVII embraces the principles of sustainable development obliging the government to promote environmentally-friendly development and public awareness of the need to manage these resources so that future generations can also benefit from them. It also obliges the government to take all possible measures to prevent or minimize damage to these resources from pollution or other causes. Lastly in Objective XXIX, every citizen of the country is given the responsibility to know the provisions of their Constitution and to ensure that they contribute to the wellbeing of the community in which they reside.

Box 1.2: Activities prohibited by law in wetlands

- Reclamation or drainage of wetlands;
- Erection, construction, placement of any structure and such, on the wetland;
- Disturbance of a wetland by drilling or tunneling in a manner that is likely to have adverse effects on the wetland;
- Depositing in, on or under any wetland any substance in a manner that is likely to have adverse effects on the wetland;
- Destroying, damaging or disturbing any wetland in a manner that is likely to have adverse effects on any plant, or animal or its habitat; and
- Introducing or planting any toxic or foreign plant or animal in a wetland, unless with authorization of NEMA in consultation with a lead agency.

(GOU, 1995)

Protection of natural resources is considered as a basic human right and Article 39 thus enshrines the right of every Ugandan to a clean and healthy environment. Article 237 allows for ownership of land under the recognized land tenure systems. However it places in trust natural lakes, rivers, wetlands, forest reserves, game reserves, national parks and any land to be reserved for ecological and touristic purposes for the common good of all citizens. Article 245 obliges Parliament to make laws for the protection, conservation and management of the environment. Some of the laws that have been enacted under this provision include the National Environment Act Cap 153 and the Land Act Cap 227. The provisions for wetlands management under these Acts are discussed in the paragraphs that follow.

The National Environment Act Cap 153

The National Environment Act Cap 153 is the framework law on the environment. Section 3 gives everybody the right to a healthy environment and further assigns everybody the responsibility to maintain and improve the environment. This may involve reporting to NEMA, WMD or relevant local government any issues of concern. These institutions are then obliged to take action if there is any significant harm to the environment. Section 19, 20 and 21 require the undertaking of an Environment Impact Assessment (EIA) for any activity that may harm the environment, including wetlands.

Wetlands are considered part of the environment and are clearly defined in the National Environment Act. Although the provisions of Section 3 presume use of wetland resources, certain activities are prohibited under Section 36 and are listed in Box 1.2. However, certain traditional uses of wetlands are allowed, unless specifically disallowed by NEMA and the WMD (see section on the regulations on the management of wetlands, river banks and lake shores).

Section 37 provides for guidelines to be made for the identification and sustainable management of all wetlands in the country. NEMA, WMD, Local and District Environment Committees are also required to identify and manage, through various means including protection, wetlands of local, national and international importance.

Nyamuhizi-Kagogo wetland in Mitooma District floods after its restoration in January 2014

Photo credit: George Lubega

The National Environment (Wetlands, River Banks and Lake Shores Management) Regulations, S.I No. 3/2000

These regulations operationalise provisions under the National Environment Act geared towards protecting wetlands from encroachment and regulating activities in the wetlands (Section 4). Under the regulations, in Section 5, wetland resources are expected to be used in a sustainable manner to ensure their continued existence and the provision of their hydrological functions and services. If any activity is to be undertaken in a wetland, it must be subject to an Environment Impact Assessment. The regulations also state that special measures may be required to protect wetlands of international, national, and local importance and to maintain the provisioning, regulating, supporting and cultural purposes they perform. To that end, public awareness campaigns and dissemination of information should be an integral part of the national and local government approaches so as to ensure wise use of the wetlands.

Although the central and local governments have the primary responsibility for wetlands protection (Section 6 and 7), this does not absolve the public of their responsibility. As a result, Section 17 states that every landowner, occupier or user who is nearby or neighbouring a wetland is accountable for preventing wetland degradation.

Section 19 aims to encourage the concept of wise use of wetlands, river banks and lakeshores in all aspects of development. Schedule II of this Regulation thus provides a list of activities which require a resource use permit issued by NEMA in consultation with the lead agencies. These include: brick making; recreation activities such as sport fishing, maintenance of green spaces; cultivation; drainage; commercial exploitation of wetland resources; sewage filtration; fishing using fish gear and weirs, fish farming and other aquaculture; construction of transport and communication facilities such as roads, railways, telephone lines; burning; and any other exploitative activity which is of a commercial or trade nature, such as harvesting of papyrus for commercial purposes. However, Section 11 allows for certain traditional uses including: the traditional harvesting of papyrus, medicinal plants, trees and reeds; cultivation - as long as the farmed area is less than 25% of the total area of the wetland; fishing using traps, spears and baskets or other method other than weirs; collection of water for domestic use; and hunting is subject to the provisions of the Wildlife Act, Cap 200.

Section 29 provides for protection for the major water bodies by the establishment of regulated zones around them based on the critical role these zones play in protecting the water resources as well as the catchments of such water resources. The major rivers are protected with a buffer zone of 100m calculated from the highest water mark. The highest water mark is defined as the highest point in history towards the dry land where the water-land interface last occurred when there was heavy discharge of water. The rivers are the Nile, Aswa, Katonga, Nkusi, Kafu, Rwizi,

Photo credit: Geoff Howard

Ecotourism at Kalagala island within the Victoria Nile drainage basin

Kagera, Mpanga, Manafwa, Mpologoma, Semliki, Mubuku, Mayanja, Sezibwa, Malaba, Sipi, Namatala, Sironko, Muzizi, and Nabuyonga and are listed in the Sixth Schedule. All other rivers not mentioned above have a protection zone of 30 m calculated from the highest watermark.

The protection zone provided for major lakes in Section 30 is 200m from the lowest water mark which is defined as the lowest point in history towards the lake where the water-land interface last occurred when there was drought and water tended to decrease. The major lakes as indicated in the Seventh Schedule include Lakes Victoria, Kyoga, Albert, Edward, George, Bisina, Mburo, Bunyonyi, Kijanibarola, Kwania, Wamala, Mutanda, Murehe, Opeta, Nabugabo, Nkugute, Katunga, Nyabihoko, and Nakivale. All other lakes have a protection zone of 100 m from the lowest water mark.

The Environmental Impact Assessment Regulations, S.I No. 13/1998

These were passed in 1998 and operationalise Section 19, 20 and 21 of the National Environment Act Cap 153. An Environment Impact Assessment (EIA) must be carried out for any project that is likely to have an impact on the environment. Section 34 of the regulations on Wetlands, River banks and Lake shores reiterates this requirement. The EIA regulations in the First Schedule specifically highlight wetlands degradation or wetlands wise-use as issues for consideration when undertaking the EIA.

The Land Act Cap 227

The doctrine of public trust is enshrined in the Land Act to ensure that wetlands and other public resources are sustainably used and that prohibited, indiscriminate and uncontrolled encroachment on these resources is avoided. Section 44 (1) of the Land Act Cap 227 reiterates Article 237(2)(b) of the Constitution and states that: 'The Government or a local government shall hold in trust for the people and protect natural lakes, rivers, ground water, natural ponds, natural streams, wetlands, forest reserves, national parks and any land to be reserved for ecological and touristic purposes for the common good of the citizens of Uganda.'

The Land Act further states that the natural resources listed here shall not be leased out by the central or other local government. This implies that any land title issued in a wetland or within any of the regulated zones surrounding a river bank or lake shore is illegal. However Section 44 (5) allows the government to grant concessions, licenses or other use permits under any law.

Section 43 recognizes and vests responsibility in the land owners, for the sustainable use and management of that land in accordance with the Forest Act, Mining Act, Environment Act, Water Act, Uganda Wildlife Act and any other law.

Tea growing in Mulehe wetland

Photo credit: George Lubega

WETLANDS MANAGEMENT IN UGANDA

Mission and Vision for wetlands management

Uganda applies both regional and national framework to achieve its long-term goals for wetlands management.

The mission of wetlands management in Uganda is **"to ensure the conservation, wise use and protection of wetlands in the country through increased appreciation and effective management, as a means to achieving sustainable development"**. The vision is to **"provide sustainable benefits to the population of Uganda and mankind in general and contribute to environment protection"**.

The vision and mission emphasise the parallel and complementary concepts of conservation and use. Wetlands must be conserved if they are to continue to provide goods and services of value to the riparian communities and the wider world. They can be used, and must of course be used if their value is to be fully realized. But, they should be used wisely. This fundamentally means sustainable use in line with conservation ideals.

The urgent need to alleviate the poverty of so many of its populace makes economic development a prime objective of the government. Every asset must be exploited to that end; and wetlands are no exception. If used wisely, wetlands will make a continued and sustainable contribution to economic development. To achieve wise use, balancing conservation and use so that a continued future stream of benefits is assured, four guiding principles need to be followed as indicated in Table 1.6.

Water intake point at Kiyanja, Masindi

Table 1.6: Guiding principles for the wise use of Uganda's wetlands

Guiding principles	Implications for wetlands management
1. The hydrological and ecological integrity of the wetland ecosystem must be maintained	The Wetlands Policy advocates for sustainable use of wetlands implying that the wetlands can be used, but in such a way that the resources will be available for others to use in the short term or even after decades. This 'wise use' is possible as long as the main hydrological and other ecological processes that make it a wetland are not interfered with. Many of Uganda's wetlands are resilient and can be utilized in this manner. There are a few, however where their unique or more fragile nature implies that either minimal or no modifications at all should occur if the wetlands ecological integrity is to be preserved.
2. Management must comply with larger ecosystem management objectives	Wetlands are not isolated ecological units. They are flowing systems interlinked to ecosystems within the country and in the region. For example research by Bugenyi and Balirwa (1998) indicates that the wetlands system in Uganda plays a significant role in the recharge of the River Nile and more broadly in the eco-hydrology of the basin. As such local and national utilization of wetlands must be sensitive to the wider conservation ideals and standards. So the scope of strategic management should encompass functionally defined hydrological units like catchments or river and lake basins.
3. Wetland management options must be supportive of the socio-economic objectives and aspirations of the people of Uganda.	The National Development Plan recognises that wetlands and their resources are central to national development supporting industrial development such as agriculture, tourism and associated cottage industries. Despite these assets, poverty is still widespread in the wetland adjacent communities thus poor people are often forced to overexploit the wetlands. So to address the issue of reducing poverty while allowing for sustainable livelihoods, the management options proposed by WMD are to improve on the range, quality and quantity of products derived from the wetlands; to add value to the wetlands goods and services; to ensure equitable distribution of wetlands resources to those with a valid claim to them and to avoid monopolies (and monoculture) by maintaining a diversity of uses and users. This will enhance the value and appreciation of wetland products and services, while increasing the competitiveness of wetland-derived goods on the market. In the long term, the conservation and management of wetlands will be effective only if rural communities appreciate the values of wetlands and have a stake in the utilisation of these resources. This way, they will have the incentive to protect and conserve the wetlands.
4. The precautionary principle should be applied whenever the impacts of management options are uncertain	The precautionary principle simply states that any action or policy that is undertaken should aim to avoid harm or destruction to the wetland ecosystems and to the communities. It basically advocates for prudence when utilizing the wetlands. Since wetlands use is widespread in Uganda, there are a variety of tried and tested methodologies. However as the pressures increase, it will be necessary to investigate different management options to find the best use-balance. Meanwhile, caution should be exercised especially in wetlands that have high value in terms of hydrology, habitat functions and biodiversity.

Oil Palm processing on Ssese Islands

INTERNATIONAL AND REGIONAL POLICY AND LEGAL FRAMEWORK

The Ramsar Convention

The Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat is the overarching global environmental treaty guiding the management of wetlands. It is an intergovernmental treaty that provides the framework for international cooperation for the conservation of wetland habitats. It was ratified in 1971 in Ramsar, Iran. It originated as a tool intended to protect migratory waterfowl. However, over time, the importance of wetland ecosystems for ground water protection, regulation of the water cycle, water storage, water purification and habitat for fish and other organisms grew justifying the need for the wider focus for this convention (Matthews, 1993). The Ramsar Convention provides for a network of protected wetlands and encourages the wise use principle for their management.

Uganda ratified the Ramsar Convention in 1988 and it has since been localized and integrated into national laws such as the National Environment Act which was enacted in 1995 and related regulations. The Wetlands Management Department under the Ministry of Water and Environment is the national focal point for the implementation of the Ramsar Convention in the country. Parties to the Ramsar Convention are expected to demonstrate their commitments to wetland management through three 'pillars' of action: wise use of wetlands; identification of internationally important wetlands for inclusion on the Ramsar List; and international cooperation and sharing of information and expertise. In 1988, Lake George was the first Ramsar site to be designated. To date, there are 12 Ramsar sites covering a total of 3548.03 km^2 and representing 12% of the wetlands in the country. All are also Important Bird Areas. Two of them are located in protected areas: Lake Mburo-Nakivale Wetland System in the Lake Mburo National Park and Murchison Falls-Albert Delta Wetland System, in the Murchison Falls National Park. This latter site has also been proposed for UNESCO World Heritage status. The geographical spread can be described as occurring along the Lake Victoria shoreline (3 sites), Lake Victoria hinterland (2 sites), Albertine Rift region (2 sites) and the Lake Kyoga basin (3 sites) (Byaruhanga, Opige, & Mafabi, nd). These are described briefly in Figure 1.3 and Table1.7.

Hunting is one of the common activities in Sango Bay wetland

Photo credit: George Lubega

Figure. 1.8: Ramsar Sites in Uganda

(Ramsar Secretariat, 2008)

Table1.7: Ramsar sites - Value and uniqueness of each

Zone	Ramsar site	District location	Area (Km^2)	Protection status	Value and uniqueness
Lake Victoria Shoreline (4 sites)	Sango Bay-Musambwa Island-Kagera Wetland System (SAMUKA)	Masaka, Rakai	551.10	IBA	Ramsar Site no. 1641. Includes the biggest tract of swamp forest in Uganda. It supports large numbers of water birds, hosting an average of 16.5% of the population of Grey headed Gulls (*Larus cirrocephalus*), and is home to globally endangered mammals such as Black and White Colobus Monkey, Elephant, and a subspecies of the Blue Monkey. It is a source of fish, medicinal plants, grazing and raw materials for building and making crafts, chairs and mattresses.
	Lutembe Bay Wetland System	Wakiso	0.98	IBA	Ramsar site no. 1637. The site supports globally threatened species of birds, endangered *Cichlid* fish, and over 100 butterfly species, including three rare ones. It is a breeding ground for *Clarias* and lungfish, and regularly supports more than 52% of the White-winged Black Terns (*Chlidonias leucopterus*) population. Important hydrological role, with the surrounding swamps acting as natural filters for silt, sediments and excess nutrients in surface run-off, wastewaters from industries, and sewage from Kampala.
	Mabamba Bay Wetland System	Wakiso, Mpigi	24.24	IBA	Ramsar site no. 1638. It is the only swamp close to Kampala where the globally threatened Shoebill (*Balaeniceps rex*) is easily found. About 190,000 birds are found and it is part of the wetland system which hosts approximately 38% of the global population of the Blue Swallow (*Hirundo atrocaerulea*) and the globally threatened Papyrus Yellow Warbler among others. There is a lucrative fishery, raw materials for local crafts, building materials, water for domestic and livestock use and non-wood products.
	Lake Nabugabo	Masaka	220.00	IBA	Ramsar site no. 1373. A shallow freshwater lake, with three smaller lakes, separated from Lake Victoria by a sand bar. Endemic fish present that are extinct in Lake Victoria due to the Nile perch. Stopover for migratory bird species and at times, holds more than 15% of the world's population of the Blue Swallow. Supports five globally threatened and near-threatened birds: Blue Swallow *Hirundo atrocaerulea*, Shoe Bill *Balaeniceps rex*, Great Snipe *Gallinago media*, Pallied Harrier *Circus macrourus*, and the Papyrus Gonolek *Laniarius mufumbi*. Wide variety of plant species, including insectivores of the family *Droseraceae*. Fishery for subsistence and sale, domestic water, handicraft materials.
Lake Victoria hinterland (2 sites). Part of Katonga river and Bukora/ Rwizi which drain into the north-western part of Lake Victoria.	Nabajjuzi Wetland System	Masaka, Sembabule, Mpigi	17.53	IBA	Ramsar site no. 1639. It provides a spawning ground for mudfish and lungfish, and supports the endangered Sitatunga among others. It is of cultural value to the Buganda Kingdom since it is located in the traditional Buddu county. Some of the wetland plants and animals are associated with cultural traditions such as the totems. It important in stabilizing the banks of River Nabajjuzi, groundwater recharge, flood control and is a natural filter for silt and sediments in the runoff. The wetland is the source of water supply for nearby urban centres and provides fish, clay, papyrus, medicine and game meat (from Sitatunga).
	Lake Mburo-Nakivale wetland system	Mbarara	268.34	IBA; Partly National Park.	Ramsar site no. 1634. System of seasonal and permanent wetlands and five lakes, of which Lake Mburo is the largest. The system is a unique habitat, lying at the convergence of two biological zones, giving it very high biodiversity. Globally threatened birds like the Papyrus Yellow Warbler and Shoebill are found *also* 22 species of Palearctic and Afrotropical migrant birds. Supports two endangered *Cichlid* fish species which have become extinct in the main lakes, and it is the only area in Uganda in which the Impala is found. Has socio-economic value as a source of water for domestic use, livestock and wildlife, pasture for the local herds during droughts, fish, and materials for crafts and thatching. The park is also used for tourism and scientific research.
Albertine rift region (3 sites) in the Albertine Rift Valley and in the montane areas of the Rwenzori's.	Lake George	Bushenyi, Kasese, Kamwenge	150.00	IBA; Biosphere Reserve; National Park	Ramsar site no. 394. A complex of river systems originating in Mount Rwenzori that supply the permanent swamps on Lake George. Elephants, hippopotamus, antelope, numerous species of wintering Palearctic water birds and resident birds. A research station is located on the site. Chemical seepage from Kilembe mines and inflow of agricultural chemicals into the wetland from the Mubuku Irrigation Scheme led to listing on the Montreux Record in 1990.
	Murchison Falls-Albert delta	Masindi, Gulu	172.93	IBA; National Park (partly); Proposed for World Heritage Site status.	Ramsar site no. 1640. Extending from the Murchison Falls to where the delta converges with Lake Albert. Shoebill, Pelicans, Darters and various Heron species are found. The delta is the most important spawning and breeding ground for Lake Albert fisheries, containing indigenous fish species. Important dry season pasture and watering refuge. Oil exploration is on-going in the Albert Nile delta and this thus poses some threats. It is one of the most productive natural ecosystems in the world.
	Rwenzori Mountains Ramsar Site	Kasese, Kabarole, Bundibugyo	2.24	IBA; In National Park; World Heritage Site.	Ramsar site no. 1861. The entire Afro-alpine ecosystem between 1,600 and 5,100 masl is unique. Various wetland types are present including peatlands, freshwater lakes, and tundra. The mountains support 21 species of small mammals, including L'Hoest's monkey, Horseshoe bat, Rockefeller's Sunbird and the endemic and vulnerable Rwenzori Shrew. Common indigenous fish species are of Cyprinid species including *Varicorhinus rwenzorii.*
Lake Kyoga Basin (3 sites) associated with tributaries entering the eastern end of the Lake Kyoga basin.	Lake Nakuwa Wetland System	Kamuli, Pallisa, Soroti	911.50	IBA	Ramsar site no. 1635. A permanent wetland with dense papyrus and interconnected with some satellite lakes. *Sitatunga* and the Nile crocodile are present. It has the most diverse *cichlid* species collection and also a number of non-*cichlid* species no longer found In Lakes Kyoga and Victoria. Important in water purification, flood prevention and groundwater recharge. It is in pristine condition due to its remoteness and sparse population in the vicinity. Fishery for commercial purposes and papyrus for mats, thatching, and crafts.
	Lake Bisina	Kumi, Katakwi and Soroti	542.29	IBA	Ramsar site no. 1633. The wetland is a shallow freshwater lake with a thin fringe of papyrus. The shallow areas are dominated by water lilies which is important for its diversity of macrophytes. It is used as a feeding ground by wading birds, including the globally vulnerable Shoebill (*Balaeniceps rex*). Fish extinct in main lakes are found here. Important for fishing, transport and domestic and livestock water supply.
	Lake Opeta Wetland System	Nakapiripirit, Sironko, Katakwi, Kumi	689.12	IBA	Ramsar site no. 1636. One of the remaining intact and probably most important wetland marshes in Uganda. The Fox's weaver, Uganda's only endemic bird has been recorded breeding in the swamp. It is also important as a refuge for fish species that have become extinct in Lakes Victoria and Kyoga. Pian-Upe wildlife reserve has potential for big game viewing and bird watching.

(Ramsar Secretariat, 2006)

Other international laws

Other international agreements pertinent to wetlands management include:

- Convention on Biological Diversity (CBD);
- Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention);
- Agreement on the Conservation of African-Eurasian Migratory Water birds (also known as AEWA or African-Eurasian Water bird Agreement);
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES);
- Convention Concerning the Protection of the World Cultural and Natural Heritage;
- United Nations Convention to Combat Desertification (UNCCD);
- United Nations Framework Convention on Climate Change (UNFCCC); and,
- Kyoto Protocol to the United Nations Framework Convention on Climate Change.

A service tunnel within Murchison Falls National Park for the construction of Karuma Hydropower station

Regional Policy and Legal Framework

The African Convention on the Conservation of Nature and Natural Resources is a framework convention that provides a number of avenues for wetlands management. It provides for the management of wetlands through the conservation and integrated management of water catchment areas. It encourages the consultative management of transboundary water resources including wetlands through the setting up of inter-governmental bodies; and calls on countries to adopt science-based and indigenous conservation methodologies for wetlands management. At the same time, the convention recognizes the need to take social and economic issues into consideration as wetlands must contribute to the wellbeing of the people and the nation at large.

The African Initiative for the Conservation of Migratory Water birds and their Habitats in Africa (the AEWA African Initiative or African Initiative) was established in 2009 and aims to support the implementation of the 1995 Agreement on the Conservation of African-Eurasian Migratory Water birds (AEWA) in Africa. One of its goals is to reverse the decline in populations of migratory water birds. The single species action plans are in place, but mainly covering intra-African migrants. In addition, general surveys such as annual waterfowl counts and wetland inventories are undertaken. Single species research and monitoring is on-going especially for the crested cranes and blue swallows. Community capacity to monitor birds is being developed at Musamba islands Ramsar site by Nature Uganda.

The Nile Basin Wetlands Management Strategy. The inter-dependence of the wetlands in Uganda as part of the Nile river hydrological system makes the management of the wetlands in Uganda of paramount importance. For example, releases from Lake Victoria have great implications on the wetlands of the Sudd region in South Sudan and further up in Egypt. The Nile basin wetlands management strategy is premised on wise use with five strategic objectives. These include improving the knowledge base; increasing awareness on the importance of wetlands; developing a basin-wide approach for wetlands management; strengthening national policies and institutions; and improving financing for wetlands management (NBI 2013).

East African Community (EAC) Strategies for Wetlands Management. A number of tools are available at the East African regional level that present the opportunity for wise use of wetlands. These include the Treaty of Establishment of the East African Community which in chapter 19 (Art. 111 and 114) provides for joint management and utilization of natural resources within the Community for the mutual benefit of the partner States. The treaty provides also for joint development and adoption of harmonized common policies and strategies for sustainable management of transboundary natural resources within the Community. With regard to water issues, the actions by the Community are to have the following objective: “To ensure sustainable utilization of natural resources like lakes, wetlands, forests, and other aquatic and terrestrial ecosystems and to jointly develop and adopt water resources conservation and management policies that ensure sustenance and preservation of ecosystems.”(Art.111.2c and d)

Migratory birds in Lutembe Bay wetland, a Ramsar site in Uganda

EAC Protocol on Environment and Natural Resources provides for co-operation in environment and natural resources management (Chap. 3). More specifically, in Art. 13 related to the management of water resources, the Protocol stipulates that Partner States shall develop, harmonize and adopt common national policies, laws and programmes relating to the management and sustainable use of water resources and shall utilize water resources, including shared water resources, in an equitable and rational manner (13, 1and 2). Art. 14 provides for sustainable wetlands management; and the strategic action plan for the Lake Victoria Basin Commission. Two development objectives of the Lake Victoria Basin Commission Strategic Action Plan (2011-2016) are relevant:

- harmonizing approaches for sustainable management and development of natural resources in the Lake Victoria Basin; and,
- promoting conservation and management of natural resources and biodiversity in and outside protected areas.

The Strategy for the Lake Victoria basin aims to invest in the rehabilitation and restoration of degraded wetlands by integrating and harmonizing wetland management with spatial planning and Integrated Water Resources Management (IWRM) approaches and promoting local methods and practices that reduce pressures on wetlands (LVBC 2007).

The development of an integrated management plan for Lake Victoria basin and the harmonization of supporting laws and regulations amongst the partner states would also ease current management challenges.

The EAC Regional Environment Impact Assessment Guidelines for Shared Ecosystems are an integral part of the EAC Protocol and are used to help in the identification and application of environmentally sound approaches to manage and ensure the sustainability and biophysical integrity of the shared ecosystems within the East African region. Such guidelines are crucial for the proper conduct of impact assessment studies on shared ecosystems such as wetlands, fresh water, forests and protected areas.

Managing transboundary wetlands

Uganda is a landlocked country with a land area of 241,550km^2 of which open water bodies cover 36,527km^2 and wetlands 4,500 km^2 (UBOS, 2015). Many of these water bodies and wetlands are part of Uganda's transboundary natural resources portfolio (Table 1.8). They play a major role in providing resources to the local, district and national level; and also at the regional level. Because they lie astride international boundaries, they are governed by differing policies and laws as prescribed by the countries in which they lie. The management of these wetlands presents a challenge since national level policies and laws cannot adequately address the transboundary impacts and issues faced by these shared wetlands. The Lake Victoria Development Commission and the Nile Basin Initiative are two institutions that deal with the transboundary water and wetland resources in the region.

Elephants play fighting in a wetland

Table 1.8: Major shared water bodies, river courses and wetland systems of Uganda

Water resource	Countries sharing	Basin wide
River Nile	Uganda, South Sudan, Sudan, Egypt	Burundi, DRC, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania, Uganda, Eritrea
River Achwa	Uganda, South Sudan	Uganda, South Sudan
River Kagera	Tanzania, Burundi, Rwanda, Uganda	Nile Basin Reparian States - Burundi, Tanzania, Rwanda, Uganda
River Semuliki	DRC, Uganda	Nile Basin Reparian States
River Malaba	Kenya, Uganda	Kenya, Uganda
River Sio	Kenya, Uganda	Kenya, Uganda
Lake Victoria	Uganda, Kenya, Tanzania	Nile Basin Reparian States
Lake Albert	DRC, Uganda	Nile Basin Reparian States
Lake Edward	DRC, Uganda	DRC, Uganda
Sango Bay Swamp	Tanzania, Uganda	Kenya, Burundi, Rwanda

Lake Victoria Development Commission

The Lake Victoria basin is an important shared resource of the five East African countries - Kenya, Uganda, Tanzania, Rwanda and Burundi. In light of this several regional initiatives have been formed to encourage its sustainable management. These include the Lake Victoria Basin Commission (LVBC), the Lake Victoria Fisheries Organization (LVFO) and the Nile Basin Initiative (NBI). LVBC is a tripartite (Kenya, Uganda and Tanzania) institution whose programmes are formulated to ensure the 'overall management and rational utilization of the shared resources of the Lake' (LVBC, 2014). LVBC's current flagship project is the transboundary

Semliki River breaking off at the Uganda-DRC border

Photo credit: George Lubega

Lake Victoria Environmental Management Project Phase II (LVEMP II) being implemented in the five basin countries. It has a two pronged approach to enhance cooperation in the management of the transboundary natural resources of the lake basin and to reduce environmental stress in selected pollution hotspots (LVBC, 2014).

Nile Basin Initiative

The Nile Basin Initiative (NBI) an intergovernmental organization of the ten countries of the Nile Basin works for the equitable and sustainable utilization of the diverse resources of the Nile Basin in order to achieve water security and avert conflict. Member states include Burundi, Democratic Republic of the Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda, with Eritrea as an observer.

Even as it seeks to use the waters of the Nile for individual nation state development, the NBI as an institution is aware of the fact that certain transboundary activities will need to be implemented to ensure wealth creation, security and peace for the different riparian communities. Some of the initiatives include irrigation and drainage; trade and investment; flood preparedness and early warning; power export projects; and watershed management projects, among others.

An example of a transboundary collaborative approach is the River Sio-Siteko wetland system along the Kenya-Uganda border which is fed by a river that has its origins on the Kenyan side of Mount Elgon. Population pressure, over-abstraction of water, sand harvesting, poor agricultural activities have compromised the wetlands ability to perform water purification actions. There are also conflicts between the various resource users including water users, crop farmers, herdsmen, fishermen, sand miners and so on. Attempts for integrated management have been done through the development of the Sio-Siteko Transboundary Wetland Community Based Management Plan (NBI, 2009).

All activities in wetlands are regulated by the law

Photo credit: George Lubega

BIBLIOGRAPHY

BakamaNume, B. B. (2010). *A Contemporary Geography of Uganda*. Dar es Salaam: Mkuki Na Nyota.

Byaruhanga, A., & Kigoolo, S. (2005). *Mabamba Bay Wetland Ramsar Information Sheet*. Gland, Switzerland: Ramsar Secretariat.

Byaruhanga, A., Opige, M., & Mafabi, P. (nd). *The Role of International Conventions in Protection of Species: A Case of Ramsar Sites in Uganda*. Kampala: NatureUganda.

Emerton, L., & Muramira, E. (1999). *Uganda biodiversity: Economic assessment*. Nairobi: The World Conservation Union (IUCN).

Emerton, L. (2001). Why Forest Values are Important to East Africa. In Emerton, L. and Karanja, F., (Eds.)
Valuation of Forest Resources in East Africa, ACTS INNOVATION Vol. 8, No.2 July 2001. 36pp

FAO. (1993). *Soil tillage in Africa: Needs and challenges*. Rome: Food and Agriculture Organisation of the United Nations.

FAO. (1998). *Wetlands Characterization and Classification for Sustainable Agricultural Development*. Harare: Food and Agricultural Organization of the United Nations (FAO).

GOU. (1995). *National Environment Act Cap 153*. Kampala: Government of Uganda (GOU).

Harrop, J. (1960). *The soils of the western province of Uganda. A reconnaisance survey*. Kampala: Department of Agriculture, Uganda Protectorate.

LVBC. (2014). Retrieved January 15, 2016, from Lake Victoria Basin Commission: Overview of LVBC: http://www.lvbcom.org/index.php/who-we-are/overview-of-lvbc

Matthews, G. (1993). *The Ramsar convention on wetlands: its history and development*. Gland, Switzerland: Ramsar Convention Bureau.

MEA. (2005). *Ecosystems and Human Well-being: Synthesis*. Washington D.C.: Millenium Ecosystem Assessment (MEA). Island Press.

Mitsch, W. J., & Gosselink, J. G. (1993). Wetlands (4th ed.). *Wetlands*.

MWE. (2014). *Water and Environment Sector Performance Report 2014*. Kampala: Ministry of Water and Environment (MWE).

MWE. (2011). *Water and Environment Sector Performance Review 2011*. Kampala: Ministry of Water and Environment (MWE).

NBI. (2013). *Nile Basin State of Basin Report*. Entebbe: Nile Basin Initiative (NBI).

NCSU Water Quality Group. (n.d.). Retrieved January 28, 2016, from Watersheds: Functions of wetlands (processes): http://www.water.ncsu.edu/watershedss/info/wetlands/function.html

NFA. (2008). *National Biomass Study*. Kampala: National Forest Authority (NFA).

NRCS. (undated). Retrieved January 14, 2016, from Natural Resources Conservation Service website: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/hydric/?cid=nrcs142p2_053961

Nsubuga, F. N., Namutebi, E. N., & Nsubuga-Ssenfuma, M. (2014). *Water Resources of Uganda: An Assessment and Review. Journal of Water Resource and Protection, 2014* , 1297-1315.

Nyakaana, J. B., Sengendo, H., & Lwasa, S. (2007). *Population, Urban Development and the Environment in Uganda*: The Case of Kampala City and its Environs. Kampala: Makerere University.

Ramsar Secretariat. (2006). *The Annotated Ramsar List: Uganda*. Gland, Switzerland: Ramsar Secretariat.

Tiner, R. (2012). *Defining hydrophytes for wetland identification and delineation*. Washington D.C: US Army Corps of Engineers.

UBOS. (2015). S*tatistical Abstract 2015*. Kampala: Uganda Bureau of Statistics (UBOS).

Lake Victoria shoreline

Chapter

2

LAKE VICTORIA BASIN

INTRODUCTION

Lake Victoria is the most prominent hydrological feature in Uganda and is a critical economic resource linking countries in eastern Africa that lie within its drainage basin. The wider catchment area is about 181,000km^2 as shown in figure 2.1 and table 2.1 (Okurut & Weggoro, 2011). The lake is shared with Kenya and Tanzania and is fed by rivers from Rwanda and Burundi. The lake is quite deep averaging 40 m with the deepest point recorded as 80m (Ntiba, Kudoja, & Mukasa, 2001). The population around the lake is extremely high and mostly rural. Around the shoreline are numerous wetlands especially in the shallow portions, and there are also wetlands along the major rivers that feed the lake. The lake is of tectonic origin and lies within a shallow depression.

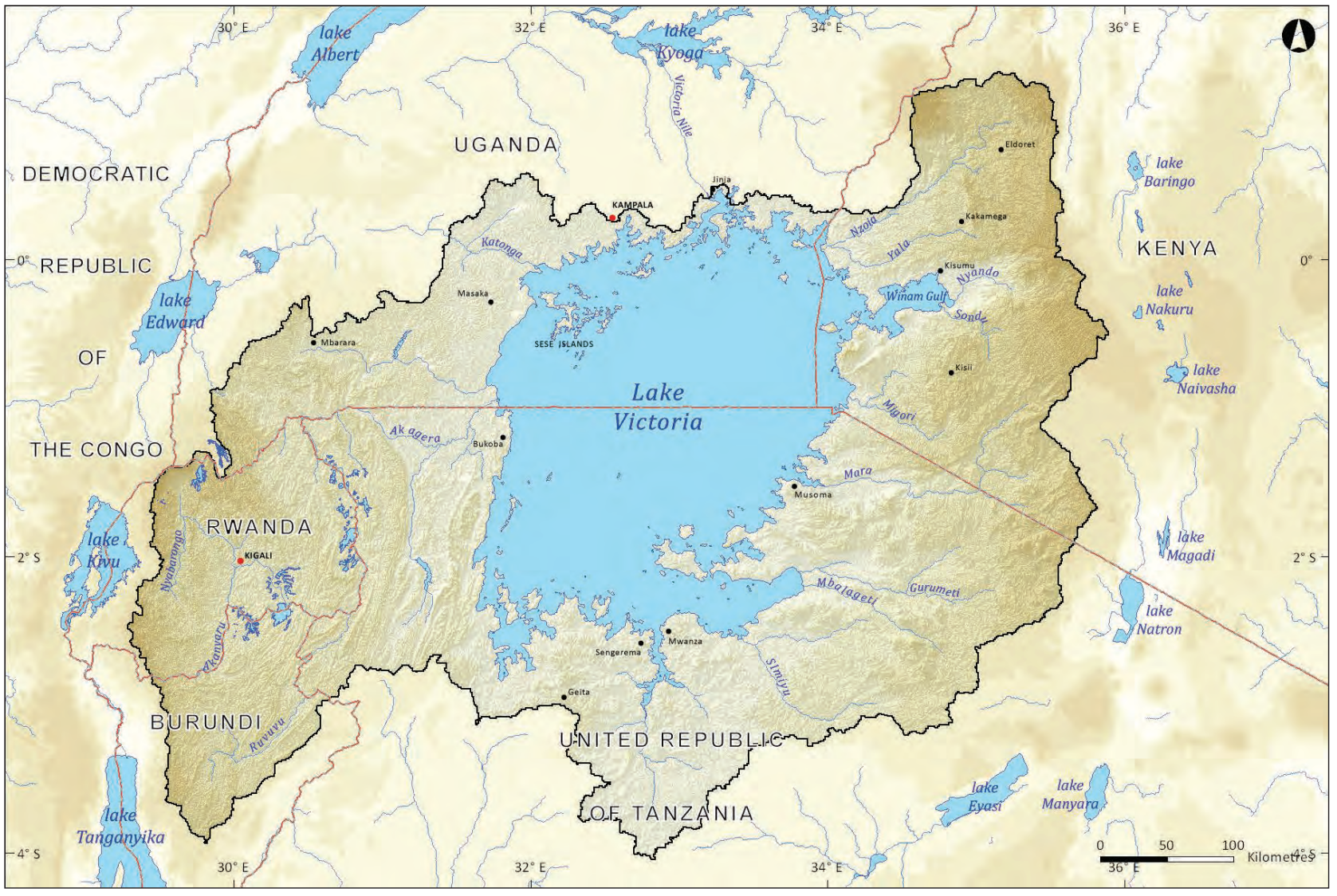
Key messages

Lake Victoria Basin has the highest population growth rate in Africa. A situation which is likely to occasion a constantly increasing pressure on the wetlands resources in the basin.

Lake Victoria fisheries have a beach landed value of between US$350-400 million.

The lake is the most reliable source of water for all major towns and rural areas around it.

Figure 2.1: The wider Lake Victoria basin



(UNEP, 2015)

Table 2.1: Lake surface, shoreline and catchment area of Lake Victoria

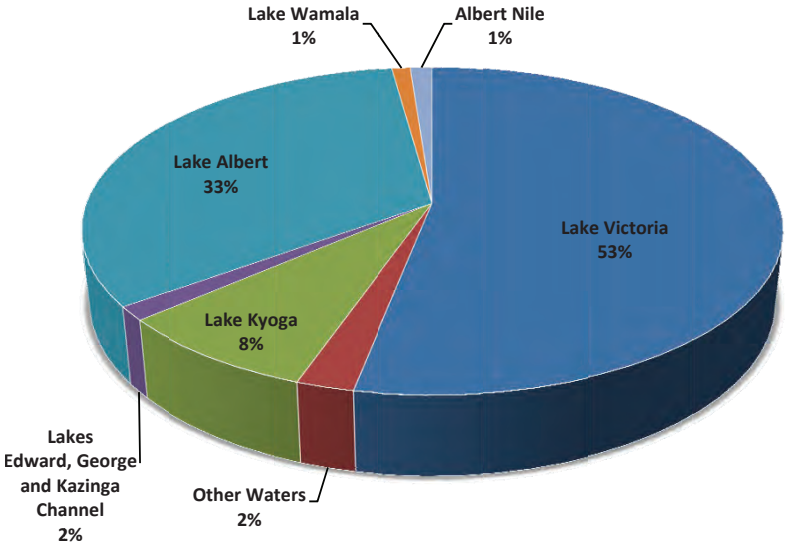
Country	Lake Surface		Shoreline		Catchment Area	
	Area (km^2)	%	Kilometers	%	(km^2)	%
Kenya	4,113	6	550	17	38,913	22
Uganda	31,001	45	1,750	50	28,857	16
Tanzania	33,756	49	1,150	33	79,570	44
Rwanda	0	0	0	0	20,550	11
Burundi	0	0	0	0	13,060	7
Total	**68,870**	**100**	**3,450**	**100**	**180,950**	**100**

(Okurut and Weggoro, 2011)

IMPORTANCE OF LAKE VICTORIA

There is great investment potential at national and local levels from this lake and its basin resources such as fish, water, biodiversity, land, forests, wildlife and minerals. These resources create ready opportunities for investment in agriculture, fisheries, tourism, trade, transport and communications, water, energy and industry. The Lake Victoria fisheries is a very important industry with a total harvestable fish biomass of between 800,000-1,000,000 tonnes, with a beach landed value of US$ 350-400 million and US$ 250 million in export earnings (LVFO, 2016). The industry is thought to contribute to the livelihood of more than 5.3 million people (DFR, 2011). In Uganda, Lake Victoria dominates the total fish catch contributing 53% in 2014 up from 45.9% in 2013 as shown in Figure 2.2 and Table 2.2 (UBOS, 2015).

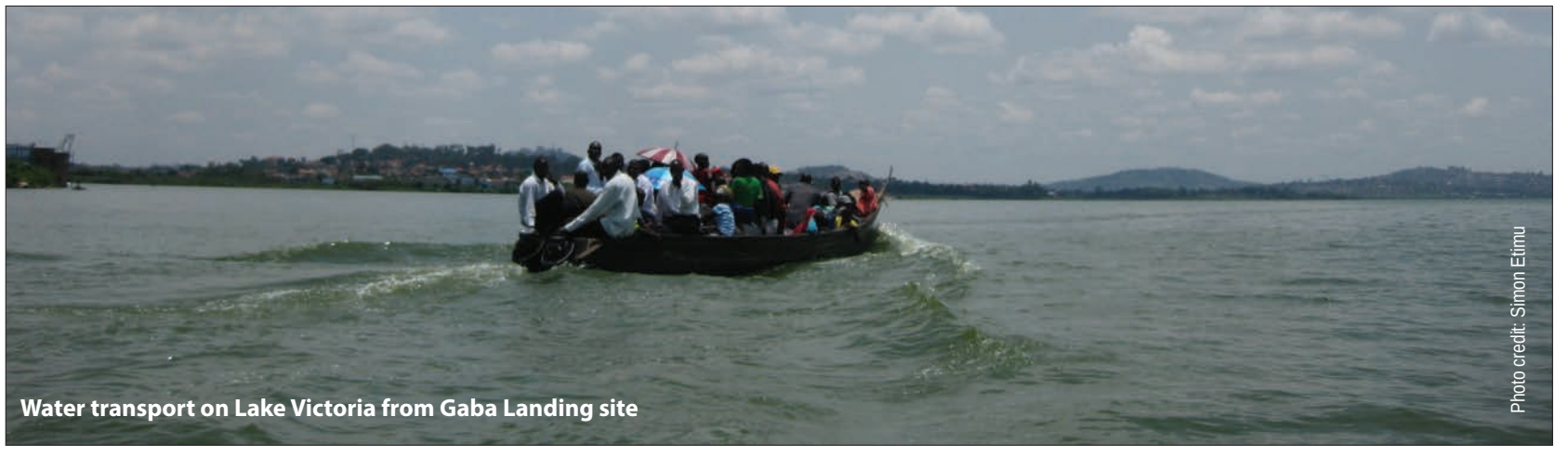
Figure 2.2: Proportion of fish catch in Uganda by water body, 2014



(UBOS, 2014)

Table 2.2: Fish catch by water

Water Body	2010	2011	2012	2013	2014
Lake Victoria	162,929	175,817	185,000	193,000	245,000
Lake Albert	155,811	163,949	152,000	160,000	152,000
Lake Kyoga	51,707	61,586	44,049	40,000	38,000
Lake Edward, George & Kazinga Channel	4,500	5,300	5,208	6,248	6,246
Albert Nile	5,200	5,300	5,043	5,500	5,390
Lake Wamala	5,600	75,112	5,712	4,500	4,590
Other waters	10,300	7,075	9,547	10,000	10,500
Total	**408,066**	**479,620**	**407,119**	**419,248**	**461,726**

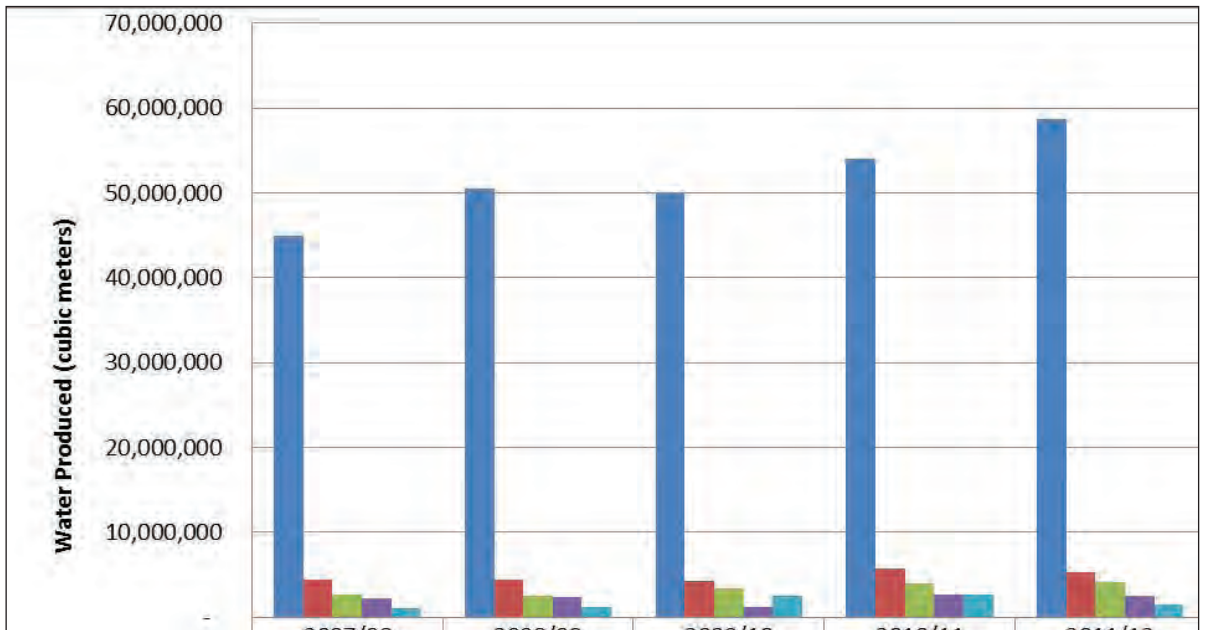


Water transport on Lake Victoria from Gaba Landing site

Photo credit: Simon Etimu

The lake is the most reliable source of water for all major towns and rural populations located around it and in the wider catchment area (see figure 2.3). Industries in the basin also draw water and discharge their effluent waste into the waters and soils in the catchment. Although various pressures in the catchment are contributing to a decline in water quality, the papyrus that commonly grows in the wetlands is important for buffering the lake from runoff and sediment in the catchment and for generally improving the quality of the lake water (Ryken, et al., 2015).

Figure 2.3: Amount of water produced by NWSC



	2007/08	2008/09	2009/10	2010/11	2011/12
Kampala/Mukono	44,895,513	50,444,455	49,965,795	53,982,345	58,621,020
Jinja/Njeru	4,449,272	4,458,433	4,282,931	5,688,194	5,246,721
Entebbe	2,698,751	2,507,564	3,447,686	3,947,527	4,043,707
Mbarara	2,195,264	2,311,524	1,187,657	2,630,715	2,473,624
Masaka	1,068,000	1,146,000	2,432,933	2,609,713	1,535,220

(UBOS, 2013)

Kampala Water - Lake Victoria Water and Sanitation project, Gaba Water works

H.E President Yoweri Museveni commissions the Isimba Hydro Power Dam on 7th October 2013 at Kayunga. The dam is expected to produce 183.2MW.

Figure 2.4: The artistic impression of the Isimba Hydro Power Dam in Kayunga and Kamuli Districts.

(China International Water & Electric Corporation (CWE), 2015)

Lake Victoria is the natural reservoir for hydropower plants located on Victoria Nile. These include Nalubale Power Plant that has been generating 180MW since its establishment in 1954; Kiira Dam (200MW since 2000) and Bujagali Generation Limited (250MW since 2012). Recently, Government approved the construction of a hydropower plant at Isimba village in Kamuli District which is expected to generate about 183.2MW (Figure 2.4). Uganda's hydroelectricity is used both locally and exported to the neighbouring countries of Tanzania, Kenya and Rwanda (UEGCL, 2016). Of all the benefits discussed, energy generation, alone, makes a tremendous contribution the the socio economic development of Uganda and the region.

Isimba Hydro Power Dam under construction

Photo credit: Nancy Alimadi

LAKE VICTORIA WETLAND SYSTEM

Figure 2.5: Lake Victoria basin

(Uganda Atlas, 1967)

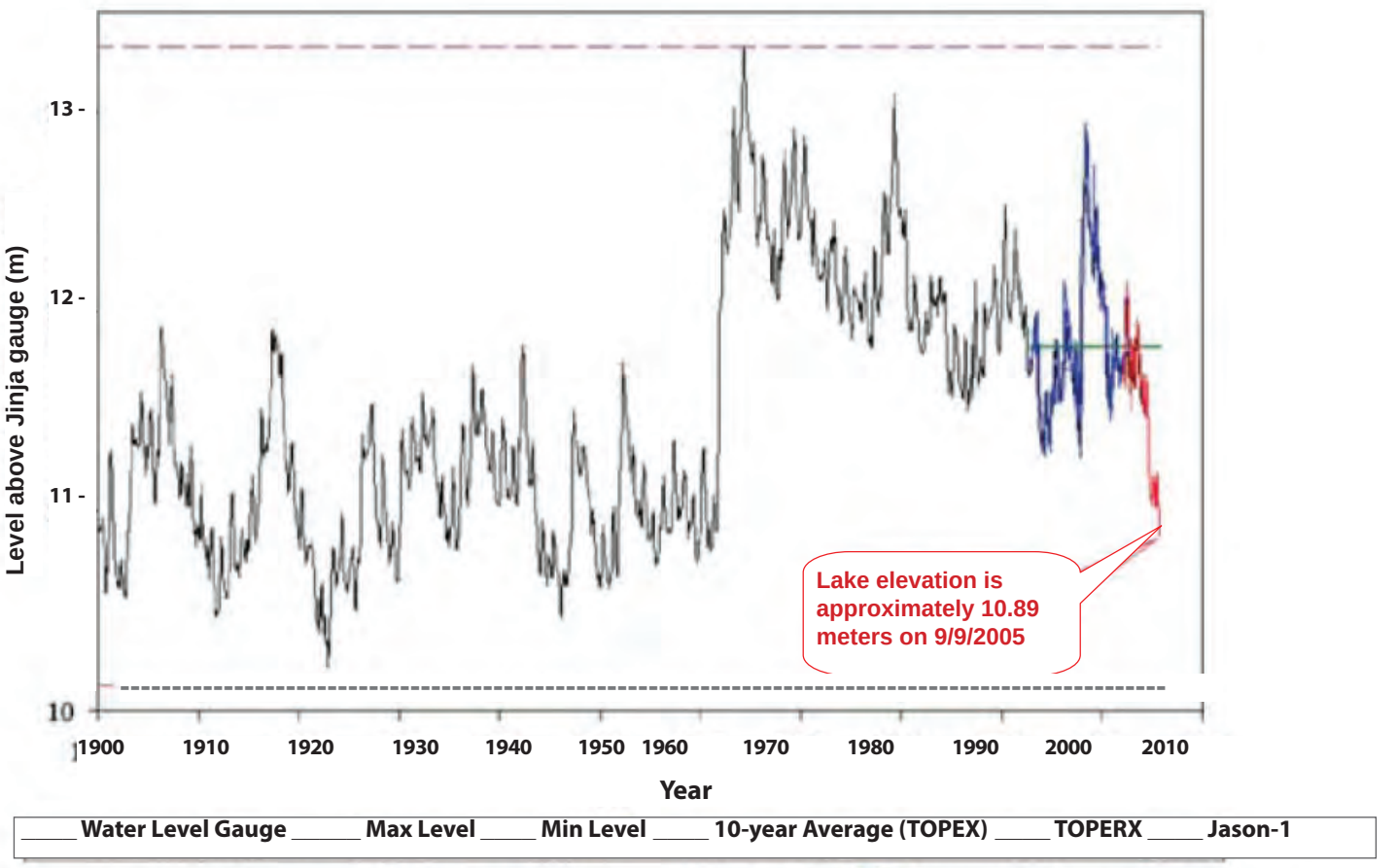
In Uganda, the Lake Victoria drainage basin lies to the eastern part of the lake and measures approximately 57,910 km² traversing over twenty districts as indicated in Figure 2.5. The main river-wetland systems in this basin includes the River Rwizi wetlands system located in Ntungamo, Mbarara, Buhweju and Shema Districts; Lake Mburo/Nakivale wetland system located in Isingiro and Mbarara Districts; Lake Wamala wetland systems in Mityana and Mubende Districts; River Katonga wetlands in Masaka; Lake Kijanebalola-Bukoora wetlands; Sango Bay-Musambwa Island-Kagera Wetland System (SAMUKA) Ramsar Site in Rakai District; Nabajjuzi-Nakaiba wetlands systems and Nabakazi wetland system in Mubende District. The rivers draining these wetlands have indefinite water courses and are embedded in deeply incised valleys. The wetlands have a close relationship with the lake in terms of hydrology and soil.

The wetlands that surround Lake Victoria are estimated to be around 422, of these, about 219 are found in Uganda (LVBC, 2011). Many of these have already been discussed in the Uganda Wetlands Atlas Volume I. These include Kaliddubi, Kasa Mabamba, Makanaga, Lufuka, Lutembe, Lumpewo, Kisubi Bay, Entebbe peninsula, Tende bay, Nambirgirwa, Mayanja and Mayanja Kato wetlands in Wakiso district. In Kampala the wetlands discussed included Kinawataka, Kyetinda, Nakivubo, Lubigi, Nalukolongo, Nabisasiro, Kitante and Kansanga in Kampala. While in Mukono on the list were Namanve, Njogezi, Mbalala, Namayuba, Ntunda-Kyabazala, Namafuko, Zirimiti and Namasoloza wetlands (MWE, 2015).

The vegetation is primarily swamp systems typified by rooted herbaceous and grass-like plants consisting mostly of *Cyperus papyrus* (Papyrus sedge), *Phragmites sp* (Common reed) and *Vossia cuspidata* (Hippo grass). Along with these are some perennially green shrubby vegetation. In the Mabamba bay, which is a Ramsar site, there is an extensive stand of *Miscanthus* interspaced with *Cladium* towards open water. Swamp forests are common along the fringes and include mainly *Piptadeniastrum, Albizia* and *Celtis sp* and a few *Phoenix* stands. Sitatunga, bushbuck, monkeys and birds are common; and some globally threatened birds including the Shoebill, Papyrus Gonolek and the Madagascar Squacco Heron (MWE, 2015).

The wetlands of Lake Victoria are central to the wellbeing of the lake ecosystem. The high faunal and floral biodiversity they support are exploited as wetland products. They buffer the lake from various pollutants, while the good and fertile soils make them suitable for agricultural activities which is one of the reasons why they are under such intense pressure. The wetlands are a major source of water for domestic use and wastewater treatment facilities for the urban areas that lie within the basin such as Masaka, Kampala, Jinja, Majanji and other landing sites and fishing villages.

Figure 2.6: Historical Water Level Elevation for Lake Victoria



Data Source

Historical water level gauge data from Jinja, Uganda (near Lake Victoria's outlet)

Satellite radar altimeteter data from USDS/NASA/UMD at

http//www.pecad/as.usda.gov/cropeexplorer/global_reservoir/

US Department of Agricultural (USDA)
Foreign Agricultural Service (FAS)
ProductionEstimates & Crop
Assessment Division (PECAD)

Major threats to the Lake Victoria wetlands

There are numerous inter-linkages between water systems and the associated wetlands and the threats they face are common to many of them. These include fluctuating water levels, population growth, soil erosion and sedimentation and alien invasive species.

Lake Victoria's level variation, derived from satellite altimeter measurements (see figure 2.6), shows a negative height variation trend - even after the significant inflows of water from the 1997-98 flooding event. Water levels have remained above-average for more than 40 years, but current water levels are below normal and the lowest level since September 1961. In over a century of scientific tracking of the lake, water levels have fluctuated widely. For instance, in 1961 and 1962, heavy rains led to an increase in water levels by up to 2 m with consequent heavy flooding in the surroundings which took decades to recede. Since then, levels measured at the Jinja gauge remained consistently above 11.9 m (about 1,134 masl) until December 2005 when they started to drop (NASA, 2006). This drop is projected to continue well into the 2030s as the impacts of climate change intensify (Tate, Sutcliffe, Conway, & Farquharson, 2004) and is especially worrying since reclamation of the wetlands that recede during the dry spells will intensify (Schuyt, 2005).

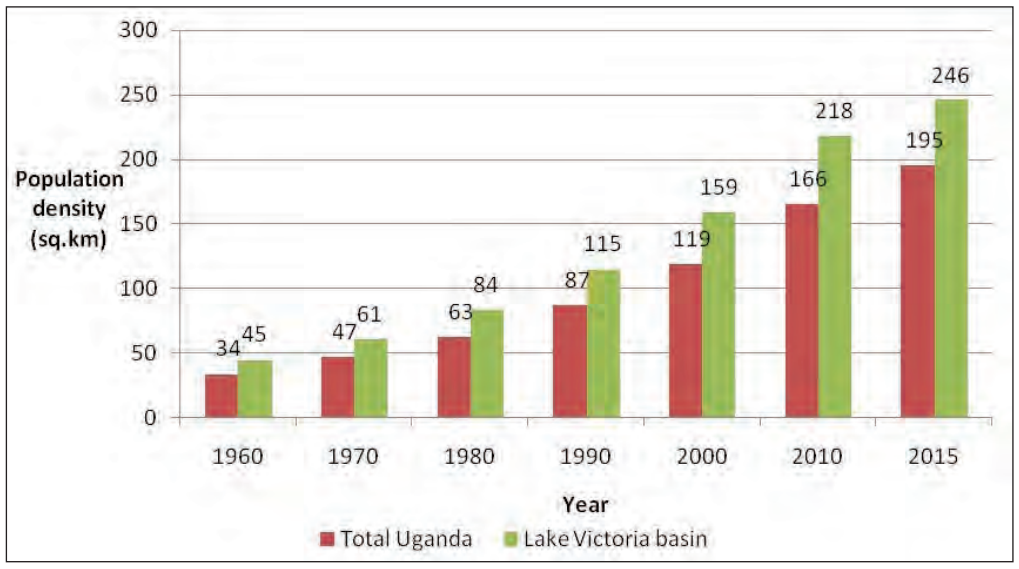
The population has increased phenomenally around the lake and the population density is significantly higher than the average national

Area in Bwaise suburbs flooded due to unplanned settlements and related illegal activities in the wetland

Flower farming in Lutembe wetland

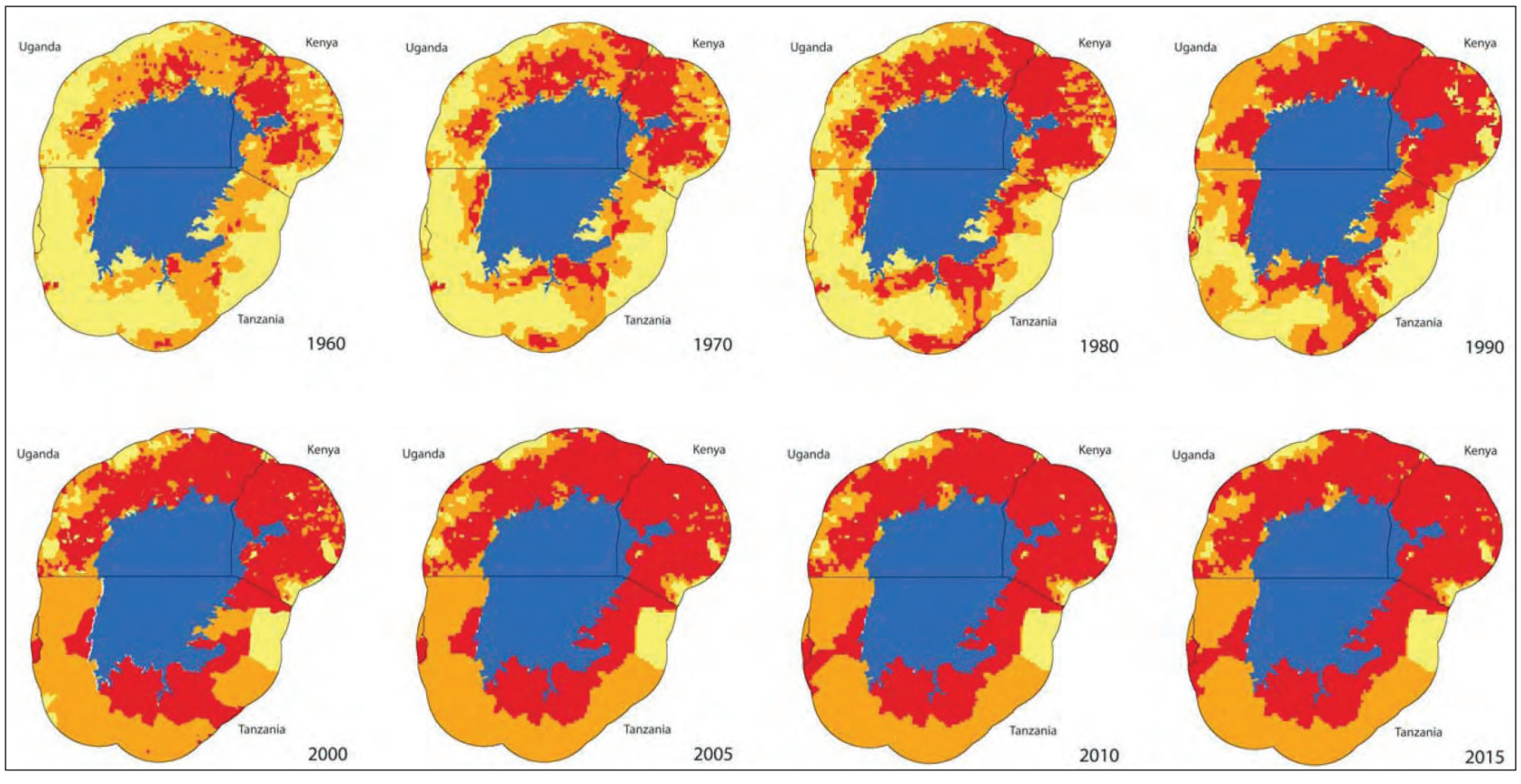
density (see Figures 2.7 and 2.8). This growth is due to the favourable conditions offered by the basin – agriculture, fishing and climate. This dense population is rapidly urbanizing and with this comes increases in water and sanitation needs. Much of this growth ends up encroaching on the wetland areas. For instance, wetlands in the peri-urban districts of Wakiso, Mukono and Kampala covered an estimated area of 68,300 km² in 1995. By 2010, when an inventory was conducted, the area had shrunk to about 58,650 km², representing a 14% loss in area. This loss was largely due to encroachment from human settlements and industrial development.

Figure 2.7: A comparison of population density: The whole of Uganda vs the Lake Victoria basin



(UNDESA, 2015), (UNEP, 2006)

Figure 2.8: Population growth in the greater Lake Victoria Basin



(UNEP, 2006)

Table 2.3: Location of industries (by Division) around the Inner Murchison Bay

LOCATION (DIVISION)	NO. OF INDUSTRIES	%
Nakawa	212	41.3
Central	244	47.6
Makindye	36	7.0
Kira	8	1.6
Mukono	13	2.5
Total	**513**	

Table 2.4: Types of industries found around Lake Victoria

No.	Category	No.	Category
1.	Aluminum manufacturing	21.	Mini steel mills
2.	Base metal and iron ore mining	22.	Mixed fertilizer plants
3.	Breweries	23	Nickel smelting and refining
4.	Cement manufacturing	24.	Nitrogenous fertilizer plants
5.	Chloro-alkali industry	25.	Oil and Gas development (onshore)
6.	Coal mining and production	26.	Pesticides formulation
7.	Coke manufacturing	27.	Pesticides manufacturing
8.	Copper smelting	28.	Petrochemicals manufacturing
9.	Dairy industry	29.	Petroleum refining
10.	Dye manufacturing	30.	Pharmaceutical manufacturing
11.	Electronics manufacturing	31.	Phosphate fertilizer plants
12.	Electroplating industry	32.	Printing industry
13.	Foundries	33.	Pulp and paper mills
14.	Fruit and vegetable processing	34.	Sugar manufacturing
15.	General manufacturing	35.	Tanning and leather finishing
16.	Glass manufacturing	36.	Textile industry
17.	Industrial estates	37.	Thermal power
18.	Iron and steel manufacturing	38.	Vegetable oil processing
19.	Lead and zinc smelting	39.	Wood preserving industry
20.	Meat processing and rendering		

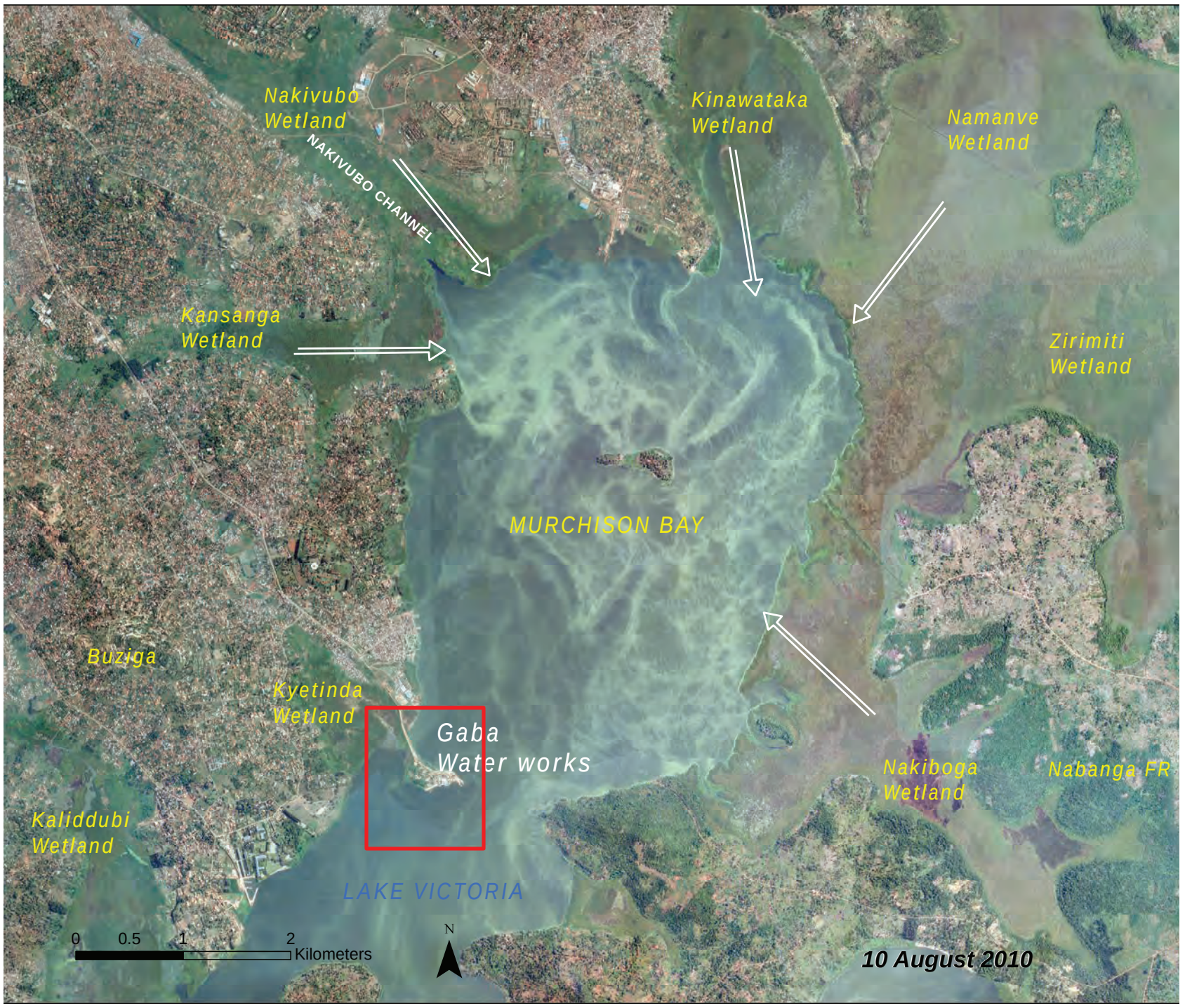
Poor land management practices, including deforestation in the lake's upper catchment and cultivation extending to the rivers and lake shore line have resulted in excessive sediment flowing into the lake. Runoff from agriculture (including floriculture) in the vicinity may include agrochemicals with negative impacts on the wetlands and the lake. Much of the sediment loading is brought in by the rivers entering the lake. For instance the Inner Murchison Bay receives all the storm water and other effluent that drains from Kampala City into the lake through the Nakivubo channel (see satellite image on the Inner Murchison Bay wetlands). The water that comes through the channel is highly polluted with partially treated wastewater and solid waste of which 74% is biodegradable (MWE, 2015).

The rapid rise in the human population in the greater Lake Victoria basin has increased solid waste and sewage generation (figure 2.9). Owing to poor sanitation management systems, much of this ends up polluting the lake and increasing the nutrient load (Kateregga & Sterner, 2007). There is also point source pollution from the numerous industries dotted around the lake shores that discharge their waste into the lake. Tables 2.3 and 2.4 show the location and type of industries around the lake.

This provides the ideal conditions for the proliferation of water weeds including invasive ones like the Water hyacinth

Testing water quality on Lake Victoria

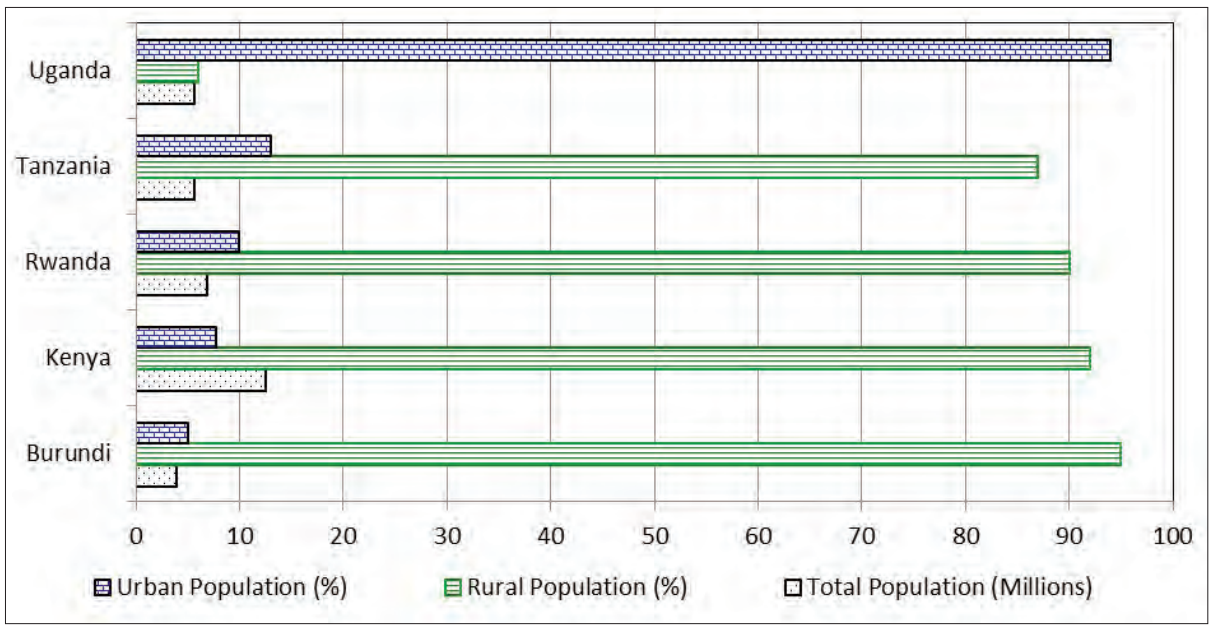
Photo credit: Simon Etimu



(Inner Murchison Bay wetlands, 2010)

(*Eichhornia crassipes*). The most affected area is the Murchison Bay, and shorelines of the lake in Mukono and Jinja Districts. The hyacinth has a negative effect on the fisheries as well as the water quality and is thought to affect the hydrological cycle by transpiring up to about three times the amounts of water that indigenous vegetation in the lake may transpire (de Groot, 1993).

Figure 2.9: Population growth around Lake Victoria



(Okurut, 2000)

KIRINYA WETLAND

KIRINYA WETLAND

Kirinya wetland is one of the major wetland systems in Jinja Municipality that fringe Lake Victoria. Located in Old Boma Parish, it buffers the lake from the development activities in Jinja Municipality. The wetland is of importance because it is used for tertiary treatment of effluent from the National Water and Sewerage Corporation wastewater treatment plant in Kirinya. Most of the wetland section is dominated with permanent wetlands. It has an area of about 471,000m^2 with an average depth of 2.3m (Kelderman P. and Kansiime F, 2007).

Cyperus papyrus and *Phragmites mauritanus* are the dominant wetland vegetation in the wetland with some scattered areas with *Typha species*. The wetland used to be dominated with several animals such as *Sitatunga*, crocodiles, snakes, fishes and birds but today these have been reduced. Today, a large section of the wetland has been reclaimed for industrial and agricultural development. Most sections of the wetland is under the Leasehold Land Tenure system under Uganda Land Commission and Jinja Municipal Council. A large part of the wetland today forms part of the Jinja Industrial Area. Most of these industries fringing the wetland

lack effluent treatment facilities. As a result, large quantities of pollutants including heavy metals are discharged directly into the wetland.

The wetland was used for craft and building materials, sand extraction, and wetland edge gardening. Today a number of destructive activities such as waste dumping, industrial pollution and expansion are major threats. Another visible change in land use is the conversion to agriculture—mainly for Sugarcane and Maize. This has set a bad precedent, jeopardizing all wetlands conservation management efforts. Two major tanneries located in the wetland (Leather Industries of Uganda (LIU) and Skyfat Tanneries) have on a number of occasions, been found to discharge their wastes directly into Kirinya wetland. In June 2008 NEMA closed LIU when they were found burying chrome sludge at the factory and discharging effluent into the wetland and Lake Victoria containing heavy metals especially chromium which is known to cause cancer. Leather tanning, a process of converting decomposable animal skin into leather, is one of the most chemical and water intensive industries associated with a number of environmental and health risks, including cancer among the tannery workers as a result of exposure to a wide range of chemicals with suspected carcinogenic and mutagenic properties.

Management efforts and recommendations

In January 2013, Government through the NEMA, and the Lead Agencies, the Police and the Wetlands Management Department evicted encroachers from Kirinya wetland. All the structures erected by the encroachers were demolished and wetland restored. In 2012, Government carried out the physical demarcation of Kirinya wetland to guide development in the area. Despite these efforts, the community continue to reclaim the wetland.

NAMANVE WETLAND

NAMANVE WETLAND

Namanve wetland is located in Kira Municipality (Wakiso District) and Mukono Municipality in Mukono District. A large section of the wetland is located within the Namanve Forest Reserve. It is one of the pristine intact wetlands that buffer Lake Victoria at the Inner Murchison Bay. The seasonal section of the wetland measuring 894 acreas was originally occupied by a Eucalyptus forest under the management of

the National Forest Authority (NFA). In 1997, Government degazetted the forest for the development of the Kampala Industrial Business Park (KIBP). Over 200 businesses acquired land and space for development on concessional terms. Despite the degazettement of the forest reserve for industrial development, it is important to conserve the integrity of the wetland within the KIBP in its natural state. This is because Namanve provides important functions in terms of waterway provision and flood amelioration; buffering the lake from industrial activities from the catchment; and as a habitat for aquatic biodiversity.

Kinawataka Wetland

KINAWATAKA WETLAND

Kinawataka wetland is located in Nakawa Division (Kampala City) and Kira Town Council in Wakiso District forming the border between the two Local Governments. The wetland measuring about 1.5km^2 drains into Lake Victoria through the Inner Murchison Bay. The wetland is of importance because it slows down runoff from the catchment, controlling upstream floods, and removing nutrients from the storm water. The wetland used to be predominantly a permanent wetland dominated by native vegetation types such as *Cyperus papyrus, Typha latifolia, Phragmites mauritianus*, and *Phoenix reclinata*. The edges of the wetland was occupied by transitional and colonizing dry land species such as *Cyprus rotundus, Melinis ripens, Leonotis nepotofolia, Digitaria abbysinica* and *Imperata cylindrica*. These wetland ecosystems has today been replace with settlements.

Five major rivers drain the Kinawataka catchment area namely;

1. River Vubyabirenge, along the valley between Ntinda and Naguru hill across Nakawa-Ntinda Stretcher road. This river drains into River Kinawataka just before Kampala-Jinja highway.
2. River Kinawataka, along the valley between the Kyambogo University and Ntinda Ministers Village in Nakawa Division.
3. River Fuwengombe, along the valley between Kyambogo and Banda hills that drains into Kinawataka River between Plots 4 and 6 Hill Crescent Road.
4. River Wamalenge, along the valley between Banda and Kireka hills that drains Kawoya wetland into River Kinawataka just before crossing the Railway line at Katogo village.
5. River Nkolokolo that starts from Nambole Stadium long the valley between Kirinya and Kireka hill in Kira Town Council.

The wetland vegetation encourages infiltration and retention of water, thus regulating flows in the rivers. A significant portion of the fairly new and fast expanding Ntinda Industrial Area is located within Kinawataka wetland system. Kampala Capital City Authority (KCCA) development plans show that the entire wetland was sub-divided into plots with road networks which motivates settlements and industrial development, the biggest threat to this very important wetland.

Nakivubo Wetland

NAKIVUBO WETLAND

Nakivubo wetland is located in Nakawa and Makindye Divisions. The wetland catchment extends as far as Central Division and Kawempe Division from Makerere-Kivulu area to Owino market through the Yard area at Mukwano into Kampala Industrial Area. It is fed by the Nakivubo River and its tributaries include Kayunga, Kitante, Lugogo and Nakulabye. It is dominated by *Cyperus papyrus* (Papyrus), *Typha sp* (Cat tails), and *Phragmites sp* (Common reeds) with a large area on the northeastern side covered by *Miscanthidium* grass. The wetland is bisected by a Railway line running from the city to Port Bell on the shores of Lake Victoria. This effectively divides it into two zones of human influence. The section below the railway line is relatively deep. This depth and recent Government conservation efforts have left it relatively intact with only minimal cultivation along the fringes.

However, a large section of the shallow wetland above the railway line is under severe human pressure and has been reclaimed for settlement, industry and cultivation. It runs from the central industrial area of Kampala through dense residential and industrial settlements before entering the lake at Murchison Bay. Three major settlements have encroached into Nakivubo Wetland. These includes the high class residential areas of lower Bugolobi Bangalow and the low class residential villages (slums) of Kitintale Zone 12 in Nakawa Division and Namuwongo in Makindye Division. More than 100,000 people live on the fringes of the wetland.

Importance of Nakivubo wetland

1. Lake Victoria Buffer. Nakivubo wetland functions as a buffer through which much of the city's industrial and domestic wastewaters pass prior to discharge into Lake Victoria at Murchison Bay. The lower section of the Inner Murchison Bay (IMB) is the main source or water for the city that is located downstream of this wetland. The buffering capacity of the lake by this wetland cannot therefore be underestimated.

2. Drainage. The Nakivubo River and its tributaries, which flow into the wetland, provide the main drainage channel for Kampala. They carry wastewater from the city centre, industrial area, and residential zones. About 9 out of 10 Kampala's residents are not connected to a piped sewerage supply and so these wastes are largely organic. Together they are equivalent to the raw sewage produced by about 500,000 people or 40% of the population of Kampala (COWI/VKI 1998).The majority of the low-cost residential settlements abutting Nakivubo are excluded from the municipal sewerage system. More than 33,000 people discharge domestic wastes into the wetland, either as runoff into the surface waters which enter it or through groundwater inflows from the infiltration of rainfall on hills beside the swamp, from pit latrines, septic tanks, soak pits and leaking waste pipes.

3. Tertiary treatment of NWSC Sewage. The outflow for Kampala's sewage treatment works, at Wankoko Bugolobi, also runs into Nakivubo wetland. Partially treated sewage is mixed with the untreated effluents already in the Nakivubo Channel before entering the wetland, where it contributes about 7% of the total nutrient load, equivalent to an additional flow of sewage from about 7,000 people (COWI/VKI 1998).

4. Point source pollution treatment. At least three other point sources of wastes enter southern parts of the wetland directly, including effluents from Uganda Breweries and two sewage outflows from Luzira Prison. Nakivubo Swamp also receives industrial effluents. Up to a third of the enterprises in the industrial area have no treatment facilities, and so dispose of their wastes directly into the wetland. Effluents and pollutants contained in these untreated wastewaters, and in the industrial wastewaters which have passed through Bugolobi sewage treatment works, include detergents, lubricants, oils, acids, xenobiotics, nitrates, phosphates and heavy metals such as zinc and mercury which are carcinogenic.

Kyewaga Lakeshores Wetlands

KYEWAGA LAKESHORES WETLANDS

Kyewaga lakeshores wetlands are located within Kitinda Village along the shores of Lake Victoria in Katabi Subcounty in Wakiso District overlooking Entebbe Municipality. The wetland and forest reserve which is located near Missed Call beach is located 10km on Entebbe Road off Abaita-Ababiri in Katabi Subcounty. A large section of the wetland is located within Kyewaga Central Forest Reserve under the management of National Forestry Authority (NFA).

Major threats to the wetland

The lakeshore forest and wetland covers about 209 ha but during the last decade has come under threat from the surrounding communities, high ranking security officers and government officials. It started with the forest being encroached upon by people from the nearby communities before city businessmen moved in. The locals were youth from the surrounding villages of Nkumba central, Bufulu, Kisembi and

Kitinda among others. They were among the first to discover the sand in the forest reserve and started mining it, while clearing the trees in the vicinity. Later the city businessmen moved in with sophisticated equipment that they used to dredge sand directly from the lake bed.

In 2011, the wetland (within and outside the forest reserve) came under attack from youthful bricklayers from Kabai subcounty, who later changed their activity to sand mining. This led to a public outcry over the rate at which Kyewaga CFR was being degraded.

Sand mining leaves behind huge ditches that later fill with water. These are then used by other community members to make bricks. The stagnant water also forms breeding ground for malaria-carrying vectors. Sand mining is common around Kisubi areas and Nambigirwa wetlands. The activity is mainly carried out at night when the traffic along the Kampala-Entebbe road is low and when there are few or no law enforcement officers around.

The NFA has attempted to stop these activities without success. It started with the large scale sand miners or investors (such as M/S Aka Bino Fish Farm project) seeking technical assistance from the Fisheries Department and NEMA to develop fish farms, and they even took a loan from the African Development Bank. The fish farmers later expanded their farms into the CFR and in order to avert the attention of law enforcers, carried out their activities at night. These included cutting down trees from the forest and ferrying them to unknown destinations. During the day, they would mine sand under the pretext of creating fish ponds.

Namiro Wetland

NAMIRO WETLAND

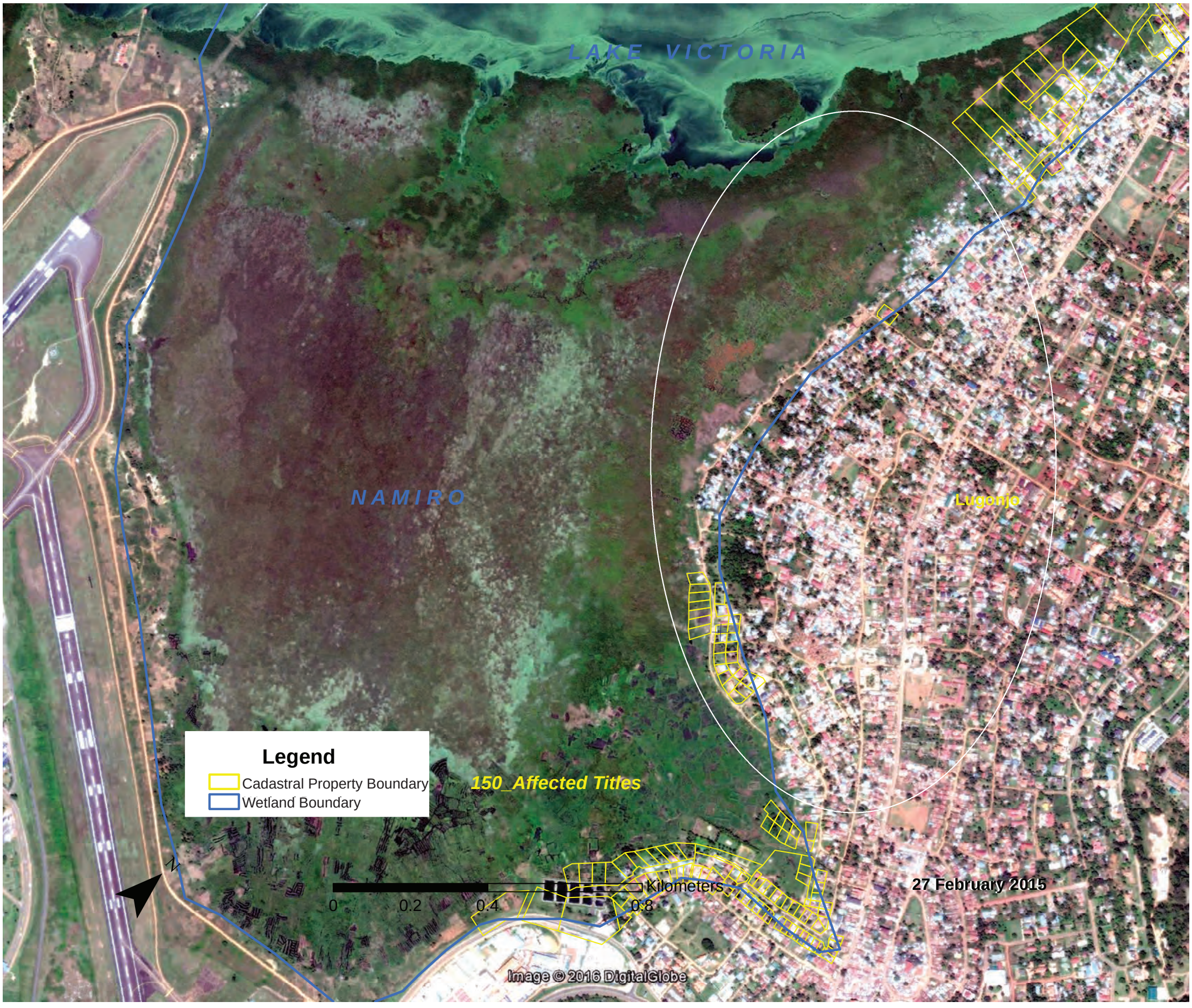
Namiro wetland is located within Entebbe Municipality, between Entebbe Airport, Kiwafu and Lugonjo villages in Entebbe. It is a permanent shoreline wetland measuring about 3.5km^2 and lies at an altitude of about 1,143m.a.s.l. The wetland forms part of Waiya Bay. The wetland surrounds the eastern side of Entebbe International Airport about 3km from State House and derives its name from a famous myth among the people in the area that a mysterious Namiro, who had the body of a woman and feet like the tail of a fish, protected the wetland. The entire wetland is under the jurisdiction of Wakiso District Land Board.

Namiro wetland is of particular importance because it is used for tertiary treatment of waste water from the NWSC from the entire eastern side of Entebbe Municipality. A large number of community members also derive their livelihoods from the wetland for growing yams, potatoes, sugarcanes, and sprinklings of bananas along the wetland.

The wetland is also viewed by ecologists as the last remaining buffer between the people's settlements and the pollution of Lake Victoria. In Entebbe, as in all major towns in Uganda with sewerage lines, domestic sewage, industrial wastewater, and other effluents are discharged into swamps surrounding Lake Victoria. It is believed that the swamps filter out the dangerous substances before the effluent enters the lake. When it rains in Entebbe, all the storm water and silt also ends up in Namiro Swamp where it is filtered before it is finally deposited in the lake. The wetland has also ensured that Entebbe, unlike most major urban centers in Uganda, suffers only minimal flooding.

Major threats to the wetland

The most visible threats to the wetland are brick making and encroachment by settlers. Real estate developers have also filled up parts of the wetland with murrum and debris from construction sites and erected structures on it. The wetland also supports many farmers (estimated at over 300) who grow crops in the wetland. The major recent threat to the wetland has been alienation of titles by the Ministry of Lands and issuance of land titles to individuals. These land titles owners are so far proposing a number of development activities in the wetland but all have been rejected.

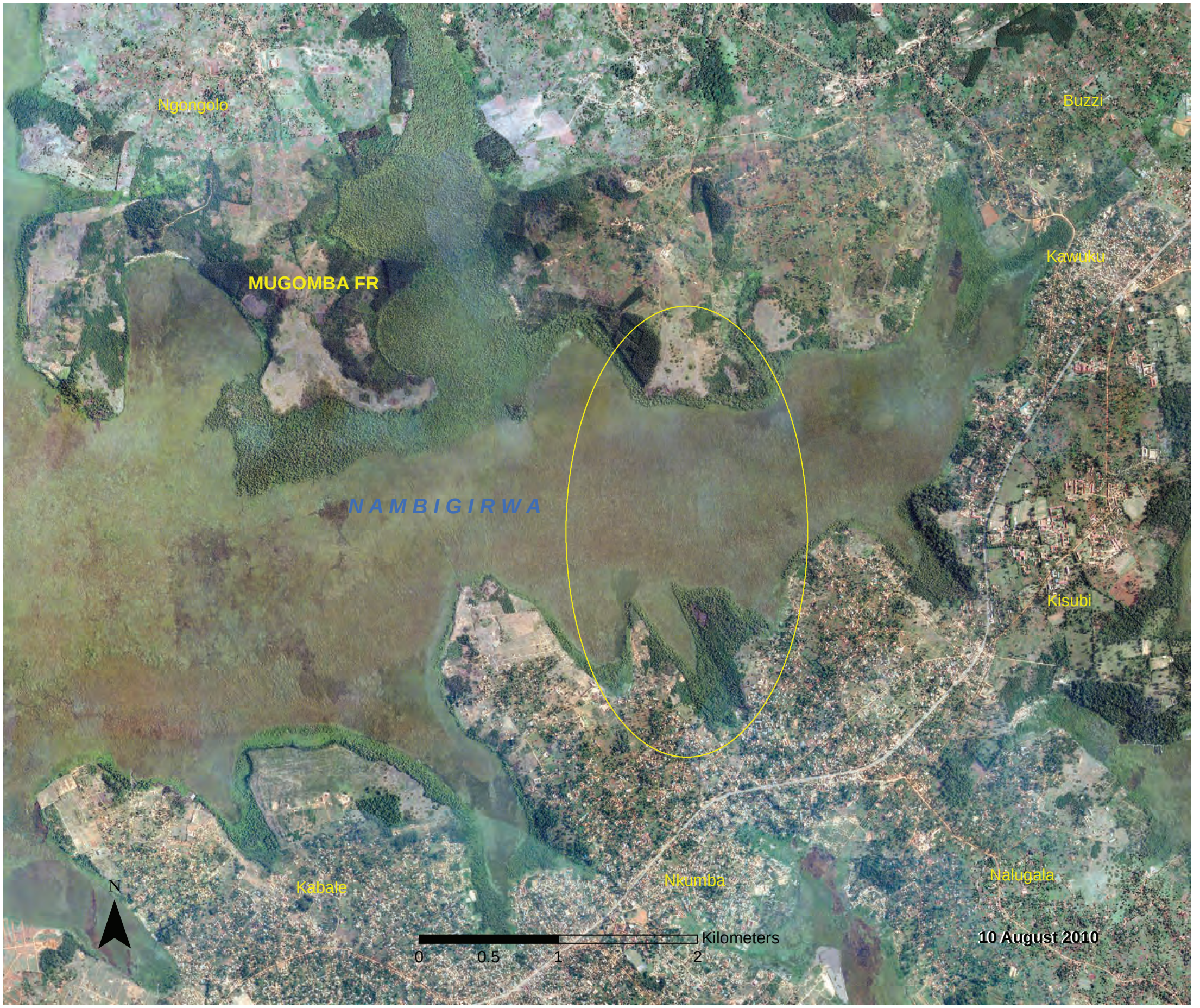


Nambigirwa Wetland

NAMBIGIRWA WETLAND SYSTEM

Nambigirwa is a privately owned permanent wetland located in Wakiso District and forms the boundary between Entebbe Municipality, Sissa and Katabi Subcounties. The wetland measures about 23.3km^2 and lies at an altitude of 1,143ma.s.l. The most significant wetlands that drain into Nambigirwa Wetland include Kalandazi, Nalumenya, and Mugomba river wetlands. All these combine to form Waiya bay at the shores of Lake Victoria near Entebbe Airport. The wetland is easily accessible from the Kampala-Entebbe highway.

The most dominant wetland vegetation at the lake front is *Cyperus papyrus* while *Miscanthus sp* is the most dominant inland with several pockets of swamp forest with *Raphia sp*. Today, most of these pockets of swamp forest areas have been cleared for agriculture. The wetland is a habitat for a number of Cranes and other birds as well which are normally found at the lake front. It forms part of Entebbe

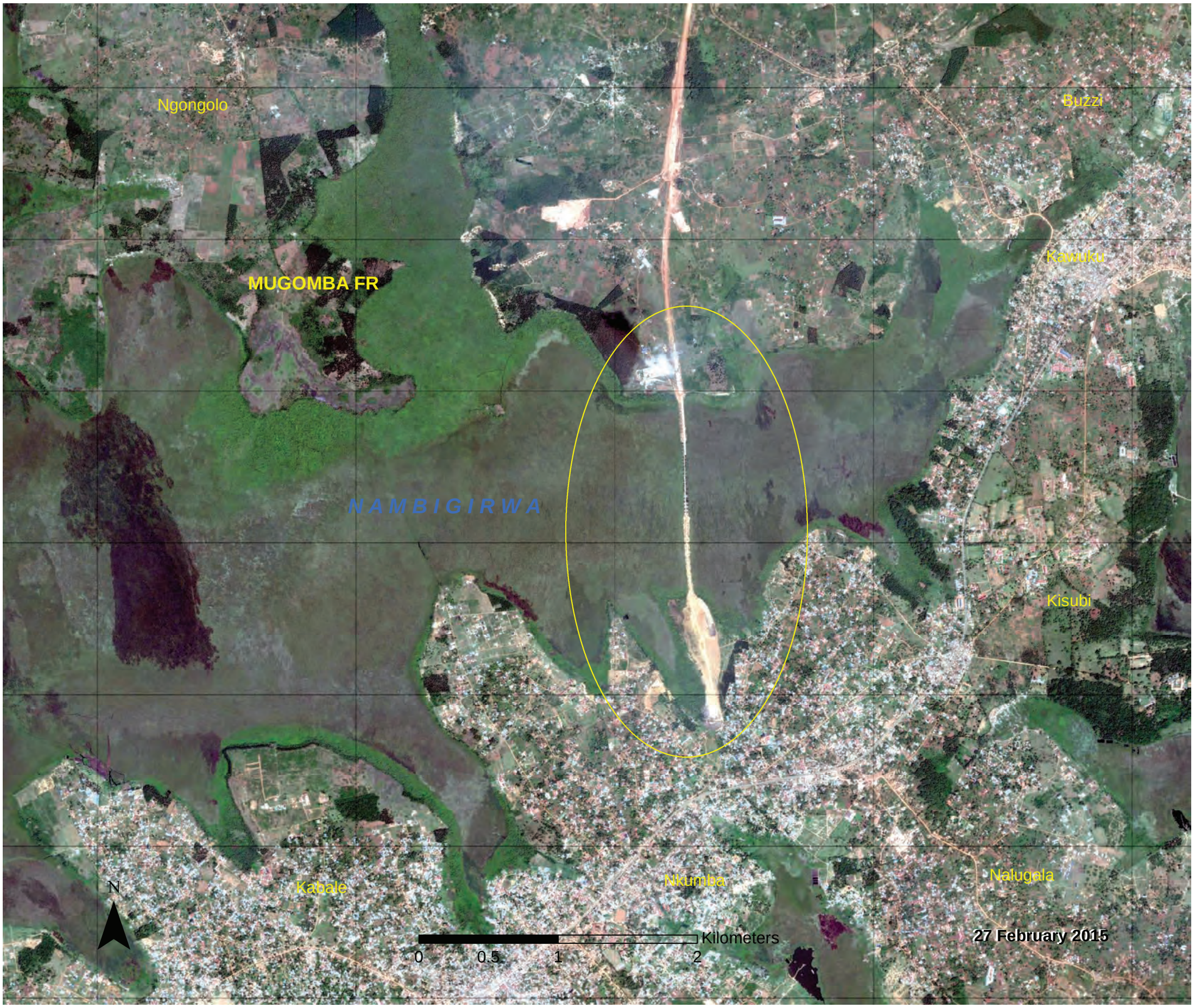


Bird Sanctuary. The wetland used to have Sitatunga and Bushbuck but these are now rare due to hunting activities. The fringes have a variety of monkeys among which is the Black and White Colobus monkeys.

The most common land use in the catchment of this wetland includes settlements, cultivation, ranching, floriculture, brick-making, fuel wood collection, charcoal protection and timber harvest. During the recent past, because of population explosion, most of these activities have been extended into this pristine wetland. The most common degrading activities in the wetland include settlements, sand mining and expansion of flower farms. The demand for sand in the construction industry in the neighbouring commercial areas of Kajjansi, Entebbe, Kisubi including Kampala City has put a lot of pressure on the Regulators to protect the wetland integrity from encroachment.

Management efforts and recommendations

Although the entire wetland is under private ownership and some is a protected area, there has been some efforts by Government which has reduced human impact on the wetland. For instance the construction of the Kampala-Entebbe Expressway was approved only after an Environment Impact Assessment was undertaken. In order to preserve the integrity of the wetland the road was designed on raised pillars to minimize its ecological footprint. This intervention is the first of its kind on such a large project in a wetland.



RIVER KATONGA SUB BASIN

The Katonga river once flowed away from Lake Victoria into Lake George along its entire length but uplifting events between the two lakes associated with the formation of the rift valley caused the inundated region to the southwest of Lake Wamala to become the new divide for the Katonga river. It now flows mainly eastwards into Lake Victoria and is fed by tributaries along the way. The river enters Lake Victoria near Lukaya in Kalungu district. The 220km long river flows through the districts of: Kalungu, Bukomansimbi, Mpigi, Butambala, Gomba, Mityana, Mubende, Sembabule, Kiruhura, Ibanda and Kamwenge.

Major threats to the wetland

The river's importance in the basin is due to the fact that it is the only reliable source of water in this dry cattle corridor. During the dry season, many pastoralists travel long distances in search of water for their livestock and this has occasionally led to conflicts with other land owners who fence the entire riverbank.

Although the law provides that a 100m buffer zone be conserved as a common good, this legal provision has been abused in many parts of the river especially in Luguru and Ntuusi Subcounties in Sembabule and Gomba Districts respectively. As a result, the District Local Governments register many land related conflicts emanating from water availability.

Photo credit: George Lubega

LWERA RIVER WETLANDS

The Lwera section of River Katonga forms part of the Nabugabo wetland Ramsar site.

Major threats to the wetland

The main threat facing this wetland is the mining of sand for the construction industry in Kampala City and other urban areas. For instance the sand from this wetland was recently used for the construction of bridges and pillars for the Kampala-Entebbe Expressway and other major infrastructure projects in Kampala and Entebbe. The sand mining business has become very lucrative and efforts to control the activity especially at night have been almost impossible.

Management efforts and recommendations

There have been some initiatives to regulate the sand mining industry as required by law. Guidelines have been developed by NEMA together with lead agencies. The guidelines require sand mining to be regulated through a Permitting System as required by law. The minimal requirements for approval of permits include:

1. All developers must put in place a sand deposition yard for draining the sand before loading onto trucks and ensure no sale or transportation of wet sand on all feeder and major access roads including the Kampala-Masaka highway;
2. All sand miners must ensure that the trucks ferrying sand to the different markets or yards are fitted with functioning tailgates and tarpaulins, and other appropriate types of containments, to cover or contain the sand to prevent spillage or littering and sand/dust emissions and that there is no deposition of sand on the roads;
3. Developers should seek written authorization from the Uganda National Roads Authority (UNRA) for connecting a feeder road to the main Kampala-Masaka highway. In any case, small tarmac adjoin roads should be constructed to join the major road;
4. All access roads to be constructed to the sand deposits must be reinforced with hardcore stones at the bottom, to ensure continuous flow of water and stability of the road;
5. All sand mining should be carried out at least 200meters away from the Kampala-Masaka Highway and the area between the Highway and the sand excavation sites should be maintained under natural wetland vegetation;
6. Sand miners should also ensure that all original traditional users of the wetland are fully compensated before commencement of any sand mining activity; and,
7. Ensure that the use of the wetland for sand mining is harmonized with the activities of the local communities using these resources in various ways, and that the concerns of these communities about use of the resources including access to the Kampala-Masaka Highway and other neighbouring villages are adequately addressed as they arise.

Unregulated sand mining activities in Lwera wetland, Mpigi.

Photo credit: George Lubega

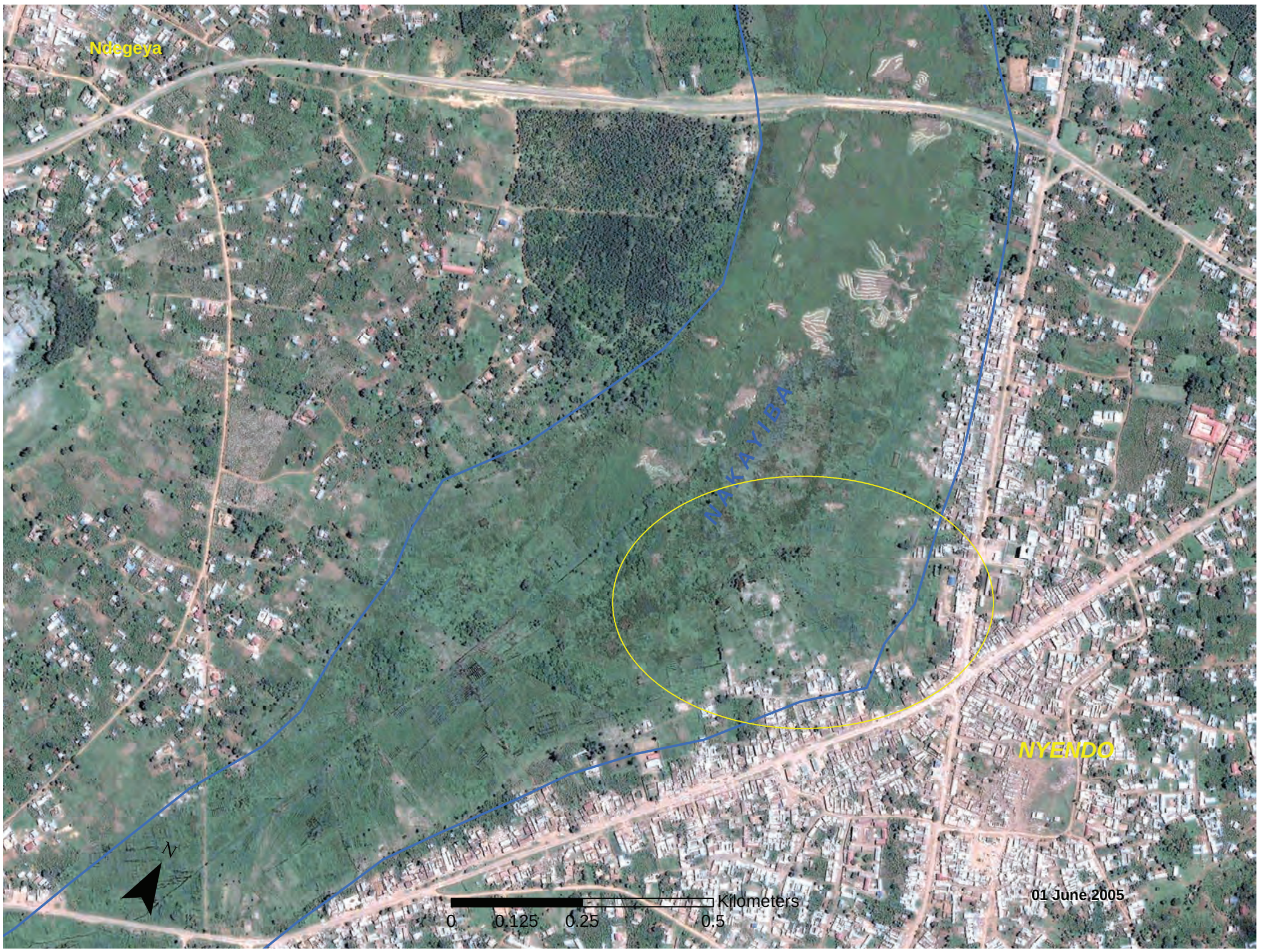
Nakayiba wetlands

NAKAYIBA WETLANDS

Nakayiba wetlands also drain into the Katonga River. The two wetlands start from Masaka Municipality and are critical for the social economic development of this urban area. Nakayiba wetland acts as a pollution buffer offering municipal wastewater treatment and reducing the public health risk of disease through the abatement of potential surface and ground water pollution.

Major threats to the wetland

The wetland is located in the middle of Masaka Municipality and serves as an integral part of the NWSC treatment of wastewater at Jethabai Road. It also carries storm water from the central business area of Masaka Town. The Masaka Wastewater Treatment plant serves only about 8% of the municipality and its effluent does not meet national standards for discharge of wastewater into the environment (Lukooya, 2013). Nakayiba wetland effectively augments the performance of the Masaka wastewater treatment plant. This is essential in enhancing downstream pollution control as well as safeguarding public health. The plant requires rehabilitation and expansion, as does the town's sewerage network. The Urban Landscape Plan considers Nakayiba wetland as a key ecosystem for municipal sanitation and wastewater management.



The capability of any wetland to maintain the quality of the downstream water depends on its natural integrity. Like other wetlands close to urban areas, Nakayiba wetland is under threat due to high population explosion in Masaka municipality, urbanization and agriculture. This has implications on the ability of the wetland to perform its water quality regulation function. Despite dilapidation of the wastewater treatment plant at Bwala, the wetland continues to show effective downstream pollution attenuation through reduction of organic matter, suspended solids, faecal coliform, and nutrients. But this may not be for long.

Before 2000, the wetland was mainly used for cultivation (mostly sugarcane and horticultural crops) until 2003 when NEMA directed that the wetland be restored to perform its tertiary water treatment function. In the downstream Senyange Zone, the community had in stages transformed the gardens into settlements. First was the erection of temporary structures that were progressively replaced with permanent structures.

At Nyendo-Senyange area overgrazing and siltation is the main challenge. Trees that were planted along the wetland were destroyed by animals straying into the wetland affecting restoration efforts. Downstream towards the Masaka-Mbarara highway, the unregulated brick making is also a major challenge as the demand for construction materials has increased.

Management efforts and recommendations

Although restoration activities were undertaken by NEMA in collaboration with the MWE and the Masaka District Local Government between January and March 2005, there are still challenges. By September 2015, the section of wetland between Nyendo-Masaka Road and the NWSC plant had completely regenerated with permanent wetland vegetation *(Cyperus papyrus)* now visible. This is in big contrast to the gardens that used to dominate. Some of the people evicted from the wetlands set up seedling nurseries along the Nyendo-Masaka road. At the current scale, they pose no harm, but large scale growing of seedlings is likely to be detrimental to the longer sustainability of the wetland.

River Kagera Wetlands

RIVER KAGERA WETLANDS

The 400 km Kagera River is the largest of the 23 rivers draining into Lake Victoria. It contributes between 24-34% of the annual inflow into the lake depending on the season (WSP, 2003). The waters of the Kagera are provided by two major tributaries - the Nyawarongo (Niavarongo) of Rwanda, which feeds Lake Rweru, and the Ruvubu of Burundi. Only the lowest reaches of the Kagera flow through Uganda. It enters Lake Victoria about 25 miles north of Bukoba. The major part of the Kagera River Basin lies in Rwanda and includes the Akagera National Park. In terms of management, it forms the the Sango

Bay-Musambwa Island-Kagera Wetland System (SAMUKA) system in Uganda. It is the biggest swamp forest in the country. There are also papyrus and herbaceous swamps, palms and seasonally flooded grasslands.

Major threats to the wetland

The landscape is predominantly hilly and mountainous with some lakes and swamps and this coupled with the extremely high population densities found in the Kagera river catchment area is threatening the integrity of these wetlands. The rapidly growing population, agricultural and livestock intensification and unsustainable land use practices have led to land degradation, deforestation and encroachment into wetlands with impacts on the water quality, the hydrological regime and water table recharge. Siltation from erosion in the catchment affects the lake through nutrient loading (NEMA, 2009). Since the Kagera is part of the wider Nile River basin, issues of environmental integrity are of utmost importance.

Lake Mburo and Lake Nakivale Wetlands system

LAKE MBURO AND LAKE NAKIVALE WETLAND SYSTEM

Lakes Mburo and Nakivale are very fragile having been formed by water accumulating in the wide and shallow saucer-like basin flanked by wide-ranging ridges and hills which were formed as a result of earth movements long ago. The lakes are shallow and have numerous, finger-like narrow arms extending inland and forming many peninsulas. They are very vulnerable and any disruption of inflows can cause them to dry up. The lakes are located in a dry area compared to the rest of this region.

It can be described as a kind of rain shadow due to the climatic dynamics associated with the prevailing relief and the proximity to the rain-bearing winds from Lake Victoria.

Lake Mburo is wholly located in Lake Mburo National Park under the management of Uganda Wildlife Authority (UWA). There have been reports from UWA of dwindling quantities of water in the lake. However, the management of the shoreline wetland is still good.

The wetlands and shores of Lake Nakivale are mainly located on private land. Here, the impacts of degradation of Lake Nakivale wetlands and lakeshores are already evident and getting worse. The waters of the lake have been gradually declining as seen from the shrinkage in size. There are now, growing fears of the lake demise; which would be devastating since the lake is the sole source of permanent and reliable water in this region. Elders who have lived in the area for over 20 years have described it as a sinking lake.

Major threats to the wetland

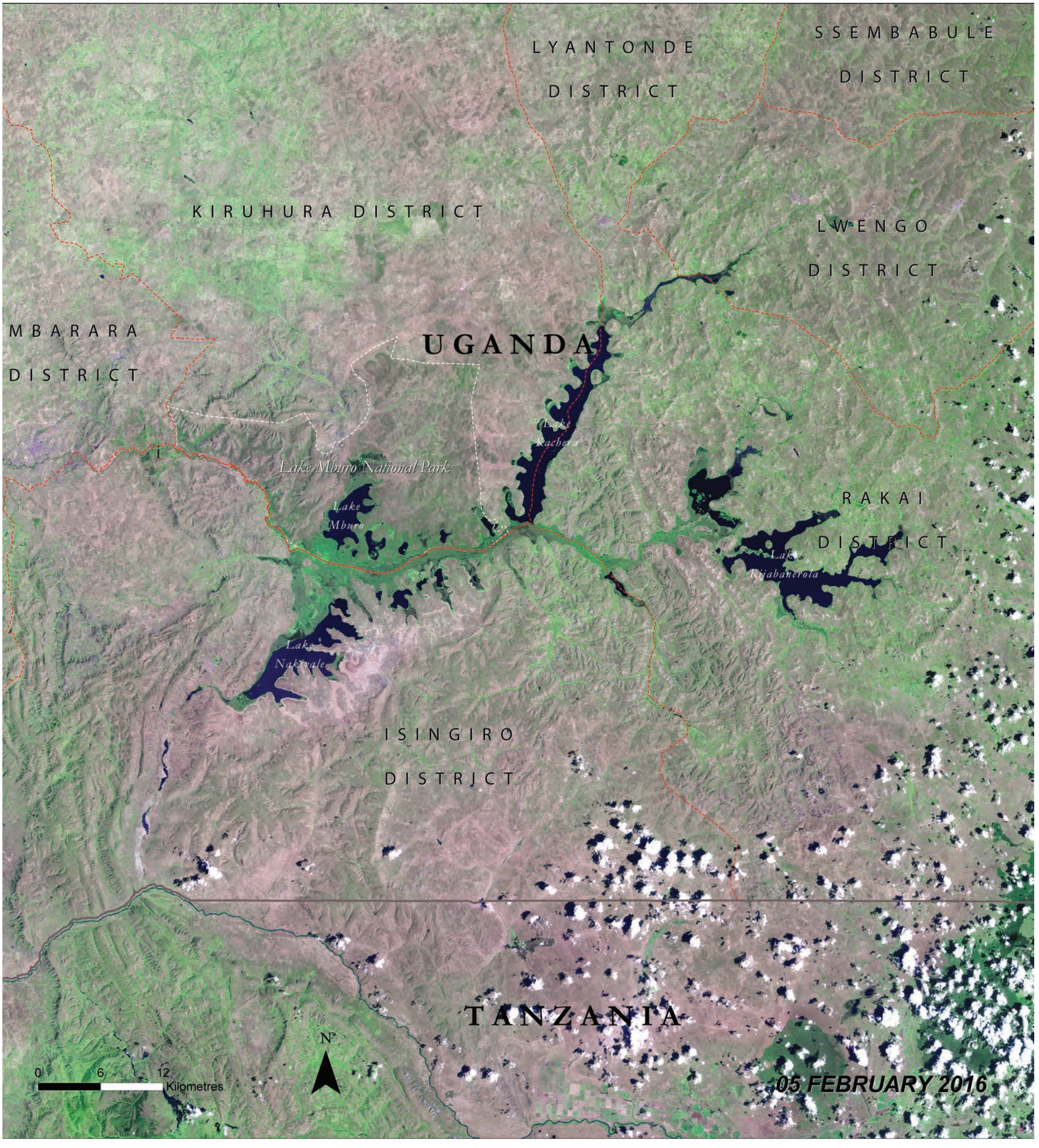
Most of the land in the immediate vicinity of the lake is a government managed refugee resettlement scheme, while the rest is privately owned land used mainly for cattle grazing. Nakivale Refugee Settlement was created in 1960 in the wake of an unprecedented influx of Rwandese refugees. The colonial government exchanged a few scattered parcels of land it owned in Nyabushozi, Mbarara district for six parcels of land in the Nakivale area that were owned by the King of Ankole (Omugabe). Nakivale was considered suitable as there were very few nationals living there due to tsetse fly infestation and also because it was fairly close to the Rwandan border. This then became the Nakivale Refugee Settlement of today.

Management efforts and recommendations

In order to maintain the integrity of the wetlands, there is a policy against planting perennial plants. However within the refugee settlement agriculture with maize and beans as annuals and bananas as perennials is common. There are even some locals who have encroached on the area and planted extensive areas of bananas. Cultivation and settlement is on the increase so much so that these activities have encroached on the 200m statutory protection zone of the lake. Between February and March 2013, the government (through the Office of the Prime Minister and with technical support from NEMA) restored a 57 km-stretch along the lake. Crops and structures in the wetlands and within the 200m lake shore protection zone were demolished and the lakeshore restored to its natural state. In localised areas along the shoreline, indigenous tree species were planted to provide fuel wood and other ecosystems services.

Currently, the Directorate of Water Resources Management is working with stakeholders to establish a Catchment Based Water Resources Management system for the River Rwizi catchment. It will build on current integrated water resources management initiatives and hopefully reduce the amount of siltation in the Lake Nakivale wetland system.

Cattle grazing in Lake Mburo National Park


LYANTONDE
DISTRICT
SSEMBABULE
DISTRICT
KIRUHURA DISTRICT
LWENGO
DISTRICT
MBARARA
DISTRICT
UGANDA
Lake
Rachera
Lake Mburo National Park
Lake
Mburo
RAKAI
DISTRICT
Lake
Kijabanerola
Lake
Nakivale
ISINGIRO
DISTRICT
TANZANIA
N
0
6
12
Kilometres
05 FEBRUARY 2016

River Rwizi Wetland System

RIVER RWIZI WETLAND SYSTEM

River Rwizi is one of most important catchments of Lake Victoria and forms the uppermost watershed of the basin in the ridges of Rwampara in Ntungamo and Mbarara Districts and Katala in Buhweju District and also in Isingiro district. The landscape comprises steep ridges separated by deep valleys, on the sides of which the main road, most settlements and prime agricultural land are located. These include the Mbarara-Kabale Road and Ibanda-Buhweju Road, among others. The relief was formed as a result of tertiary earth movements which were responsible for the uplift of the southwestern highlands together with the formation of the western rift system. In geological terms, the landscape is still young and there are high and competent denudational processes taking place on the slopes making it a very dynamic and fragile landscape.

The valley bottom is mostly occupied by wetlands through which the river flows. The Buhweju and Rwampara highlands form the upper catchment of the river. As the river traverses through Katala and Itojo Hospital to Lake Victoria through Lakes Mburo, Nakivale and Kijanebalola, it is joined by a number of tributaries and streams which are very important for water supply in the area such as Ruhoroboro which is part of Kandekye wetland in Kyabugimbi and Kyeizoba Subcounty in Bushenyi District. The most reliable and remaining water storage areas for the river is the large expanse of Kyeirungu and Rwengwe wetlands in Katala Parish; Mushasha-Katara wetland in Bitsya and Karungu Subcounty; Kibimba-Mpanga-Kamira wetland system in Rwengwe Subcounty and Nsiika Town Council; Kanunka wetland system in Nyakishana Subcounty; Kyonyo wetland system in Nyakishenyi Subcounty and Kanono wetland in Bisya Subcounty.

The soils in the Rwizi catchment are shallow sandy to loam soils on the slopes and fairly deep to deep sandy soils in the valleys and there is the occasional occurrence of sandy clay and clays in the valley. The soils are loose and combined with the steep landscape are prone to erosion and landslides especially during the rains. They are of low to medium productivity supporting crops such as bananas, coffee, and legumes.

Major threats to the wetland

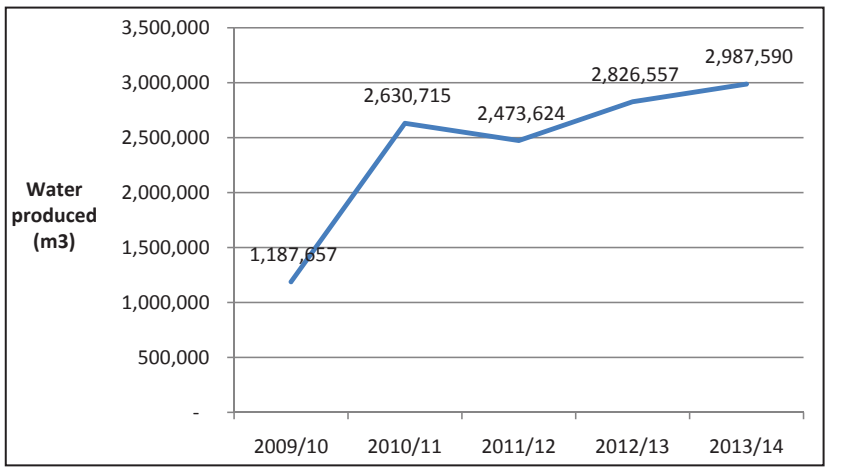
Population is a major threat creating much demand for water, land for agriculture and settlements and increasing encroachment on the fragile riverbanks, wetlands, steep and marginal slopes. The environmental outcomes include loss of fertile topsoil, siltation of wetlands, reduced recharge of groundwater aquifers and land fragmentation. Some of the tributaries have been tapped for gravity water schemes affecting the downstream water supply for Mbarara Municipality and for watering animals in the cattle corridor. Population growth is fuelled by the high fertility rates averaging 6% in the country (UBOS, 2014). Large family sizes have led to land fragmentation, reducing the average land holding with serious impacts on agricultural production, food security and social welfare.

Almost all the vegetation in this area is gone due to land pressure. Crops and settlements now cover the valleys and lower valley slopes while the upper more marginal slopes have been deforested and over grazed leading to almost bare surfaces, forming what is colloquially called the 'bare hills of the southwest'. Only small patches of permanent wetland, with *Cyperus papyrus* species, remain in what used to be extensive wetlands. The only intact sections of the wetlands are only in Katala parish in Buhweju district and Ndeija and Buhanama subcounties in Mbarara and Ntungamo districts respectively.

Land tenure is partly to blame. The main land tenure system is customary tenure with a few patches of public land (formerly Crown Land) on the hill tops most of which has been alienated to individual holdings through leases from Uganda Land Commission. The remainder of this land is still under communal utilization especially grazing, including the wetlands and marginal slopes. With existing pressures from the population, the rules of engagement regarding common property such as the wetlands change resulting in overexploitation and ecosystem damage.

Industrial development is also presenting additional pressures as they sometimes come with increased demands for water. Some of the industries established include Amos Dairies (UHT milk) at Nshara, Amos Dairies (cheese plant in Rushere) and Nile Breweries Limited in Mbarara Municipality, among others. The NWSC has increased its abstraction of water from the river to meet the increasing demand (Figure 2.11). All these predominantly industrial investments are planned without evaluating the sustainability of the water resources mainly from River Rwizi.

Figure 2.11: Trends in the amount of water produced by NWSC in Mbarara Town



(UBOS, 2015)

Gold mining is another big challenge facing the wetlands. Chemical pollution of the water that supplies Mbarara municipality and drains into Lake Victoria is an ever present threat. Of particular concern is the mercury used in the process of gold extraction as highlighted in Box 2.1.

Management efforts and recommendations

In Ruhama Parish, Buhanama Subcounty in Ntungamo District and in Ndeja Subcounty, Mbarara District, the wetlands are still intact, mainly due to the efforts and commitment of the community leaders in those subcounties. NEMA has also carried out many enforcement and restorative interventions in the area. In September 2009, Mbarara High Court conducted a court session in the wetlands in Nyeihanga and a ruling was made at the site in favour of the conservation of the wetlands. A key recommendation would be to ensure the continued protection of these papyrus wetlands.

Artisan gold mining with high risk of exposure to toxic chemicals.

Box 2.1: The impacts of using mercury in gold mining in the River Rwizi wetlands catchment

Gold mining in Buhweju district occurs in the wetland areas such as Nyakishana, Bukoto, Bihanga and Kyenjogyera swamps. Much of it is at artisanal level and it has a number of environmental impacts including siltation of water bodies and open pits left behind leading to localized degradation of soil and vegetation. Furthermore, where several hundred miners work in a given watershed (as is the case in Bukoto village, Bisya subcounty) there are cumulative impacts on the downstream communities. In the case of River Rwizi, these includes siltation, health implications due to possible human poisoning, environmental contamination with mercury and the abandonment of school by the youth leading to high illiteracy levels in the district.

Environmental and health concerns arise from the exposure to mercury because of the demographics of the sector. Family members, including women and children, at times accompany the miners to help with the work. The ratio of men to women in artisanal mining in this part of the country is estimated at 3:1. Health impacts of exposure arise from inhalation of mercury vapour as the miners have no protective gear. The open pits left behind pose threats to humans and livestock and in many instances the land is impossible to re-convert to agricultural use after the miners are done. An emerging threat is the proliferation of cyanide use by some artisanal miners in conjunction with mercury amalgamation. This is happening in Busia District and could possibly spread to the gold mines around the country (see Figure 2.11).

(UNEP, 2012)

Figure 2.12: Gold mining areas in Uganda.

(UNEP 2012)

Illegal activities within the buffer zone on River Rwizi

Lake Wamala Wetland System

LAKE WAMALA WETLAND SYSTEM

Lake Wamala is of local, cultural and economic importance and is jointly administered by the districts of Mubende, Mityana and Mpigi, each of which share a border with the lake. It covers an area of about 250 km² and is dotted with many islands including Lwanju, Mabo, Bagwe, Kiraza and Kazinga among others. The lake is associated with several rivers and wetlands. The swamps throughout the system are dominated by *Cyperus papyrus*.

Inflow into the lake is mainly from the following rivers: Nyanzi, Kitenga, Kaabasuma, Mpamujugu and Bbimbye. The lake is drained by River Kibimba into the Katonga River which in turn drains into Lake Victoria. The Kibimba River is highly seasonal, and for much of the time over the past two decades its course has remained essentially dry.

Major threats to the wetland

Satellite images of Lake Wamala taken in 1984 compared to those in 1995 show that the surface area of the lake has reduced by about half. The main threat to the lake is encroachment through land titling. The challenge with the lake management is that unlike forests, the lake shores are not clearly demarcated and when the lake recedes, people go and acquire land titles which are usually not brought to NEMA or District Environment Offices for verification. The receding nature of the lake leaves behind attractive land suitable for many activities including farming and grazing, encouraging people who are able, to acquire titles.

Information at the Mityana District Local Government indicates that over 90 land titles have been issued by the District Land Board in the lake's wetlands alone in less than 10 years. In Mubende, 30 land titles have been issued on the original lakebed and wetlands. This is mostly because the district land managers do not go on the ground to see where people have applied for land before issuing titles. Currently, land owners are farming up to the lake shores and people have settled and built homes in the buffer zones.

In Mubende district (mainly in Bukoba-Nalutuntu) land related conflicts are the norm and this has eventually led to the land managers rescinding many of the land titles.

Siltation is another emerging issue arising from rapidly eroding soils on the slopes flanking the lakes. The reduction of water storage capacity has serious implications on the water resources in this area, both in terms of quantity and quality, and also within the general framework of climate change. Already there are signs of the lake shrinking. Encroachment and siltation of the lakeshores interfere with fish breeding and aquatic biodiversity and has been partly blamed for the low productivity of this lake. However, there is also need for greater regulation of this lake. For instance, the law allows a maximum of 250 boats on Lake Wamala, but the actual number exceeds this. Furthermore, there are specifications on the minimum gillnet mesh size (114mm), minimum hook size (9) and the minimum size of Nile tilapia that should be harvested (28 cm), but there is no regulation on the minimum size of the African catfish that should be harvested (Ogutu-Ohwayo, Odongkara, Natugonza, & Musinguzi, 2014).

Shores of Lake Wamala


MUBENDE
DISTRICT
UGANDA
Mityana
Lake
Wamala
MITYANA
DISTRICT
GOMBA
DISTRICT
N
GOMBA
Kilometers
0
1.75
3.5
7
22 December 1990


MUBENDE
DISTRICT
UGANDA
Mityan
Lake
Wamala
MITYANA
DISTRICT
GOMBA
DISTRICT
N
GOMBA
Kilometers
0
1.75
3.5
7
31 December 1999


MUBENDE
DISTRICT
UGANDA
Mitya
Lake
Wamala
MITYANA
DISTRICT
GOMBA
DISTRICT
N
GOMBA
Kilometers
0
1.75
3.5
7
02 February 2015

BIBLIOGRAPHY

COWI/VKI. (1998). *Kampala water quality monitoring programme.* Kampala: National Water Sewerage Corporation (NWSC), Ministry of Water and Environment.

de Groot, P. J. (1993). Introduction and summary. (A. Greathead, & P. J. de Groot, Eds.) *Control of Africa's Floating Water Weeds*, AGR-18 (295), p. 187.

DFR. (2011). *Department of Fisheries Resources Annual Report 2010/2011*. Entebbe: Department of Fisheries Resources (DFR).

Hinton, J. (2012). Uganda Case Study. In UNEP, *Analysis of formalization approaches in the artisanal and small-case gold mining sector based on experiences in Ecuador, Mongolia, Peru, Tanzania and Uganda*. Nairobi: United Nations Environment Programme.

Kateregga, E., & Sterner, T. (2007). Indicators for an invasive species: Water hyacinth in Lake Victoria. *Ecological Indicators*, 7, 362-370.

Kelderman, P., Kansiime, F., Tola, M.A. and A. van Dam (2007). The role of sediments from phosphorus retention in Kirinya wetland (Uganda). Wetlands Ecology and Management. Vol 15. Issue 6. p.481-488.

Lukooya, N. B. (2013). *Wastewater pollution attenuation in a tropical urban wetland system: Nakayaiba, Masaka, Uganda*. Vienna: Austrian Development Corporation.

LVBC. (2011). *Identification and mapping of ecologically sensitive areas (ESAs) in Lake Victoria, Kenya*. Nairobi. Kisumu.: ACTS Press African Centre for Technology Studies, Lake Victoria Basin Commission (LVBC).

LVFO. (2016). (Lake Victoria Fisheries Organisation (LVFO)) Retrieved January 16, 2016, from State of Fish Stocks: http://www.lvfo.org/index.php/lvfo/lvfo-secretariat/6-state-of-fish-stocks

MWE. (2015). *Uganda Wetland Atlas - Volume One: Kampala City, Mukono and Wakiso Districts*. Kampala: Ministry of Water and Environment (MWE).

NASA. (2006, March 13). Retrieved December 16, 2015, from NASA Earth Observatory: http://earthobservatory.nasa.gov/Features/Victoria/

NEMA. (2009). *Uganda - Atlas of our changing environment*. Kampala: National Environment Management Authority (NEMA).

Ntiba, N. M., Kudoja, W. M., & Mukasa, C. T. (2001). Management issues in the Lake Victoria watershed. *Lakes & Reservoirs Research and Management, 6*, 211 – 216.

Ogutu-Ohwayo, R., Odongkara, C., Natugonza, V., & Musinguzi, L. (2014). *Application of policies to address the influence of climate change on inland aquatic and riparian ecosystems, fisheries and livelihoods. A policy brief on Lakes Wamala and Kawi (Uganda)*. Jinja: National Fisheries Resources Research Institute (NaFIRRI).

Okurut, T. O., & Weggoro, C. N. (2011). *Lake Victoria basin : a new frontier for development of East Africa*. Nairobi: Twaweza Communications.

Ryken, N., Vanmaercke, M., Wanyama, J., Isabirye, M., Vanonckelen, S., Deckers, J., et al. (2015, April 1). Impact of papyrus wetland encroachment on spatial and temporal variabilities of stream flow and sediment export from wet tropical catchments. *Sci Total Environment*.

Schuyt, K. D. (2005). Economic consequences of wetlands degrdation for local populations in Africa. *Ecological Economics*, 53 (2), 177-190.

Tate, E., Sutcliffe, J., Conway, D., & Farquharson, F. (2004). Water balance of Lake Victoria: Update to 2000 and climate change modelling to 2100. *Hydrological Sciences Journal*, 49 (4), 563-574.

UBOS. (2014). *Statistical Abstract 2014*. Kampala: Uganda Bureau of Statistics (UBOS).

UBOS. (2015). *Statistical Abstract 2015*. Kampala: Uganda Bureau of Statistics (UBOS).

UEGCL. (2016). Retrieved January 16, 2016, from Uganda Electricity Generating Company Limited: http://uegcl.com/hydro-power-plants/

UNDESA. (2015). *UNDESA*. Retrieved December 15, 2015, from World Population Prospects: The 2015 Revision.: http://esa.un.org/unpd/wpp/Download/Standard/Population/

UNEP. (2012). *Analysis of formalization approaches in the artisanal and small-scale gold mining sector based on experiences in Ecuador, Mongolia, Peru, Tanzania and Uganda. Uganda Case Study*. Nairobi: United Nations Environment Programme (UNEP).

UNEP. (2006). *Lake Victoria: Falling Water Levels Concern for Growing Population*. Washington D.C: United Nations Environment Popuation (UNEP).

WSP. (2003). *Kagera River basin Integrated Water Resources Management Project*. Project Document. Sweden: WSP International Sweden.

Fishing in Awoja wetland

Chapter

3

LAKE KYOGA BASIN

Figure 3.1: Lake Kyoga basin

(WMD, 2008)

INTRODUCTION

The Lake Kyoga basin is located in the eastern and north-eastern lowlands of the country (see figure 3.1). It is the second largest drainage basin and covers an area of 57,233 km², of which 3,152 km² is open water and 2,356 km² is wetland (Nsubuga, Namutebi, & Nsubuga-Ssenfuma, 2014). The lakes in the catchment include Kyoga, Kwania, Bisina, Nakuwa and Opeta. Some of the wetlands systems are summarised in table 3.5 at the end of this chapter.

The basin is wide covering the entire eastern Uganda from Kayunga district in Buganda to Karamoja region. There are five main sub-basins of Lake Kyoga basin recognized under the Kyoga Water Management Zone (COWI 2010). These include:

(i) Lake Kyoga sub-catchment which has streams entering the lake from the south such as Sezibwa and Victoria Nile;
(ii) Mpologoma dominated by Mpologoma-Malaba River systems;
(iii) Bisinia-Sironko which covers the river systems of Sironko, Sipi, Muyembe and Manafwa and those rivers that flow from the surrounding volcanic mountains of Elgon, Napak and Kadam.
(iv) Karamoja (Kapiri), which contributes to two seasonal rivers namely Okok and Okere, which join the lake by discharging into the wetland system around Lake; and
(v) Kwania which covers L. Kwania and the wetland systems found around Amolatar, Dokolo and Apac.

Key message

The districts of Kayunga, Jinja, Kamuli, Luuka, Kaliro, Iganga, Mayuge, Bugiri, Namutumba, Pallisa, Budaka, Kibuku, Butaleja, Mbale and Tororo are hotspots districts for wetland degradation, driven by rice and sugar cane cultivation, with risk of irreversible damage to the ecosystem and disastrous impact on biodiversity and food security.

Some wetlands like Opeta-Bisina wetland system have benefitted from robust protection interventions and are thriving.

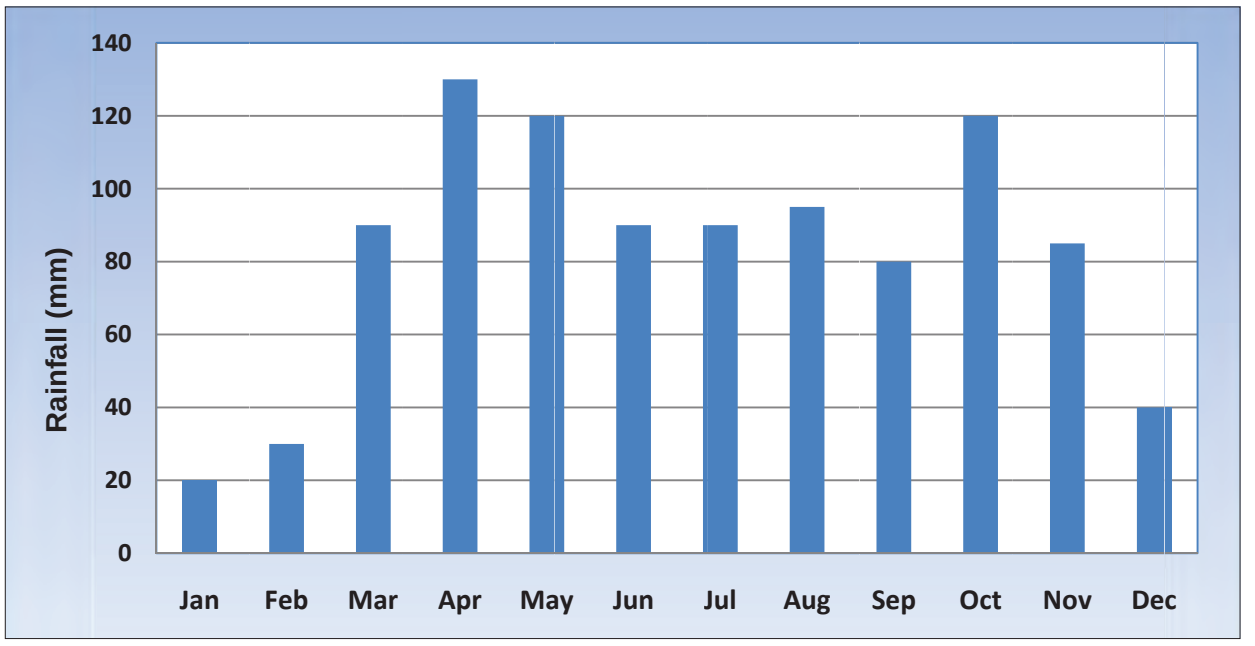
The entire basin covers 41districts of Apac, Amuria, Amudat, Amolatar, Bududa, Bugiri, Bukwo, Bukedea, Budaka, Buikwe, Bulambuli, Butaleja, Buyende, Busia, Dokolo, Iganga, Lira, Kaliro, Kamuli, Katakwi, Kayunga, Kaberamaido, Kabong, Kapchorwa, Kotido, Kibuku, Kumi, Kween, Luwero, Luuka, Mbale, Manafwa, Moroto, Nakapiripirit, Ngora, Nakasongola, Namutumba, Pallisa, Sironko Serere, and Tororo.

Sezibwa Falls

The main human activities in the Lake Kyoga basin are fishing, cultivation and livestock keeping. There are no industrial enterprises in the area, due to lack of grid or any other power connectivity.

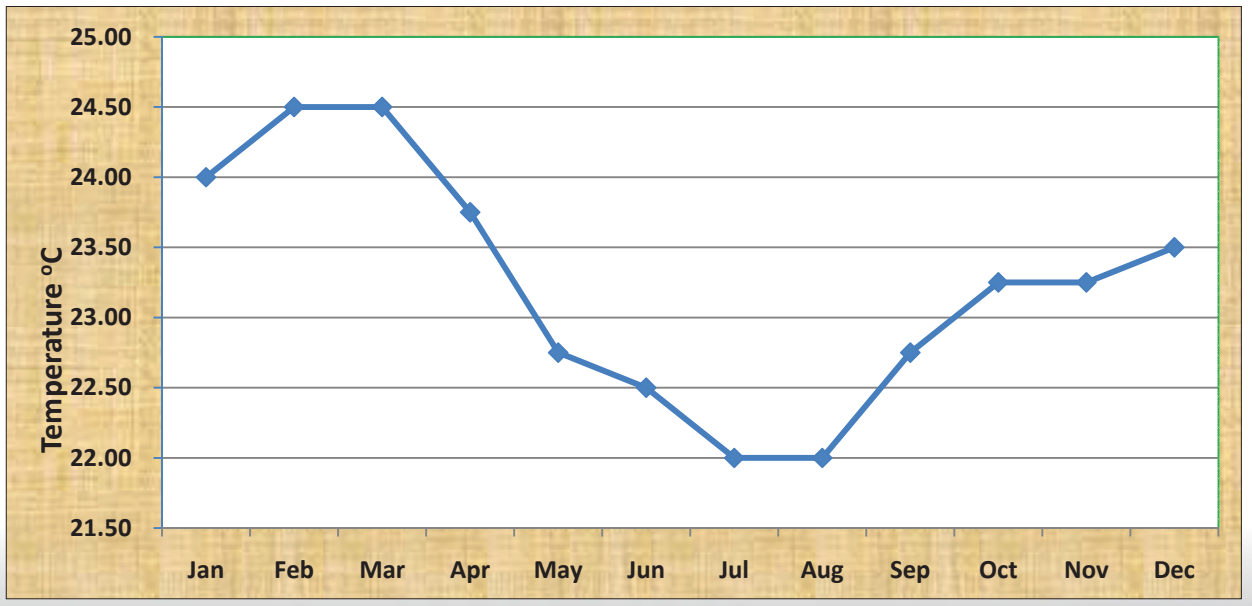
The climate experienced within the Lake Kyoga Basin is the modified equatorial type of climate. Maximum temperatures are high during the months of December, January, February and March. During this period, minimum temperatures are in the range of 15 and 17 °C. Mean historical monthly rainfall records from selected stations in the basin reveal a spread out rainfall distribution. Areas to the north receive about 600 mm of annual precipitation in a single rain season, while the south and south western part of the zone receive rainfall of up to 1,500 mm over two rain peaks (COWI 2010). Mean monthly temperature and rainfall characteristics for the zone are displayed in Figures 3.2 and 3.3, which are derived by averaging area records of the meteorological stations within the basin.

Figure 3.2. Mean historical monthly rainfall computed by average area records of selected stations in the Lake Kyoga Basin between 1900-2009.



(Nsubuga et.al, 2015)

Figure 3.3. Mean historical monthly temperature computed by average area records of selected stations in the Lake Kyoga Basin between 1900-2009.



(Nsubuga et.al, 2015)

Lake Agu within Awoja wetland in Ngora District

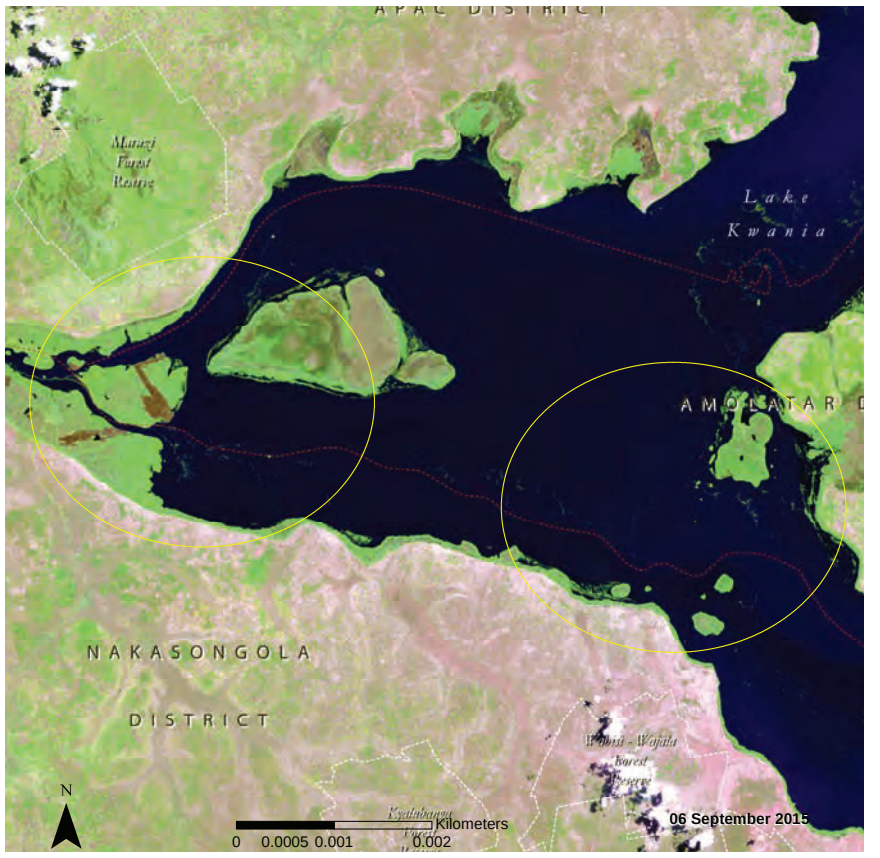
Lakes Kyoga and Kwania Wetland Systems

LAKES KYOGA AND KWANIA WETLAND SYSTEMS

Lake Kyoga, the biggest lake in this catchment, lies in the flooded branches of the low west-flowing Kafu River. It receives most of its inflow waters from the Victoria Nile. The waters then flow in a northerly then westerly direction over the low northern end of the Rift escarpment (the Murchison Falls) to Lake Albert. The entire Lake Kyoga can be classified as a wetland as it is less than 7m deep (Temple, 1970). Lakes Kyoga and Kwania were formed by earth movements that started in the Miocene period and resulted in the faulting of the Western Rift Valley. As a result, River Kafu that previously used to flow westward, started flowing eastwards. The subsequent 'ponding back' resulted in the formation of these lakes. There are three distinct sections to the lake – the open water that is deeper than 3m; area with water covered entirely by water lilies that is less than 3m deep; and the papyrus swamps that line the shore (Temple,

1970). There are many sudds or papyrus islands in the lake and some are inhabited by fishing communities. In stormy weather, they sometimes break free moving around in the lake and becoming deathtraps to those living on them. The sudds are also hazardous to fishing nets set in the lake and crocodiles are also abundant around these floating islands. The government has attempted to evict people from these sudds for their own protection, but they always go back. For instance in 2003, over 300 families from Pabo, Kamuli, and other islands in the lake were evicted and resettled along the lakeshore in Nakasongola and Apac districts. Six months later most had relocated back to the sudds. This can partly be blamed on policy conflicts as the establishment of a polling station on Pabo sudds has undermined these environmental enforcement efforts.

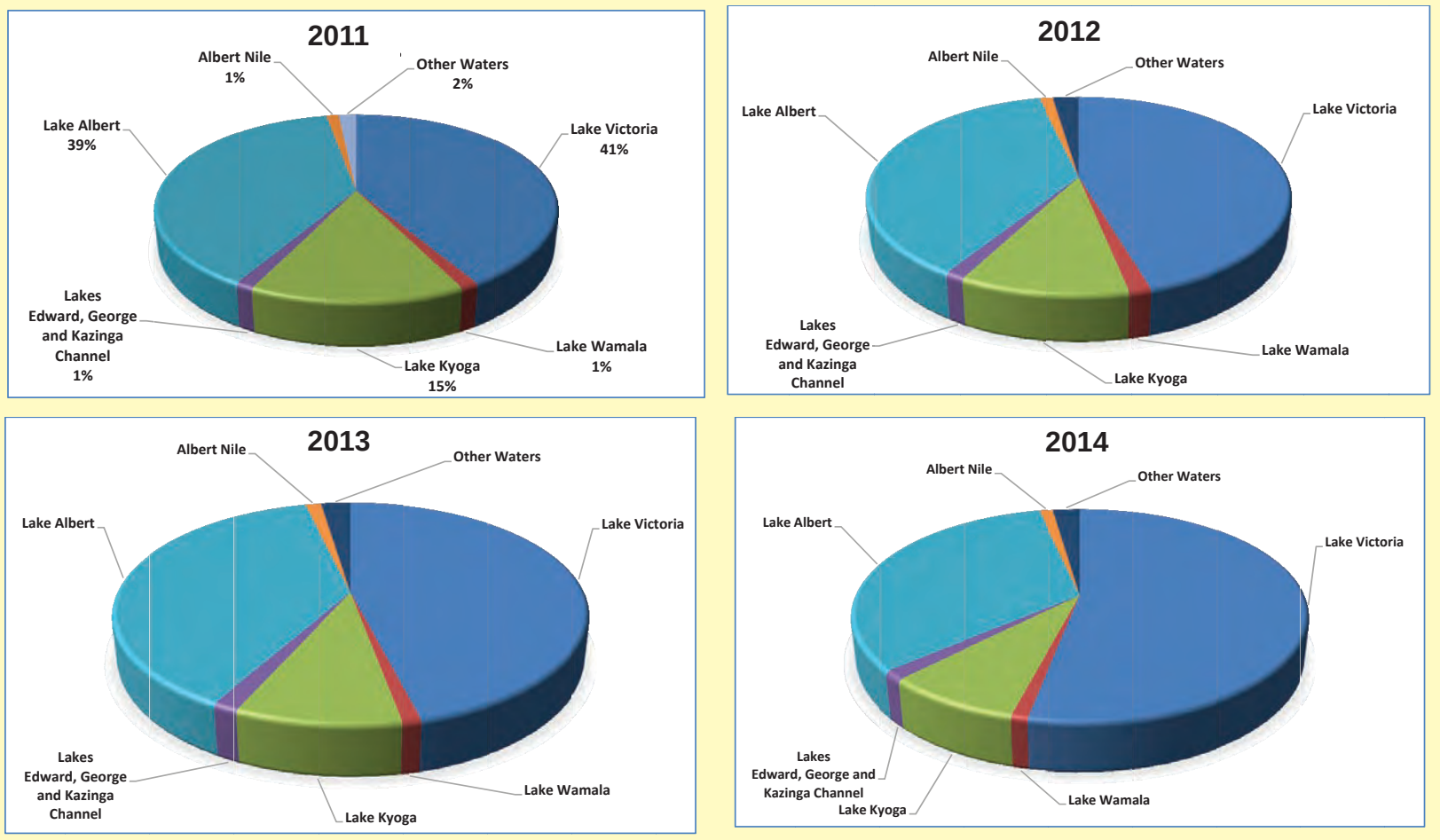
The satellite images show the floating sudds on the lake. By 2002 many of them had moved west blocking the outlet to the Nile River and increasing the incidence of flooding around the lake. The floods resulted in displacement of people, destruction of infrastructure and livelihoods. The Directorate of Water Development opened two channels in the lake and later, a team from Egypt dredged a section to allow water flow downstream.



Floating Island on Lake Kyoga

The Kyoga wetlands systems are rich in biodiversity due to the expansive eco-region straddled by the basin. Floral species include the common Papyrus sedge (*Cyperus papyrus*), Hippo grass (*Vossia cuspidate*), Cattail (*Typha sp*), Water Lily (*Nymphea sp*), Water lettuce (*Pistia stratiodes*). The papyrus is widely used for making mats, roof thatch, fishing floats and rafts. The lakes are the third largest contributers to fish catch in Uganda (Figure 3.4). Over 40 species of fish are found in the lake. These include the exotic Nile Perch (*Lates niloticus*) and native species such as Lake Victoria squeaker (*Synodontis victoriae*), *Engraulicypris argentus, Barbus kiogae, Tilapia esculenta, Tilapia variabilis, Mormyrus kanumme, Clarias mossambicus, Schilbe mystus* and *Haplochromis macrodon*.

Figure 3.4 Percentage contribution of fish catch by water body, 2011 - 2014



(UBOS, 2015)

A landing site on Lake Kyoga blocked by a combination of *Salvinia* **and** Water hyacinth **(2014)**

Photo credit: Tony Kiwanuka

Major threats to the wetland

The most serious threat to this basin is alien invasive species. The dominant ones are the Nile perch (*Lates niloticus*, Water hyacinth (*Eichhornia crassippes*) and the Giant Salvinia or Kariba weed (*Salvinia molesta*) all of which are native to Latin America.

The invasive *S. molesta* was first sighted by fishermen on Lakes Kyoga and Kwania in December 2013 and by December 2014, was a major threat to the economy of the subregion. It is a free floating aquatic fern with bristly fronds originally from Brazil. Given suitable conditions, it multiplies quickly doubling its body mass within 48 hours (Donaldson, 2002). This has serious environmental and economic implications affecting transportation, fishing activities, human health and the aquatic and riparian environment.

Infestations undermine the aesthetic value and quality of the lake water. The lakeshores are now smelly with increased dead organic matter. The lakes are the only reliable source of drinking water for the riparian communities. Women and children who primarily bear the responsibility of collecting water now struggle to access clean water from the lake for domestic use.

Fishing is critical to the local economy with Lake Kyoga accounting for 9.5% of the fish catch by water body in Uganda in 2013 (UBOS, 2014). Where the *Salvinia* mat is very thick, it creates an oxygen deficient environment resulting in fish kills. Any change in wind direction blows the weed from place to place and at times this tangles or carries away fishermen's nets. This has also adversely affected the breeding grounds for Tilapia resulting in reduced fish catch over the years. For instance fish catch from Lake Kyoga was 60,000 tonnes in 2009 declining to 38,000 tonnes in 2014 (UBOS, 2014), (UBOS, 2015).

Transportation is affected by the unpredictable movement of the weed. It floats on still or slow-moving water and can grow rapidly to cover an entire landing site with a thick mat of vegetation in only a few days. Fishermen in Rwampanga, Zengebe, Kiguli, Kityoba and Kikaraganya landing sites in Nakasongola district have reported that at times the thick mat may be blown off the landing site making it accessible, only to be covered up again overnight, at times leaving fishermen stranded out in the lake. Navigation planning is becoming more difficult and this has discouraged many of the business community that used to provide transportation connecting the landing sites on the lake. Consequently local transport costs on the lake have soared. The Uganda National Roads Authority (UNRA) ferry from Zengebe to Amolatar is now the only reliable means of transport across the lake. However, the frequency of the ferry crossing has reduced due to the time taken to navigate through the thick mat of the weed.

The thick mats provide ideal breeding grounds for disease vectors and could be linked to the increase of diseases such as malaria and bilharzia (Aloo, Ojwang, Omondi, Njiru, & Oyugi, 2013). For instance, the incidence of malaria in Kibuye, Zengebe, Rwampanga, Kityoba, and Kikaraganya in Nakasongola, and in Namasale and Bangaladesh in Amolatar and Kayeyi in Apac districts reportedly increased between December 2013 and December 2014 with the invasion of the weed. Infestations of the weed can also be dangerous to animals and people because the mats look like solid ground, and sometimes people and animals may mistakenly walk on them, running a risk of drowning.

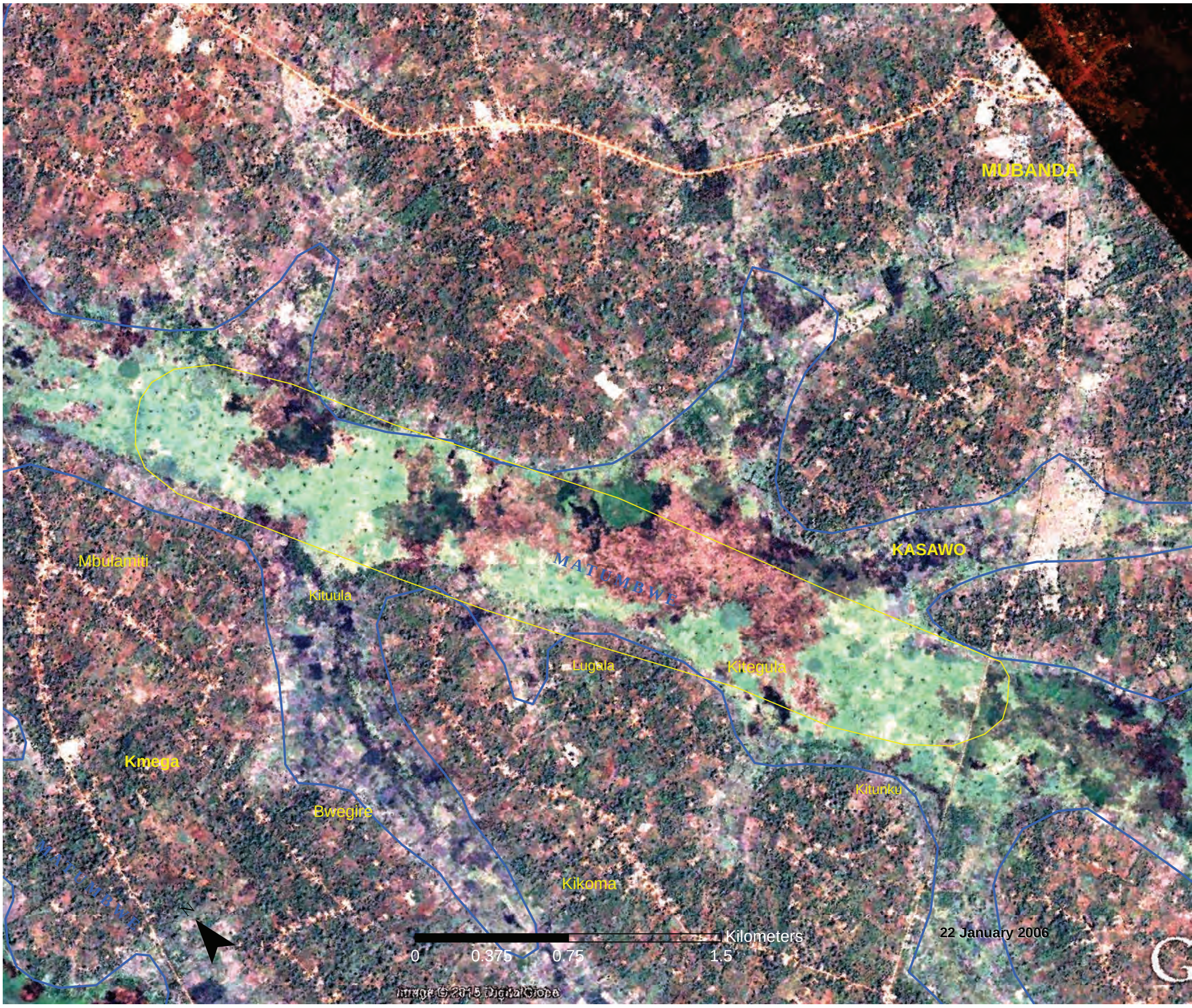
A frond of *Salvinia molesta*

Photo credit: Tony Kiwanuka

Sezibwa and Victoria Nile Wetland Systems

SEZIBWA AND VICTORIA NILE WETLANDS

The River Sezibwa wetland system is located in the south-central part of the country. The 150km long river has its source in Buikwe district, near Ngogwe town, west of the Victoria Nile. The flow of the river is northerly through Mukono district and finally to Lake Kyoga in Kayunga District, near Galiraya town. The wetland that fringes the river is relatively intact compared to other wetlands in central region. The Sezibwa Falls near Kayanja is of cultural significance and this has contributed to the conservation of the river and its wetlands. The wetlands that form the Victoria Nile watershed are extensive. They are located within small pockets of flat land along the steep cliffs. Cultivation and cattle grazing are common activities but not to a large extent due to the steep gradient which makes access difficult. Examples include Nankandulo in Kisozi Subcounty in Kamuli District, and Nakimbalede, Nankwanga, Wakisu, Namayiya, Kalagala, Kakoge, Sowa, Gobogobo, Kiziro and Kireme in Kayunga District.



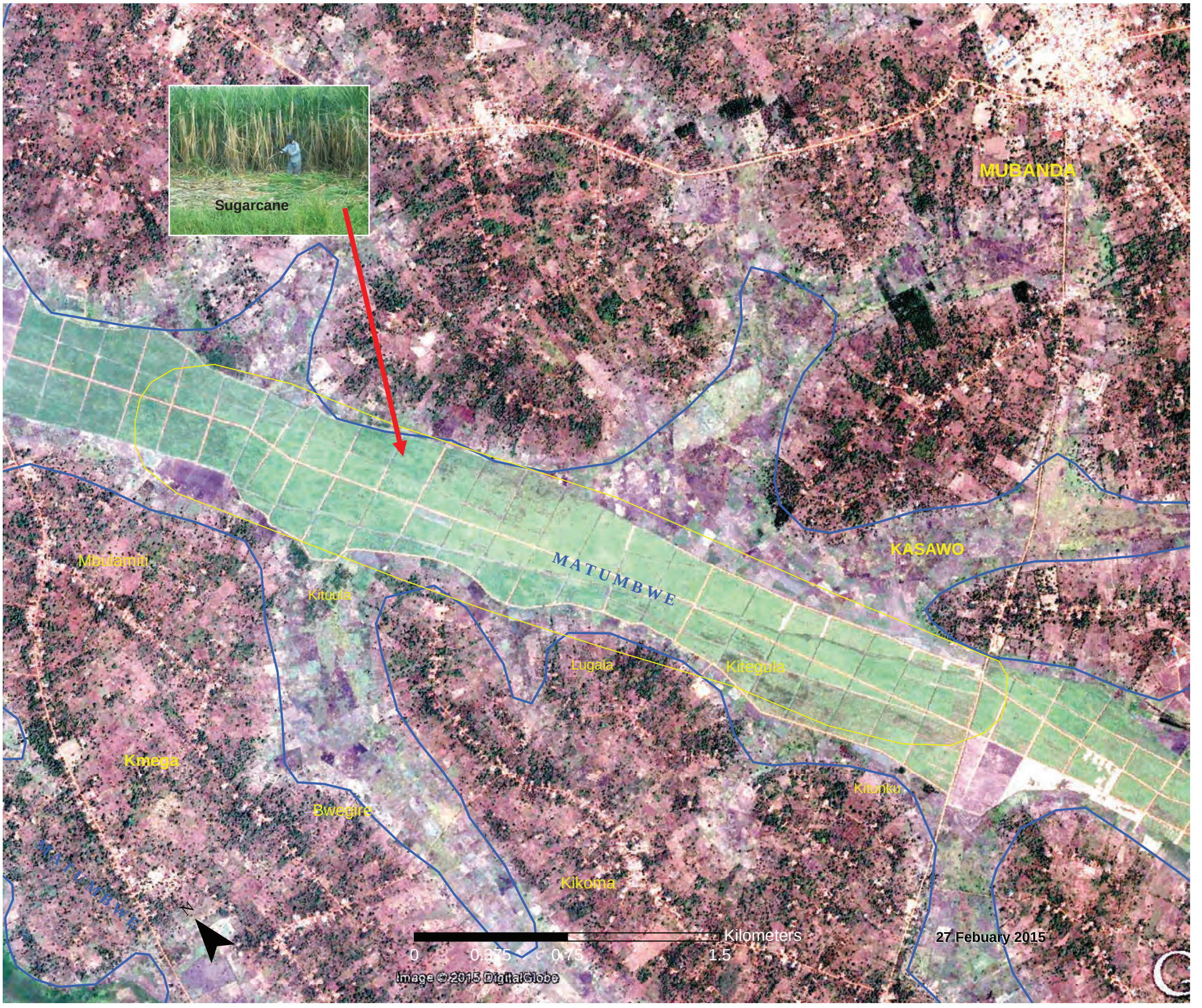
Major threats to the wetland

Agriculture and livestock are the main threats to this wetland. For example, sugar cane, rice and vegetable growing have severely degraded the Musamya wetland which is major tributary of the Victoria Nile. Livestock grazing and crop cultivation is also common in the northern part of the Sezibwa system around Kawolokota wetland.

Bush burning of the riparian vegetation is another serious problem. It is usually done in the dry season in order to clear land to regenerate pasture. Examples of this are evident in the Namatogonya, Kibundade, Kyamugonjo and Maluga wetlands.

Sand mining, brick making and vegetable cultivation is also common near the urban areas of Mukono, Lugazi, Njeru and Nkokonjeru Town Councils. Specific affected areas include Lwajjali, Musamya, Kaasala, Njogezi and Nakiyanja. In September 2008, Musamya Bridge was washed away leading to reduced impoundment of the water in the wetland.

The local community later invaded the wetlands and started growing maize, cabbages and tomatoes. Attempts to restore the wetland have not been successful due to lack of cooperation especially from the local leadership. In some cases, vegetable gardens are being replaced with sugar cane for commercial purposes.



Kyabakazi Wetland

KYABAKAZI WETLAND

Kyabakazi (locally known as Kiko) wetland is one of the most critical wetlands in Kamuli and Luuka Districts that drains into Victoria Nile in Mbulamuti Subcounty. It is located at the boundary between Namaganda and Kiyunga Parishes in Kisozi Subcounty within the villages of Nababirye, Bulangira and Bukose. It is mainly a seasonal wetland that flows within a narrow valley on a steep gradient into Victoria Nile.

This now heavily converted wetland is under intensive agricultural with only a few scattered *Acacia* and *Albizia* trees. The dominant wetland vegetation is mainly towards the banks of Victoria Nile and a few patches along the wetland. The entire catchment is under intensive grazing, cultivation and coffee growing which has now extended into the wetland.

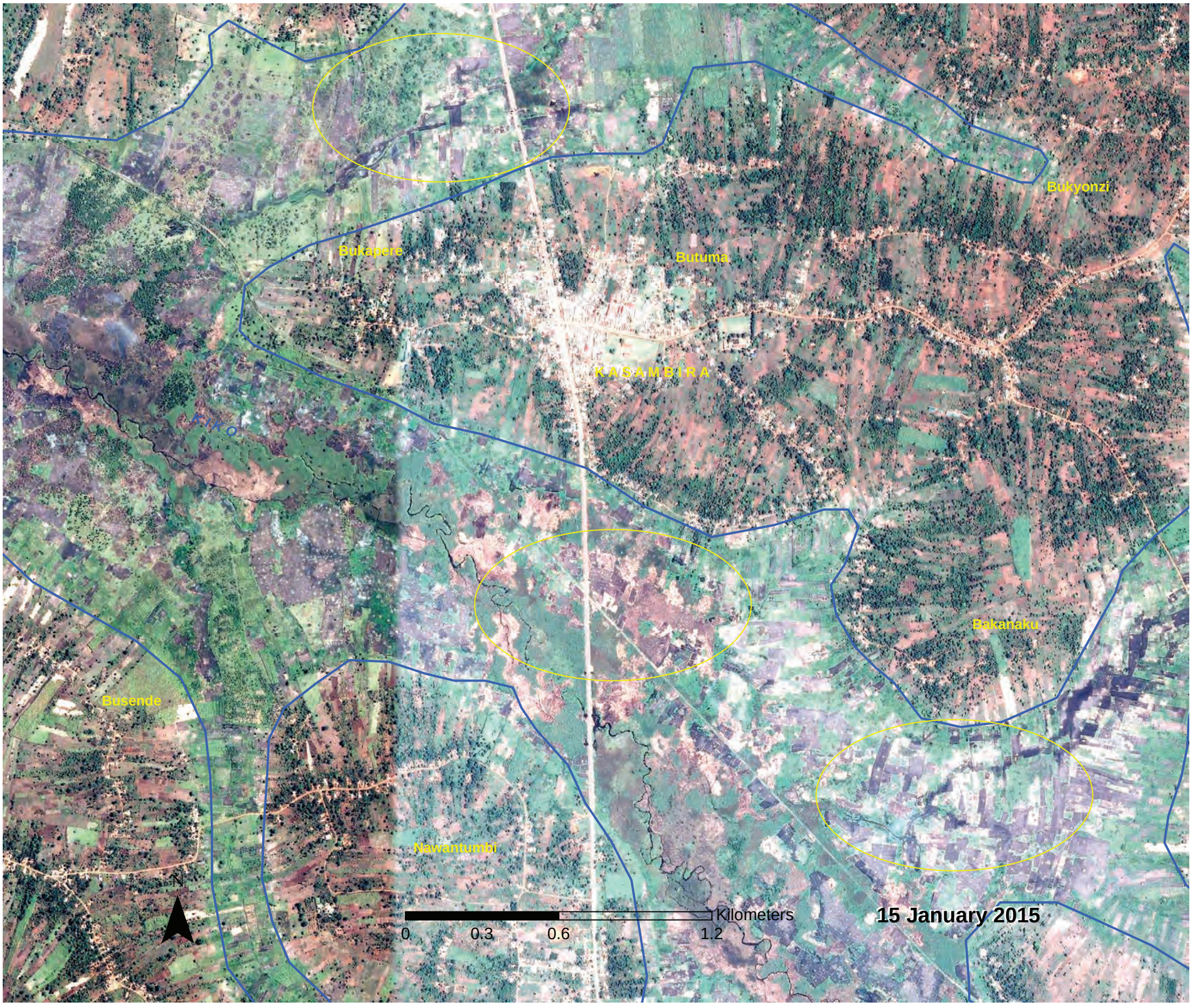
Major threats to this wetland

The major threats are reclamation for paddy rice cultivation, sugar cane growing, clay and sand mining. With improved market for cane in the region, the farmers have even resorted to converting their original farm land into cane farms to supply the sugar factories in the area. This is likely to result into food security issues.

In the dry seasons, most sections of the wetland are burnt down for the regrowth of fresh palatable grass for livestock and also to scare away wild animals that a threat to the community farmland. The farmers in the catchment do not practice prudent soil and water conservation measures and as result, there has been siltation into the wetland.

Management efforts and recommendations

There have been several attempts by Government to conserve this wetland including introduction of sustainable use practices. For example, in 2008 Government sought financial assistance from the African Development Bank (ADB) to pilot fish farming activities in this wetland. Unfortunately, these efforts were not adopted by the community.

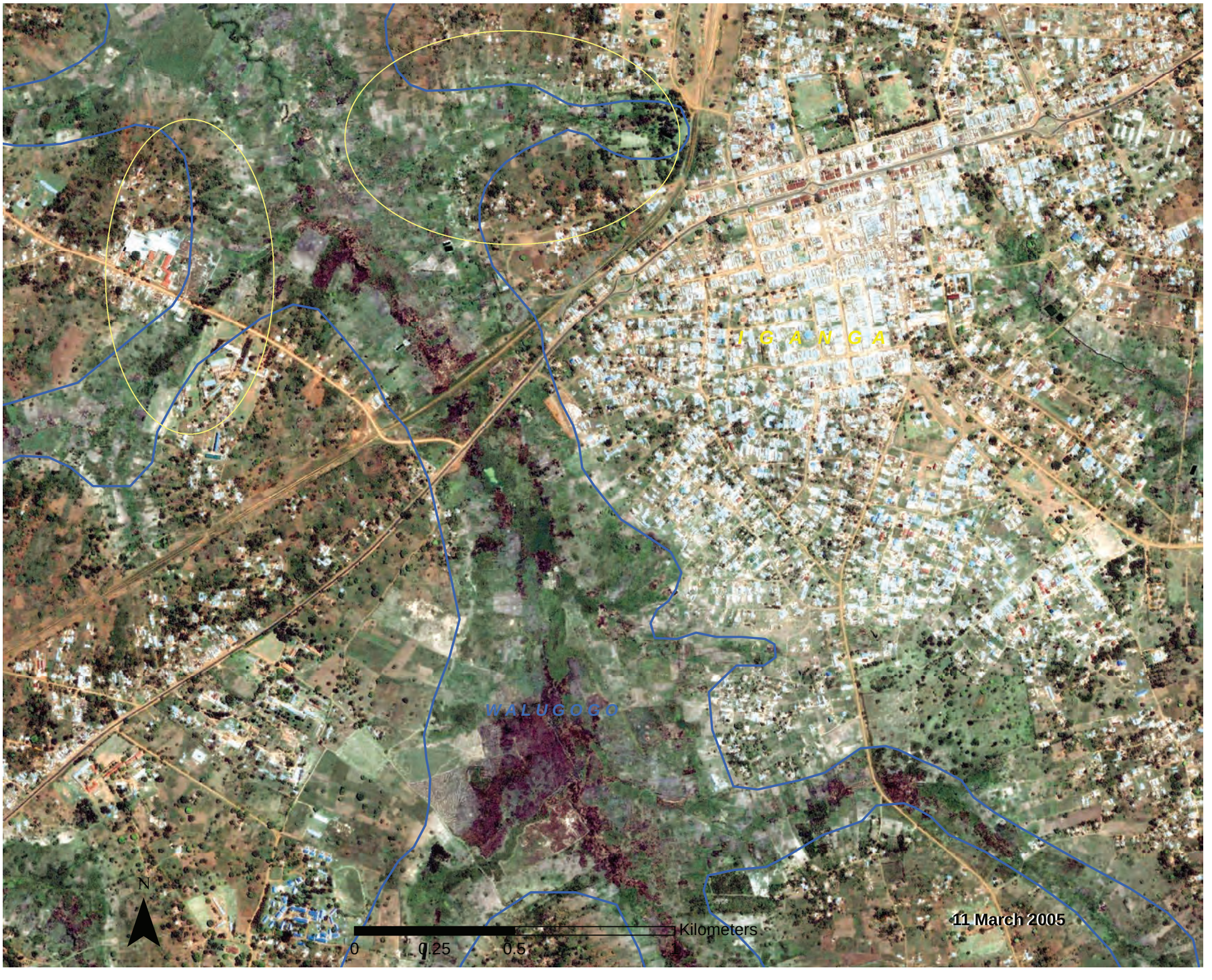


Lumbuye Wetland

LUMBUYE WETLAND

Lumbuye wetland system is a major ecosystem in Busoga region and forms the boundary between Luuka and Iganga Districts that drains into Lake Nakuwa which forms part of Lake Kyoga complex. It also forms the boundary between the Subcounties of Nawaikoke in the west and Namugongo and Bumanya in the east. The key villages contingent with the wetland includes Bulumba, Nabikoli, Namukoge, Budomero, Kyanfuba, Buluya, Nansololo, Nawaka, Bwite and Kiyunga. The wetland is accessible on Namwendwa-Nawaikoke Road, Namwendwa-Gadumire Road, Bulumba-Nawaikoke Road.The landscape through which Lumbuye wetland traverses is generally flat with altitude varying between 1,045m-1,106m with only a few river valleys that are generally wide (MWE, 1996). As a result, there is impeded drainage in most valleys resulting into formation of wetlands. These are a source of water for domestic use and livestock.

The main tributaries that drains into the Lumbuye wetland system includes the Nakiyanja, Nabitakali, Nabisira, Nawansega and Kamirantumbu wetlands. The soils in the wetland are of fine texture and black in color and where

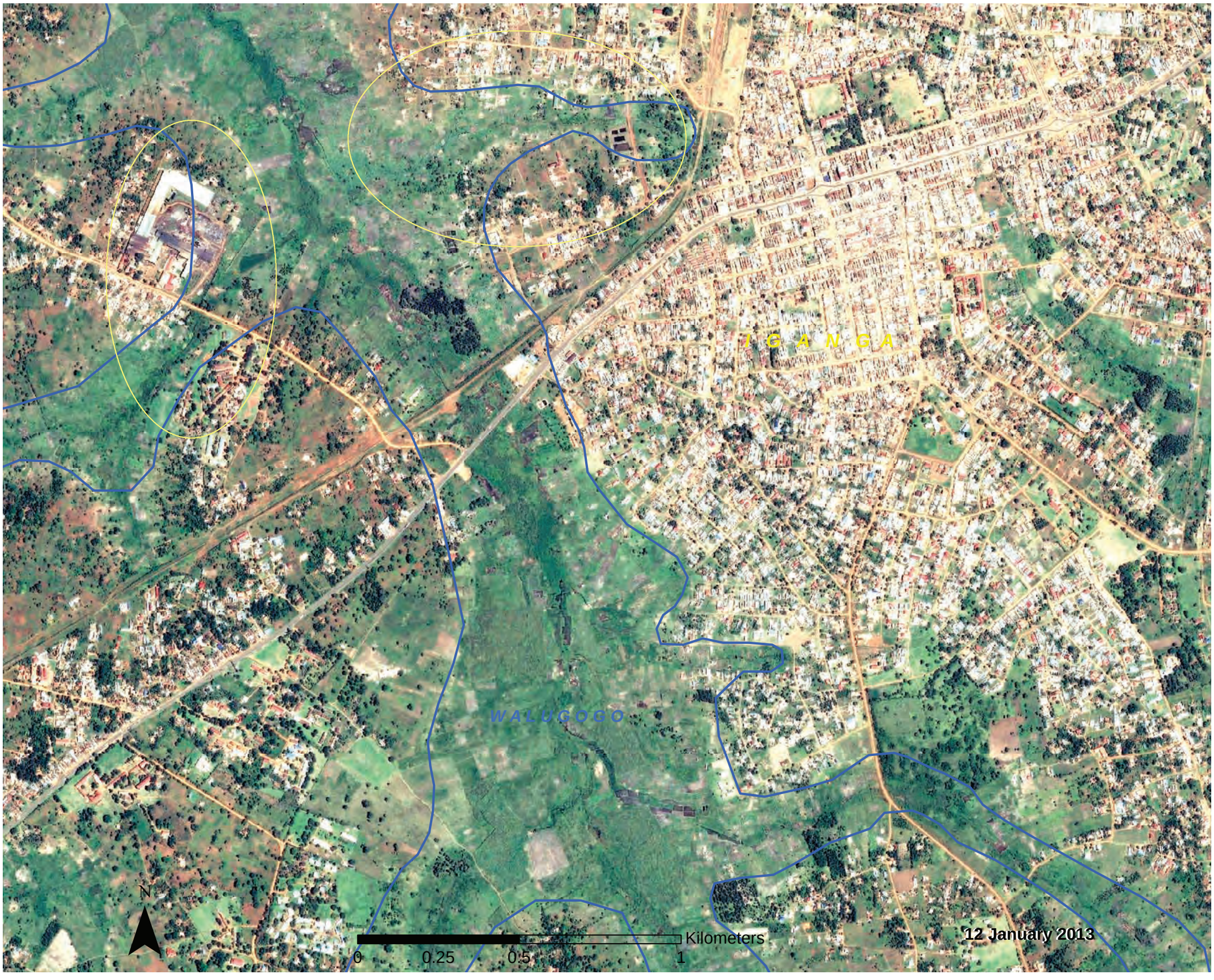


papyrus is dominant, contains peat. The wetland is among the few remaining intact wetlands in the area dominated with *Cyperus papyrus*. Some parts have *Typha sp*. There is an extensive area in Namasiga where *Acacia sp*. is dominant and was under waterlogged conditions. Some of the seasonally flooded fringes were formerly dominated by *Echinochloa* and *Sorghastrum spp*. dominated grasslands but are now rice and maize growing areas. The animals reported to be present include *Sitatunga* and otters. There are many birds especially Cormorants in Namasiga area and plenty of fish (lungfish and catfish). Table 3.1 describes the land use and key threats to the wetland system. Dumping of 'foreign' soils, settlements, cultivation of sugarcane and unregulated rice are among the several factors that threaten this wetland. Physical wetland demarcation for Lumbuye in Kaliro District and community management planning in Kamirantumbu section Luuka District are the prime interventions along this system.

Table 3.1 Land use and key threats to the Lumbuye wetland system

Name	Area (km^2)	Wetland Type	Land-use	Key threats
Kamirantumbu	55.9	Seasonal	Rice and maize cultivation, grazing, and fishing	Drainage
Lumbuye	137.0	Permanent and Seasonal	Rice and maize cultivation, grazing, hunting, fishing harvesting of papyrus and palms	Drainage
Nabitakali	32.2	Seasonal	Rice cultivation, grazing and ranching	Drainage
Nabisira	11.7	Seasonal	Non-significant	Insignificant
Nawansega (Bunabale)	5.0	Seasonal	Rice and maize cultivation, grazing	Drainage

(WMD, 2006)



Mpologoma Wetland System

MPOLOGOMA WETLAND SYSTEM

Mpologoma, meaning lion, is one of the largest and most extensive permanent wetlands in the east of the country. It is over 100km in length and discharges over 600 million m^3 of water annually into Lake Kyoga. Mt.Elgon forms the largest catchment area for the Mpologoma wetland system. The largest rivers that drain into the wetland includes Kibimba in Busia and Bugiri Districts, Malikisi near Malaba on the Uganda-Kenya border, Manafwa river from Bududa and Manafwa Districts and Nabuyonga and Namatala from the Wanale hills of Mt. Elgon. On their descent from Mt.Elgon, these rivers form wetlands that are now under intensive use especially for growing paddy rice. About 70-80% of the original size is intact, although abuses are visible along the edges for instance in Namakoka village in Ivukula Subcounty and Buyenvu in Kagulumu Parish, Magadasca in Namutumba District and Kadama, Kirika, Tirinyi and Kasasira Subcounties in Kibuku District.

The wetland has a rich biodiversity and is dominated by papyrus (*Cyperus papyrus*) and Hippo grass (*Vossia cuspidata*). Fish species present include *Bagrus docmac, Clarias gariepinus, Oreochromis leucostictus, O. niloticus, Protopterus aethiopicus, Rastrineobola argentea and Tilapia spp* (Vanden-Bossche & Bernacsek GM, 1990).

Mpologoma wetland system has got six major subcatchments. The dominant land use activities in all these wetlands are rice cultivation and fishing (Table 3.2).

Major threats to the wetland

There have been several attempts to drain the wetland but all these efforts have failed, largely due to its size, hydrology and government's determination to protect it. For example, in 2008 Uganda Investment Authority (UIA) granted permission to a private company to grow cotton and sunflower in the Apapa and Kasodo wetlands that form part of the larger Mpologoma system. These developments were stopped by NEMA and the drained section of the wetland re-flooded for natural regeneration.

Management efforts and recommendations

Although the wetland is a good case study and relatively intact, its values and functions need to be conserved through strict conservation management measures to abate the would-be threats. Communities along this system in Namutumba District are already sensitized about physical demarcation of the wetland boundary.

Table 3.2: Major wetlands in Mpologoma system

Name	Wetland type	Land use	Key threats
Walugogo-Lumbuye	Permanent and seasonal	Rice cultivation, fishing, grazing and papyrus harvesting	Drainage and silting
Naigombwa	Permanent	Rice cultivation, fishing, grazing and papyrus harvesting	Siltation and drainage
Malaba-Kibimba	Permanent and seasonal	Commercial rice growing, grazing, hunting, fishing and papyrus harvesting	Drainage
Mpologoma	Permanent	Fishing, papyrus harvesting and hunting	Silting
Limoto-Lemwa	Permanent	Rice cultivation, fishing, papyrus harvesting and hunting	Drainage
Namatala-Doho	Permanent and seasonal	Commercial rice growing, fishing and papyrus harvesting	Drainage and silting

(WMD, 2006)

Photo credit: George Lubega

Mpologoma wetland along Iganga - Mbale Highway

Lake Lemwa-Limoto Wetland System

LAKE LEMWA-LIMOTO WETLAND SYSTEM

Lake Lemwa lies within the catchment of the Mpologoma wetland system in Pallisa District. The lake receives most of its waters from the Limoto wetland system that drains most of Pallisa and Kibuku Districts. Limoto is a hotspot wetland. About 70-90% of the original area has been converted to farmland. Lake Lemwa is of great significance in the area because it is the source of piped water for Pallisa Town supporting a population of about 32,700 people (UBOS, 2014).

Major threats to the wetland

Human activities have severely affected water supply from the lake. During the 2011 elections, local politicians in the Bugwere area used the promise of access to wetlands in exchange for votes. They encouraged farmers to invade the wetlands and grow rice in order to fight poverty. The invasion of wetlands, especially Limoto, for rice growing led to a considerable reduction of water in Lake Lemwa. As a result, the Water Authorities in Pallisa District could not abstract water from the lake to supply the town. In fact Pallisa Town has not had a reliable source of water since November 2013. The major hotspot areas along this wetland are in Limoto and Puti-Puti subcounties in Pallisa district and Buseta 1 village in Buseta Subcounty in Kibuku District.

Another challenge is the fact that the wetland is shared by Pallisa and Kibuku Districts and the lack of a proper boundary makes management interventions extremely difficult as efforts from one district are watered down by non-compliance from the other. Management interventions by Kibuku District Local Government to date include the demarcation of a 30-meter buffer zone of the Limoto Central Forest Reserve using *Euphorbia* plants.

Limoto wetland, Pallisa District

Photo credit: George Lubega

Namatala-Doho Wetland System

NAMATALA-DOHO WETLAND

Doho wetland is located in Butaleja district and is famous for the Doho Rice Scheme that was established in 1942 as a government venture to increase food production in the country. The scheme was created on the seasonally flooded wetlands of River Manafwa at the foot of Mt. Elgon and covers an area of 3,200 ha. In addition to a network of channels to serve the rice fields, this intensively irrigated rice cultivation scheme was constructed with an associated dam to provide water supply to support its operations. The rice scheme has since been identified as an Important Bird Area (IBA) (Odull & Byaruhanga, 2009) due to the presence of threatened birds species and congregation of migratory birds.

Namatala wetland is located between Kamonkoli subcounty in Budaka district and Mbale municipality in Mbale District. It is a permanent wetland dominated by *Cyperus papyrus* and *C. dives*. The wetland is fed by the Nabunyonga and Manafwa river systems.

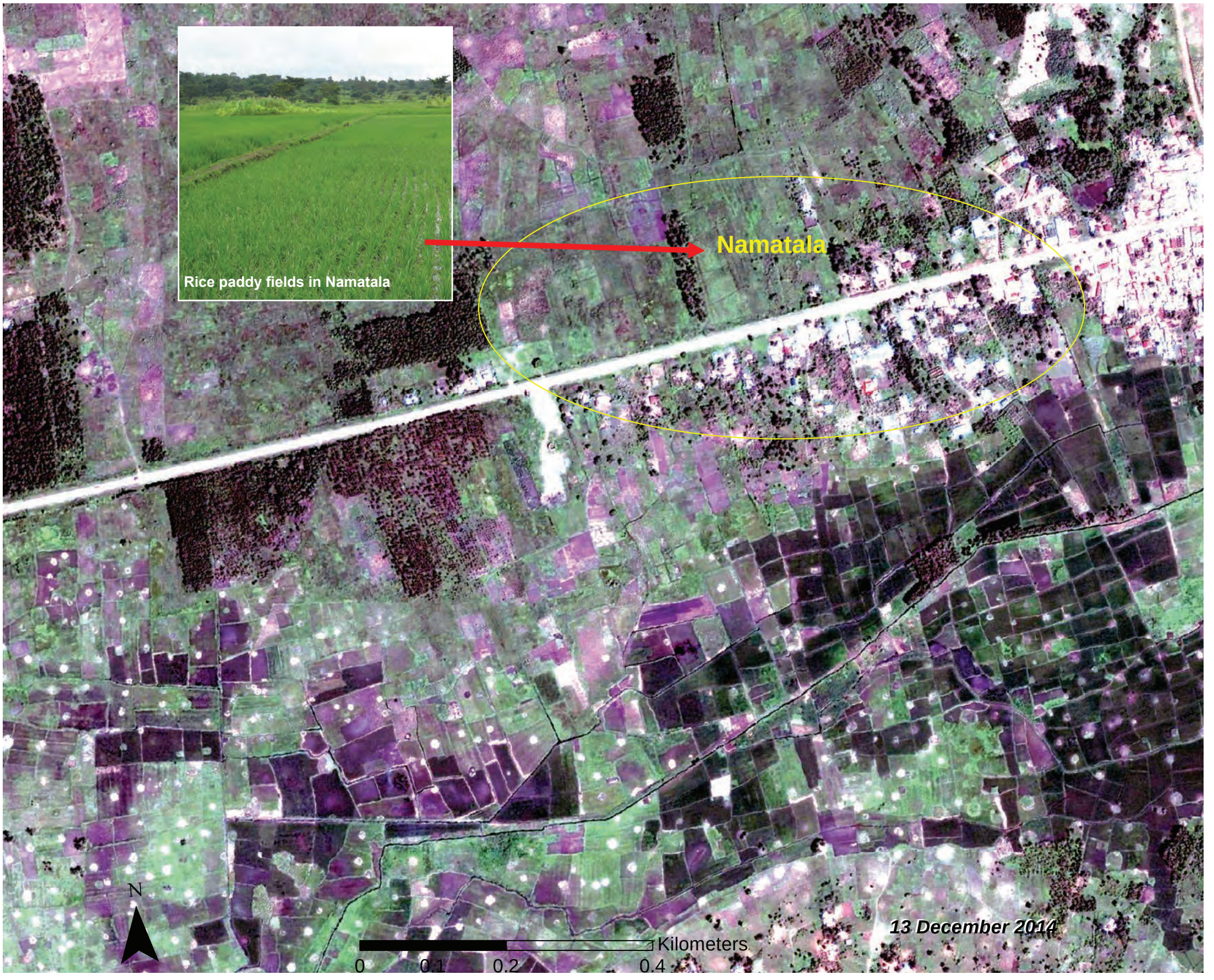
Major threats to the wetland system

Birds in the Doho wetland system are under threat from hunting and from poison being used to kill them in the Doho rice scheme (Odull & Byaruhanga, 2009).

Namatala wetland is highly degraded from rice cultivation, waragi (local gin) distillation and sewage, which is now directed straight into the River Namatala. The wetland was intact until about 15 years ago when it was invaded by smallholder framers for paddy rice cultivation. The main river course has been channelized and there is cultivation of rice and maize on its riverbanks. It is estimated that 80-90% of the wetland area in Mbale and Butaleja Districts has been converted to rice farms or paddy fields. Box 3.1 highlights some of the environmental impacts of rice growing.

Pollution from Mbale Town is also contributing to its destruction and during the last ten years it has also been invaded for settlements. A relatively big portion of this wetland, on the Mbale side, has been delineated and land titles processed contrary to the Constitution, the Land Act and other conservation laws. For example, there are plans to develop an industrial park under the Uganda Investment Authority. Other planned developments include Livingstone University among others.

The intensity of use of this wetland has often degenerated into sharp conflicts between local communities, with each claiming the right of access and ownership. For example, since 2005 to date several fatal incidents involving the local communities have been recorded. Interventions by the Ministries of Local Government and that of Water and Environment have so far not yielded any lasting solution.



Box 3.1: Environmental impacts of paddy rice growing in wetlands

Rice (*Oryza spp*.) is an increasingly important staple in Uganda. The major rice producing areas in Uganda include the districts of Pallisa, Butaleja, Iganga, Lira, Bundibugyo and Gulu. Rice growing in wetlands may have environmental impacts. However these will depend on the wetland type, the intensity of drainage and agronomic practices utilized. Some of the impacts include:

- The propagation of disease vectors due to the presence of ideal breeding conditions. Such disease vectors such as mosquitoes and snails spread malaria and schistosomiasis respectively.
- Excessive use of fertilizers which leads to eutrophication and adversely affecting the ability of the wetland to maintain and improve water quality.
- Drainage for agriculture which is particularly harmful to seasonal wetlands. It has been reported that 60% of the seasonal wetlands in Pallisa and Iganga districts have been lost as a result of this practice.
- Paddy rice fields have been shown to be a source of greenhouse gases such as methane. Intensification of farming practices increases these emissions.

(Oonyu, 2011) (Roger & Joulian, 1998)

Soil erosion in the rice fields reduces the life span of the irrigation channels

Photo credit: George Lubega

Management efforts and recommendations

A management plan has been prepared for this wetland however there have not been any further interventions. However, demarcation of the physical boundaries is on-going in Mbale municipality by the Ministry of Water and Environment and so far this has checked the rate at which wetlands are being converted by the local communities.

Although guidelines have been developed for agricultural use of wetlands, these have not been widely implemented. It is strongly recommended that these guidelines be operationalised. In addition, a study is critically needed to assess the impacts of rice growing on the wetlands in Uganda.

Photo credit: Flickr

A Rice field in Namatala wetland

Awoja Wetland System

AWOJA WETLAND SYSTEM

Awoja wetland is the largest sub-basin in the Lake Kyoga wetland system and is shared with Soroti, Ngora, Kumi and Katakwi districts. It derives most of its water from Mount Elgon and also drains most of the Karamoja, Sebei (Mt. Elgon) and Teso regions. At its upper most section just before crossing the Kumi-Soroti road, the wetland is a complex of two wetland ecosystems - Lake Opeta and Lake Bisina wetlands. The wetland later feeds the satellite lakes of Adais, Nyasala (which is also fed by Lake Nyaguo from Akadot wetland) before entering Lake Kyoga at GPS location 556949.11 m E; 144640.55 m N.

The most dominant wetland vegetation includes *Typha*, papyrus, *Phragmities* and swamp forests. Unlike in much of eastern Uganda, the wetlands here are still intact and used for traditional purposes such as hunting, grazing of livestock, fishing mainly for domestic consumption, mining of clay for brick making, harvesting of materials for craft making, building materials and medicinal plants and performing rituals and cultural activities. It is estimated that 70% of this wetland has not been tampered with, indicating that its integrity and capacity to continue providing goods and services to neighbouring community is still high. On the other hand, impunity actions by some user especially at the Ngora District side pose a threat to the survival rate of this wetland. Rice cultivation, poor traditional means of land management in the region coupled with governance issues are the prime underlying causes of this shift in the wetland uses.

The section of this wetland between Ngora and Serere district is one of the most lucrative rangelands in Uganda. About 30km upstream of the Ngora-Serere Road, Awoja river divides into two riverine systems that is Agu wetland in Agu village in Ngora District that later drains into Kobwin Subcounty and Abuket wetland in Serere District.

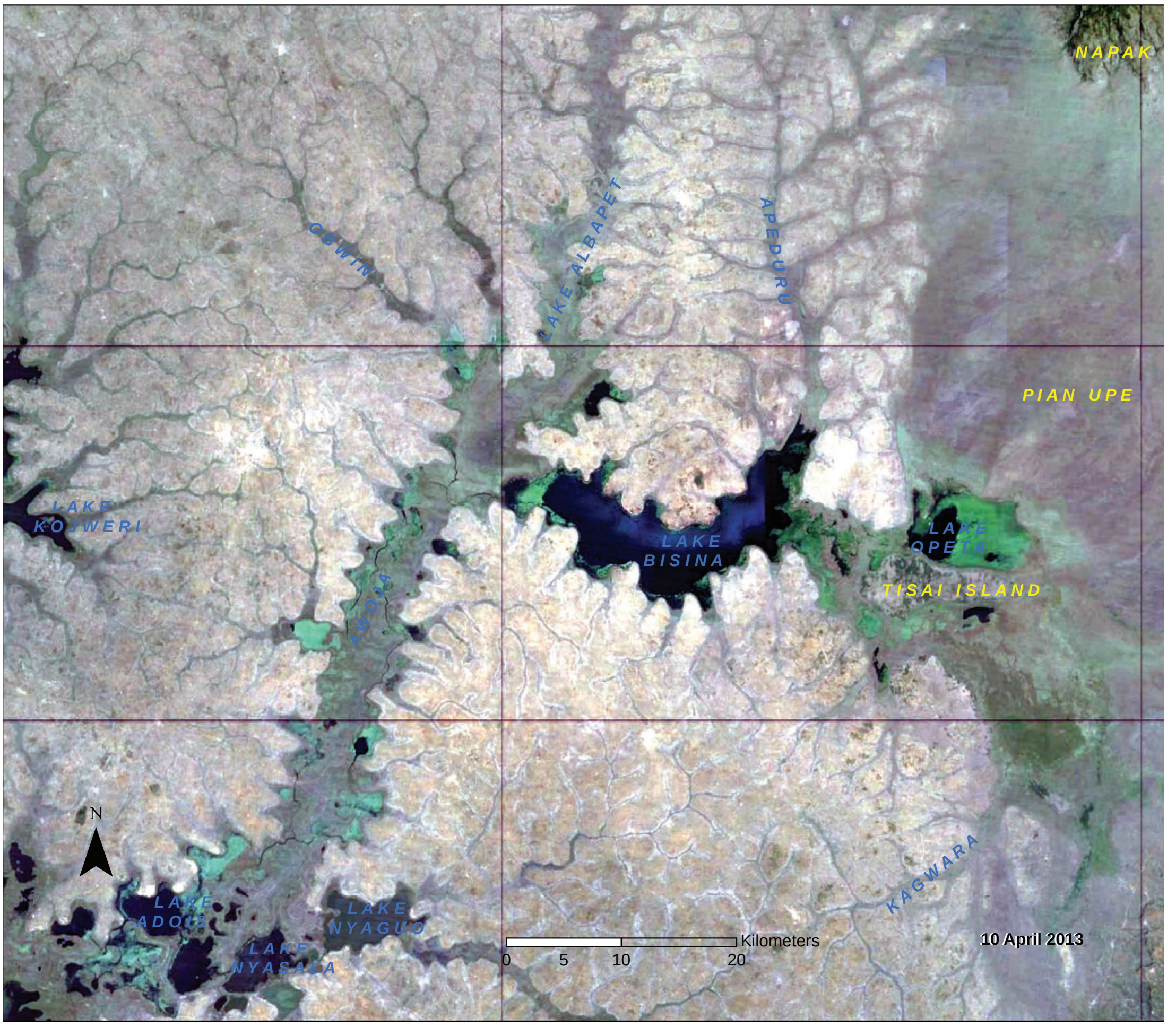
The seasonal wetland between these two riverine wetlands measuring about 6km is mainly used for livestock grazing. In 2001, the wetland attracted pastoralists from Wakyato in Luwero District and Ngenge plains at the foot slopes on Mt. Elgon with over 6,000 heads of cattle; the pastoralists settled in the wetland. This resulted into serious wetland degradation and conflict between these pastoralists in the wetland and the local community who had been discouraged from degrading and settling in the wetland by Government.

Lake Awoja that lies within Lake Kyoga Wetland system

The entire Awoja wetland system is one of the best areas for livestock production in Uganda. It has very good pasture and a reliable source of water throughout the year. Because of this, the region continues to receive pastoralists from other parts of the county that are water stressed such as Nakasongola and Luwero. This has in the past led to conflicts in the area.

Management efforts and recommendations

In 2002, NEMA evicted over 100 pastoralists and their families from the wetlands of Agu, Abuket and Awoja in accordance with the provision of the National Environment Act Cap 153. This allowed the wetland to regenerate to its current natural state. The management of Awoja wetland system requires a framework management plan to address all the common interests including that of Government. This includes the need to conserve Lake Agu for the water supply to upcoming towns in the area such as Ngora, Serere, Kanyum and Nyero.



Lake Bisina and Opeta Wetland System

LAKE BISINA AND OPETA WETLAND SYSTEM

Bisina-Opeta wetland is an extensive system which covers districts of Kumi, Katakwi, Bukedea, Ngora, Sironko and Bulambuli. The prime sections are in Kapujan and Toroma subcounties in Katakwi District, Ongino and Kumi Subcounties in Kumi District, Malera and Kolir Subcounties in Bukedea District, and Bunambutye Subcounty in Bulambuli. It is a gently sloping system with fresh waters and supports a diversified wetland community thus internationally recognized as a Ramsar site.The wetland provides breeding ground for the crested cranes in Kumi Subcounty and a reasonable number of shoebills had been noticed in Omatenga Parish, Kumi Subcounty.

Lake Bisina wetland system measures about 32 by 6.5 km at its widest point covering an area of about 192km^2. Along its perimeter is a thin strip of papyrus. It is fed by one major river called Apendura which flows from the northern direction between Kumi and Katakwi Districts. The shallower parts of the lake are dominated by submerged and floating wetland plants while the deeper sections have got papyrus, reeds and sedges. Unlike Lake

Opeta, here rain generally occurs in two separate seasons April-June and September-November with a mean annual rainfall of about 1,000 mm.

Lake Opeta, located at an altitude of 1,050 masl, is the largest aquatic ecosystem in the upper most section of the Awoja wetland covering 3,200ha. Rainfall in the area is highly localized averaging 500-700mm during a single rainy season between March and September. Lake Opeta wetland ecosystem remains the only significant wetland in the Karamoja region and is one of the few remaining marshes in this area. The ecosystem is formed from the seasonal flooding of rivers from Mt. Elgon such as River Ngenge and Atari from Kapchorwa District. These extensive marshes in the flood plains comprise of tall sedges and reeds, draining into the permanent fresh open water body – Lake Opeta. Lake Opeta is fringed extensively with *C. papyrus* contiguous with dry grass savanna to the west, making it very suitable for livestock grazing. This lake is full of submerged plants and covered in parts by floating plants especially Water lilies (*Nymphea caerulea*).

Major threats to the wetland

The wetland, as a whole, is relatively well conserved with about 70% of the wetland intact. But there are threats from poor land management, rice cultivation, overgrazing and over-extraction of woody biomass for charcoal production. Kumi District has been identified by NEMA as an Energy Hotspot with a severe shortage of wood for domestic and commercial use. Only a few sections of the district such as Tisai Island have intact trees. The island is about 50km^2 in area and is the only wooded island contiguous to the Lake Opeta-Bisina Ramsar site. Tisai island is now under severe pressure from charcoal production as the only source of energy to meet the demands of the neighbouring towns such as Bukedea, Kumi, Ngora, Mbale, Manafwa, Sironko, Bududa and Soroti. The biomass on this island now provides the main source of livelihood for most communities in the subregion. The land use on the island is slowly changing from the intact forest dominated with birds to a grass land with large herds of cattle, mainly the Zebu type; and the number of people settling on the island to provide services to the growing business community is on the increase.

Tisai island is critical for buffering sediment deposition or siltation of the Opeta-Bisina Ramsar site. The present rate of vegetation clearance threatens the sustainable management of the site.

Management efforts and recommendations

There have been a number of interventions carried out on this wetland and as a result, it is not really threatened. Continuous community sensitization and robust interventions such as the development of a Wetland Framework Management Plan by Wetlands Management Department and Catchment Management Plan by the Directorate of Water Resource Management have helped. Communities around the two water bodies have strictly protected the wetland from adverse effects.

Transporting charcoal from Tisai Island to Kumi Town

Olweny Wetland System

OLWENY WETLAND SYSTEM

Olweny wetland system is a permanent wetland made up of five major systems. It is located in Lira and Dokolo districts. The wetland drains into Lake Kwania across the Soroti-Lira Road just near Dokolo commercial area. Wetland grasses are the predominant vegetation but are recently being colonized by emergent vegetation. Details of the animal and plant species in the wetland system are highlighted in Table 3.3.

Olweny wetland is important as it was used by the Government to pilot a rice irrigation project in northern Uganda. Rice is the most irrigated crop in Uganda as shown in Figure 3.5. With the establishment the of Olweny Swamp Rice Irrigation Project and the increasing popularity of wetlands grown rice and vegetables in the district combined with presures on the wetlands for other uses more than 10% of the wetland has been converted (MWE, 1999). Attempts to establish irrigation schemes dates back to the 1950s: flood diversion structures of less than 14ha were established in Ngiminito, Nadunget and Namalu and in Oruchinga Valley and Nyakotonzi on about 20ha each (FAO, 2005). After a few years, however, these were all abandoned. From the 1960s onwards, larger irrigation schemes were developed by the government and are highlighted in Table 3.4. The Kiige, Odina, Labori, Ongom and Atera schemes were government farms for the promotion of citrus production, mangoes andcashew nuts. The Kibimba and Doho Rice schemes were designed for rice technology development and for seed multiplication respectively. Olweny swamp rice irrigation project became operational in 1997 (nucleus site) with a command area of 500ha and 2001 (Itek and Okile) and is also earmarked for rehabilitation.

Management efforts and recommendations

Olweny wetland system is a fairly well conserved wetland. This has been mainly due to diligence of the local leader's right from the Traditional Chiefs during colonial times to the present day Local Authorities. For instance in July 2013, the local chiefs in both Dokolo and Lira districts asked NEMA to limit the development of the Opuyo-Lira Electricity Transmission line to only the seasonal wetlands (NEMA, 2013). The two local governments also strictly monitored the upgrading of the Lira Soroti Road thus minimizing the degradation of the wetland.

Table 3.3: Major wetlands in Olweny wetland system

NAME OF WETLAND	SUB-COUNTY/ PARISH OF ORIGIN	WETLAND TYPE	ECOLOGICAL FEATURES
Abutoadi	Rao (Amac) Bardyang (Agwata)	Seasonal grassland	Water lilies, *Echinochloa*,Palms are common mixed with *Acacia*. Animals: Sitatunga, Edible rats and Rabbits. Fish: Catfish, Lungfish, Tilapia and Haplochromis. Birds: Ducks, Cranes, Pelicans, Ibis, Herons and Egrets.
Aminkwach	Alwitmach (Dokolo)	Seasonal grassland	Water lilies, Algae, *Vossia*, shrubs and thickets. Trees are mostly *Acacia*. Animals are Sitatunga, Reedbucks and snakes. Fish: Catfish, Lungfish, Tilapia. Birds include: Ducks, Cranes, Pelicans, Ibis, Herons and Egrets.
Anino	Alal (Aloi) /Acede (Abako)	Seasonal wetland or grassland	Natural grassland. Trees: palms, *Combretummolle* (Ioro). Animals: otters, snakes and edible rats. Fish: tilapia. Birds: egrets
Obangocet	Alenga	Seasonal grassland	grassland, palms and thickets. Animals are: reedbucks and snakes. Fish: catfish and lungfish, Haplochromis. Birds include: Ducks, Cranes, Herons, Ibis, Egrets and Pelicans.
Wiodyek	Abeli (Akalo- Apac)	Seasonally flooded grassland	*Acacia* trees and *Miliciaexcelsa* (mvule). Animals: Sitatunga, Otters, Reed bucks. Fish: Lungfish, Haplochromis. Birds: Ducks, Cranes, Pelicans, Ibis, Egrets

(MWE, 1999)

Figure 3.5: Crop irrigation in Uganda

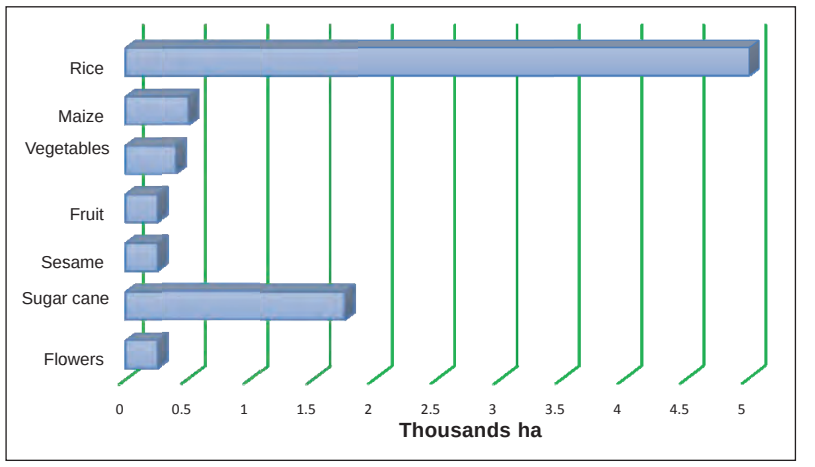


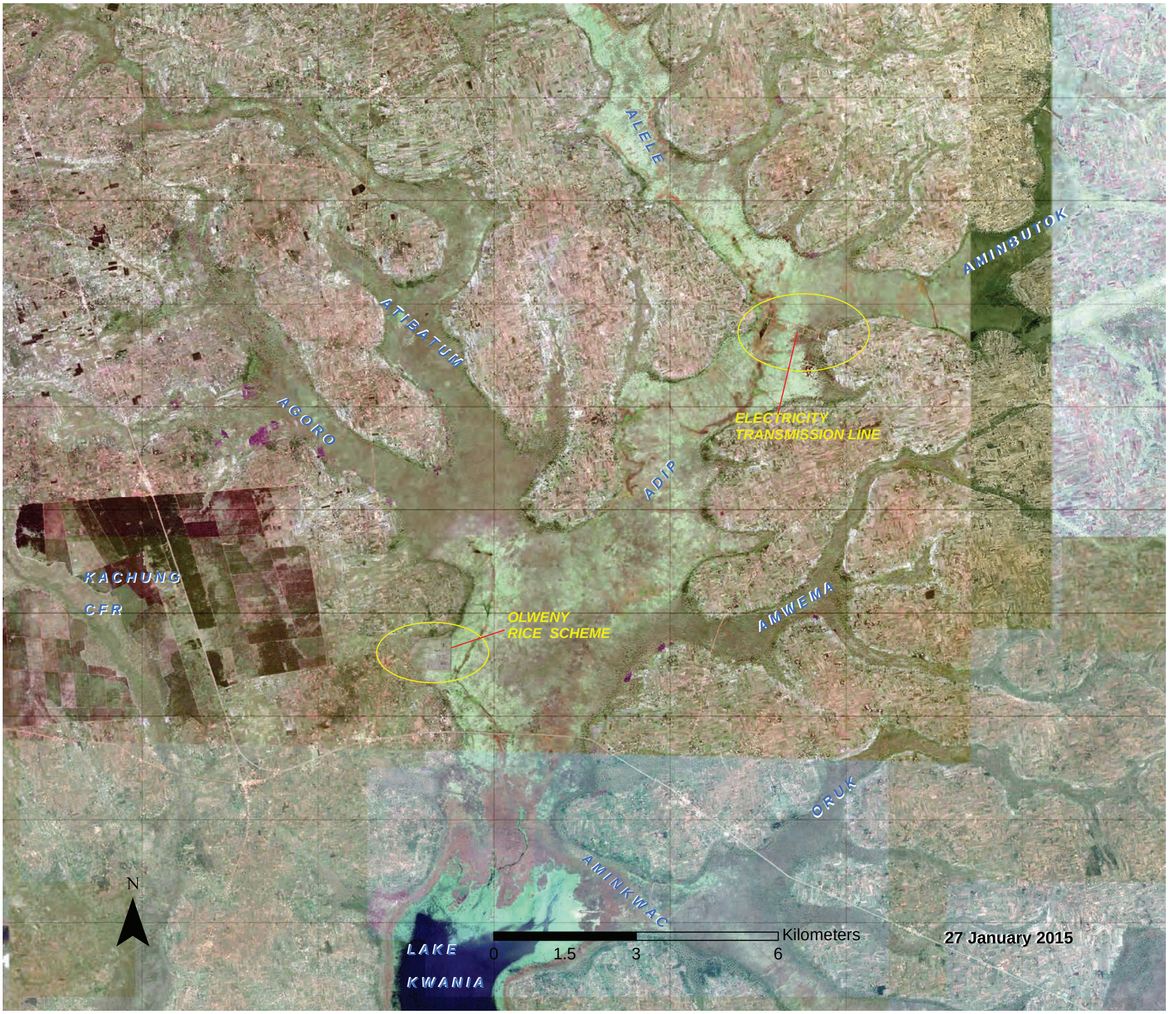
Table 3.4: Irrigation schemes developed by the Government

IRRIGATION SCHEME	DISTRICTS	SOURCE OF WATER	EQUIPPED AREA	YEAR OF CONSTRUCTION	IRRIGATION METHOD	STATUS IN 2013
Kiige	Kamuli	Lake Kyoga	60	1967	Sprinkler	Not Functional
Odina	Soroti	Lake Kyoga	67	1967	Sprinkler	Not Functional
Labori	Serere	Lake Kyoga	132	1962	Sprinkler	Not Functional
Ongom	Alebtong	Ongom and Owameri dams	0	1967	Sprinkler	Not Functional
Atera	Apac	Lake Kyoga/Nile River	150	1970	Furrow	Not Functional
Doho	Butalejja	Doho wetland	965	1970	-	Rehabilitated
Mubuku	Kasese	River Mubuku	672	1970	Sprinkler	Rehabilitated
Agoro	Kitgum	Agoro river	650	1970	-	Rehabilitated
Olweny	Lira/Dokolo	Olweny wetland	500		Flooding (rice)	Functional
Kibimba	Iganga	Kibimba wetland	665	1970	Flooding (rice)	Functional

(FAO, 2005)

A review of the literature (Gilbraith, Amerasinghe, & Huber-Lee, 2005) highlighted that irrigation in wetlands may cause negative impacts on wetlands from small localized effects to severe long-distance ones such as submersion or drying out of wetlands with impacts on downstream wetland communities. For instance even without drainage, studies indicate that the Olweny Rice scheme has reduced the Mudfish population in the swamp impacting food security (MWE, 1999). Irrigation may also lead to improvements in wetland functions or resources such as in the case where rice fields support habitat for wetland biodiversity. In such instances one can argue that irrigation may coexist with irrigated agriculture, however, this will depend on the scale and nature of the irrigation activity. What is clear that this subject needs further study especially since in many instances, when the impacts of irrigation on wetlands are being studied, human factors are forgotten and also because the potential long-term ecological benefits of water storage schemes are rarely investigated (Gilbraith, Amerasinghe, & Huber-Lee, 2005).

Against that background, there is need to build up quantitative information on the relationships between irrigated agricultural activity and ecological effects so as to learn from failures or successes and therefore ensure that future activities use strategies that minimize environmental impacts (Gilbraith, Amerasinghe, & Huber-Lee, 2005).

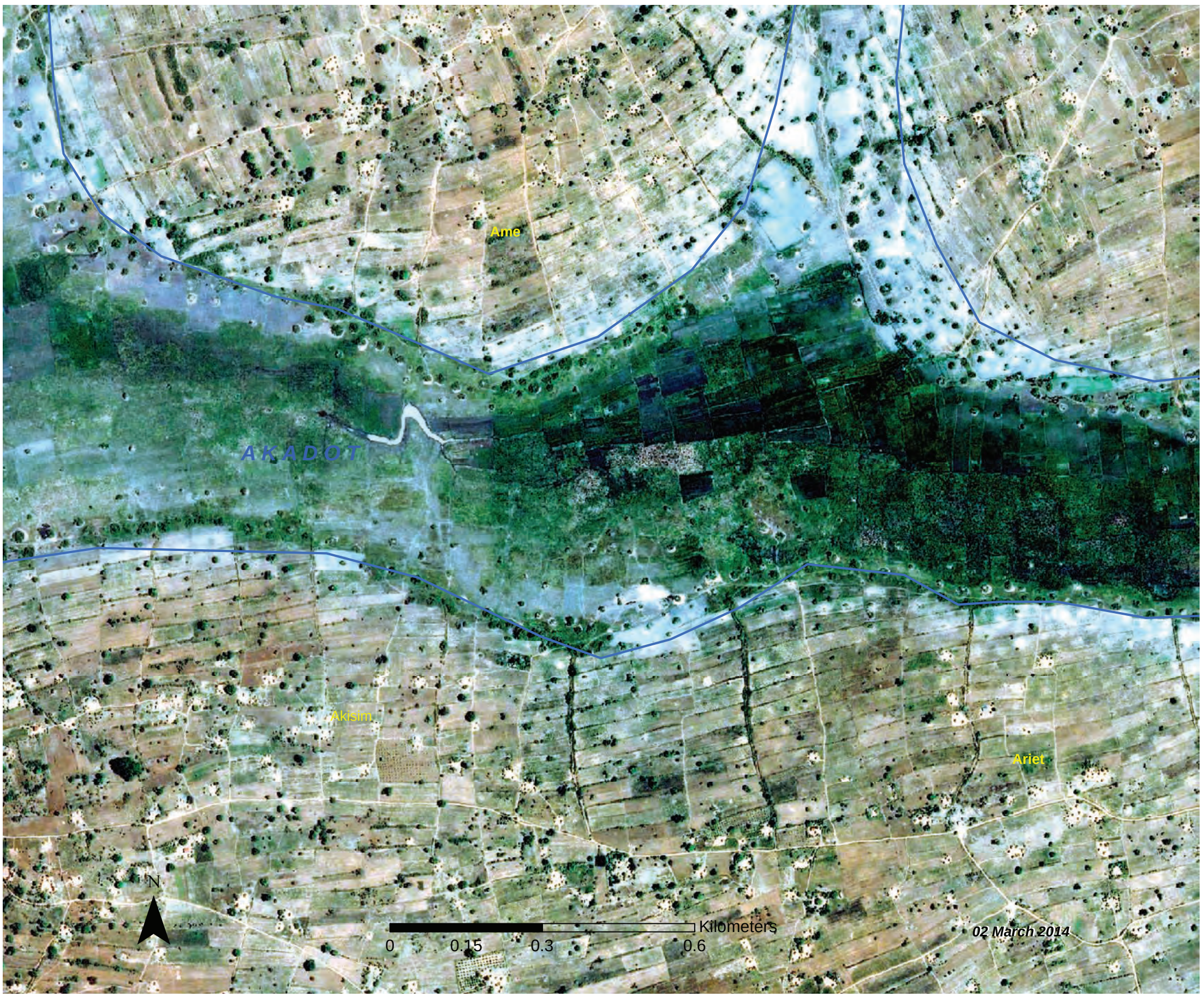


Akadot Wetland System

AKADOT WETLAND

Akadot wetland is one of the largest wetlands in Kumi district forming part of the Upper Lake Kyoga wetland system. The wetland covers Atuturi, Kumi, Nyero, Mukongoro Subcounties in Kumi District; and Kobwin and Ngora Subcounties in Ngora District. The wetland drains into Lake Nyaguo which in turn drains into Lake Kyoga.

The wetlands are important to the local communities for their ecological, economic and socio-cultural values. They are also the major source of water for domestic and livestock use and also a source of fish. It also provides miscellaneous income from various wetland products. The wetlands also function as reservoirs of water for downstream water systems and provide purification, filtration, flood control and water supply services. They are also used for cultivation of rice, millet, maize, sugarcane, dry season vegetables and mushroom collection. However, they are under threat and the riparian community has asked for government support to restore the wetland. Restoration of Akadot wetlands will ensure the stability of water flows throughout the year.



Major threats to the wetland

Unsustainable agricultural practices have been the major cause of the degradation of these wetlands. This has also been compounded by the nature of the wetland soils in the area.

During the last few years, the wetland was reclaimed for rice cultivation. Although rice cultivation does not completely change the hydrology of the wetland, it changes its ecosystems from a natural to an artificial one with reduced biodiversity. The lack of a planned irrigation system in the wetland has resulted into continued deep canalization of the main drainage channel hence lowering the water table in the wetland and draining it at an accelerated rate. This has affected the ecological status of the wetland compromising the water quality and its recharge functions.

The main sources of water that recharge the wetlands are rain water and shallow springs. The springs and rivers in the wetland system were perennial and a stable source of water for the communities and their livestock. Quite a number of streams originated from springs, but today only nine springs out of the 30 springs recorded 10 years ago are still productive. This loss is as a result of unsustainable farming practices in the wetland and its catchments and also the deep drainage channel downstream in the middle of the wetland.

The wetland system was connected to satellite lakes of Abiele and Okokor which in the past contributed to the recharge of the wetland and also provided feeding and breeding grounds for fish, birds and other animal species. These lakes have since dried up and a significant amount of biodiversity and habitat has been lost. Furthermore, the Atoot River which had perennial water flows is now seasonal and no longer has direct entrance into Lake Nyaguo.

Management efforts and recommendations

These have centered around addressing the impacts of piping erosion, a phenomenon where soil erosion occurs underground through 'pipes' or channels formed naturally in the soil (Jones, 1994) (Schneider, 2014). The pipes are difficult to see and thus are easily ignored by environmental managers. They may start out as small pores, gradually enlarging into large gullies. Soils with impeded drainage are prone to the formation of soil pipes.

The soils in this wetland are alluvial clays known as vertisols or black cotton sandy clays, which absorb plenty of water and expand during the wet season and shrink and develop extensive cracks when dry. In such conditions, plant roots may die leaving behind channels that aid water movement and consequently sub-surface pipe formation. As water erodes the pipes, the soil above the pipe will no longer be supported and may collapse leading to gullies and river bank failure (Schneider, 2014). Inspections of the area, showed soils quickly collapsing when the riverbank is destabilized mainly due to undercutting of the river flow downstream to Lake Nyaguwa.

The economics of gully restoration requires that action is taken in time before it becomes too deep to be financially feasible. Luckily, the request for the restoration of this wetland came directly from the community and thus there was no need for the lengthy legal procedures, restoration orders or evictions that usually accompany such processes. In June 2014, the Minister of State for Environment launched the process for the restoration of Akadot wetland. The restoration methodology is described in Box 3.2. Most of the focus was on reinstating the water quantity and quality through blockage of drainage channels and raising the water table of the wetland.

Communities participate in restoration of Akadot wetland

Photo credits: George Lubega

Box 3.2: Restoration methodology for Akadot wetland

1. Consultation with the Local Leaders and affected parties on the restoration modalities. This exercise was spearheaded by the Minister of State for Environment during a June-July 2014 field inspection in the upper catchment of Lake Kyoga. NEMA and other technical Government officials later held consultative meetings with the Councillors in the subcounties of Nyero, Kanyum and Mukongoro that were more affected by the degradation.
2. Baseline data collection and taking inventory of the affected parties within the wetland boundary was conducted by the District Local Government. During the exercise, it was noted that almost all the wetland degraders were not native to Kumi district. They originated from Pallisa, Bukedeya, Budaka or even as far as Iganga district. It was also noted that the local people contingent with the wetland who are mandated by law to prevent the degradation of the wetland, were instead hired to open up the wetlands for rice planting or to help with the harvesting.
3. Removal of illegal plants from the wetland, mostly crops to minimize loss on the side of the community was one of the planned activities. At the start of the exercise, the owners of the crops mainly sugar cane requested that they be given time of not more than a week to harvest their crops and go. They didn't comply and the restoration team asked the community to graze their cattle on these crops in the wetland.
4. Re-distribution of wetland vegetation rhizomes to speed up the regeneration process. More than 20 km of the wetland had been reclaimed and completely replaced with crop. So wetland vegetation rhizomes were harvested from Agu wetland along the Ngora-Serere Road and physically planted in the wetland.
5. Blockages of secondary drainage channels that run from the edge of the wetland towards the main channel. These channels were erected by rice growers and used to drain the entire wetland by feeding into the main channel. The secondary drainage were so deep and required use of sand bags. The sand was carried by the community from the edge of the wetlands manually for a period of about three weeks.
6. Construction of check-dams along the main channel at the intervals of 30-40m. Each check dam was constructed using not less than 50 sand bags and not less than 15 stone gabion baskets. This intervention reduced the momentum of the water and hence reduced it erosive potential. It also raised the water table at these check dam points and caused it to divert from the main channel to the reticulation shallow channels that now distributes the water in to the entire wetland. The reduced speed of the water increases the residence time of the water in the wetland and this resulted into flooding of the entire wetland.
7. Monitoring recovery of the site restored, including repairs and re-enforcement of restoration structures has been an on-going process. By September 2015, more repairs of the damaged check dams were still on-going in the wetland.
8. At a later stage during the restoration exercise in April 2015, it was found necessary to arrest and prosecute persons who were not complying with the restoration exercise and were still growing rice in the wetland. Over 50 people were arrested and prosecuted before Magistrates Court in Kumi.

The railway line is among some of the infrastructure that cross wetland systems in eastern Uganda

Table 3.5: Summary of wetland systems in Lake Kyoga Basin

WETLAND SYSTEM	STATE	RECOMMENDATIONS
Lake Nakuwa wetland system Ramsar site in Kaliro and Pallisa	• Lake Nakuwa wetland system is located within Gogonya Sub County. It is a fresh lake and internationally recognised as an IBA thus a Ramsar site. • The wetland is fed by three other satellite lakes - Kawi, Lemwa and Daraja/Gigati; however, the three lakes have been massively degraded through cultivation and invasion of foreign species. • LakeLemwa is estimated to have lost about 40% of its original wetland area, posing a threat to the Lake NakuwaRamsar site.	• Although a number of interventions including stakeholder dialogues have been prioritised by districts surrounding the wetland, more stringent measures such as physical boundary demarcation should be considered to save the escalating situation.
Namatala wetland system	• Namatala wetland is shared by mainly four districts, that is, Mbale, Butaleja, Budaka and Pallisa. However, the biggest portion is in Nakaloke, Namanyonyi, Bukasankya, Bungokho and the Industrial Division of Mbale District; and Nambale Nasenyi, Namawa, Mawanga Parishes from Butaleja side. • The wetland is highly degraded through rice cultivation, *waragi* distillation and sewerage which is now directed straight into River Namatala. • A big portion of this wetland in Mbale side has been relatively delineated and land titled which has greatly hindered implementation of management interventions. • The proposed Industrial park under Uganda Investment Authority (UIA), Livingstone University and other planned facilities are within the wetland area. • It is estimated that 80-90% of the wetland area in Mbale and Butaleja Districts has been converted to rice farms.	• Physical boundary demarcation in Mbale Municipality is now guiding the development program near the wetland. • Sensitization and awareness creation by Local Governments. • Wetland Management Plan was developed but rejected by the Local Governments. This should be revived.
Naigombwa wetland system	• The wetland is located in Kibale, Nsinze and part of Ivukula Subcounties in Namutumba District. Ten years ago this wetland was permanent in nature but now gradually changing to seasonal. • It is estimated that about 31% of the wetland has been heavily converted to other land use. • Nawaibete wetland is a major hotspot section on this wetland.	• Since the Nawaibete wetland hotspot area is a source of water for NamutumbaTown Council, MWE had earmarked this wetland for physical demarcation for the FY 2015/16.
Tisai Island wetland system	• The wetland is an island covered by both Bisina and Opeta Lakes. It is actively under massive charcoal burning and firewood harvesting; it providesfuel wood to the neighbouring districts. The wetland has been overgrazed by a large number of cattle with pastoralists from all parts of the country.	• Not much management intervention has been applied to this section of the wetland. • Biomass assessment conducted under the National Wetland Management Project supported by JICA and GoU/MWE indicated that the area is able to support the current users up to more 100years due to the ability of wetland plants to sprout easily.
Ngenge-Atari-Sipi-Sironko wetland system	• The wetland runs across the three districts of Kween, Kapchorwa and Bulambuli.The wetland has an elongated flood plain at Bunambuntye Sub County called Bunambuntye wetland. This section has been much interfered with silt from upstream of the wetland. It drains into Bisina-Opeta Ramsar site through rice fields. It is permanent at certain sections, while seasonal at other areas. The area is extensively flat thus experiences periodic flooding. • It is estimated that 20% of this wetland area has been encroached on by other land use activities. • Soil and water conservation measures at slopes of some sections of Mt. Elgon in Kapchorwa and Kween District through the Ecosystem Based Adaptation (EBA) project and other several initiatives have reasonably checked the amount of still reaching this wetland	• There is need to intensify more soil and water conservation initiatives on Mt. Elgon.
Sio-Siteko wetland system	• Sio-Siteko is a trans boundary wetland between the Republic of Uganda and Kenya. It is within the Eastern Division of Busia Municipal Council, Dabani, Masinya, Buhehe, Lumino, and Majanji Sub-counties in Busia District. It harbours habitat for unique fish species, (e.g *Budonge, Esiire, Eningu*),and has potential for eco-tourism, with wildlife such as crocodiles and hippos. • Bush burning, over harvesting of papyrus reeds, sand mining and unregulated rice growing threatens its existence. • It is a good case study for a wetland that has been well conserved under management planning process with assistance from Nile Transboundary Environmental Action Plan (NTEAP).	• All the provisions of the management plan must be implemented.
Malaba wetland system	• Located between Tororo and Busia districts in Eastern Uganda. Most of it lies in Butebo and Busitema Sub-counties in the villages of Amunoit, Bulumba and Galama. Its main tributaries are river Okama, Namukombi and Solo. The wetland drains into River Mpologoma. • In most sections of the wetland, the originally dominant *Phragmities* and *Cyperus papyrus* vegetation have been replaced with farm land mainly for rice and maize growing. This is likely to compromise the natural benefits from the wetland such as lung fish which is common in the wetland.	• Wetland management planning of this wetland should be developed and implemented.

(NEMA 2015)

BIBLIOGRAPHY

Aloo, P., Ojwang, W., Omondi, R., Njiru, J. M., & Oyugi, D. (2013). A Review of the impacts ofinvasive aquatic weeds on the biodiversity of some tropical water bodies with special reference to Lake Victoria (Kenya). Biodiversity Journal , 4 (4), 471-482.

CRC for Australian Weed Management. (2003). Retrieved November 21, 2015, from Weed Management Guide: Salvinia - Salivnia molesta: https://www.environment.gov.au/biodiversity/invasive/weeds/publications/guidelines/wons/pubs/s-molesta.pdf

Donaldson, S. (2002). Identification and Management of Giant Salvinia (Salvinia molesta). Fact Sheet 02-69. Reno NV: University of Nevada Reno.

Jones, J. (1994). Soil piping and its hydrogeomorphic function. Cuaternario y Geomorfologfa , 8 (3-4), 77-102.

Nsubuga, F. N., Namutebi, E. N., & Nsubuga-Ssenfuma, M. (2014). Water Resources of Uganda: An Assessment and Review. Journal of Water Resource and Protection, 2014 , 1297-1315.

Odull, M. O., & Byaruhanga, A. (2009). Important Bird Areas in Uganda. Status and Trends. Kampala: NatureUganda.

Oonyu, J. (2011). Upland rice growing: A potential solution to declining crop yields and the degradation of the Doho wetlands, Butaleja district, Uganda. African Journal of Agricultural Research , 6 (12).

Roger, P. A., & Joulian, C. (1998). Environmental impacts of wetland rice cultivation. International Rice Symposium Nottingham UK 24-27 November 1997. Marseille Cedex: CIHEAM.

Schneider, C. (2014). From pores to pipes: The problem of underground erosion in soils. Soil Horizons , 1-3.

Temple, P. (1970). The lakes of Uganda. In S. (. Ominde, Studies in East African Geography and Development (pp. 86-98). London: Heinemann, London.

UBOS. (2014). National Population and Housing Census. Provision Results. November 2014 Revised Edition. Kampala: Uganda Bureau of Statistics (UBOS).

UBOS. (2014). Statistical Abstract 2014. Kampala: Uganda Bureau of Statistics (UBOS).

UBOS. (2015). Statistical Abstract 2015. Kampala: Uganda Bureau of Statistics (UBOS).

Vanden-Bossche, J. P., & Bernacsek GM, G. M. (1990). Vanden-Bossche JP, Bernacsek GM (1990). Source book for the inland. Rome: Food and Agriculture Organisation of the United Nations (FAO).

The giant Lobelia found in the Albertine graben

Chapter

4

LAKE ALBERT BASIN

Figure 4.1: Lake Albert basin

(Uganda Atlas, 1967)

INTRODUCTION

The Lake Albert Basin (figure 4.1) is located within the Albertine Rift at the border with the Democratic Republic of Congo (DRC). The Albertine rift is one of the most important areas for biodiversity conservation in Africa. It is an area of high endemism with a number of threatened species and has been identified as an Important Bird Area by Birdlife International; an ecoregion by World Wildlife Fund (WWF); and a biodiversity hotspot by Conservation International.

The wetlands in this catchment are associated with Lake Albert and the rivers and seasonal streams that drain into the lake. Lake Albert is the largest water body in the catchment and is the 7th largest lake within Africa (NEMA, 2009). It is also a transboundary lake shared with the DRC. The basin has an area of 18,037 km² with wetlands covering an area of 286 km² (Nsubuga, Namutebi, & Nsubuga-Ssenfuma, 2014). The main affluent rivers into Lake Albert are the River Semliki, which comes from Lake Edward through the western edge of the Ituri tropical rainforest in the DRC; and the Victoria Nile River which enters very close to the northern end in Uganda. Both rivers have built deltas into the lake and that of the Semliki is larger with 90% of its delta located on the Ugandan side (NEMA, 2009). Huge wetlands exist in these deltaic regions and are endowed with a rich biodiversity. There are other smaller streams entering the lake from both Uganda and DR Congo, but some of these are seasonal and only of minor hydrological importance.

Key messages

The Lake Albert Basin lies within the Albertine Rift and is one of the most important areas for biodiversity conservation in Africa.

Discovery of oil in the basin poses a challenge to conservation efforts, requiring concerted Government efforts to monitor compliance with environmental laws on the part of those involved in the oil sector development in the basin.

The main wetland systems that are part of this basin include those associated with the following rivers: Muzizi, Nkusi, Wambabya, Waki, Waiga, Sonso, Waisoke and Semliki.

An oil rig at the shores of Lake Albert

RIVER MUZIZI WETLAND SYSTEM

River Muzizi starts from the hills of Mubende District (1,300 masl) and drains through Kyegegwa, Kibaale, Kyenjojo, and Kabarole Districts, discharging its water at Ndaiga (650 masl) in Kibaale District near Ntoroko Town Council in Ntoroko district covering a total distance of 120km. This riverine wetland drains most of the originally forested wetlands and catchment areas of Kaija wetlands in Kakabara Parish and Kahomba Wetland in Matiri Subcounty in Kyenjojo District.

Major threats to the wetland

The main challenges are the deforestation of the swamp forests for charcoal production and the opening up of farm land and for settlements, mainly by the new settlers from Kigezi region. NEMA has received proposals to establish mini hydropower plants downstream of this riverine wetland ecosystem. There are implications on the quantity of the riverine water if the catchment degradation is not halted.

RIVER NKUSI WETLAND SYSTEM

River Nkusi riverine wetland starts from Kakumiro in Kibaale District (at about 1160 masl) and flows in a northwesterly direction to enter a wetland near Kitoma village. This is the point where two rivers (Nkusi and Kafu) are believed to have changed and drained into opposite directions during the tertiary period. From this wetland, River Nkusi emerges and flows westwards to empty into Lake Albert at Kigwabya at an altitude of about 650 masl. The entire river course is about 160m long.

The main wetlands that drain into River Nkusi are all located in Kibaale District and include Ruzaire, Mutunguru, Mpamba, Kanyege, Wabinyama and Kabirakengo. Other wetlands that drain into this river system includes Nyamaziga, Kiterebu, Mufumbasabuni, Nyamiyumbu, Kanyalugenda, Nyakiti, Kadebede/Katerera, Kirundi, Mususu, Mbaya, Bwizibwera, Njurwe, Kyempisi/Nyango, and Myoma/Kibira/Kasanje all of which drain into River Nkusi secondary wetland system.

Major threats to the wetland

Most of these wetlands are relatively intact, as they are indirectly protected by a poor road network which makes them relatively inaccessible. However the catchment area is experiencing severe degradation through slash and burn subsistence agriculture. Government has also planned to develop a small hydropower plant on River Nkusi (Lower Nkusi Hydropower project) with a generation capacity of up 11MW (ERA, 2014).

RIVER WAMBABYA WETLAND SYSTEM

River Wambabya, along with others like River Hohwe is a perennial river in the Lake Albert Basin that starts from Wambabya and Bujaawe forest reserves in Hoima district. The river passes at the periphery of Hoima municipality where it is used mainly for car washing. It passes through several intact wetlands before discharging its water into Lake Albert at Kaiso-Tonya. This river and other associated streams originate from the high elevated areas of the escarpment, flow down into the valley and drain into Lake Albert. A series of erosion valleys and gullies cut the escarpment and discharge runoff from the escarpment to the valley.

River Wambabya is of historical importance in Uganda because it contributed significantly to the proliferation of river blindness disease, Onchocerciasis, in western Uganda. The disease causes eye lesions which lead to impaired vision and blindness. It is caused by a parasite *Onchorcerca vulvulas* spread by the bite of the black fly (*Simulium damnosum*). The river provides the ideal habitat for the fly which in its larval stage requires fast flowing and clean streams. The flies lay their eggs in the fast flowing water. On hatching, the larvae attach themselves to rocks using tiny hooks at the end of their abdomen to hold on. Breeding success is highly sensitive to water pollution.

Kaso-Tonya before tarmac.

River blindness has been endemic in 26 districts, though by 2014, transmission had been interrupted or eliminated from 15 of its 17 focus areas putting the country on track to achieving its goal of eliminating the disease by 2020 as shown in Figure 4.2 (The Carter Centre, 2015).

Major threats to the wetland

Charcoal production for energy and agriculture are the main challenges facing this wetland. Recently, the catchment was invaded by charcoal producers especially in Buseruka Subcounty as a result of increasing demand for charcoal and firewood in Hoima Town. The depletion of forests has resulted in increased soil erosion and silting in the rivers threatening the multi-billion shilling 9MW Kabalega Hydroelectric power station on River Wambabya in Buseruka subcounty, Hoima District (Figure 4.3) (UNFCCC, 2006). The continued silting of the river is likely to reduce water volume in the Wambabya River and affect power generation.

The growing of paddy rice is also another threat facing the riverine wetlands. The wetlands have been invaded by farmers who are mainly migrants from the Busoga and Kigezi regions. Although most of the farmers had claimed to be implementing the Government program of upland rice production, they are in many cases now found deep in the middle of the wetland, growing paddy rice.

Figure 4.2: Location of Onchocerciasis sites in Uganda

http://www.cartercenter.org/resources/pdfs/health/river_blindness/status-of-river-blindness-uganda-map.pdf

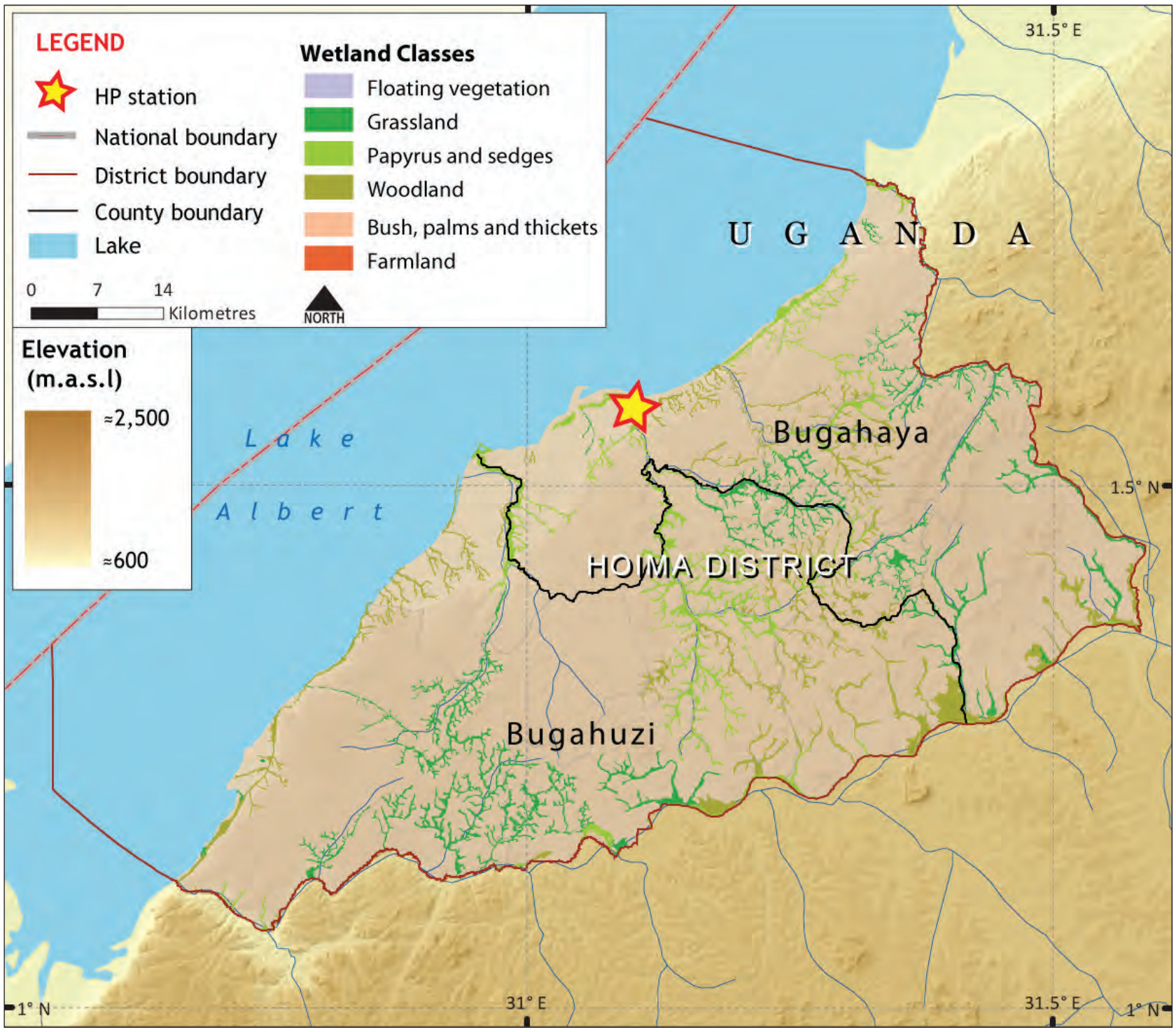
Management efforts and recommendations

Hoima District Local Government has attempted to address the forest depletion issue by raising awareness on the impacts of deforestation. In collaboration with the National Forest Authority it is carrying out activities to sensitize the public on the value of sustainable environmental management. They have been offering up to 150,000 tree seedlings per year to the community in a bid to increase the forest cover in the region.

RIVERS WAKI, WAIGA, SONSO AND WAISOKE

The Rivers Waki, Waiga, Sonso and Waisoke are located in the Butiaba-Wanseko area. The rivers flow through narrow river valleys with gorge-like features descending from the rift escarpments to cross the rift valley and finally drain into Lake Albert. The topography of the area limits the hydrological potential and some of the escarpments are drained by short-lived flows to the extent that some of the river valleys are dry most of the time (NEMA, 2009).

Figure 4.3: Location of Kabalega mini hydropower station in Hoima District

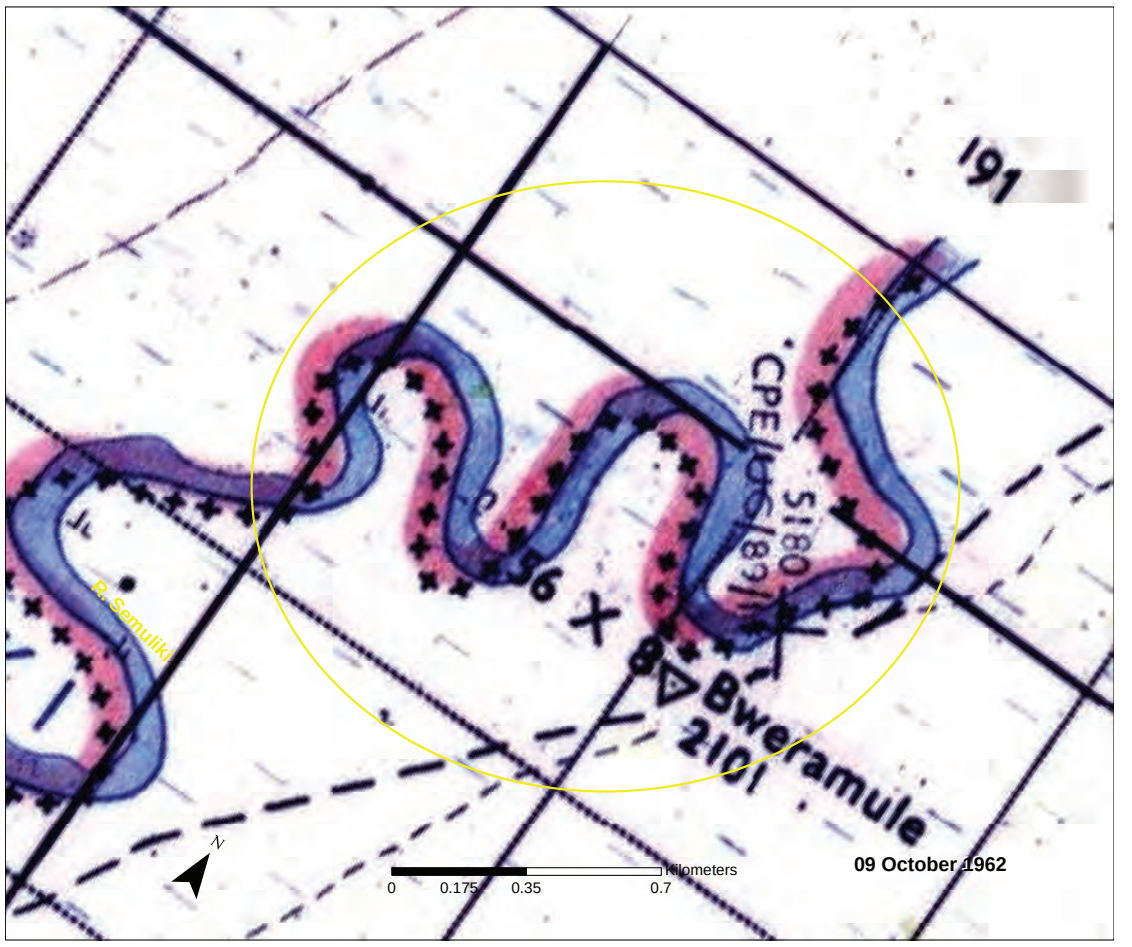


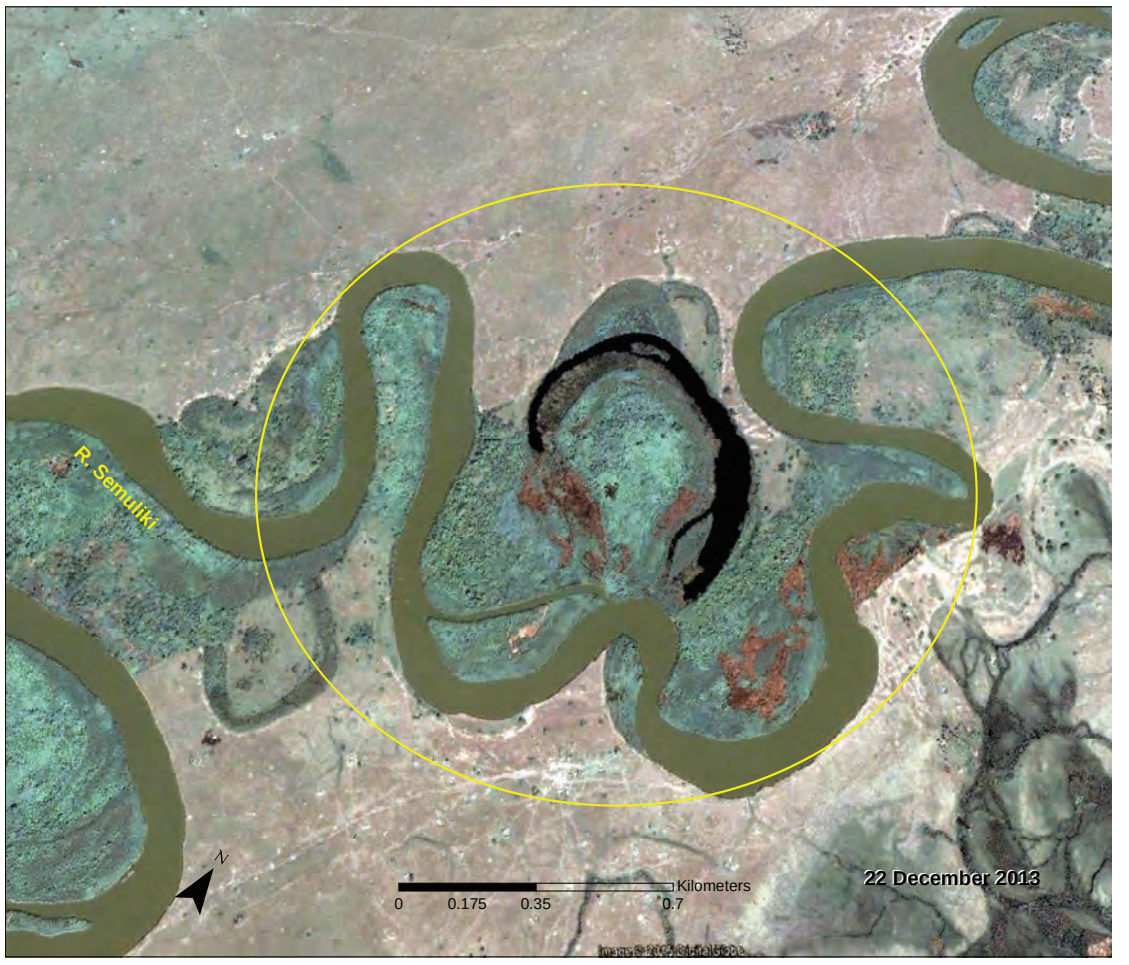
(UNEP, 2015)

RIVER SEMLIKI

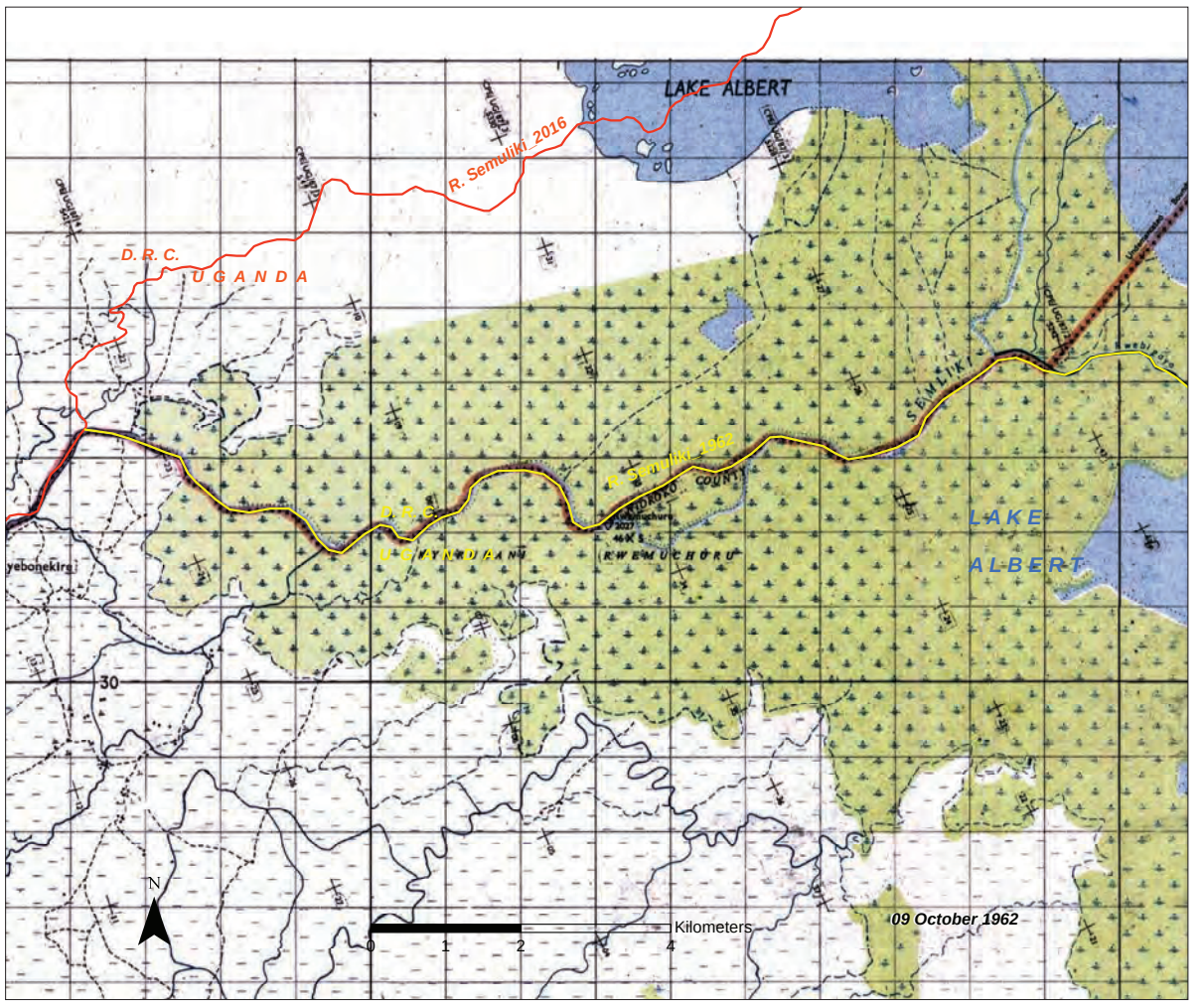
River Semliki

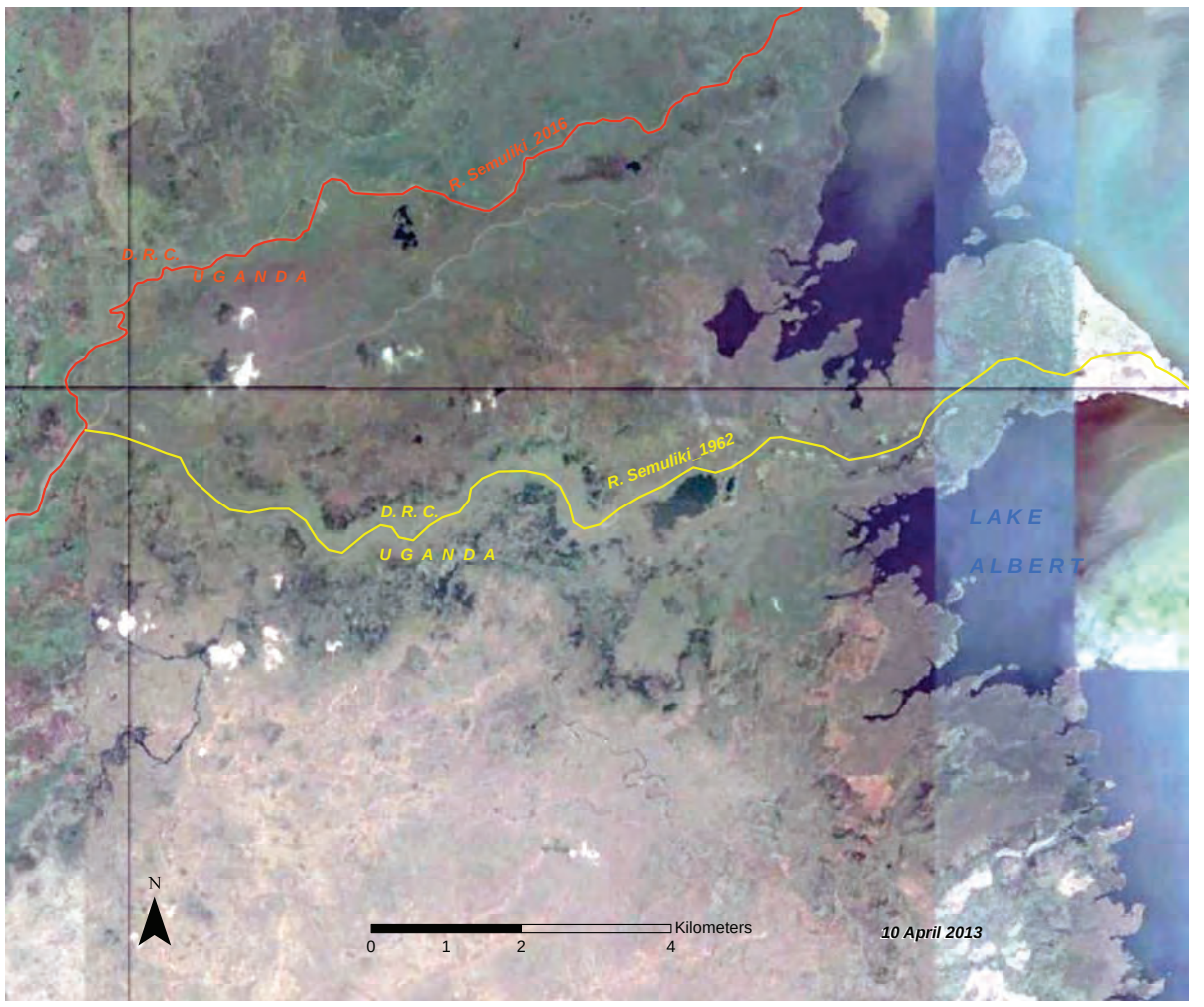
The 140 km long River Semliki is a major tributary of the Nile River originating from the Nyamulagira Mountains in the DRC, flowing through Lake Edward and eventually discharging at the north-western end of Lake Albert. It then flows through the rift valley in the DRC along the western side of the Rwenzori Mountains to the north-eastern end of the mountains to continue north-eastwards eventually joining the Albert Nile through Lake Albert. Precipitation and snow melt from the Rwenzori's also feed the Semliki. The Semliki river forms the international boundary between the DRC and Uganda.





The altitude ranges from as low as 600 m in the Semliki valley to more than 5,000m on the Rwenzori slopes. This makes the catchment an area of great contrasts that reflects in the biodiversity and ecosystem. Some of the ecosystems include grasslands, dense forest and woodlands and swamps. The area also includes the Toro-Semliki Wildlife Reserve and the Semliki National Park (UNDP, 2012). Parts of the area are geologically active with the presence of hotsprings which are tourist attractions for instance at Sempaya, Kibuku and Buranga. The hot springs attract substantial numbers of wetland birds, supply salt for many animals and provide prospects for geothermal energy. Examples of prospective sites for geothermal energy include the Buranga hotsprings, Katwe in Kasese district and Kibiro in Hoima district (Natukunda, 2010). Energy development close to a wetland can have environmental implications as highlighted in Box 4.1.





Box 4.1: Impacts of energy sector projects in wetlands

Activities of the energy sector are likely to have negative consequences on the ecological character of a wetland. Below are some of the impacts that wetland ecosystems could face when development projects in the energy sector are undertaken in or near them. These are taken verbatim from Resolution XI.10, 2012 of Ramsar. There may be:

- changes in water quantity available for wetlands due to consumptive use of surface water or groundwater or to alterations of natural flow regimes or drainage
- changes in water, soil and air quality due to chemical, thermal, radioactive and organic pollutants resulting from energy sector activities
- direct impacts on wetland habitats arising from the conversion of wetlands for construction and operation of energy generation facilities and infrastructure and disruption in sediment flow and ecosystem connectivity of energy related activities or infrastructure
- direct impacts on wetland fauna, especially birds and bats, due to collision and electrocution
- indirect impacts of habitat fragmentation and connectivity between hydrographic basins, their wetlands and primary forest zones with a high biodiversity component
- indirect impacts of atmospheric emissions, including water quality impacts from emissions (for example of particulate materials, sulphur or nitrogen compounds) and those due to climate change effects resulting from greenhouse gas (GHG) emissions in the energy sector
- effects on local climate which can reduce the potential for carbon sequestration and storage in peat lands

(Ramsar Secretariat, 2012)

Sempaya Hot springs within Semliki National Park

Wildlife in the area include elephant, hippopotamus, crocodile, civets, buffalo, leopard, various and abundant species of antelope including the Bay Duiker (*Cephalophus dorsalis*) and the Pygmy Flying Squirrel (*Idiuus zenkeri*) that occur nowhere else in East Africa (UWA, 2012). The area is host to 40% (441 species) of the country's total bird species (UWA, 2012). These include the Nkulengu Rail, Swamp Palm Bulbul, Lemon-bellied Crombec, Yellow-throated Cuckoo and various species of Hornbill (UWA, 2012). Common tree species include the Uganda Ironwood (*Cynometra alexandri*), *Acacia* and scattered *Albizia* trees. Sedges and *Phragmites* form part of the wetland vegetation along the river and adjoining streams.

Major threats to the wetland

The underlying causes of this degradation are the loose soils, huge erosive power of the river, the high population density and related human activities such as agriculture and livestock rearing.

The soils along the riverbank are loose silt and clays of recent formations (quick clays), which quickly collapse when the riverbank is destabilized. As the Semliki River emerges from the forested Semliki National Park onto the Semliki flats in Rwebisengo subcounty, Bundibugyo district, it has enormous erosive power and undercuts the banks as it flows. It is this 100 km section of the river that suffers serious erosion and breakage of the riverbanks. Once the soil collapses into the river, it is rapidly taken away by the high calibre flow of the river and has led to the river channel advancing in land on the Ugandan side of the river valley. For example in Masaka parish, the main course of the river has moved towards the DRC as land collapsed on the Ugandan side of the river. On the DRC side of the riverbank, there has been no significant loss of land especially where vegetation still exists. The resulting siltation has resulted in the river changing course significantly over the years as it enters Lake Albert (NEMA, 2009).

River meanders in border areas between states have the potential for conflict especially as land is 'lost' to one state or the other. For instance over 10m of the river bank on Uganda's territory is eroded annually at various points of the river and as a result, the river seems to have doubled its width within the last ten years (see 22/12/2013 image). As the river meanders, cutting into the soils along the shores of the river, it increases the fragility of the riverbank. The local authorities have reported that over a nine year period from 1986, there were 29 locations within a distance of 22 km where over 20 acres of land in each location was lost due to the degradation of the riverbanks. In Rukoro village in Bweramuli parish in Rwebisengo subcounty, a Uganda Telecommunications Limited Relay Mast site, which nine years before used to be located at a distance of over 3km away from the river was by June 2005 less than 15 meters away from the bank. By July 2014 the original position of the Mast had been washed away and another established further off the riverbank.

Formation of an Ox-bow lake along River Semliki at Bweramule, Ntoroko District. This resulted into loss of land parcels to the DRC

Cattle grazing is a major economic activity along the river banks on both sides of the border. On the Ugandan side, however, the area has been overstocked and overgrazed, leading to severe trampling of the vegetation particularly around watering points on the river. The situation is further compounded by Hema immigrants fleeing political instability in the DRC who come with their cattle adding to the already overstocked area. Although watering of cattle seems to occur about every 5km along the riverbank, it is done in a random, unplanned manner with the degradation worse where the cattle are watered.

There is a lot of cultivation along the riverbanks in Masaka parish stretching northwards toward the Lake Albert area. Common crops planted include bananas, maize, sweet potatoes, cassava, and sugar cane. Most of the natural vegetation that stabilizes the riverbanks has been removed and replaced with crops right up to the water mark. Siltation of the river has also tremendously increased, thereby affecting the natural river meander and accelerating shifting of the river course. At the same time soil erosion on the riverbanks is making the farmland barren as most of the fertile top soil is carried away to the river. In a number of instances where land has been 'lost', Ugandan's have been crossing the river to go and cultivate what used to be 'their land' which is now claimed to be in the DRC. Anecdotal information indicates that officials in the DRC now charge a fee for those who cultivate across the river. There have also been attempts by the community in Kabimbiri village to block the water that was just about to break off their land, but this was foiled by a local Chief in the DRC using armed personnel.

The process of riverbank breakage on the banks of River Semliki in Uganda

Population density on the Semliki flats is high and is rapidly increasing. For instance, on the Uganda side, the rapidly growing town of Rwebisengo is located only 1.5 km away from the riverbank and is bordered by numerous other homesteads. Active exploration for oil adjacent to the town over the last couple of years has also attracted more people, substantial investment and urban development along the river. Waterborne diseases such as malaria and cholera are prevalent especially in Bweramule parish. Communities are enclosed between the Semliki National Park to the south, the Toro Wildlife Reserve to the east, the Semliki River to the west and Lake Albert to the North. This limits their access to land and forest resources. Pressure for firewood, building poles and other forest resources, as well as frequent fires within the area, have led to a loss of tree cover and shortage of tree resources. Presently, the Ugandan community collects their firewood on the DRC side of the river, which still has abundant vegetation and fewer human settlements. This is also an indication of degradation and shortage of vegetation resources on the Uganda side of the river.

Increased flooding of the Semliki River in recent years has also led to major shifts in its course. Climate change has led to increased precipitation leading to increased flooding that is partly to blame for the river shifting beyond its natural meander belt.

This process of land recession and shifting of the river thalweg (middle point of the river) is likely to aggravate border disputes and conflict in the future. The 09/10/1962 image shows comparison between the original positions of the River Semliki before 1964 when the river was mapped on the 1:50,000 scale topographic maps, and the current position as traced from a satellite image. The disparity clearly indicates a significant shift of the river into Uganda during the last 50 years.

Management efforts and recommendations

The following are recommended for implementation:

1. Mobilize and assist the communities to demarcate a zone of non-utilization along the riverbanks to allow vegetation to regenerate, as well as undertake planting of fast growing trees and other vegetation on the degraded areas to stabilize the riverbanks and control erosion. The boundary of the non-utilization zone could be marked off using hard-line and damage resistant species that are unpalatable to cattle such as sisal, cactus, *Erythrina* and *Ficus species*.
2. The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), NEMA and Bundibugyo District Local Government should locate and gazette cattle watering points at appropriate distances along the riverbank to stop the rampant random and intensive cattle trampling on the fragile riverbanks.
3. The Ministry of Foreign Affairs should take steps to initiate a discussion and negotiation with the relevant authorities in the Democratic Republic of Congo (DRC) for the two countries to establish a committee of technical experts to undertake re-tracing of the Uganda-DRC boundary along the thalweg of River Semliki, using GPS technology and 1964 Topographic Maps; and then to undertake a survey of a fixed border-line; and through inter-country discussions, agree upon the original border.

Overgrazing at the banks of River Semliki in Bweramule Subcounty

BIBLIOGRAPHY

ERA. (2014). *Press Statement for Quarter 4: September 2014*. Kampala: Electricity Regulatory Authority (ERA).

NEMA. (2009). *Environmental Sensitivity Atlas for the Albertine Graben*. Kampala: National Environment Management Authority (NEMA).

NEMA. (2009). *Uganda - Atlas of our changing environment.* Kampala: National Environment Management Authority (NEMA).

The Carter Centre. (2015). *Carter Centre Global Health Efforts - Uganda - River Blindness Elimination.* Retrieved January 4, 2016, from Fighting Disease Uganda: Eliminating River Blindness: http://www.cartercenter.org/countries/uganda-health-river-blindness.html

UNFCCC. (2006). *Project design document form (CDM-SSC-PDD) - Version 3*. Bonn: United Nations Framework Convention on Climate Change (UNFCCC).

UWA. (2012). . Retrieved December 16, 2015, from Wildlife and Birding: http://www.ugandawildlife.org/explore-our-parks/parks-by-name-a-z/semuliki-national-park/wildlife-and-birding-summary

Lake Bunyonyi

Chapter

5

LAKE EDWARD BASIN

Figure 5.1: Lake Edward Basin

(WMD, 2008)

INTRODUCTION

The Lake Edward Basin is located in the south-western corner of Uganda neighbouring the Democratic Republic of Congo (DRC) and Rwanda (figure 5.1). The entire catchment covers an area of about 7,130 km² and drains towards the DRC. The main water bodies in the area include Lakes Edward, George, Chahafi, Mulehe, Mutanda and Bunyonyi. The rivers that drain the catchment includes Katonga, the Kazinga Channel, Mpanga, Nomulemu-Rushebeya-Kashambya, Nyamuliro and the north Kiruruma drainage systems. All these major lakes and rivers are fringed by extensive wetlands systems that are important to the riparian communities.

This basin shows much evidence of volcanic and geological events over the last 5,000 years. On either side of the Kazinga Channel and on the northwestern shores of Lake Edward are the Katwe-Kikorongo and Bunyaruguru volcanic fields. They have extensive cones and craters which don't occur anywhere else in the country. Historians believe that Lakes George and Edward were originally joined and were divided by volcanic activity leaving Kazinga Channel as their only link.

Key messages

Lake Edward Basin has some of the most beautiful landscapes in the world and is key to the tourism sector.

Promotion of tea growing in the wetlands of Kigezi region is a threat to food security as it is largely taking over land originally used for growing foodcrops such as potatoes and vegetables.

Sunset over Lake Edward

RWENZORI MOUNTAINS RAMSAR SITE

Rwenzori Mountains Ramsar site was listed on 13th May 2009 as a Ramsar site. The wetlands have an area of approximately 99,500ha and are located in Kabarole, Kasese and Bundibugyo Districts within the Rwenzori Mountains National Park. The wetland lies on the top of the mountain at an altitude of about 5,100 masl. The peaks are snow-capped contributing significantly to the rainfall and water supply to the Nile River system.

The high altitude wetlands on these mountains include freshwater lakes, peat lands and tundra. The mountains slopes are habitat to 21 species of small mammals, including the endemic and vulnerable Ruwenzori Shrew, Horseshoe bat, L'Hoest's monkey and Rockefeller's Sunbird (Ramsar, 2014). Fish distribution is dependent on the altitude. The most common indigenous fish found are Cyprinid species such as the *Varicorhinus rwenzorii*.

Major threats to the wetland

Population growth is the main challenge being faced as there are growing demands for land for agriculture and settlement, community uses such as bamboo collection and development of tourism among others. Climate change is also a growing threat affecting the glaciers at the mountain tops and this may affect the wetlands on the lower slopes that provide water supply for animals and humans in the area. The glacial ice is also of cultural importance to the indigenous Bakonzo peoples who live on the mountains (Nakileza & Taylor, Undated).

River Mubuku at its source. Lake Mubuku located at 4000 metres above sea level on Mt. Rwenzori Ramsar Site is the source of River Mubuku that occasionally causes floods in the footslopes of the mountain in Kasese District

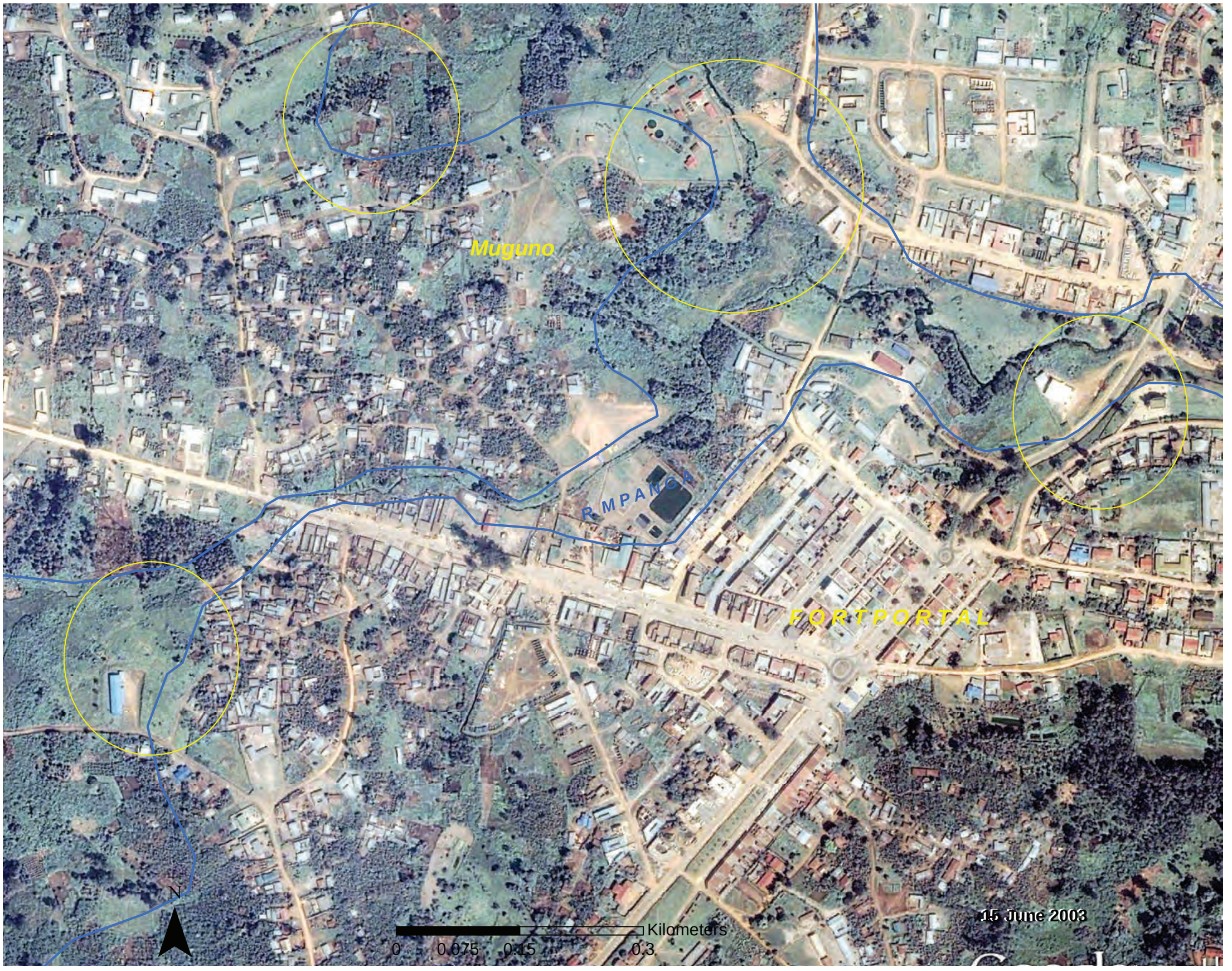
Photo credit:M. Musonda

River Mpanga Wetland System

RIVER MPANGA WETLANDS SYSTEM

The origin of the River Mpanga is in the Rwenzori Mountains between 1,700 to 914 masl. It flows for about 200km to empty into Lake George. The river traverses Kabarole, Kyenjojo, Ibanda and Kamwenge Districts. From Fort Portal Municipality, the river flows through a rural area with a number of tea plantations into Kibaale Central Forest Reserve. This ecosystem is one of the most important indigenous forests still present in Uganda today and has a high environmental value. River Mpanga plays a key role in its existence and conservation.

The river flows through different wetlands for which it also plays an important role in maintaining various environmental flows. Its provisioning function is evident as the red sandy-clay soils of Kiamara Series in Mwenge, Kibale, Burahya and Bunyangabo counties and peaty clays along the Mpanga River, are the most productive soils in the region. However, the soils are vulnerable to erosion and degradation which has resulted into loss of agricultural productivity over the years. The river is also the main source of drinking water for Fort



Portal Town and Kamwenge District where a new water supply system has been recently installed.

The Mpanga River flows into Lake George over Mpanga falls. This site borders the Queen Elizabeth National Park and the Lake George Ramsar site and is habitat to many floral and faunal species. Worldwide, the Mpanga Falls Gorge is the only known habitat for the rare Uganda Giant Cycad plants (E*ncephalartos whitelockii*). At this site a hydropower dam was constructed and became operational in 2011, with a maximum hydropower potential of 18 MW.

Threats to the wetland

Population pressure is the main threat to these wetlands with wetlands being reclaimed for settlement and commercial purposes such as Mpanga market along Fort Portal-Kyenjojo Road. The catchment area is densely populated with over 100 people/km^2. Deforestation along the slopes of the Rwenzori's, is leading to severe soil erosion and the increased risk of landslides. Downstream, the main wetlands are under serious degradation from sand mining and agriculture. For instance, as the river flows through Kamwenge District towards Lake George, the area is heavily deforested and the riverine wetlands cultivated with bananas, maize, yams, sugar canes, vegetables and tree planting. To satisfy the needs of this subsistence community, the soils are never left under fallow. This has resulted into highly degraded soils that lead to increased erosion, siltation and sedimentation of streams and rivers. This situation has also resulted in increased destruction of the available wetlands in the catchment that are perceived fertile by the local communities.

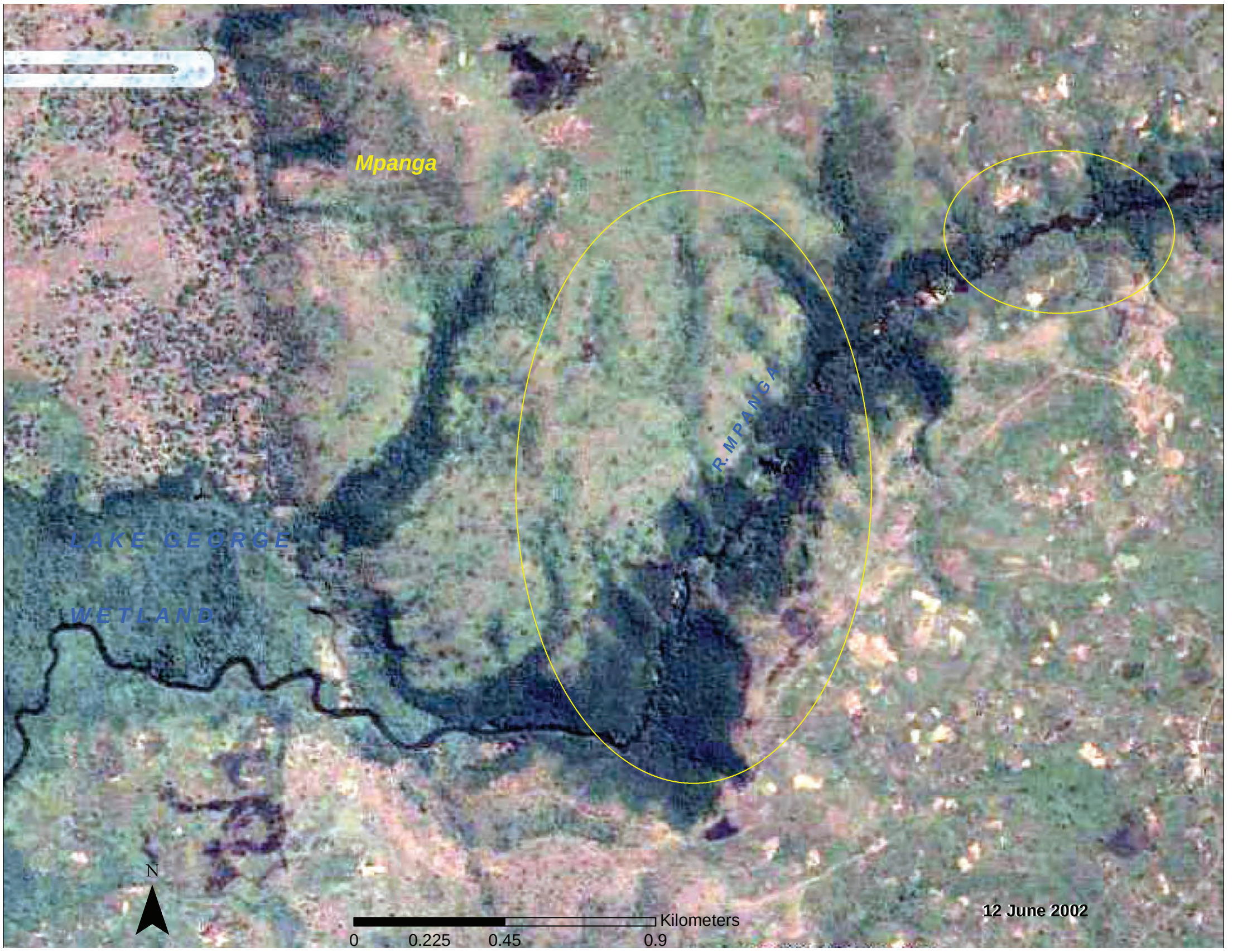
Lake George Wetland System

LAKE GEORGE WETLAND SYSTEM

Lake George wetland, was the first to be gazetted as a Ramsar site in Uganda in 1988 for its unique biodiversity. The lake is located at an altitude of 914 masl and has a surface area of 250 km² (World Lake Database, 1999). It has several islands such as Kankuranga, Irangara and Akika. It drains in a southwesterly direction into Lake Edward through the Kazinga Channel. The lake is supplied by several inflows from Mount Rwenzori (Rivers Nsongya, Rwimi, and Mubuku), as well as Rivers Dura and Mpanga from the agricultural area to the north-east. This wetland is habitat to the Sitatunga antelope (*Tragelaphus spekii*) and other herbivores, the Shoebill and other bird species. The northern shoreline is lined with dense papyrus wetland, the lake is extremely productive and profitable fishery is carried out here. Fish species include *Cyclopoid copepod, Thermocyclops hyalinus, Tilapia nilotica* and *Haplochromis nigripinnis* (QENP, 2016).

Threats to the wetland system

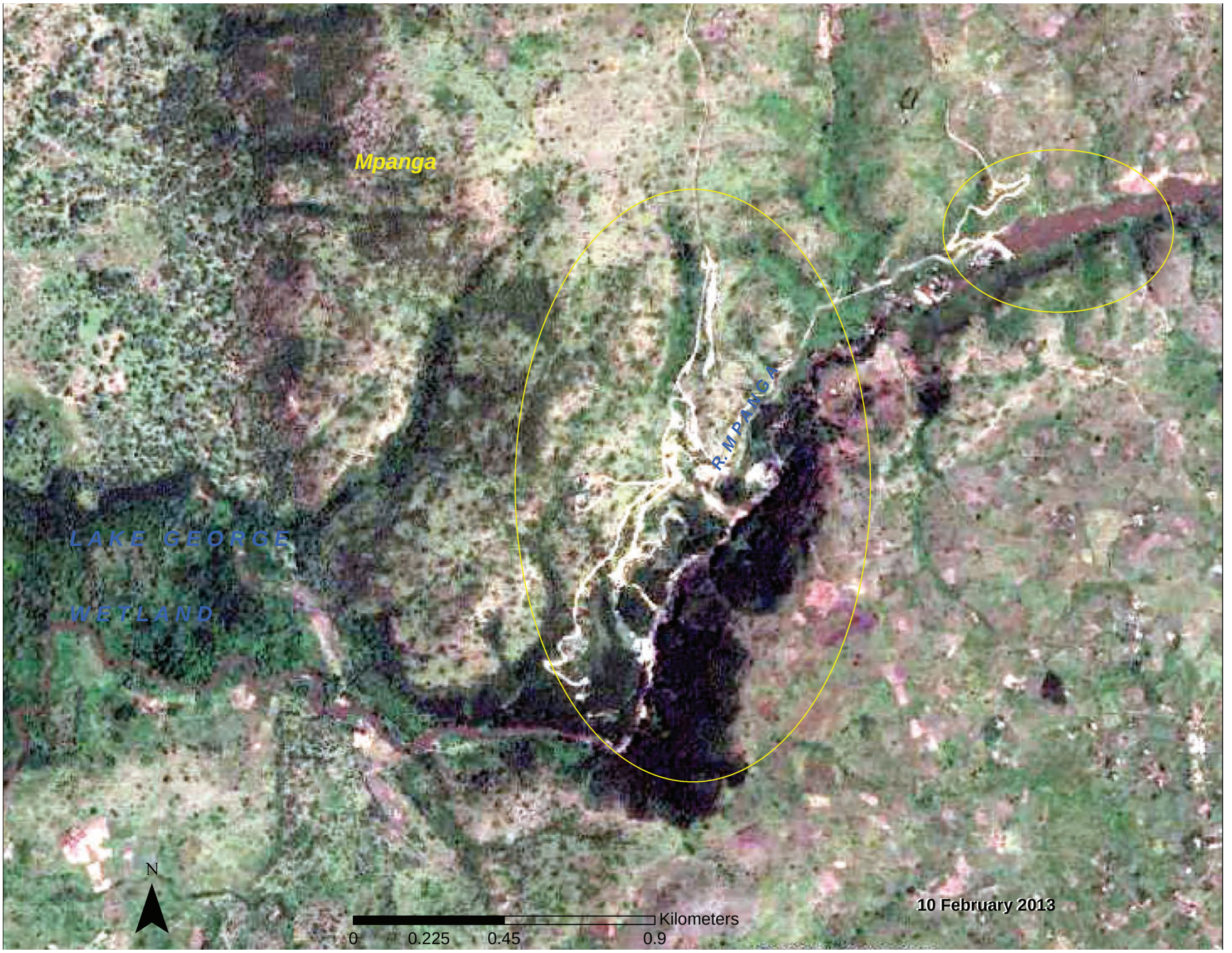
The major threats are related to the inflowing rivers, issues of pollution control and the management of the fisheries resource. Lake levels appear to have been steadily declining over the years. Although the causes are unknown, climate change and wetlands destruction along the inflowing rivers are the main suspects.



The impacts of the declining water levels could result in a reduction of the overall breeding or nursery sites for some fish species in the lake and ultimately its productivity (Water Resource Assessment for river Mpanga, 2009).

The area is rich in copper and cobalt and there are plans by government to re-open the Kilembe Copper Mines (at the foot of the Rwenzori Mountains). The mines were operational between 1956 and 1979 and during that time, about 15 million metric tonnes of pyrites were generated during the processing of the copper-cobaltiferous pyrite ores (Mwongyera, Mbabazi, Muwanga, Ntale, & Kwetegyeka, 2014). The cobaltiferous pyrites byproduct were dumped in Kasese about 11km east of the mine. In 1992 the Kasese Cobalt Company Limited was set up to extract cobalt from the pyrites and in so doing reduce the threat of acid water runoff and pollution of Lake George and Queen Elizabeth National Park. However, leacheates are still thought to contaminate the soils and water in the area. Studies indicate that the mining activities, coupled with anthropogenic pollution from the rapidly growing population, have left some of the rivers, especially within the Kilembe mine valley and along River Nyamwamba contaminated with heavy metals (cadmium, nickel, copper, cobalt, lead and zinc). For example, analysis of the surface water around Kasese town indicated 0.016 µg mL-1 for lead, 0.024 µg mL-1 for nickel and 0.61 µg mL-1 for cadmium (Mwongyera, Mbabazi, Muwanga, Ntale, & Kwetegyeka, 2014). The WHO limit for cadmium in drinking water is 0.003 µg mL-1m.

Pollution appears to be greatest in the Kilembe mine valley followed by the area before the mine (near river sources) and least in the water after the Kilembe mine valley. For instance analysis of the Kahendero swamp in Hamukungu bay on the western shores of Lake George recorded much higher levels of copper and cobalt than a swamp on the southern end of the same bay. This could be an indicator of the efficacy of the Kahendero swamp in filtering some of these metal elements (Mutekanga, 2014).



Management efforts and recommendations

The National Park is contiguous with the Parc National des Virunga Ramsar site in the DRC and there are some transboundary activities between the two countries. Although there are some challenges with harmonizing the respective wildlife laws, communication barriers and the movement restrictions at the borders (Kizza, 2014). The National Park is governed by a management plan that allows for activities such as tourism, firewood collection and research according to specially zoned areas.

LAKE EDWARD WETLAND SYSTEM

Lake Edward lies 20km south of the Rwenzori Mountains with the western escarpment of the Rift valley extending up to 2,000m above the western shore. To the east and south are flat lava plains. The lake is 33.5m deep on average, has a total surface area of 2,325 km^2 and lies at an elevation of 920 masl (MWE, 2013). It is 77 km long by 40 km wide at its maximum points and is the 15^{th} largest in Africa (World Water Database, undated).

Lake George to the northeast empties into Lake Edward via the Kazinga Channel. Other rivers feeding the lake include Rivers Nyamugasani, Ishasha, Rutshuru, Ntungwe and Rwindi. Lake Edward empties to the north via the Semliki River into Lake Albert.

Lake Edward is shared with the DRC and on that side of the border it lies completely within the Virunga National Park, while in Uganda it is located within the Queen Elizabeth National Park. It therefore does not have extensive human habitation on its shores, except at Ishango (DRC) in the north, which is home to a park ranger training facility. About two-thirds of its waters are in the DRC and one third in Uganda. In Uganda the main settlements are Mweya and Katwe in the north-east, near the Crater Lake, which is the chief producer of salt for Uganda.

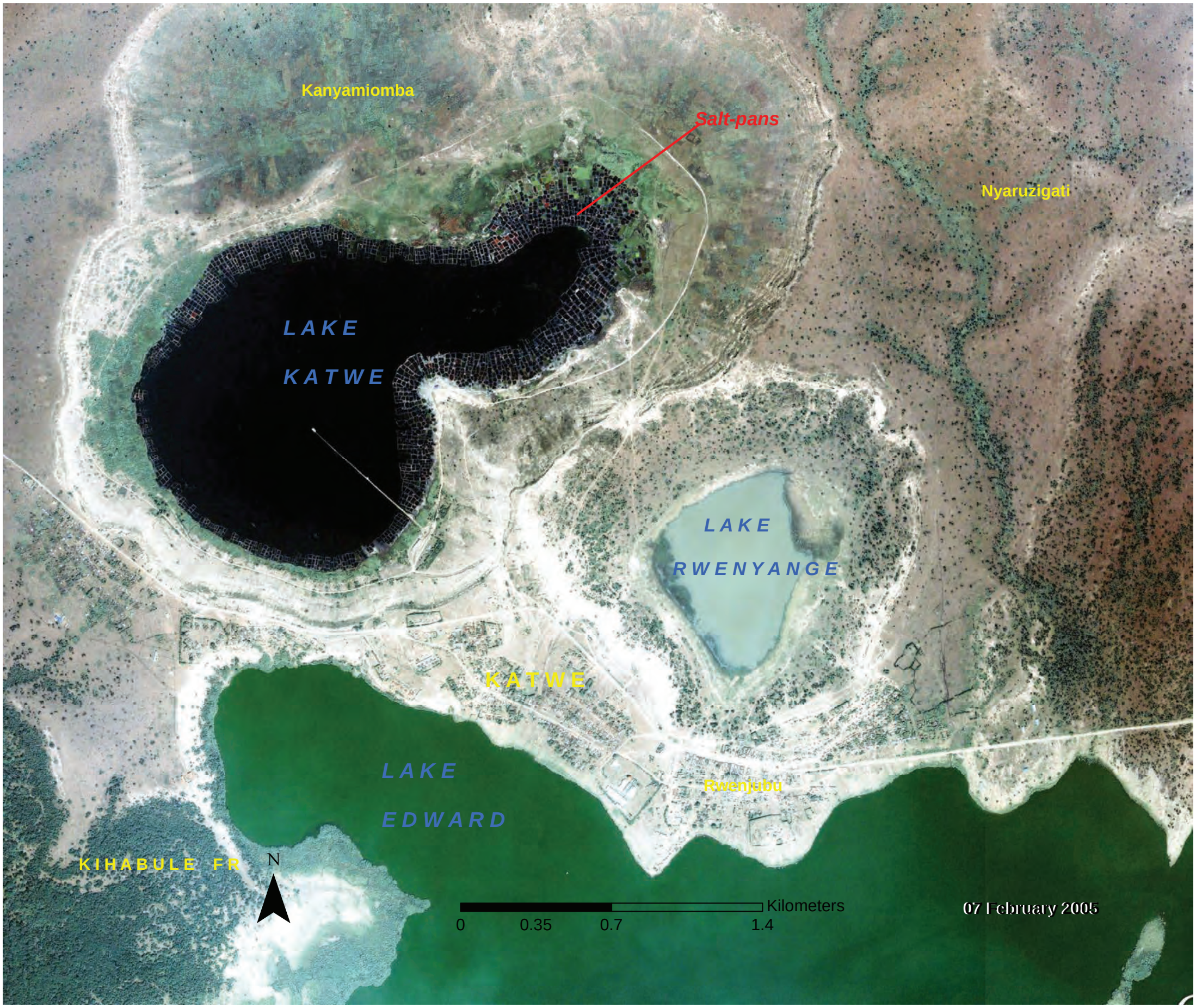
The Lake Edward wetland system is of economic importance as a source of salt. The growth of Katwe-Kabatoro town has been dependent on the salt economy with about 80% of the population indirectly or directly relying on this activity for their livelihood. Fish is another important activity amongst the locals especially the Bakonjo for whom it forms an important portion of their diet. The fish species include *Bagrus docmac, Sarotherodon leucostictus, S. niloticu*s and many other Haplochromine species, of which only 25 are documented. There is also plenty of wildlife in the Queen Elizabeth Protected Area. The dominant fauna living on the banks of Kazinga Channel and shores of Lake Edward include chimpanzee, elephant, crocodile, buffalo and lions among others. There are also many perennial and migratory bird species including the Crested Crane.

Threats to the wetland system

Encroachment on the wetland is the main threat. For instance as late as 2015, the local community invaded the wetland to reclaim it for agriculture, although the Katwe-Kabatoro Town Council and NEMA intervened to stop the practice.

The Rift Valley

LAKE KATWE SALT PANS



Nomuremu-Rushebeya-Kashambya Wetland System

NOMUREMU-RUSHEBEYA-KASHAMBYA WETLAND SYSTEM

The Nomuremu-Rushebeya-Rushoma-Kanyabaha and Kalimbanya-Nyakasa-Kashambya wetlands system is one of the very few surviving wetland systems in the Kigezi Highland Region (Kabale, Kanungu, Kisoro and Rukungiri districts) following the central government policy decision to reclaim and drain wetlands in the area in the 1950s. Wetland reclamation was undertaken by the colonial government to provide additional land to local communities for agricultural production in the face of increasing population density. This wetland is a remnant of what used to be extensive wetland systems in one of the most expansive valley systems in the region. It survived as a result of government intervention in the late 1980s, when wetlands reclamation was banned; and later with the coming into force of the National Environment Act in 1995.

The wetland system is habitat to wildlife, including the endangered *Sitatunga*, which is now under community protection in this wetland. This could be important for future ecotourism efforts.

Threats to the wetland system

This wetland system is important for water quality protection, as a habitat, for micro-climate moderation and for energy and water production to support the high population. The wetland system runs through a set of valleys flanked by one of the most extensive and gigantic ridges in the Kigezi region. The ridges are heavily settled and cultivated, and have suffered serious loss of vegetation cover leading to severe soil erosion and landslides.

The wetland system acts as an important buffer to heavy runoff and sediment from these hills into the main drainage channel. But the high population on the ridge and valley system continues to expand and urban-like settlements are beginning to emerge. Degradation in the catchment to make way for settlements is jeopardizing the gravity water schemes and water supply for the communities. It may also threaten energy supply as the wetland system forms the catchment and reservoir for a river that supplies the Kisizi Falls on which a 300KW hydroelectric power plant was constructed in 2008 to replace a smaller 60 KW plant.

The function of microclimate moderation has drastically reduced due to wetland destruction and deforestation on the flanking hills and ridges

especially in Kashambya area. Temperatures are on the increase with environmental consequences such as increased malaria infection and increased incidence of water-borne diseases. Land productivity in the area has also declined and this is attributed to increased soil erosion on the hillsides, increased temperatures and desiccation, and reduced fog and ambient moisture all of which have a strong link to swamp drainage and lowering of the water table.

Management efforts and recommendations

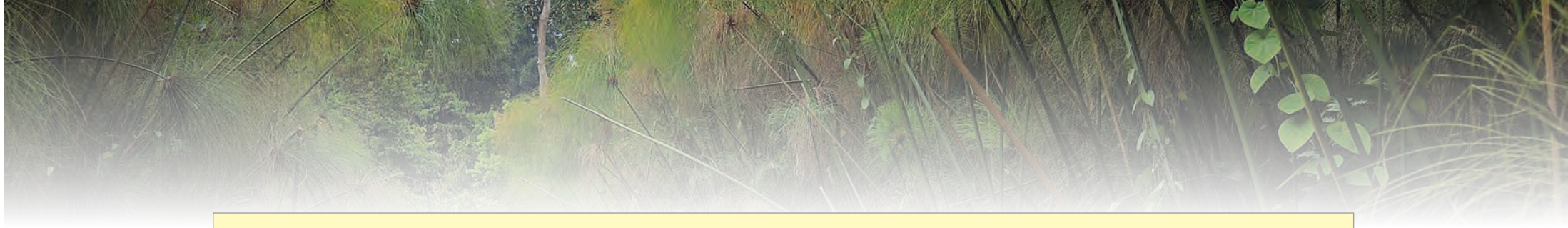
There have been some efforts to manage these wetlands. For instance in the 1990s, the National Wetlands Conservation and Management Programme initiated activities to protect this wetland system. These included community involvement in wetlands management and the promotion of alternative livelihood options such as the establishment of demonstration and fish-fry multiplication ponds at Kitanga. This facility is still operational and managed by the community. In addition, community wetland management committees were set up to act as watchdogs and advisors in the protection of the wetland system. At the time, many people who had reclaimed and drained the wetland left and large parts of it recovered especially in Muhanga and Kyerero Parishes in Bukinda Subcounty and some small portions in Kangondo-Sindi area in Rwamucucu subcounty.

However, the increasing population, weak law enforcement, settlements and commercial interests have recently led to a re-emergence of encroachment and drainage on parts of the wetland. The situation is particularly worrying especially with the establishment of large tea plantations by the Kigezi Highland Tea Company. In Muhanga the rapidly growing commercial centre is a threat especially since it is happening in a planning vacuum and the sanitation and waste disposal system is endangering the wetland system and the health of the downstream communities.

Kisiizi Falls in Rukungiri District

Management efforts and recommendations

In line with its mandate, NEMA has taken a number of steps to secure the integrity of wetlands in Kabale District in conjunction with the Kabale District Environment Office. Activities include inspections, inventory of the natural resources, status of use and prohibited activities being carried out and stakeholder sensitization and consultations. Where necessary, this is usually followed by a restoration exercise and protection of the wetlands.



Box 5.1: Impacts of growing tea in Rurindo wetlands

Rurindo wetland is one of the few surviving wetlands in this region since the wetlands reclamation policy of the 1950s. In the 1990s, Rurindo wetland was leased to a local cooperative society by The Uganda Land Commission for the purpose of mixed farming based on small scale crop growing (mainly potatoes and sorghum) and dairy farming. The premise was that this kind of land-use was sustainable and friendly to the wetland ecosystem as it involved a rotation and fallowing system, which enabled continued existence and growth of indigenous wetland vegetation and fauna. It also ensured continued existence of the near surface water table, which in turn facilitated the stability of water resources.

In June 2014, the Cooperative Society sold the wetland to a tea growing company. The activities of the company led to extensive channelization, drainage of the wetland above Kamirantende bridge and the complete destruction of the hitherto conserved patches of wetland vegetation. Currently there is a marked difference between the modified wetland and the still surviving original part of the wetland below the bridge, with the latter still having lush vegetation, animal life and voluminous and dynamic water flow through the wetland. Despite immense pressure, the plans to clear this remaining part of the wetland have been resisted by the local community even in the face of violence.

Tea growing affects the wetlands in a number of ways:

- Since it is grown as a monoculture with pure stands, it does not encourage fallowing or rotation nor the existence interspersed patches of natural wetland vegetation.
- There is also a pollution risk from agro-chemicals that may be applied. Pesticides, herbicides and artificial fertilizers could potentially pollute the soils and the wetlands consequently contaminating sources of domestic water and the aquatic biodiversity.
- Wood used in the drying of the leaves is taken from the surrounding local forests contributing to deforestation.
- Vegetation loss causes habitat losses leading to a reduction in the general number of species with possible threats to the entire ecosystem
- Decades of vegetation cover loss limits water recharge into the ground and the volumes of water flow in rivers draining the area could dwindle.
- Ground water recharge could be reduced due to poor vegetation cover and severe soil erosion, exposing impervious subsoil in many parts, leading to rapid runoff and limited ground recharge whenever it rains.

Photo credit: E. Mutayanjuluwa

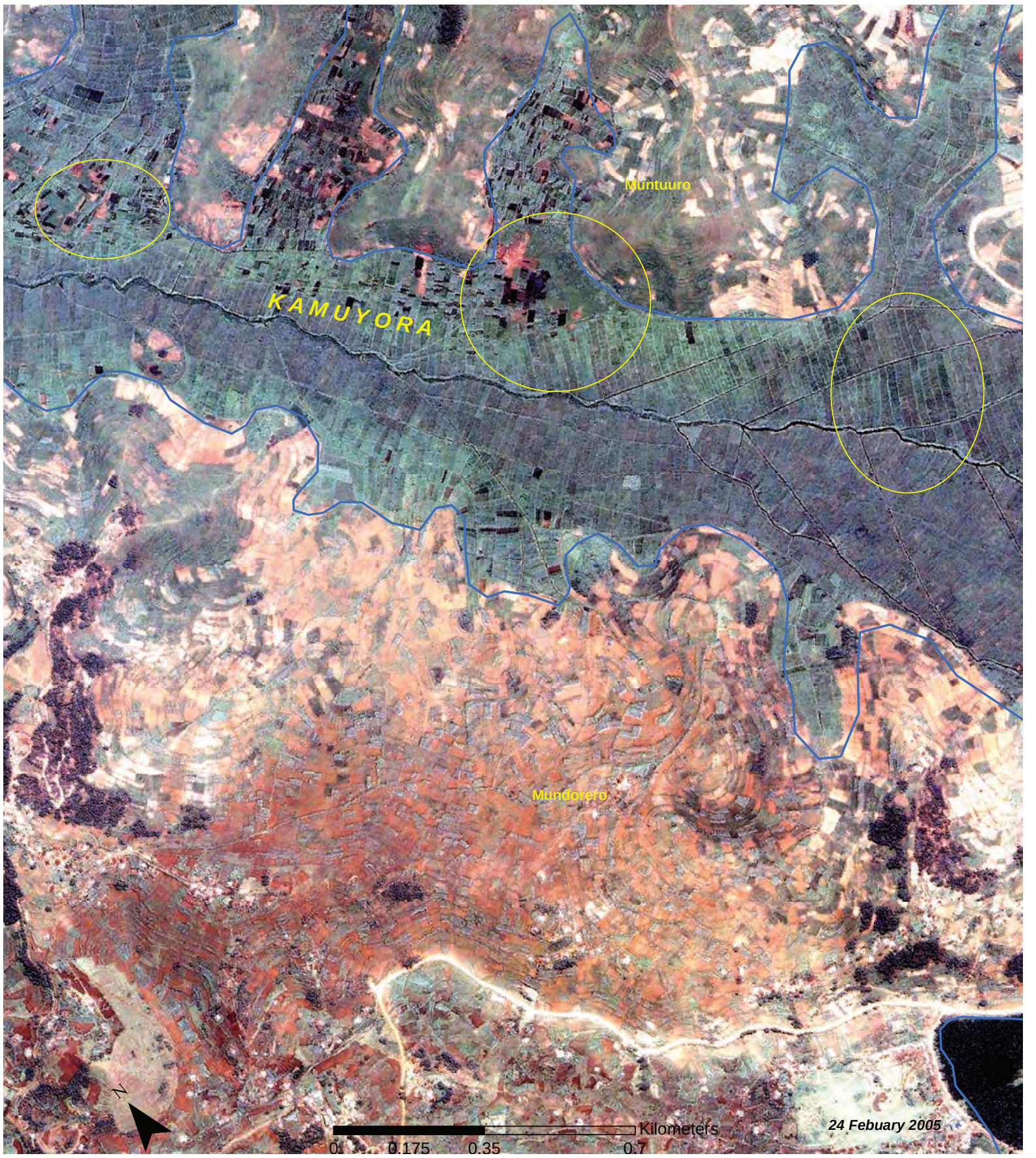
Lake Bunyonyi

Nyamuliro Wetland system

NYAMULIRO WETLAND SYSTEM

Lake Bunyonyi is located at an altitude of 2,030 masl and was formed during the Tertiary period in association with formation of the western arm of the Rift Valley. A combination of intense rifting and back tilting of the landscape and later the damming of river flows by volcanic lava led to its formation. It covers an area of 46km^2 and has an average depth of 139m. Water leaves Lake Bunyonyi through a breach in the lava band and flows through the previously extensive and deep Iyamuriro Wetland System into the Ruhuuma through a narrow valley across the Kabale-Kisoro boundary into Lake Mutanda in Kisoro district.

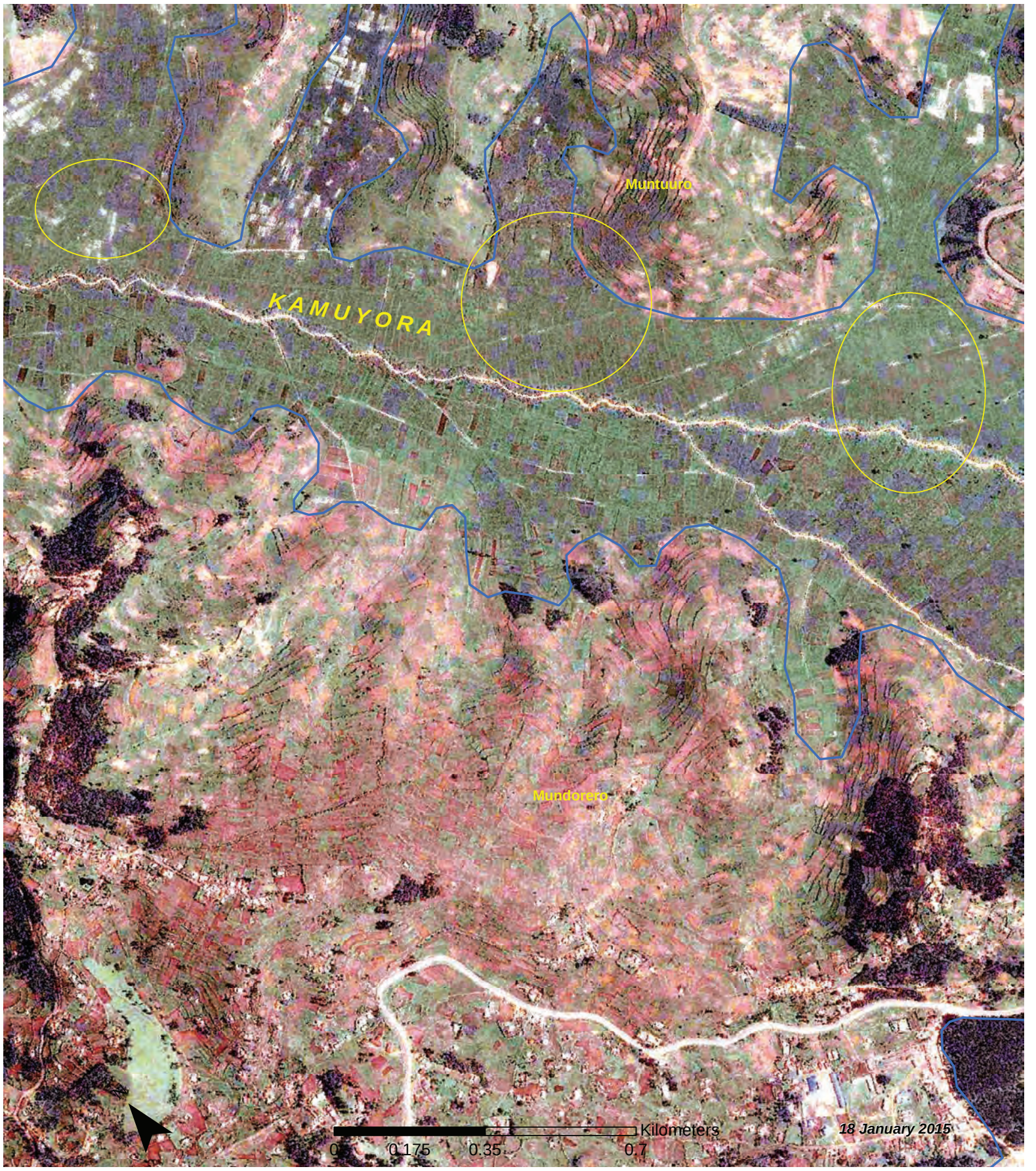
Lake Bunyonyi is an important tourism attraction and has some aquatic biodiversity. There are Louisiana crayfish (*Procamuurus clarkii*), introduced during the 1970s, and native fish such as Mudfish (*Clarius cassoni*) and haplochromines. Smaller numbers of Tilapia species and Mirror carp (*Cyprinus carpio*) are also found in the papyrus swamps (Chapman et al. 1996: 263). Fishing is carried out on a relatively small scale on Lake



Bunyonyi, but due to its depth, and the associated scarcity of shallow breeding grounds for fish and low temperatures, productivity is low. These fish, in addition to being sold commercially, provide an important source of protein in the diet of local people.

Threats to the wetland

The wetlands fringing Lake Bunyonyi continue to face severe pressure from human encroachment for agriculture. For example, before 1995, Iyamuliro wetland was relatively intact. However, in 1997, it was invaded and reclaimed by a group of community members for growing crops, mainly potatoes. These wetlands receive an annual rainfall of approximately 2300 mm per year, and although it can rain at anytime, it rains less in December-January and July-August. Most wetland drainage and harvesting occur in these drier periods. At these times, rural farmers are forced to abandon their land on higher ground and drain parts of the swamp to grow crops. During wetter periods the swamps re-flood and the farmers use their upland holdings again. Crops grown include Irish potato (*Solanum*), sweet potato and cabbages are the main crops planted in these wetter areas. Tomatoes, beans, carrots, cauliflower and sugar cane are also occasionally grown. These crops are an important source of food and income, but over-exploitation can lead to loss in the ecological goods and services provided by the wetlands. The wetlands provide papyrus which is used to make fences, soundproof houses with corrugated iron roofs, thatch outdoor kitchens and bathrooms and as a source of energy. Handicrafts such as carpets, mats, trays and baskets are woven from thin strips of papyrus stem and sold primarily on the domestic market.



Mulehe and Mutanda Wetlands System

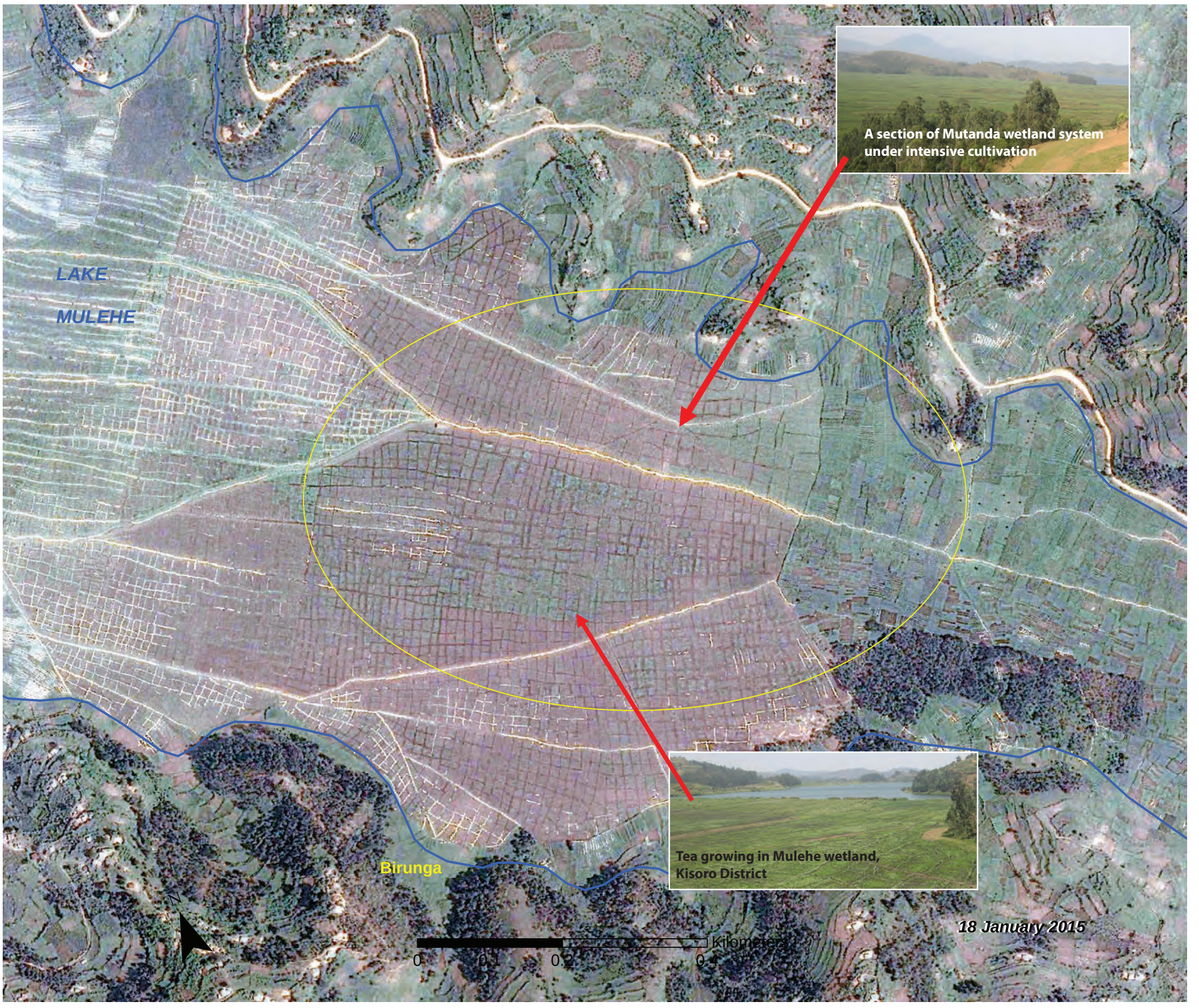
MULEHE AND MUTANDA WETLANDS SYSTEM

Lake Mutanda was also formed due to river valley drowning and lava damming of the Kisoro plain (NEMA, 2009). The average depth of the lake is 22m and it covers an area of 22km^2. The other lava dammed lakes in Kisoro district are Mulehe, Chahafi and Kayumba, but these are smaller and shallower and are almost completely filled as a result of heavy siltation. River Kaku flows out of Lake Mutanda, crosses the Uganda-DRC border to form part of the upper River Semliki system.

Threats to the wetland system

Siltation, from soil erosion in the slopes flanking the lakes, is the major threat facing these lakes and is rapidly causing their disappearance. Combined with climate change, this will seriously impact the water storage capacity and the quality of the lakes waters. Current trends indicate progressive shrinkage of the lake sizes through stages, beginning with silting of the immediate shores that are later occupied by swamps which, in turn are encroached upon and reclaimed for cultivation. A case in point is the expansive swamp fringing Lake Mutanda. Silting and encroachment on the lakeshores interfere with fish breeding and aquatic biodiversity in general and has been partly blamed for the low productivity of these lakes.

Plantation agriculture is another challenge in this area. It has displaced the traditional subsistence farmers and the use of agro-chemicals presents a pollution threat to the lakes. For instance tea growing in the overpopulated Kisoro district has put greater pressure on the land. Over 200 families that used to rent wetlands along the shores of Lake Mulehe from the Catholic diocese have been displaced to pave way to grow tea. This has led to a reduction in the quantity of sweet potatoes grown with impacts on food security. Secondly, application of agrochemicals in tea grown in wetlands will lead to direct pollution of Lakes Murehe and Mutanda and their associated wetlands with consequences on the aquatic environment. This is discussed in Box 5.1 (page 135).



BIBLIOGRAPHY

Gherardi, F. (Ed.). (2007). *Biological invaders in inland waters: profiles, distribution and threats*. Dordrecht, The Netherlands: Springer.

Kizza, F. (2014). *State of Conservation periodic Report for Rwenzori Mountains National Park World Heritage Property – Uganda.* Kasese: Rwenzori Mountains National Park (RMNP).

Mutekanga, N. M. (2014). Impacts of copper mining stockpiles on diversity of plants, soils and Cyperus papyrus of Kahendero wetland. *Journal of Science* , 4 (4), 195 - 205.

MWE. (2009).

MWE. (2013). *Uganda National Water Resources Assessment 2013.* Kampala: Ministry of Water and Environment (MWE).

Mwongyera, A., Mbabazi, J., Muwanga, A., Ntale, M., & Kwetegyeka, J. (2014). Impact of the disused Kilembe mines pyrites on the domestic water quality of Kasese town, western Uganda. Carib.J.Sci.Tech, 2, 482-495.

Nakileza, B., & Taylor, B. (Undated). *Climate Change in the Rwenzori Mountains:implications for the Bakonzo and other surrounding communities*. London: University College London (UCL).

QENP. (2016). Retrieved January 9, 2016, from Queen Elizabeth National Park: Lake George: http://www.queenelizabethnationalpark.com/lake-george.html

Ramsar (2014). *Rwenzori Mountains Ramsar Site*. Ramsar Secretariat, Switzerland.

Ramsar. (2014). Ramsar. Retrieved February 2016, 23, from Rwenzori Mountains Ramsar Site: http://www.ramsar.org/rwenzori-mountains-ramsar-site

Tibihika, P. D., Barekye, A., & Byakora, E. (2015). Fish species composition, abundance and diversity of minor lakes in southwestern Uganda/Kigezi region. International Journal of Science and Technology, 4.

World Lake Database (1999). Retrieved January 9, 2016, from Lake George: http://wldb.ilec.or.jp/Lake.asp?LakeID=AFR-10&RoutePrm=0%3A%3B4%3Aload%3B8%3Aload%3B

World Water Database (undated). Retrieved January 9, 2016, from Lake Edward: http://www.waterdatabase.com/lakes/lakeedward/

giraffe in Murchison Falls National Park

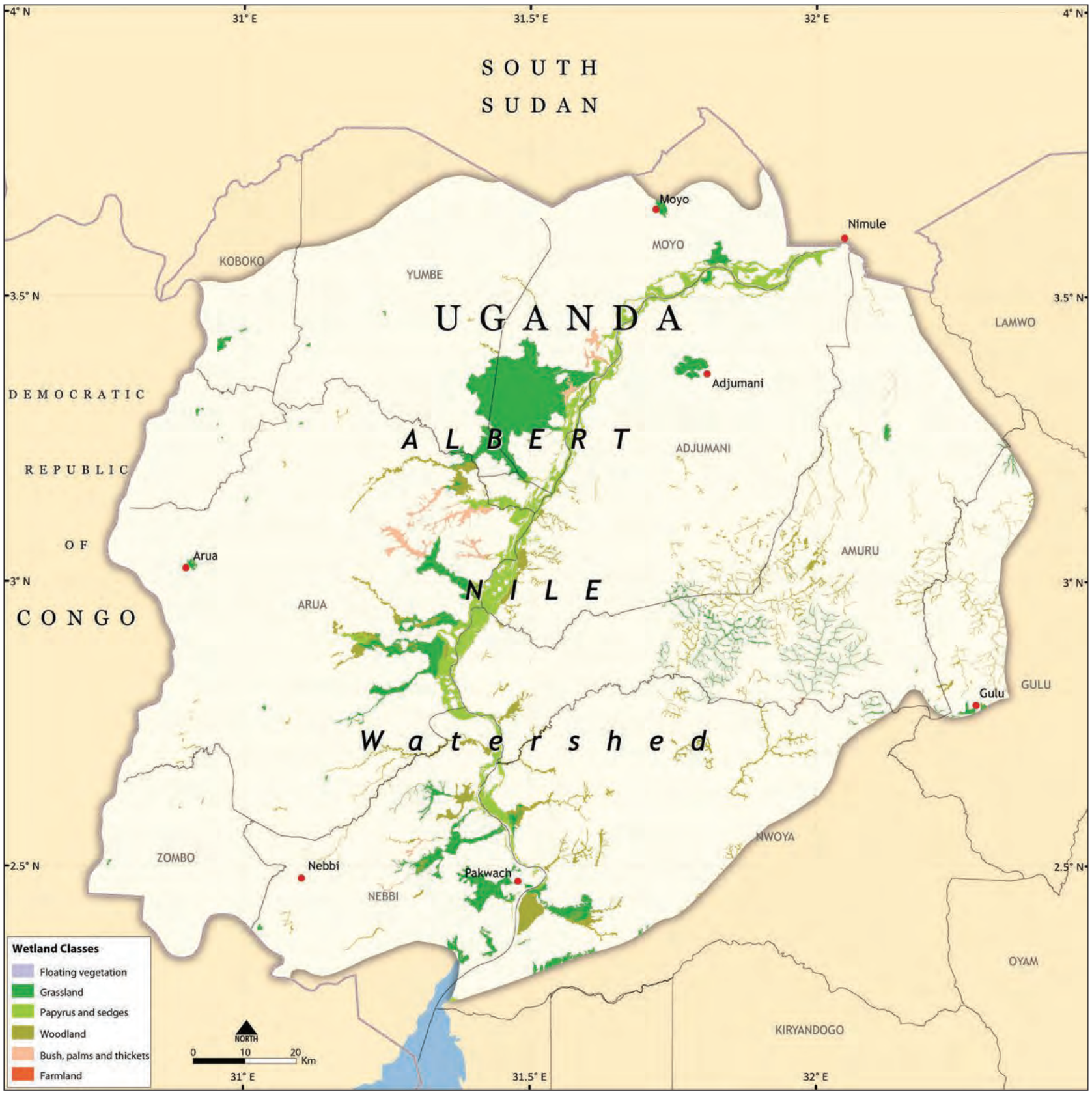
Photo credit: Flickr

Chapter

6

ALBERT NILE WETLAND BASIN

Figure 6.1: Albert Nile Basin



(WMD, 2008)

INTRODUCTION

The Albert Nile Basin (see figure 6.1) lies mostly in the West Nile and East Nile regions of Uganda neighbouring the DRC and South Sudan. Most of the wetlands in the basin drains into the Albert Nile. The Albert Nile begins as the outflow from Lake Albert on the border between Uganda and the DRC. A few meters from the northern tip of Lake Albert where the Albert Nile begins, the river receives an inflow from the Victoria Nile which drains Lakes Kyoga, Kwania and Victoria. The river also receives an inflow from River Semliki through the lake at its southern end. The Victoria Nile inflow into Lake Albert is about 22.5 billion m^3 of water (NBI, 2012). The wetlands in this basin are important for water provision to many towns. These are summarized in table 6.1.

The Albert Nile Basin covers an area of about 20,047 km^2 - the size of which is influenced by the Albert Nile which flows over a distance of 210km from Lake Albert past Pakwach to the South Sudanese border at Nimule, a point where its names changes to Al-Jabal River or Mountain Nile. Unlike other rivers in Uganda, the entire Albert Nile is navigable throughout the year with only one major bridge at Pakwach. According to satellite image analysis (MWE.2008), wetland vegetation cover classes within the Albert Nile consists of 21% woodland, 4.3% bush and thickets, 36% grassland, while papyrus and sedges are 36% and 1.6% respectively.

Key messages

Arua Municipality is the largest town in the region with an urbanization rate of 3% (higher than Kampala which is urbanising at a rate of 2%).

Urban growth is fuelled by regional insecurity and the search for economic opportunities.

The wetlands such as Enyau and Pece are important for waste water treatment, but are facing pressures from the rapidly growing population.

Table 6.1: Water produced for selected towns from wetland systems in the basin (cubic metres)

TOWNS	WATER SOURCE	2007/08	2008/09	2009/10	2011/12	2012/13
Gulu	Oyitino Wetland	730,730	840,817	723,483	778,119	768,814
Arua	River Enyau	605,000	591,186	645,894	677,063	696,962
Nebbi	Nyamrwodo	106,255	84,925	96,060	74,465	-
Pekele	River Nile	4,744	10,015	10,637	6,931	4,341
Moyo	River Nile	-	88,426	88,427	87,382	70,364
Pakwach	River Nile	-	67,531	70,991	-	-
Yumbe	River Nile	-	7,701	27,930	23,698	-
Wandi	River Nile	-	-	2,352	6,397	5,615

(UBOS 2013)

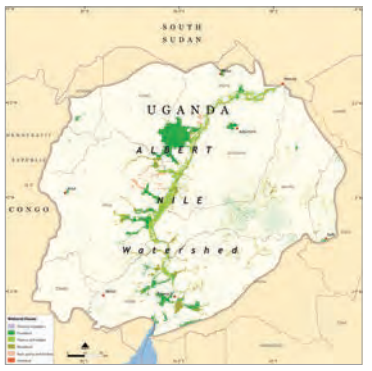
The main wetland systems in the Albert Nile catchment are riverine with fast flowing unidirectional stream flows. These rivers flows through the hot, dry wooded savannah composed mainly of *Combretum* (Bush willows) and *Terminalia* shrubs (Tropical almond), tree species and tall elephant grass. The inflows are lined with a dense papyrus, *Phragmites mauritius* (Common reeds) and *Penissetum purpureum* (Napier grass) plants and its water levels fluctuate minimally. Some of the inflows are very productive and have some common local fisheries. Just like many other wetlands in northern Uganda, the information about most of the inflows remains scanty. However, its conservation importance at both national and international level cannot be overstated.

The main wetlands systems that drain into the Albert Nile from the western side include the following:

- Ora-Nyarwodho-Nyagak wetland system which transverse Zombo, Nebbi and Arua districts;
- Enyau wetland system which passes through Arua and Maracha Districts;
- Kochi/Omvoso which starts in Koboko district and passes through Yumbe and Moyo districts before finally entering the Nile;
- Nyawa/II (Ee) wetlands system which starts in South Sudan and passes through Moyo before it enters in the Albert Nile Oyitino wetland system; and,
- Amua and Ichala system which starts in the hills of Metu subcounty (forest reserve) in Moyo district and then flows to the Nile.

The major inflows from the eastern side of the Albert Nile include Tangi in the Nwoya district, Aswa and Ome in Amuru and Nwoya districts, Zoka and Esiya from Adjumani district and finally Aswa from Gulu and Amuru districts. Some of wetlands that feed into this system are transboundary and require close cooperation with neighbouring countries like DRC and Republic of South Sudan.

Shells of snails from Lake Albert used for making chicken feed



Enyau Wetland System

ENYAU WETLAND SYSTEM

River Enyau and its wetlands form an important system in the greater Arua District. Its source is at the border of Uganda and the DRC in Omogo subcounty at the western end of Arua Municipality where it starts as a very small stream. It drains to the east and is fed by riverine wetlands such Nara Mretrei and Kalubi from Maracha District eventually emptying its water into the vast Balala and later into Albert Nile.

Wetland soils are mainly heavy black clays commonly referred to as black cotton soils with some carbonate concretions. The soils are saline. Water conditions control the use of the clays. The textures are heavy and clay quantity changes due to sedimentation. Organic carbon and phosphate contents are high. Sodium is sometimes

present. Top soils are acidic (below pH5) and calcium carbonate is present. The faunal composition of the wetland is concentrated mainly at the delta point where Enyau joins the Albert Nile. Examples include: Sitatunga, Hippopotamus, Cane rats, antelopes monkeys and baboons. The common fish species are catfish, lungfish, tilapia, and mudfish. Fishing is practiced on a small scale and is largely for domestic consumption. This has boosted the dietary requirement of the community along the wetland. The bird species include the Crowned crane, Heron, Weaver birds, Marsh harriers, Crakes, Egret, ducks and jacana.

Major threats to the wetlands

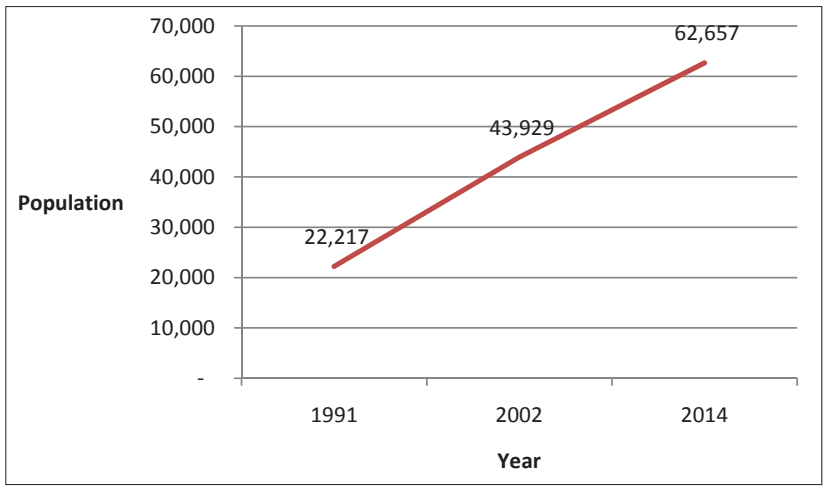
Most of the pressures on the wetland system originate from the ever growing population. Arua district is the fourth most populous district in the country with 785,189 people. In addition, Arua municipality used to be predominantly rural but is now the sixteenth biggest municipality in the country. Between 2002 and 2014 the urbanization rate was 3%, higher than that of Kampala City which had a rate of 2% (UBOS, 2014). This growth is fed primarily by two factors – migration due to insecurity in South Sudan and rural-urban migration of people in search

of economic opportunities.The predominant vegetation system in the seasonal wetlands is mostly savanna with open mixtures of trees and shrubs standing amongst tall grass that at times exceeds 80cm in height. The *Combretum-Acacia-Hyparrhenia* mix is common along Rivers Enyau, Ora and Ala. The savanna consists of perennial grasses, mixed deciduous trees and sedges. *Acacia drepanolobium* (Whistling thorn), *Balanites aegyptica* (Desert date) and *Combretum ghasalense* (Bush willows) are prominent in open tree cover while *Hyparrhenia rufa* (Thatching grass), *H. filipendula, Bothriochloa glabra* (Beard grass), *B. inscrulpta and Eragrostis exasperata* (Cane grass) are common among the grasses. Other common trees are *Erythrina*, *Ficus*, Mahogany, Stigma, *Terminalia sp* and *Anona senegalensis*. Papyrus is dominant in the permanent wetlands. Water hyacinth exists only at points close to the Albert Nile where it forms a small delta. The weed has been a problem since it was first sighted in the river in 1988.

Enyau wetlands system is of particular importance in the basin because it is the source of water for Arua Municipality, which is the largest town in the West Nile region (Kansiime, Muwanga, & Niwagaba, 2013). The water works is managed by the National Water and Sewerage Corporation. The river also provides water to the communities that live along its catchment. Boreholes drilled around the wetlands produce much more water compared to the more distant ones. In addition, the Enyau wetlands purifies the storm water that comes loaded with waste and faecal matter arising from poor waste disposal. If it was not for the wetland that provides a buffer, River Enyau would be heavily silted and polluted.

Location of Arua water treatment works near Enyau wetland

Figure 6.2: Population growth in Arua Municipality



(UBOS, 2014)

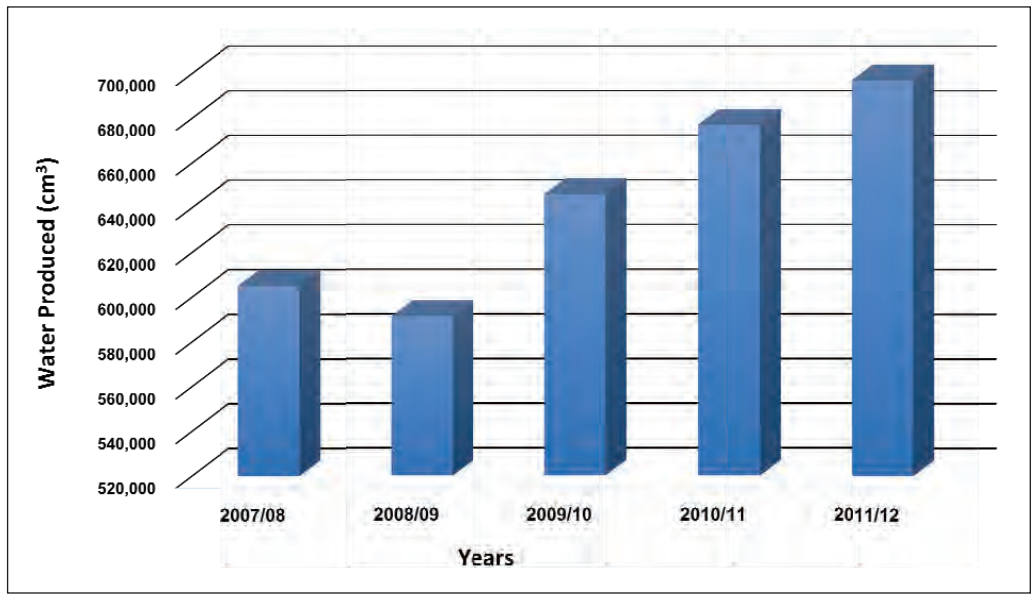
As the population has grown, so has the amount of water abstracted and wastes that ends up in the streams that feed the Enyau wetland (figures 6.2 and 6.3). Washing bays and pit latrines also direct their outlets into the stream. This has led to the systematic deterioration of the quality of the wetland over the last 20 years. In fact, reports from the NWSC Arua indicates the volume of chemical used in the treatment of raw water has more than doubled during the past ten years. This is an indication of massive degradation in the catchment. People cultivate up to the stream, waste (including human refuse) is disposed of directly on the stream, sand mining is unregulated, open defecation and washing bays are all directed at the streams that drain into River Enyau.

The existence of homesteads within the river banks area and the wetland poses a great threat to the water quality of the river. Some homes have pit latrines that means that many of the households directly disposal their waste along the wetland. Recent data shows that the 79.6% of people in West Nile region use pit latrines and 19.3% use the bush (UBOS, 2014). West Nile comprises Adjumani, Arua, Koboko, Maracha, Moyo, Nebbi, and Yumbe and Zombo Districts. Further, discussions with Officials from National Water and Sewerage Corporation Arua revealed that the raw water had high Coliform values ranging from 200-3000 which is a clear indication of the faecal contamination with potential of spreading water borne diseases. It was noted the best raw water quality registered by NWSC in terms of physical parameters was registered in the dry season but in this season the coliforms were high and vice versa.

Cultivation in Enyau River leading to compromised water quality

Data from the Ministry of Water and Environment on Enyau indicates that about 10% or 18.3 km^2 of the wetland area in the district, mostly in the seasonal sections of the wetlands, has been converted to crop and livestock agriculture (Mugyenyi and Mujurizi, 2000). The district therefore, has 164.7 km^2 of unconverted wetland. Projections however, indicate that this wetland area will rapidly decrease if strong measures to regulate the use of wetlands in the district are not implemented. Over 60% of the wetland has been encroached (mainly for cultivation of crops such as maize, yams, sorghum, bananas and sweet potatoes) and this has consequences on both the quality of water and quantity. Wetlands are known to recharge ground and surface water and their degradation directly impacts on water release and recharge, a case in point is the drying up of boreholes in Rhino Camp. Trees along the entire extent of Enyau wetland have been cleared and replaced with gardens and a few scattered plantations of Eucalyptus. There is need to restore the river banks and plant indigenous trees along the banks both for stabilization of the banks and to act as wind breakers in the area which is largely without trees. The wetland is highly encroached upon for cultivation of crops such as maize, yams, sorghum, bananas and sweet potatoes.

Figure 6.3: Arua water produced by NWSC from River Enyau



(UBOS, 2013)

Bush fires especially in rural areas, is another threat facing wetlands. This is regularly done during dry season to clear vegetation for hunting and for trapping of catfish. The practice destroys biomass, raises water temperature, accelerates nutrient transfer out of the wetlands and eventually undermines the integrity of the wetland ecosystem. It also accelerates further removal of surface soils and thus promoting siltation into the wetland. The combined impact of drainage, burning and siltation has been a considerable reduction in the ecological functioning of the wetlands in the district including apparent reduction in wetland water purification potential, flood control and ground water recharge.

Management efforts and recommendations

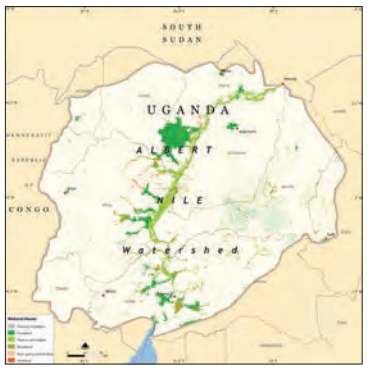
The need to protect the Enyau wetland catchment system cannot be overstated. The Ministry of Water and Environment, Arua District Local

Women collect water for domestic use from Lake Albert

Government and the NWSC have come together to implement activities for its conservation. Activities include community mobilization and sensitization, demarcation of the wetlands boundary. For instance, motor vehicle washing bays have been relocated outside the streams and demarcation of the boundary within the 30m distance as prescribed by the law for small streams such as Enyau wetland is about to begin. In particular the following are recommended:

1. There is need to embark on sensitization as soon as possible to allay fears of the communities about the ongoing demarcation process. The sensitization should follow the communication plan drafted by awareness unit with some changes where necessary;
2. As well as use of pillars, the demarcation of Enyau wetlands should explore the use of natural boundaries as a means of showing the boundary but also protection of the river banks which are heavily encroached;
3. The Department of Environment should utilize the support of the Arua District leadership to engage the Local Government Technical Officers in the sensitization exercise;
4. There is need to designate a focal person for Environment Protection Police Unit to be based in Arua and coordinate security during sensitization and demarcation; and,
5. The District Environment Officer and Municipal Environment Officer need to follow up the improvement of the washing bays so that the washing of cars does not happen directly in the river so as to reduce pollution of the river.

Pollution of Enyau River from unregulated car washing in Arua Municipality

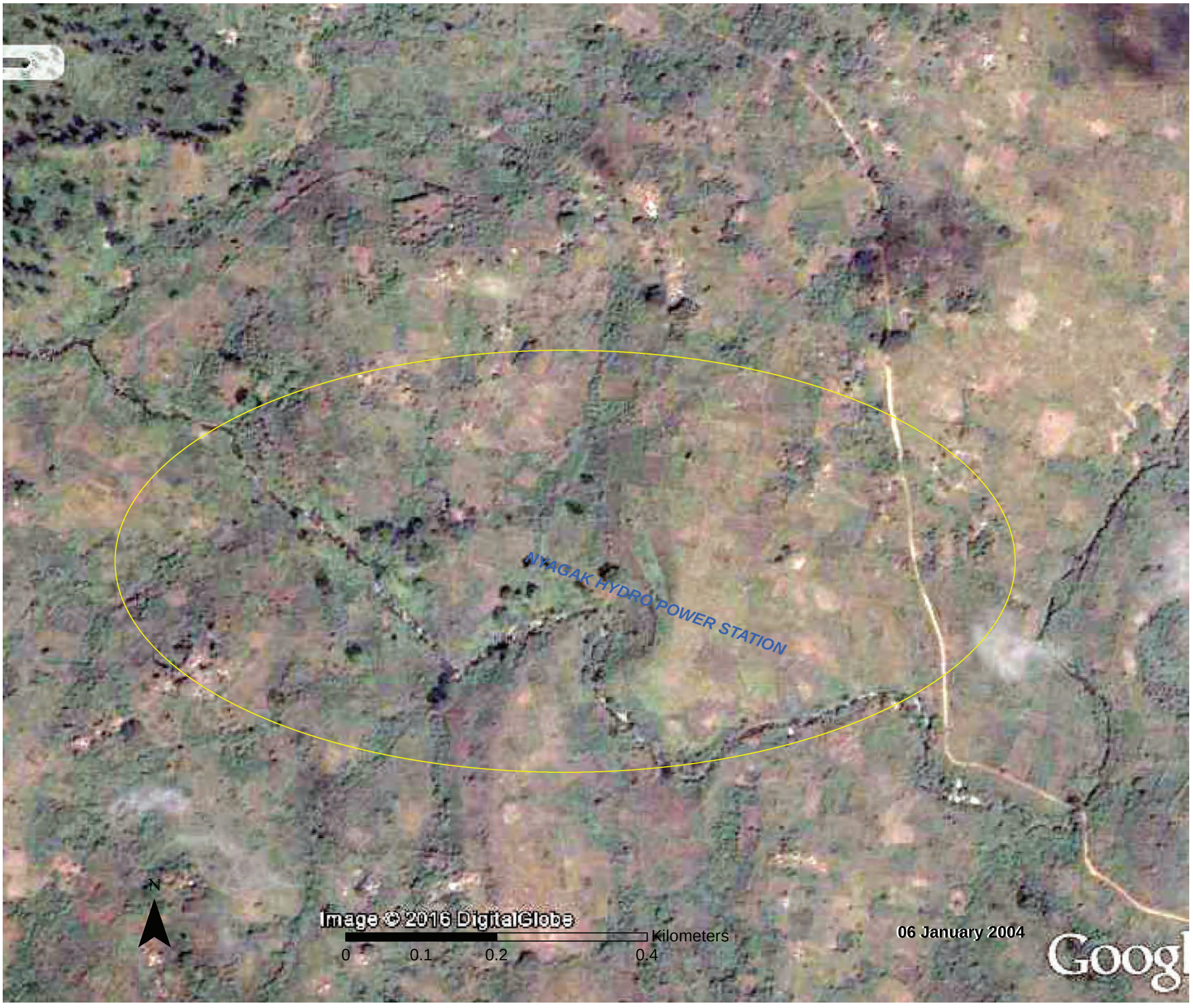


Ora-Nyamrwodo-Nyagak Wetland System

ORA-NYAMRWODO-NYAGAK WETLAND SYSTEM

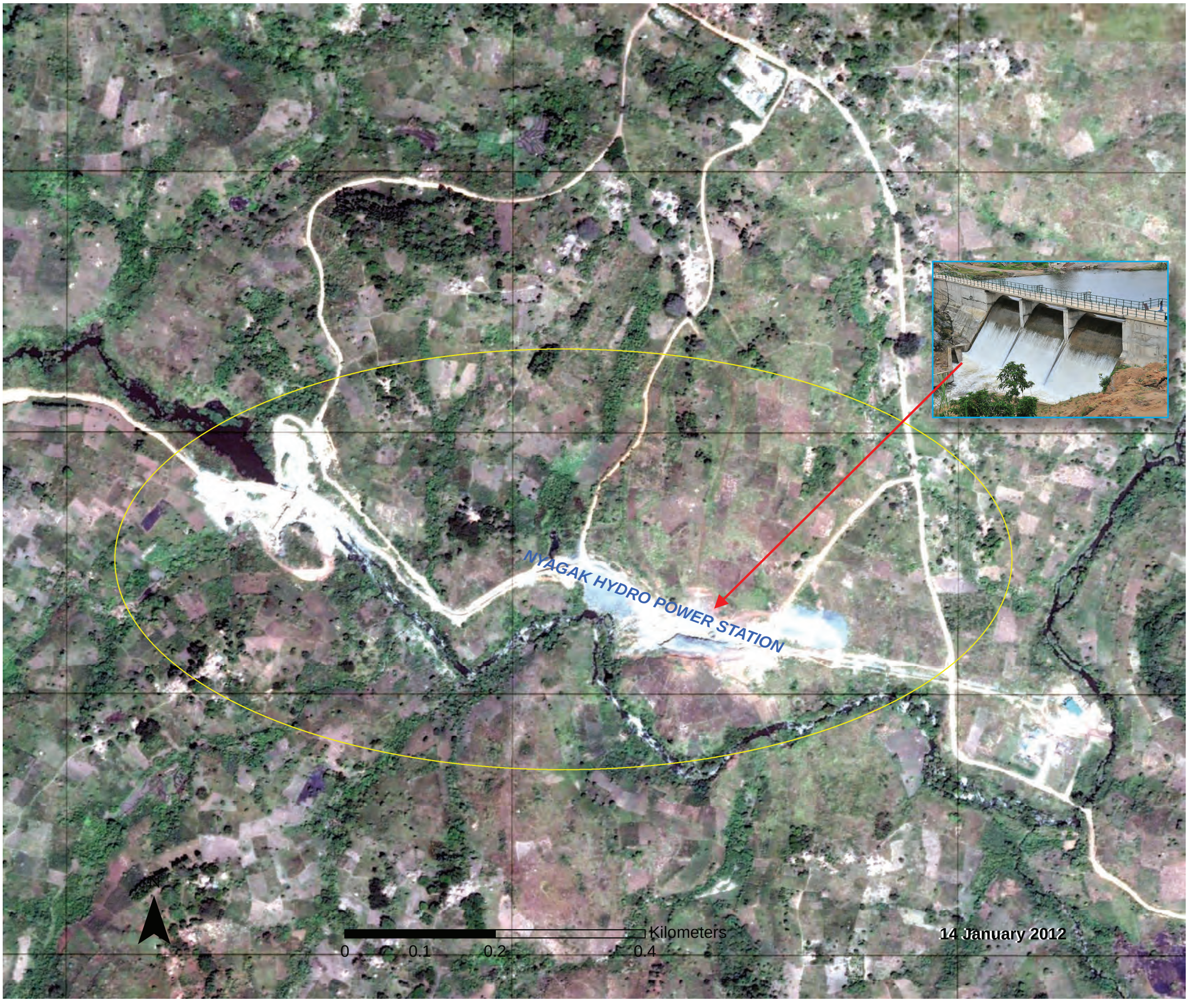
Ora-Nyarwodho-Nyagak wetland system consists of three major tributaries which all originate from the upland terrain in the DRC and flow into Uganda via Zombo and Nebbi districts. They eventually join up to make the Ora system before entry into the Albert Nile. The system has a network of dendritic and parallel patterned tributaries that spread out over a 3,500km^2 area. Other inflows into the system include Korpio, Wangnyang, Oceke, Cido, Kivunje which are either seasonal or intermittent. Ora, Nyagak, Acwera, Ayila and Namrwodho are permanent although the volume of flow fluctuates considerably during the seasons.

The vegetation characteristics conform to the description of (Langdale-Brown, Omaston, & Wilson, 1964) where the *Combretum-Acacia-Hyparrhenia* formation is the most dominant. It also has patches of mixed deciduous trees



with both annual and perennial grasses. It is dominated by *Acacia hockii and Terminalia molliis*. *Vitellaria* (Shea Butter tree) and *Hyparrhenia* are common along the drier savannah catchment interspersed with valuable mahogany species of *Khaya anthotheca* and *Cordia milleniia* which are all species of conservation concern. The riverbanks are lined with *Pennisetum purpureum* (Elephant grass) and *Arundinaria alpine* (Bamboo). Other common grasses are *Digitaria scalarum* (East African couch grass), *Hyparrenia rufa* (Jaragua grass), *Panicum maximum* (Guinea grass) and *Setaria* (Bristle grasses). However, the Elephant grass here appears as an invasive species that clogs the natural waterways of Nyarwodho wetland (CABI, 2016). Local farmers reportedly cut the grass, carrying it home in huge piles on their backs for their animals, for roofing or fencing homes.

The water in the riverine Ora-Nyamrwodho-Nyagak wetland system is fast flowing and its fish stock is limited. A few *Haplochromis* species and Tilapia are present nearer the Albert Nile where the system broadens into a flood plain. This is an indication the delta sections of the wetland system should be conserved as it provides potential sites for fishing and fish breeding. The wetland system has large diversity of birds, reptiles and insects. However, wildlife population in the area is low. This is partly as a result of habitat loss due to agricultural encroachment. Isolated animal occurences are found in areas that are fairly vegetated and with thin human population.



Major threats to the wetland

Human needs for agriculture, livestock and energy account for much of the pressures on the wetlands reducing the biodiversity and its ability to perform its provisioning and ecological functions.

The primary source for energy in the district is wood fuel and this is driving deforestation in the catchment surrounding the wetlands of Ala, Enyu, Ora, Nyagak and Uyu. Wood fuel is used for tobacco curing, charcoal burning and for domestic energy. In the West Nile region, 86% of the population uses wood fuel for cooking and 23.6% use woodfuel and other forms of biomass for lighting. This is particularly common amongst poor families in rural areas who cannot afford paraffin. Another 62% use the 'tadooba' (candle wick lamp) for lighting (UBOS, 2014). The domestic use of biomass is reported to accounts for about 77% of the energy requirement, while the commercial sector which includes direct sales of fuel wood and tobacco processing utilize well over 14% and 9%, respectively (NEMA, 2004). Some households (2.3%) use grass as a cooking fuel.

The wetlands also provide water for domestic use. In Nebbi district, Namrwodo wetland is of critical importance as it provides water to Nebbi Town Council and to communities in Alwii and Wadelai subcounties.

River Nyagak is is the source of water for hydropower generation at Nyagak in Zombo district. Currently, the small hydro station at Nyagak I in Nebbi district is generating 3.5 MW and supplies the towns of Pakwach, Arua, Nebbi and Paida with electricity. A feasibility study for Nyagak III of 4.4 MW in Zombo district is underway (ERA, 2014).

Expansion for agriculture is being driven by limited land and loss of soil fertility. People have migrated to the river banks in search of fertile soils and water for cultivation. Although this works in the short run, the over intensification negatively affects the wetlands. The cultivation extends up to the stream resulting in heavy siltation as seen from the colour and turbidity of the water. Draining of the wetlands also lowers the ground water table affecting existing springs, wells and other shallow underground water sources. Some of the crops grown include maize, beans, cassava, sorghum and sugar cane.

The natural wetland ecosystems reclaimed in this way loses much of their original character, leading to reduced biodiversity and reduced performance of functions other than crop productivity. This was evidenced in some of the physical features such as colour and turbidity The examples of wetlands drained for cultivation are in Ala and Warike villages. This drainage results in the lowering of the groundwater table adversely affecting existing spring wells and other shallow underground water sources.

Excessive grazing of livestock mainly cattle in the wetlands of Acha, Alo, Obei, Nyakafundo and Ibizi has led to soil erosion. Gullies and rills were noted in the wetlands. Bush burning,carried out mainly in the dry season by hunters and livestock grazers, is also a threat. It removes the vegetation and exposes the soils to erosional forces. Other threats to wetlands in the district include excavation of clay for brick making and sand mining without refilling of the pits.

Landuse activities along the banks of River Nyamrwodo

The Pakwach Bridge just after Pakwach Town

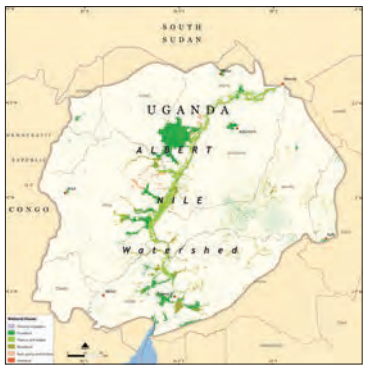
Photo credit: Flickr

Management efforts and recommendations

The Nebbi District Local Government has been carrying out activities to increase awareness on government policies and the legal provisions for managing land. They have also engaged the communities in environment action planning. However, the efforts have not yielded much as the communities feel like Government should be doing more to address their immediate needs. For instance some communities argue that the customary land that they cultivate extends up to the stream. This underlies the necessity of undertaking continuous awareness and clearly marking out the buffer strips around wetlands.

Over-dependence on woody biomass threatens the ecological stability of the wetland system and its catchment. Since the major drivers are social and economic factors, there is need to encourage greater use of efficient domestic biomass energy innovations so as to reduce the pressures on the woody biomass resources. This will limit soil erosion in the catchment, reduce the sediment load in the wetland and slow down any resulting ecological changes. Training in fuel-efficient stove and kiln construction and wood fuel harvesting from farmed plantations should be encouraged as means of reducing pressure on natural vegetation.

Community sensitization on the conservation of Albert Nile on the shores of Lake Albert at Panyimur fishing village



Oyitino Wetland System

OYITINO WETLAND SYSTEM

The riverine Oyitino wetland system originates from within Bardege Division in Gulu Municipality and flows in a northerly direction through Amuru, Bibia and finally ends up in the Albert Nile near Nimule town at the border of Uganda and South Sudan. It flows along a declining gradient from the Municipality area and ends in a broad flat aggraded valley with the water draining into the Albert Nile.

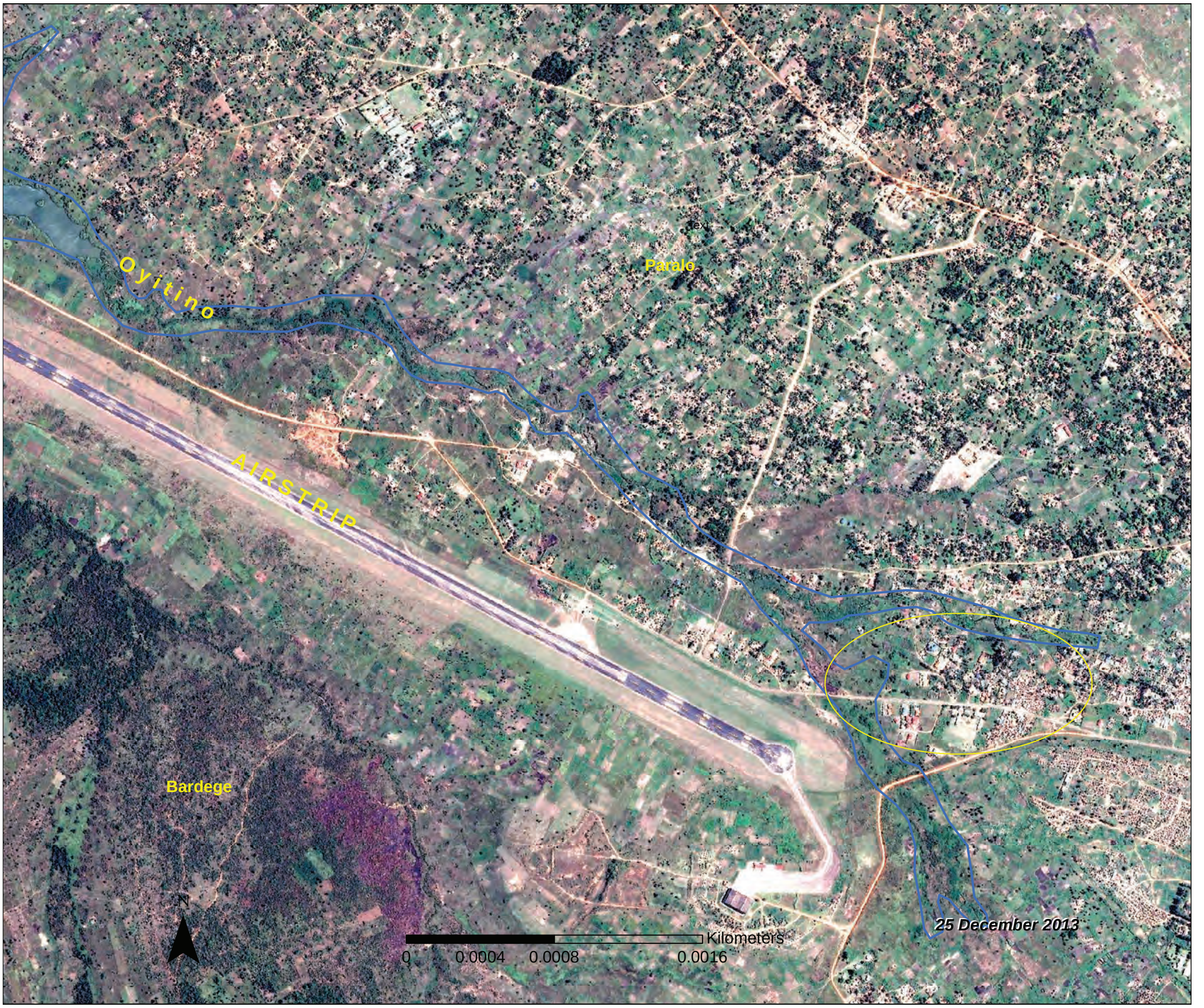
The soils are relatively young and skeletal. Their depth depends largely on the present vegetation and landuse. They are dark brown loam to reddish brown very strong clay loams. The p^H is relatively neutral and organic matter is high in the top soil. While the more southern and eastern areas have soils originating from the igneous or metamorphic rocks, in the north western parts the soils are sedimentary in origin. The surrounding area is

covered with woodlands especially in the drier north. Grass and short trees of about 4 m in height are also common (NFA, 2009).

Most wetlands in Gulu Municipality are under customary land tenure system though some of them are under a public land tenure system. Most of the wetlands in Gulu Municipality and Gulu district are under some conservation or active management interventions. For example, 40 km of Oyitino-Pece wetland system was demarcated for protection by MWE in partnership with the district and municipal Local Governments of Gulu. Only the urban sections that were seriously under threat were demarcated. The rest of the wetlands outside the municipality remains poorly protected; and restoration efforts remain a challenge in terms of the resources requirements.

Major threats to the wetland

This system is a key hot spot among the Albert Nile wetlands. The rising population explains some of the pressures on the wetlands. Between 1991 and 2014, the municipal population grew threefold: from 38,297 in 1991 to 152,276 in 2014 (UBOS, 2014). This is partly due to rural-urban migration for economic reasons and displacement caused by the civil conflict of the Lords Resistance Army which forced people out of their villages into the urban areas for safety. This has increased demand for land with many people opting for the supposedly cheap option of using wetlands for settlements. The urban population is involved in wetlands edge gardening, livestock grazing, channelization, agro-forestry, bricklaying and vehicle washing. These contribute to the dwindling wetland size and various pollution levels in the wetlands.



Two wetlands (Oyitino and Pece wetlands) are critical to the people of Gulu Municipality and surroundings. Oyitino wetlands is source of domestic supply for the 152,276 people who live within Gulu Municipality (UBOS, 2014) and approximately 1,000 people that live within the immediate catchment of the river. Pece wetland system is critical for storm water retention, sediment trapping and waste water treatment. It contains the main sewage reservoir for the entire municipality. Besides, many springs and boreholes are located within and approximately 100 m away from the wetland edge respectively. These also serve as domestic water collection points for the displaced population living in the area. However, these functions have been compromised. The self-purifying capacity of the wetlands has been exceeded by the large amounts of silt that are accumulating and the floodwater retention period within the wetland has been shortened. As a result flood waters exit the wetland at a much higher flow rate and volume in some instances causing damage to crops, settlements and livestock. Faster flow rates of the floodwaters imply that the silt will not have sufficient time to settle and replenish soil fertility. Reduced fertility will impact on the agricultural activities, and also on the wetland resources productivity.

Poor waste disposal (human and animal excreta and household domestic waste) is contaminating the water sources. This makes user communities vulnerable to infection and thus the need to protect and restore degraded areas of wetlands, designate sites for waste disposal and formulate by-laws on waste management. The presence and extent of faecal pollution in water sources has some economic implications on the NWSC and the Department of Health in Gulu.

Stone quarries along the wetland contribute to pollution of the wetland as much of the silt from the stone quarry sites drain into the Pece wetland. Many of the urban poor are engaged in the stone quarries. A good number of people involved in stone quarrying are migrants from South Sudan and the DRC.

Managing wetlands in West Nile region

The West Nile region does not have an Environment Police Protection Unit (EPPU) so mobilizing the existing police and orienting them on

Stone quarrying in the river bed of Oyitino

environment matters might require prior planning and coordination with the District Police Commander so as to avoid scenarios of not having enough backup when need arises. Where issues of land are concerned, there is usually a lot of attention and big groups follow to inquire. In some cases where sensitization is not well undertaken, there is the possibility of conflict.

Gulu District is one of the few districts with a Regional Wetlands Management Office. It is also the first district to have its wetland resources valued. But it also ranks as one of the districts with the highest rate of wetland cover loss. Gulu should take advantage of these available resources including technical support from WMD and other organizations to reverse the worrying trend of wetland cover loss within its jurisdiction.

Poor waste disposal along Oyitino wetland

BIBLIOGRAPHY

CABI. (2016). Retrieved 1 10, 2016, from Invasive Species Compendium: Penissetum purpureum (elephant grass): http://www.cabi.org/isc/datasheet/39771

Kansiime, F., Muwanga, A., & Niwagaba, C. B. (2013). *Environmental and Social Impact Assessment for Arua Water Supply and Sanitation Project.* Kampala: NWSC.

Langdale-Brown, I., Omaston, H. A., & Wilson, J. G. (1964). *The Vegetation of Uganda and its bearing on land use*. Entebbe: Government of Uganda.

UBOS. (2014). *National Population and Housing Census*. Provisional Results. Kampala: Uganda Bureau of Statistics (UBOS).

UBOS. (2013). Statistical Abstract 2013. Kampala: Uganda Bureau of Statistics (UBOS).

UBOS. (2014). *Uganda National Household Survey 2012-2013*. Kmpala: Uganda Bureau of Statistics (UBOS).

Chapter

7

ACHWA WETLAND BASIN

Figure 7.1: Achwa basin

(WMD, 2008)

INTRODUCTION

The Achwa Wetlands Catchment (figure 7.1) is the largest catchment in north central Uganda. Most are riverine wetlands with Achwa as the major river wetland system. River Achwa itself begins in hills in the northwestern part of Katakwi district and flows through the greater Lira district and drains much of the northeastern highland and northern plateau of Uganda. The distance from the Achwa's headwaters to where it meets the White Nile is about 296km. The entire catchment covers 27,601km^2 (MWE, 2013) of the land area in the districts of Katakwi, Amuria, Abim, Moroto, Napak, Kotido, and Alebtong. The seasons and the weather greatly influence the flow of the river. Flooding sometimes results in destruction of infrastructure as happened in 2000 when the bridges connecting the towns of Otuke, Pader, Agago Gulu and Kitgum were inundated**.**

Key messages

Achwa wetland system has huge potential for hydro power generation especially where the gradient is steep.

Civil war and mass displacement have intensified prevalence of poverty and increased dependence on natural resources such as wetlands.

Some wetlands like Moroto wetland system are a source of domestic water for communities.

ACHWA WETLAND CATCHMENT AREA

The Achwa river flows from Katakwi, Amuria and Napak and enters into Otuke through Alololo and Ogwete Parishes in Omoro and Olilim Subcounties as Moroto riverine wetland. It forms the border between the districts of Otuke, Pader and Gulu where the Agago River and then the Pager River flow into it. The wetland system has several tributaries such as riverine system of Moroto, Agago and the Okok-Okere-Lokichar wetland system that drains from Napak and partly from Moroto Districts.

The main ecosystem through which the River Achwa flows is the East Sudanian savanna composed mainly of *Vitellaria paradoxica* (Shea butter tree), *Combretum* (Bushwillows), *Terminalia* (Tropical

Elephant grass (*Pennisetum purpureum Schumach)*

almond) species and tall elephant grass. These species including *Acacia* (Silver wattle) and *Alibiza* (Silk plant) are all highly rated for charcoal production. Although extensive areas have been cleared by fire or for agriculture, wood and charcoal, there are some large chunks that remain intact, even outside protected areas. Extensive grasslands of *Echinochloa colona* (Jungle rice) and *Cyperus* (Sedge) species are found. The vegetation acts to limit soil erosion and the wetlands system as a whole acts as a buffer to heavy runoff, flash floods and sediment. However, degradation in the catchment area reduces the flood control function of wetlands which is the most significant social and economic benefit that they provide. Karamoja area especially Kaabong, Napak, Moroto and Kotido Districts are a hotspot for flash floods which are usually caused by sudden, excessive rainfall that causes a river or stream to very rapidly overflow its banks.

The wetland has much fauna including the Water buck and hippopotami. Arocha is the only wetland in Lira District where hippopotami can be seen during the wet season. Since it drains into Victoria Nile, usually the hippos move upward from the lake into the wetland when their normal grazing ground is submerged. A detailed biodiversity assessment has not been undertaken, but there are high indications that if well maintained, there is high potential for ecotourism. Roughly 90% of the local population relies directly or indirectly on fishing for the dietary as well as for commercial purposes.

Socio-economic and environmental pressures fuelled by the survival strategies of the people are decimating the catchment area and threatening the integrity of the river and its wetlands. Thus, considering the relationship between human well-being and wetland ecological integrity the agro-ecological catchment becomes central in management and conservation of wetland resources and public welfare. Hence, support is needed to build the required capacity and knowledge base of the farming communities, identify means through which services and institutions can be supported to adapt and adopt more diversified and productive land use systems that would rationalise the use of wetland resources, provide for the welfare as well as enhancing the lost productivity of the agro-ecological catchments.

The Achwa wetland system has good potential for hydropower generation especially in sections where the water is plentiful and the gradients are steep. Uganda's current installed generation capacity is 846 MW compared to the 600 MW potential offered by the Achwa wetland system (MWE, 2013). If the investment is undertaken, it would make a huge contribution towards boosting the local economy as well as serving as suitable trade offs for global warming.

Major threats to the wetland

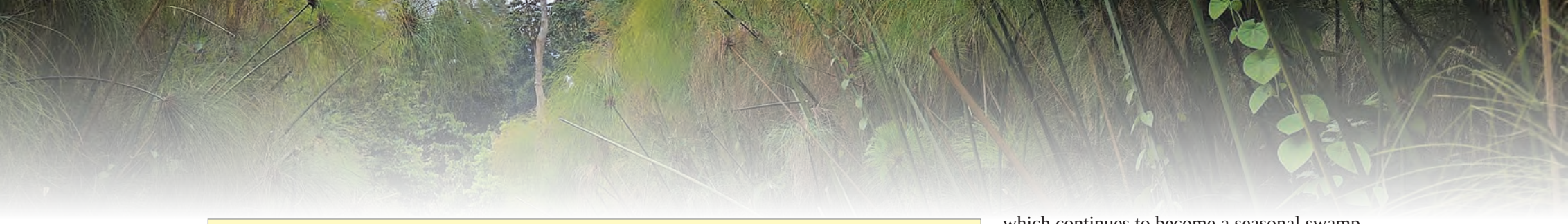
The last 20 years have seen the Achwa system at the centre of armed conflict, acute social insecurity and mass displacement of populations from rural areas towards more secure urban and peri-urban settlements. The outbreak of the war and displacement of people disrupted a variety of livelihoods including pastoral, agro-pastoral and pure farming societies. The consequences of the insurgency in the areas was poverty and famine due to the mass abandonment of farm land, subsequent over-reliance on food aid and natural resources including wetland systems and products of the Shea Butter Nut tree (*Vitellaria paradoxa*).

The Shea butter tree (*Vitellaria paradoxa*) is the dominant tree specie in the catchment previously used for its products but now popular for fuelwood

The baseline study for the upper Achwa catchment gives indications that levels of utilization of resources in the wetland and its catchment has tremendously increased. The National Biomass Study Technical Report (2003) also reveals losses in vegetative cover due to over use by IDP camps.

The insurgency created a new paradigm shift in traditional natural resources management; where resources that used to be conserved are not exploited for commercial and other purposes. For example, the Shea butter tree (*Vitellaria paradoxa*) which is the dominant tree species in the catchment (figure 7.2) used to be conserved for its products but it is now popular practice to cut it for fuelwood and to make charcoal. The economic value of the Shea butter tree is discussed in box 7.1. Wetlands used to be places reserved for grazing, fishing, hunting and source of water. However, they are now being drained and cultivated with paddy rice and other upland crops, and the practice is spreading. This intensification of community practices is detrimental to the wetlands and is resulting in soil erosion, wetland siltation, reduction of wetland size at various points, loss of biodiversity and soil infertility.

Figure 7.2: Location of Shea Butter trees in Uganda



Box 7.1: Economic value of the Shea tree

Sub-Saharan Africa accounts for all the global production of Shea nut and is the major source of trade in unrefined Shea butter (Okullo, Odongo, Sserunkuma, & Obua, undated). It is considered the second most important oil seed in Africa after the oil palm and is worth about US $150 million per annum (Bup, Mohagir, Kapseu, & Mouloungui, 2014).

The Shea tree is common in northern and eastern Uganda in the districts of Pader, Katakwi, Amuria, Abim, Gulu, Amuru, Lira, Kitgum and Nakasongola and is commonly found fringing wetlands. Its value is in its nuts and oil which are highly nutritious and medicinal. The oil is also used in the cosmetic industry. Anecdotal evidence estimates that a family may earn up to UgShs 500,000 per annum from from the sale of the nuts.

Nutritional value of shea fruit pulp

Nutritional value (on dry basis) Range	
Proximate	
Protein (g/100g)	1.3-4.2
Fibre (g/100g)	10.1-14.6
Fat (g/100g)	1.5-3.5
Carbohydrates (g/100g)	14.9-19.4
Ash content)g/100g)	3.6-5.9
Vitamin C(g/100g)	85.6-124.9
Mineral	
Calcium (mg/100g)	37.2-95.
Phosphorus(mg/100g)	69.0
Iron(mg/100g)	3.6- 7.8
Magnesium (mg/100g)	18.1-26
Sodium	7.1-18.1
Potassium (mg/100g)	42- 426
Zinc (mg/100g)	4.0

Okullo et al., 2010 and Maranz et al., 2003

AGAGO WETLAND SYSTEM

This is a tributary that feeds into the main Achwa from Agago district. It starts from Akwalakwala Parish before entering Okee Parish, both in Okwang Subcounty. Other inflows come from the neighbouring district of Abim. Its tributary includes Orama wetland at the border of Otuke and Agago Districts. The catchment area covers 12,236km^2.

Grass is the dominant vegetation, however there are also mixed communities of *Vetellaria paradoxa, Acacia, Combretum* and other common trees. Animals found within this system include Otters, Edible rats, Monitor lizards, snakes, egrets, pelicans, herons, cranes, ducks, mudfish, catfish and *Haplochromis*.

Agago wetland system is of economic importance to the economy of Uganda because it is one of the systems with reliable flow capacity for hydro electric power production. The Ministry of Energy and Mineral Development has already undertaken the feasibility assessment and confirmed that it has a flow capacity that can generate up to about 600 MW (MOE, 2013). The Environment Regulator (NEMA) has already approved the environmental impact assessment for the proposed 600MW hydropower station on this river.

MOROTO WETLAND SYSTEM

This is a riverine wetland system that extends through Katakwi, Abim, Napak, Kotido and Amuria districts covering an area of 4,959 km^2. The river enters Otuke District at the border of Alololo and Ogwete parishes in Omoro and Olilim Subcounties before joining the main Achwa system. The system links to Okok-Okere-Nangolol Apolon system with catchments in Moroto, Abim and Kotido Districts. These are small, long and narrow seasonal river networks and also include Lokichar river which continues to become a seasonal swamp at Waliwali and Nangole bwal later to drain in Kocolut, Kotipe and Loaka dams. During the flooding season, waters of Okok-Okere-Lokichar sytem drain through Abim and Amuria Districts to constitute Moroto riverine wetland system.

The river is the main source of drinking water in Katakwi, Amuria, Alebtong, Otuke and supply source for the water for production dam in Otuke districts. The catchment is a natural habitat for different species of fauna and flora and most importantly the threatened species of *Vitellaria paradoxa* subspecies *nilotica* known for its product of Shea butter oil. Other plants include *Phoenix reclinata* (palm trees), *Terminalia* (Tropical almond), *Combretum* (Bush willow) and *Albizia* (Silk plants), grasses, herbs and craft materials. There are a few species of Cactus and Mahogany. It is a habitat to a variety of fauna comprising of birds, insects, amphibians, reptiles mammals and fish. Common mammals include; Cane rat, Wild cats and Edible rats and birds such as Eagles, Doves, Vultures, Owl, Glossy ibis, Grey herons, among others. Insects include white ants, Tsetse flies, Butterflies, mosquitoes, bees, wasps, beetles. Reptiles include Snakes, Snails and Tortoises and Amphibians like toads and frogs, while the common fish species is mudfish.

Besides ecological values like water storage, flood control, micro climate regulation and biodiversity inhibiting, Moroto wetland system performs other important economic and social functions contributing to improve livelihoods of the surrounding communities. It is the sole source of domestic water for the riparian community, source of food in terms of wild fruits, wild vegetables and fish; it supports income generating activities through provision of craft materials for making ropes, mats, baskets and brooms and bee keeping. In addition to the above it has direct value such as fuelwood, sand, clay and herbs.

Major threats to the wetland

Land use change has many consequences on wetland ecology. It ranges from changes in wetland size, siltation, downstream flooding and reduced flow volume and water quality, biodiversity loss and impacts on human health. Research on wetland land use change in Uganda is limited and this hinders informed management options. Changes to the Achwa catchment affect the ecological functions of the wetland.

The productivity of land in the catchment continues to decline as more vegetation cover dwindles. The accompanying high rates of runoff and soil erosion appears to account for the decreasing soil productivity in the catchment. The literature indicates that changes to an existing ecosystem for instance, for agriculture, sets off certain soil degradation

Box 7.2: Improving ground cover in de-vegetated catchments

As a precautionary measure, there is increasing need for careful management of the catchment so as to restore vegetation cover and soil fertility and to reduce the over-dependence on natural resources. Various technologies have been developed and promoted to tackle the problem of degraded wetland catchment. These include boundary tree planting, scattered on farm tree planting and home gardens, using tree species like *Grevillea robusta* (Silk Oak), *Alnus acuminate* (Alder), *Cedrella odorat*a (Spanish Cedar), *Markhamia lutea* (Musambya), *Casuarina equisetefolia* (Australian Pine tree) and *Maesopsis eminii* (Musizi) which provide fuelwood, poles and timber to an equivalent of 25 to 30 m^3 of wood per hectare (NEMA, 2004). Such trees grow along with annual crops such as maize and beans and further act as windbreaks, soil binders and rehabilitation in the degraded catchment if properly managed.

Other cost-effective and farmer-friendly technologies can also be promoted using species like *Calliandra calothyrsus* (Calliandra), *Crotalaria paulina* (Rattlebox), *Crotalaria ochloreuca* (Slender leaf rattlebox), *Crotalaria grahamiana, Tephrosia vogelii* (Fish-poison-bean), *Tephrosia candida, Cajanus, Sesbania sesban* (Egyptian riverhemp), *Acanthus pubescens* (Bear's breeches) and *Alnus acuminate* (Alder). These leguminous plants have been proven to improve soil. They fix nitrogen, increase the soil organic matter and improve the physical properties of the soil leading to increased fertility and productivity of the catchment. Improving the soil quality in the catchment would encourage farming out of the wetland, and by providing other sources of income reduce pressure on the wetland vegetation and on the Shea Butter tree for charcoal among others.

processes (FAO, 2008). This is especially where the catchment has been de-vegetated such that rain falls directly onto bare soil not protected by any vegetation, mulches or crop residues. The existence of such bare surfaces causes heavy soil erosion in the catchment, declining soil fertility, siltation of the wetlands and flooding in the long run. Other effects are a decline in soil organic matter, increased wind and water erosion and deterioration of soil fertility.

Wetlands degradation, climate change and human activities may reduce water flow volumes and water quality. There are changes in the colour and turbidity of the water in this catchment and this has implications on water purification in terms of the cost of chemicals and power used. The degradation of wetlands leads to a reduction in the capacity to check storm run-off and floods which subsequently leads to destruction of infrastructure. Water-borne or water-related diseases are commonly associated with poor water quality. The diseases most directly linked with water contamination and reportedly common in Kitgum, Lamwo and Pader districts include malaria, bilharzia (*Schistosomiasis*) and river blindness (*Onchocerciasis*), whose vectors proliferate within the Achwa catchment. Other irrigation-related health risks include those associated with increased use of agrochemicals, deterioration of water quality as reported in Agoro subcounty in Lamwo district. The population groups at risk include farmers, consumers of crops and meat from the wastewater-irrigated fields, and people living nearby.

The prolonged civil conflict has intensified the prevalence of poverty and increased dependence on natural resources. This impacted both the diversity of flora and leading to massive biodiversity loss. For instance, the increase in paddy rice cultivation has increased the instances of mono-culture stands. Unsustainable exploitation of Shea parklands has placed additional pressure on the natural regeneration of the tree and led to deforestation of the catchment.

Crop growing and grazing in the wetland system are also a major cause of conflict. Farming communities block cattle owners from accessing the water points in a bid to protect their crops from being destroyed by animals. Claims of ownership of parts of the wetlands by land owners adjacent to the wetland system are major sources of conflict.

Management efforts and recommendations

The resource stock of Achwa wetland system remains unknown partly because this area missed out from the previous inventory due to the insecurity in the region. How much of the wetland resources contribute to the national income is also not clear. Hence, the need to undertake resource inventory and assessment and valuation studies to determine the quantity of resources and how much they add to the national earnings. This would help justify the investment cost of conservation.

The wetland boundary remains unclear to communities and that accounts, to a large extent, for the current encroachment into the system. In order to counter the rate of encroachment, efforts need to be directed towards protection of the wetland through boundary marking and demarcation.

Restoration of areas considered critical to the sustainability of the ecological integrity needs to be undertaken. For, example countering the heavy siltation, floods and infertility of the catchment are key issues since the functionality of a wetland system is largely based on the quality of its catchment. One way of addressing the challenge of catchment degradation would be through the promotion of agro forestry (see box 7.2). The practice would improve the tree cover in the area, solve the shortage of fuel wood as well as improve on the fertility of the catchment. Agroforestry practices if promoted would also help improve the regeneration of *Vitellaria paradoxa* on farmlands.

BIBLIOGRAPHY

Bup, D. N., Mohagir, A. M., Kapseu, C., & Mouloungui, Z. (2014). Production zones and systems, markets, benefits and constraints of Shea (Vitellaria paradoxa Gaertn) butter processing. *OCL 2014*, 21(2) D206 , 21 (2).

Masters, E. T., Yidana, J. A., & Lovett, P. N. (2004). Reinforcing sound management through trade: Shea tree products in Africa. 55.

NEMA. (2004). S*tate of the environment report for Uganda 2004*. Kampala: National Environment Management Authority (NEMA).

Okullo, J. B., Odongo, W., Sserunkuma, D., & Obua, J. (undated). *Characterization of traded Shea products and Shea market players in Uganda*. Kampala: Makerere University.

UBOS. (2014). *Uganda National Household Survey 2012/2013*. Kampala: Uganda Bureau of Statistics (UBOS).

The beautiful landscape of the Nile Delta catchment within Murchison Falls National Park area

Chapter

8

VICTORIA NILE BASIN

Figure 8.1: Victoria Nile Basin

(WMD, 2008)

INTRODUCTION

The Victoria Nile Basin (figure 8.1) is located in the Central and Western part of Uganda and mostly lies within the cattle corridor and most of the Murchison Falls Protected Area. It can be described as predominantly a rangeland ecosystem. The basin measures approximately 27,389 km^2 and stretches from Kawempe and Rubaga Divisions in Kampala City to the Nile delta in Nwoya and Bulisa districts.

The main wetland systems in this basin all eventually drain into the Victoria Nile. Some drain northwards including River Mayanja, Lugogo, Kiyanja, Kafu; and others drain southwards from northern Uganda towards Victoria Nile including Okole, Arocha and Pece-Tochi from Gulu. A summary of the tributaries is indicated in Table 8.1.

Although the basin has numerous rivers and wetlands, it is water stressed especially during the dry season of December to February every year where reduced water and pasture leads to increases in livestock deaths. The water scarcity combined with increasing demand by the growing population in the basin (figure 8.2) hinders economic activity and is associated with health, food security and poverty issues. Conservation of the wetlands in this area is critical for the economy of this basin. Table 8.2 highlights some of the uses, threats and impacts facing the wetlands in the basin.

Key messages

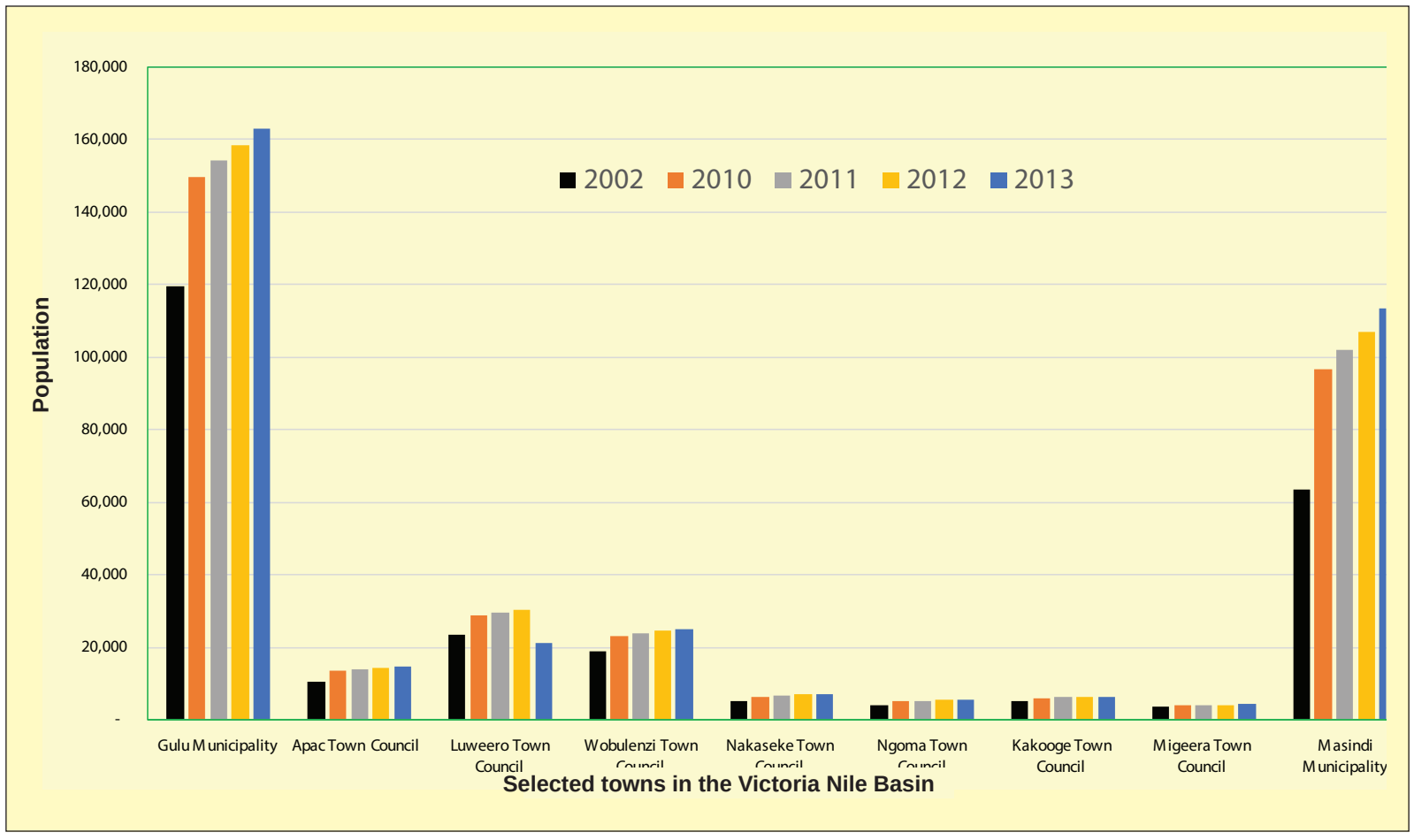
The wetlands in Victoria Nile Basin are very productive in terms of supporting a large population of both domestic and wild animals. Their integrity is therefore crucial to the sustenance of both the tourism and livestock industries in the country.

Table 8.1: Summary of the wetland systems and associated tributaries of the Victoria Nile Basin

PRIMARY SYSTEM	SECONDARY SYSTEMS	TERTIARY SYSTEMS
Mayanja	Nabisojjo, Danze, Kagoye, Nvuye, Kizikibi, Mataba, Magaga, Mayanjawenkalwe, Nambuzi, and Kabenjegere.	Kagoye, Nankonge, Kiwuku, Kirevukyampanga, Kasokanyanja, Nabikukuzi, Mutakonkome, Bubuto, Kiyirira, Ntenga, Nalyankanja, Lutabakadde, Mataba, Wakasanke, Danze, Lubumba, Wabitembe, Kakerere, Kabale, and Kayiwagobe.
Lugogo/Lumansi	Kagoye, Lubenge, Kigwe, Bangwa, Mudagado, Kiyanja, Kyawalanda, Wabisonko, Kasita, Kangadda, Kabanga, Lutabakadde, Nabayego, Nakyanika, Kiyuni, Nakaga, Nkulubiri, Nbisembe, Kyewama, Namasaba, Kabugaba, Kyakabugumire, Kachwampeba, Kamunkwale, and Katangwa.	Budola, Mudagado, Kamirampango, Nakabimba, Kasesansano, Kalwanga, Wakere, Nalinzadde, Nakolobbi, Nalimbuze, Nakabale, Nakijabaja, Kabale, Mutukula, Wabigwa,Namazzi, Kanyogoga, Munyikamondo, Lukwanzi, Nakatite, Ngaju, Lwantulege, Mwendangabe, Nalongo, Kampewo, Katansule,Nakokota, Kayebe, and Wakibango.
Lwajjali	Kiziri, Kayiwa, Nawango,Kazikake, Nabitula,Namunyaga, Natyaba,Kasiribiti, and Lwamirindi.	Nakinya, Gayira, Noba, Kababondo, Namatimba, Nalyankanja, Namazina, Nalongo, Katonga, Kiwegi, Wabiriga, Katajula, Nabalemezi, Wabitosi, Namwendo, Kyambogo, Wazigugu, Nayasandeku, Wabisonko, and Waminyira.
Towa	Kibanda, Mututwe,Kabulamuguwa, Lwenjobi, Mulika, Kabale, Nakalangala, Zambi, Bisenyi, Wanjagaza, Kazinga, Lwabidu, and Kyabatangwa.	Bujugwa, Bunabwengo, Kaziralwendo, and Babwe.
Kafu	Kiyanja, Mayanja, Lugogo	Lugazi, Lubenge, Nabisojjo, Danze, Kagoye, Nvuye, Kizikibi, Mataba, Magaga, Mayanjawenkalwe, Nambuzi, and Kabenjegere.
Okole	Kole-Apac, Amwok, Aninolal, Alute, and Okwerodok.	Owalo, Akwayo, Lelatwonlee, Apele, Kulu-Obia, Otulatum, Arodyang, Alidi, Ajurujuru, Adyaka, Ocala, Alute, Aremotwo and Okwerodot.
Arocha	Turkwere, and Itwon	
Pece-Tochi	Alee, Minakulu, and Apiojok	Ocen,Irem, Okoroo, Amiene, Apiojok, Ayami, Achet and Akao

Victoria Nile at Paraa in Murchison Falls Protected Area

Figure 8.2: Population of selected towns in the Victoria Nile Basin



(UBOS 2015)

Table 8.2: Major wetland uses and threats in the Victoria Nile Basin

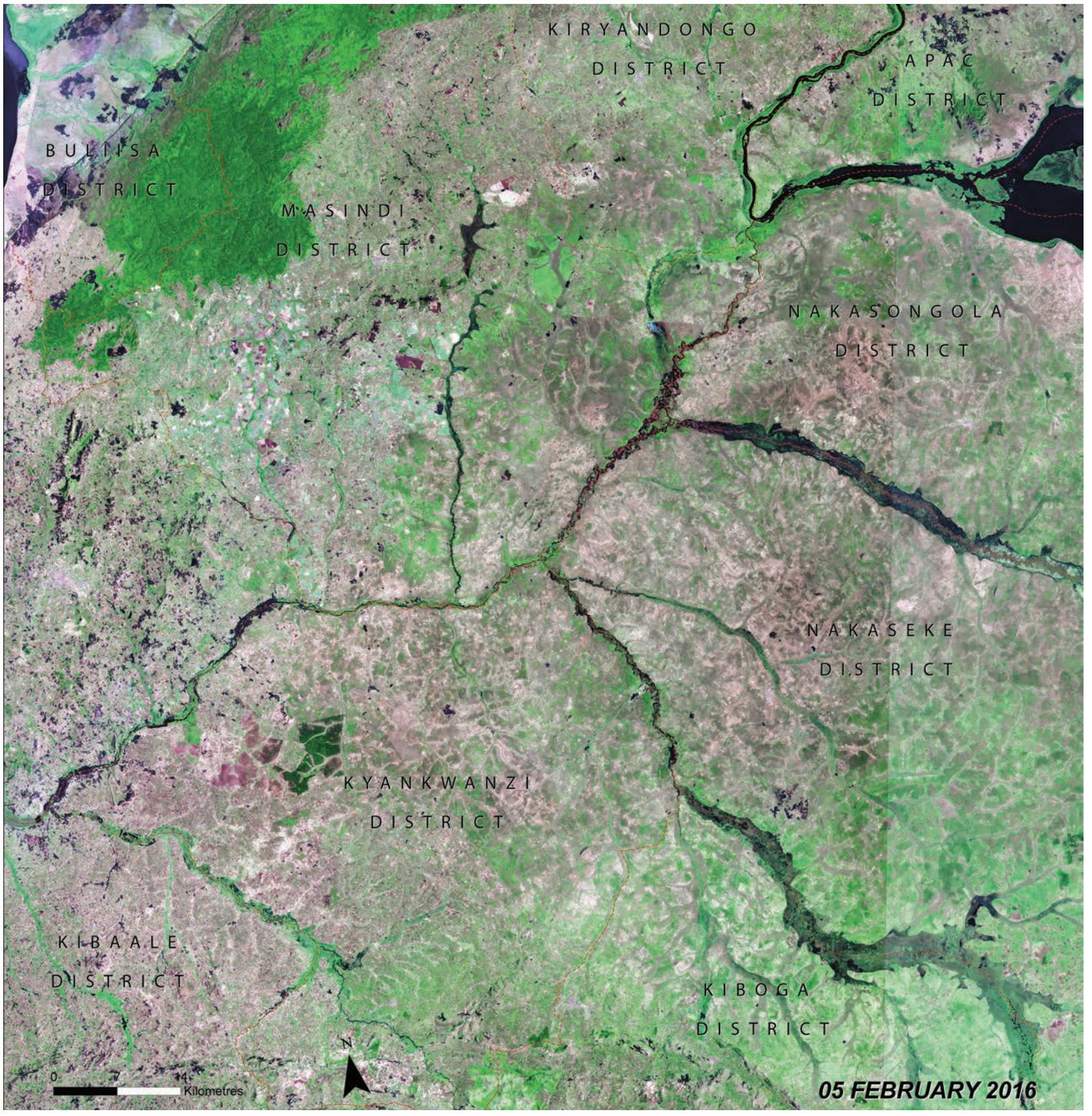
MAJOR USES	THREATS	EFFECTS
Grazing	• Overgrazing • Pesticide use • Bush burning	• Invasion by unpalatable grass species • Soil erosion • Development of species and vegetation composition affected • Animals scared away • Biodiversity loss
Cultivation	• Uncontrolled cultivation such as rice in Semuto, Kapeeka, Nakaseke and Kasangombe	• Biodiversity loss • Soil erosion • Loss of wetland services • Water pollution
Wood harvesting	• Deforestation	• Reduced tree cover
Harvesting of *Phoenix* poles and leaves	• Over exploitation	• *Phoenix* extinction
Sand and clay extraction especially in urban centers	• Over exploitation	• Scattered open pits
Brick making	• Deforestation • Over exploitation of sand and clay	• Soil erosion • Scattered open pits
Propagation of eucalyptus tree species	• Out competing wetland plants species	• Decline or loss of biodiversity
Building construction especially in urban centres	• Encourages over exploitation of sand and clay • Alteration of the hydrological regime • Unplanned construction	• Loss of habitat • Water availability

Kafu River Wetlands

KAFU RIVER WETLANDS

River Kafu is one of the main rivers that flow into Victoria Nile and finally into Lake Albert. The river flows east from a swampy watershed to the Nile, and west from the same watershed into River Nkusi and finally into Lake Albert. Along the eastward flowing section it receives two main tributaries on its right (southeastern) bank, both of which flow through extensive permanent swamp systems. These are the Mayanja, which traverses a 30km papyrus swamp and the Lugogo which flows through a continuous strip swamp for 82 km above its confluence with the Kafu. This Lugogo wetland has an area of 246 km^2 and plays an important role in recharging the river especially during the dry season.

River Kafu is a major water source within the cattle corridor especially during the dry season. The river also defines the boundaries between Masindi, Nakaseke and Nakasongola Districts; and also the boundary between Bunyoro and Buganda Kingdoms.



Major threats to the wetland

The major economic land use activities along the river include fishing (to a small extent), agriculture and livestock keeping especially in Masindi and Nakasongola. Cultivation along the riverbanks occurs mainly on the Nakaseke District side of the river and along the Lugogo wetland. Cultivation extends right down to the water mark and much of the natural vegetation that used to stabilize the riverbanks has been replaced with crops. Crops grown include bananas, maize, sweet potatoes, cassava and recently sugar cane. This has destabilized the riverbank area, leading to direct transfer of soils into the river.

On the Nakasongola side, the area has been over stocked and over grazed leading to severe trampling of the vegetation particularly around watering points along the river. In addition, the entire river stretch has no gazetted water points for cattle and as a result, grazing is random, unplanned and destructive to the riverbanks. Many of the ranches along the river have fenced off their farms ignoring the law on riverbanks protection that provides for a 100m river exclusion zone. This denies the community right of access to the river banks. In some cases where a narrow access belt is left for this purpose, there are still conflicts over right of use. Public consultations organized by NEMA in April 2012 at the Kafu Bridge near the Kampala-Gulu highway highlighted these issues as discussed in Box 8.1.

Management efforts and recommendations

It is recommended that the relevant laws and regulations for restoration of riverbanks should be enforced as follows:

1. All persons who have fenced off the 100m riverbank protection zone of River Kafu should vacate the area as soon as possible. The District Environment Officer should serve these persons with Environmental Improvement Notices. If they do not comply then NEMA or the Court should serve them with an Environmental Restoration Order issued as stipulated under Section 67 of the National Environment Act Cap 153.
2. Since the River Kafu ecosystem is the only reliable source of water for the communities in the area its banks should be urgently restored, and a management plan developed for its sustainable use. This will re-establish the integrity of the river, its wetlands, and ensure that the community does not continue to lose the benefits from the wetlands.
3. There is need for further sensitization of the community on the sustainable use of the river, its banks and basin including their constitutional rights to access the river, and a clean and healthy environment. They should also be advised to change the land use or reduce their stock to correlate with the carrying capacity of the riverbanks pasture resources.
4. The genuine landowners and users contiguous with the river should be regulated and provided with incentives to plant grass and trees along the riverbanks and protect them from destruction by the cattle.
5. There is urgent need to demarcate off the 100m protection zone as a non-utilization area along the entire riverbank to allow vegetation to regenerate as well as plant some quick growing and bank stabilizing grass and tree or shrub species. The boundaries may be marked off by live and resistant species that are non-palatable to cattle such as sisal, cactus, *Erythrina* or *Ficus* species.
6. Cattle watering and holding points should be identified and gazetted at appropriate distances along the riverbank to avoid destruction of the fragile riverbank.
7. Collection of indigenous seed and raising seedlings and planting of trees in the demarcated and zoned off areas should be carried out.

Box 8.1: Challenges Implementing the Law on Protection of Riverbanks: The case of River Kafu

Mukwano Dairy Farm (MDF) is a 62 square mile ranch along River Kafu that used to be Uganda Livestock Industries Limited before it was privatized. It is located in Kimengo Subcounty, Masindi District. The MDF, and other farms along River Kafu, have fenced off more than 80km of the riverbank protection zone for their exclusive use. This presents a challenge of access to water by pastoralists especially during the dry season. Prior to privatization, the community had ease of access to the riverbanks which is a common resource. They could also use a short-cut through the farm to travel to the headquarters of Kimengo Subcounty for services. Currently the community have to take a longer route averaging 64km around the farm to access their subcounty headquarters. The MDF argue the reason they blocked the short cut through their farm is because some of the community use the protection zone to graze their livestock, posing the threat of disease to the farm and degrading the riverbank. At times they even build temporary structures and stay for prolonged periods.

The Farm Management was informed that in accordance with the law, they are responsible for monitoring compliance with the wetlands and riverbanks contiguous with their farm, and therefore, working with Masindi Local Government, they will be able to monitor and control the use of this common resource. Under Section 29(4) 0f the National Environment (Wetland, Riverbanks and Lakeshores Management) Regulations 2000, each Local Environment Committee is mandated to determine watering points and routes for animals to have access to the water in each river. The current failure by Kimengo Subcounty (and other lower Local Governments) to implement this provision and gazette cattle watering points along River Kafu has allowed the conflict to fester.

KIYANJA WETLAND

Kiyanja wetland is located in Masindi Municipality along the Kafu-Masindi Road. The wetland is of critical importance because it is the source of water for Masindi Municipality. The population of the municipality has been exponentially increasing as shown in Figure 8.2. Like other wetlands in the River Kafu catchment, Kiyanja wetland is dominated by *Cyperus papyrus*. The entire catchment is privately owned and under extensive agricultural use and livestock production.

Kiyanja Water Works was initially constructed in the 1970s to supply water to the Masindi Army Barracks until the early 1980s when its management reverted to Masindi Town under MWE and then finally to NWSC in 2006. By July 2015 NWSC was pumping 2,250m^3/day to Masindi Town (see figure 8.3).

Major threats to the wetlands

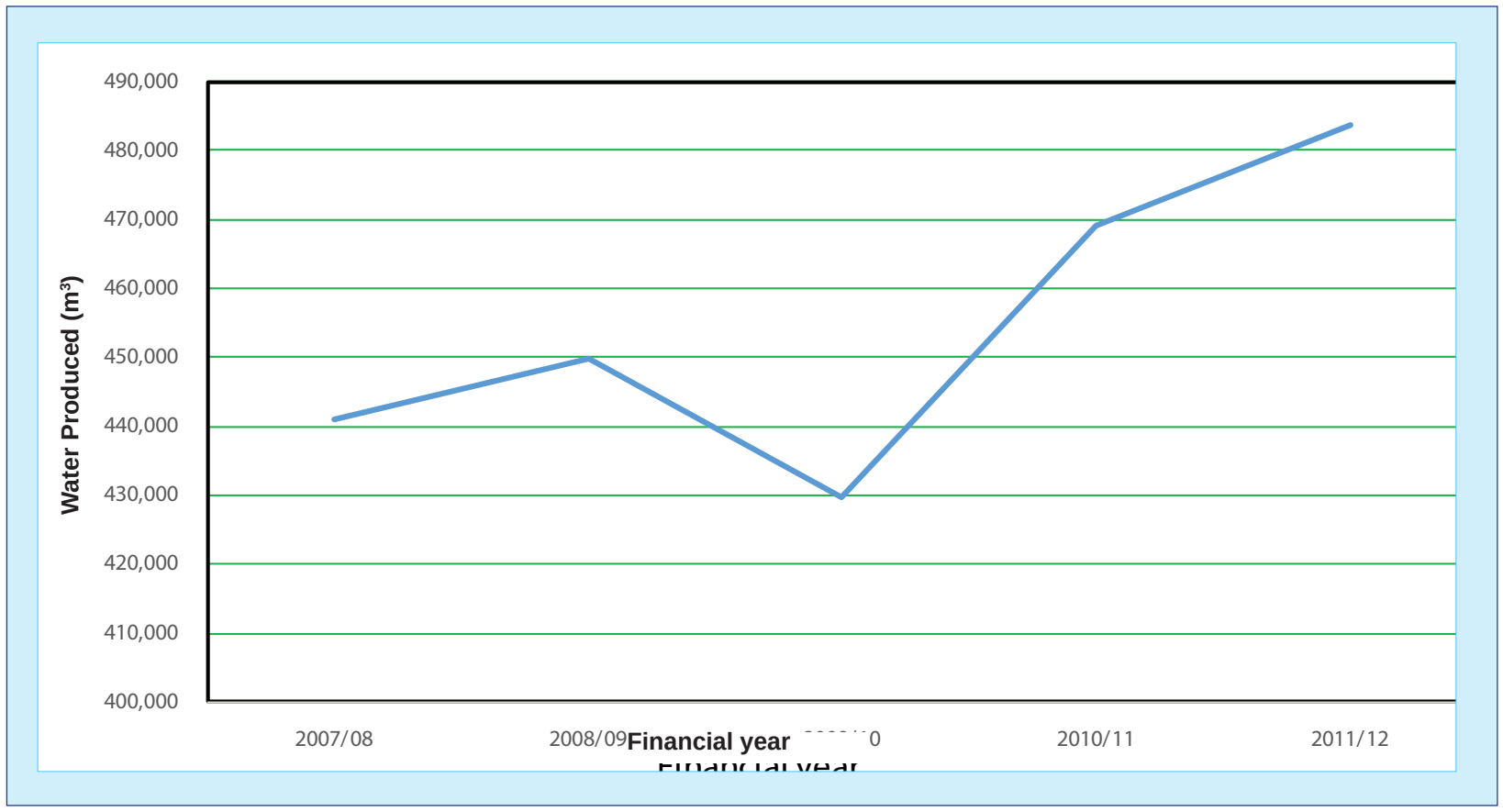
The main challenge in the management of the wetland is siltation from the catchment and the management of aquatic weeds especially in the dry seasons. Flooding of the water intake pump house is also common during the rainy season.

Management efforts and recommendations

NWSC has initiated a project to improve the water production capacity of the Masindi Water Treatment Plant by an additional 2,000m^3/day. The project is aimed at addressing the water shortages currently being experienced in Masindi Town because of the limited abstraction capacity at the Kiyanja water treatment works. Construction of a coagulation and flocculation unit, clarifier and filter is ongoing with progress estimated at 70%, 50% and 50% respectively.

NWSC Water works at Kiyanja, Masindi

Figure 8.3: Water produced from Kiyanja wetland for Masindi Municipality



(UBOS 2014)

Brewing of waragi (local gin) by waragi brewers in Bujenje, Masindi District

Mayanja Wetland

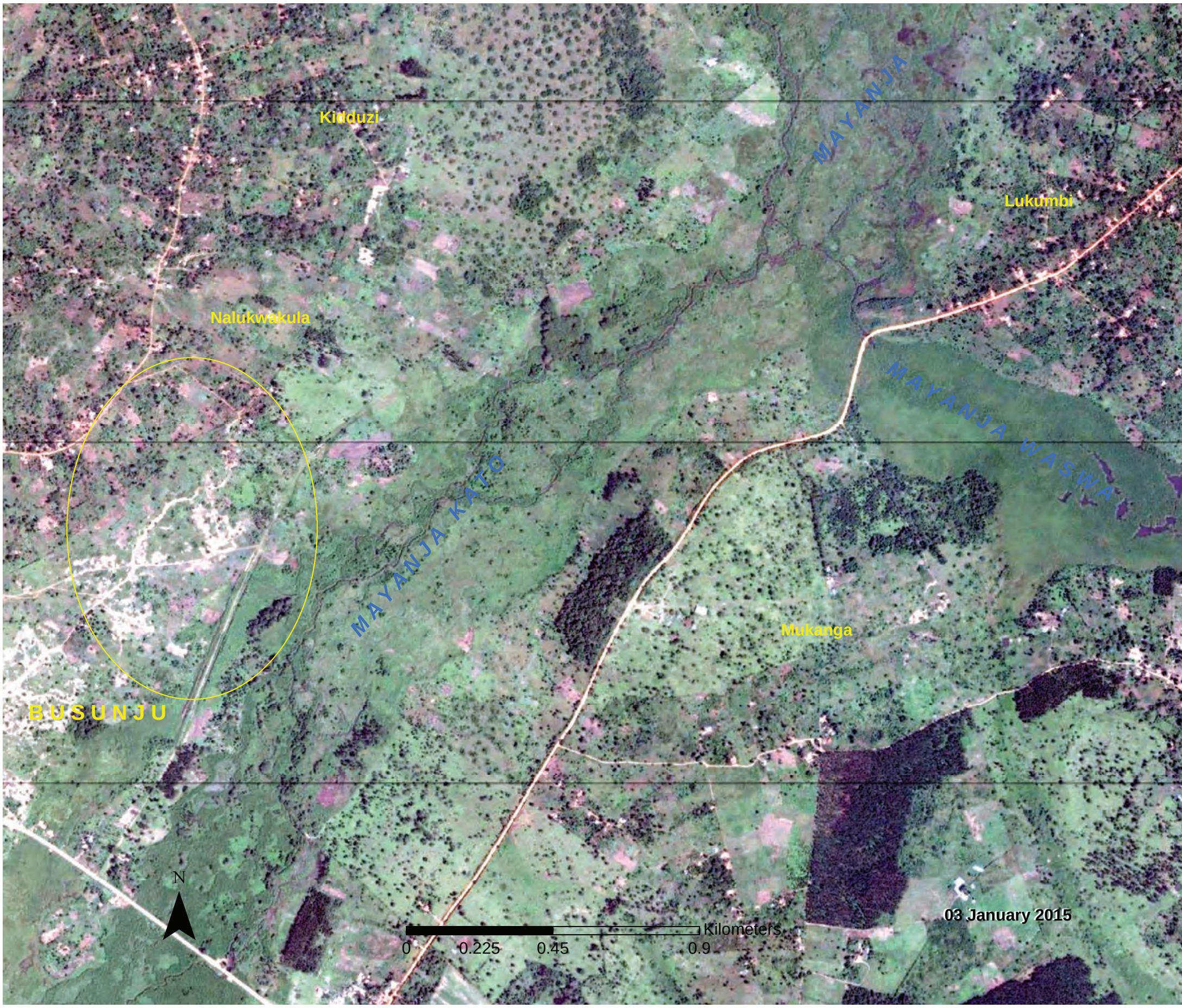
MAYANJA WETLAND

Mayanja wetland is a permanent wetland that starts in Kampala City and Wakiso District before draining into River Kafu in Ndede village in Nakaseke District. It starts as a confluence between Mayanja-Wasswa (that emerges from Kawanda) and Mayanja-Kato from Naliumunye through Nalukolongo and Lubigi wetlands to Wamiko Town near Busunju Town, about 56km from Kampala along the Kampala-Hoima Road. The river traverses many Subcounties the main one being Bukomero Subcounty (in Kateera Parish, Kakinga LCI along Kituuma-Kapeeka Road); with the wetland passing through the borders of Wakiso, Mpigi, Kyankwanzi and Nakaseke Districts.

The start of this wetland is dominated with *Cyperus papyrus* which can reach up to a width of over 1km. Other land cover types include swamp forest, natural grassland, reeds and sedges, bushland and palms. Other species in the wetland includes *Cyperus articulata, Echinocloa, Phoenix, Mimosa pigra, Ambatch, Acacia sp.* The key animal in the wetland includes hippos, crocodiles; catfish, *Oreochromis* and birds, mainly weaver birds.

Major threats to the wetland

The main wetland system has not been encroached upon, but its tributaries are under severe attack. In terms of conservation, therefore, most of these tributaries are in urgent need of restoration and protection. The key challenge here is, however, related to land ownership. Most of the Mayanja wetlands are on customary land, making them highly vulnerable to economic forces in terms of sale and conversion for other lucrative uses.



LUGOGO WETLAND

Lugogo Wetland

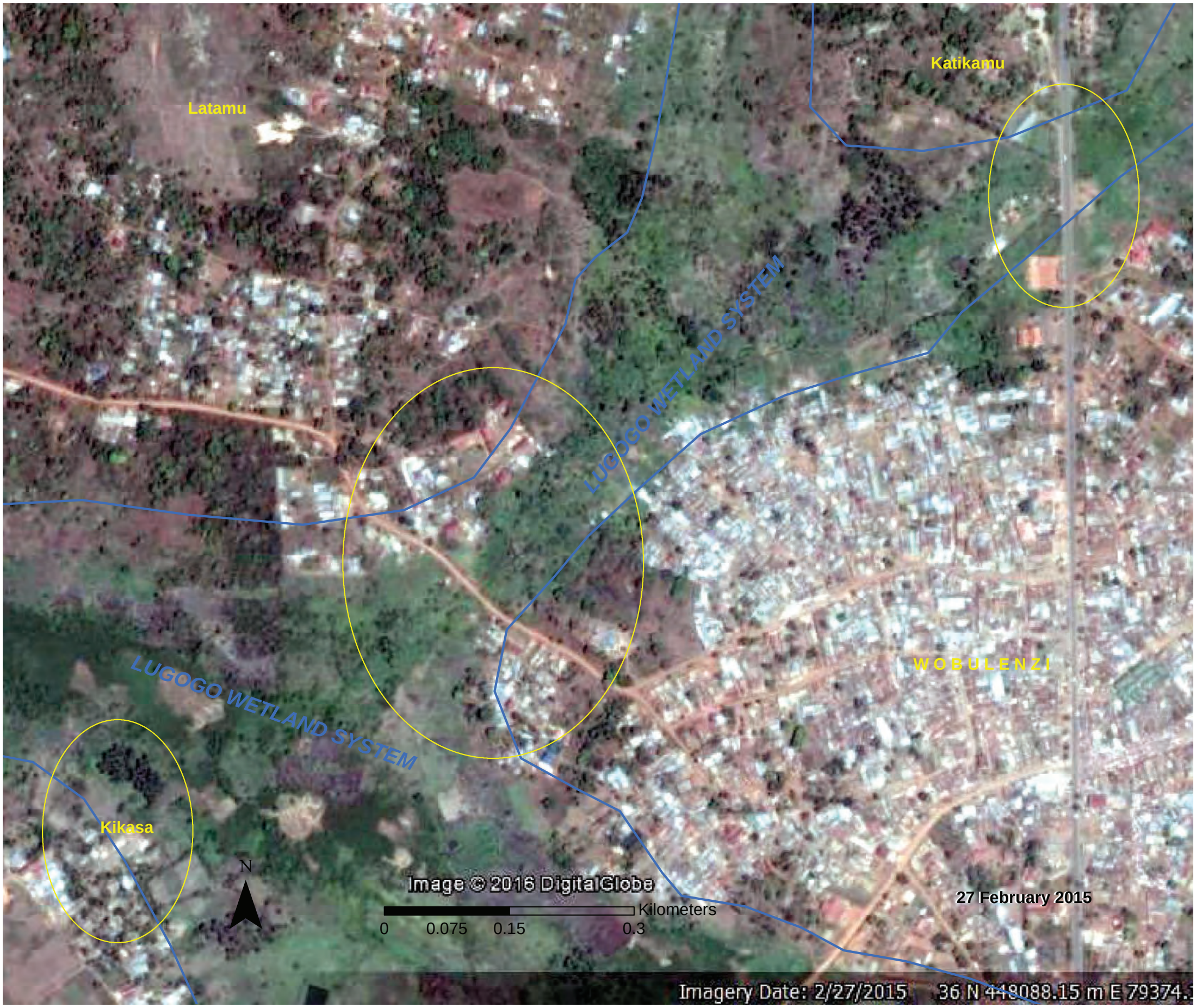
Lugogo wetland is located in Luwero and Nakasongola districts in central Uganda. The wetland is one of the best kept secrets in terms of conservation and is part of the Ziwa Rhino Sanctuary in Nakasongola District. It is habitat to a multitude of animals and rare birds including the threatened and endangered Shoebill. It is connected to River Kafu and thus maintains a cool microclimate throughout the year.

The wetland also hosts a multimillion dollar mushroom farm that is located in Kasambya village in Kasangombe Subcounty in Nakaseke District which produces for both domestic consumption and export. The mushroom farm is expected to produce about 30 tonnes of mushroom per day and is also training other out growers.

Lugogo wetland is one of the major sources of water for livestock in this predominantly rangeland area. These rangelands used to be historically managed under traditional systems where grazers had open access with mobility as the main coping strategy to drought. Changes in land ownership, population increase and attendant demand for food and fuel have led to changes in land use and cover types, affecting livestock management practices (Bukenya, et al., 2014).

Major threats to the wetland

The main pressures on this wetland are soil erosion arising from land degradation in the neighbouring catchment. Another emerging issue in the wetland is conflicts over the cattle watering points in the wetlands. Today most of the rangeland has been alienated and fenced off sparking off conflicts especially with dairy farms far from reliable sources of water. Although the laws and regulations provide for the provision of access points for the communities to get water from the rivers, this is largely missing. The management and use of River Lugogo is therefore paramount to the sustenance of the economy of the districts in this basin.



AROCHA WETLAND SYSTEM

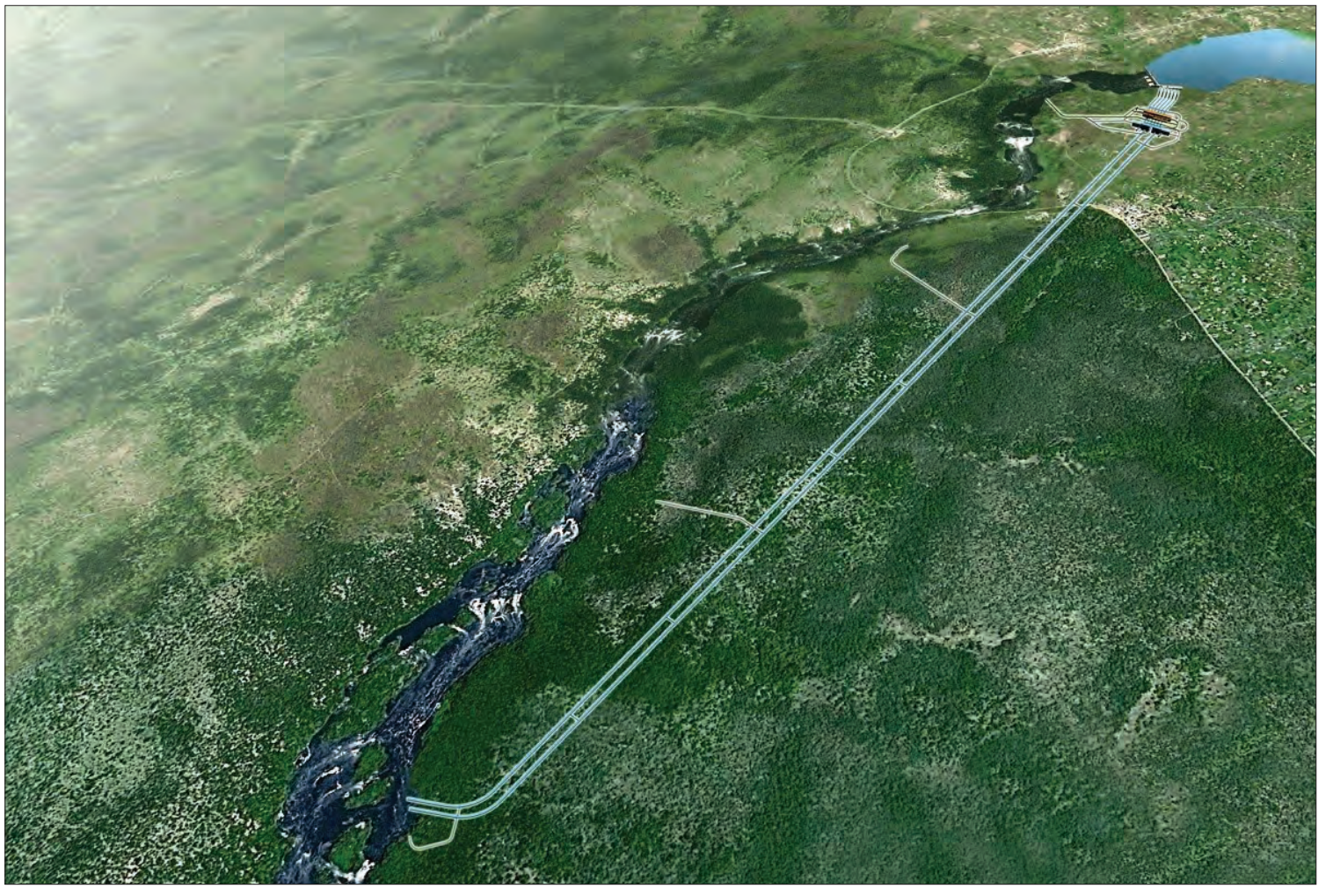
Arocha wetland is found in Apac district and is one of the tributaries of the Victoria Nile, draining into the Nile River at a point just before the Karuma falls. The main basin is in Apac and only a small section comes from Kole district. During the rainy season, Arocha wetland contributes substantial amounts of water into the Nile River. It is an important fish (*Tilapia niloticus*) breeding ecosystem, harbors the *Sitatunga*s, forms the migratory route of the hippopotamus upstream of the wetland during the rainy seasons and is important for tourism (box 8.2).. Downstream, an area of about 50ha of wetland forms the grazing grounds for more than 20,000 cattle. Rice growing is also evident in the upper basin of the wetland.

There is rich vegetation with over 100 floral species recorded in the Arocha wetland area. The most abundant tree species included *Albizia coriaria, A. grandibracteata* and *A. zygia.* Common shrubs and herbaceous plants included *Bidens pilosa, Cynodon dactylon, Hyparrhenia diplandra, H. filipendula, H. rufa, Imperata cylindrical* and *Indigofera arrecta* (EIPL, 2011). Bird species include the Crested Crane, Brown Snake Eagle and Papyrus Gonolek, Spot-flanked Barbet, White-headed Saw-wing, Grey-capped Warbler, Golden-backed Weaver and Cardinal Quelea. It is also a habitat to Shoebills (EIPL, 2011).

Threats to the wetland

Arocha wetland provides both marketed (goods) and non-marketed (services) resources for the riparian community. However, activities such as rice cultivation, livestock rearing, fishing, crafts making, settlements, fuel wood and charcoal burning are exerting a lot of pressure on the wetland. This overexploitation has an impact on the ecological functions of the wetland in terms of water provision. For instance, the wetland supports over 20 springs including abstraction from production wells which provide water for domestic use and this function is now under threat. There is also development pressure from Aduku and Apac Town Councils. Much of the riparian vegetation cover is highly degraded and attempts to enforce the environmental law have not yielded much success. Whereas the use of the wetland resources provides livelihoods support, if improperly managed there are consequences for the riparian community. For instance, a number of springs along the wetland have dried up due to massive conversion into rice gardens especially in Aduku, Inomo and Abongomola Subcounties. The practice fragments the basin of the wetland leading to the gradual decline in the flow volume, drying up of springs and wells and reduction in the natural connectivity of the ecosystem. The degradation also affects the habitat for biodiversity. There is thus need to engage the community in the management of the resources since they also obtain the products and services directly from such wetlands.

An artists impression of the Karuma hydropower project



(MEMD, 2013)

Box 8.2: Importance of Arocha wetland system to tourism

Arocha wetland system is considered as one of those which are relatively intact in the country. Its proximity to the Murchison Falls National Park, which is a major tourism circuit is significant. The wetland system plays an important ancillary role by forming dispersal areas and migratory corridors in the locations bordering the park enabling it to sustain the vibrant population of wildlife.

The 600MW Karuma Hydro Power Project under construction at Kyoga Nile, Karuma in Kiryandongo and Nwoya Districts

Photo credit: Nancy Alimadi

Okole Wetland System

OKOLE WETLAND SYSTEM

Okole Wetland is one of the major tributaries of the Victoria Nile draining from northern Uganda. It originates in Lira Municipality and also partly from Barr subcounty in Lira District. It then flows in a southwesterly direction through Ayago Parish, across Kitgum Road, Odokomit Ginnery and enters Kole district through Ayer Subcounty. The wetland loses water through evapo-transpiration, draining into River Nile at Atura in Aber Subcounty in Oyam District. It is mainly a permanent wetland, though some of the tributaries such as in Lira District are seasonal (GOU, 2014).

Surface runoff from the surrounding hills and underground recharge are the main source of water for this wetland. The wetland covers the subcounties of Akalo, Bala, Ayer, Alito and Aboke (Kole District) and Inomo, Chegere and Ibuje (Apac District) and also partly touches Oyam District (GOU, 2014). Much of Okole wetland lies at an altitude of 900 masl (GOU, 2014).

The local communities use the wetland as a source of water for domestic use and livestock, wood fuel, medicinal plants and raw materials for making crafts. Illegal hunting of wildlife especially endangered *Sitatunga* and Reed buck is prominent although these animals are now few and difficult to trap. Agricultural activities especially rice and sugar cane cultivation is prominent in the wetland areas. Field observations reveal the existence of *Cyperus papyrus* and *Typha,* Water lily, algae, *Echinochloa* and *Alchornia sp* with isolated cases of water hyacinth in some areas and there is the occasional woodlands. Common animals include snakes monitor lizards, edible rats, squirrels, pelicans, ducks, egrets, mudfish, catfish, tilapia, *Haplochromis* and frogs.

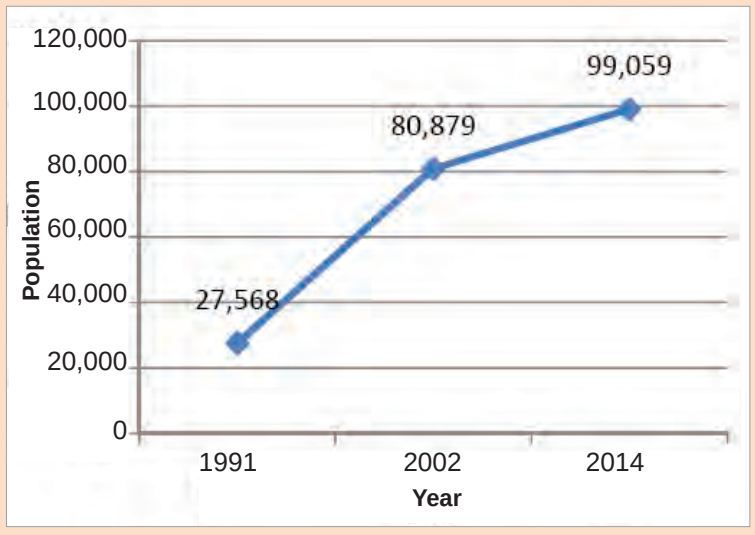
Major threats to the wetland

The main threats are driven by the rapid growth in population which leads to overfishing, poor land management practices such as bush burning, clearance of vegetation for settlement, subsistence and commercial agriculture and for industry. Bush burning in the northern region is a major threat especially during the dry season as the fires are set to encourage new growth with the onset of the rains. It is also done to clear the swamps so women and children can easily access the wetlands to fish. However inappropriate fishing methods such as the use of baskets and hands, under sized gill nets and dry season wild fishing using spears is also contributing to a decline in fish species such as *Protopterus, Clarius* and Catfish (GOU, 2014).

Fast growth in urban population in the basin of Okole wetland poses tremendous threats to the hydrology of the wetland. This is especially so in Lira Municipality which constitutes the main basin of Okole wetland. Lira municipality is the 10th largest urban centre in the country with a population growth of 1.7% per annum as shown in Figure 8.4 (UBOS, 2014) . The establishment of industry such as oil mills, cotton ginning and others attracts many migrants into the urban areas seeking employment. The rising population is linked with poor sanitation and deplorable solid waste management practices and encroaches on the wetland which is seen as a source of 'cheap' land (NEMA, 2000). The mushrooming settlements drive the exploitation of sand and clay in the wetlands. This is evident at Teboke and Aboke Trading Centres.

Lack of awareness on wise use of wetlands and poor farming methods cause soil erosion resulting in soil fertility degradation and siltation of rivers and wetlands. Much crop farming is done right up to the streams and also inside the wetlands. Farming for commercial purposes such as tobacco growing has biodiversity and socio-economic implications as discussed in Box 8.3. Internal displacement especially in Lira, Gulu, Adjumani and Moyo due to communities fleeing from the South Sudan conflict or the LRA, has forced people into the wetlands to farm.

Figure 8.4: Population growth in Lira Municipality 1991-2014



(UBOS, 2014)

Box 8.3: Tobacco cultivation and its impacts on wetlands

Tobacco growing is a dominant activity in northern Uganda (figure 8.5) and accounts for massive degradation of wetlands especially in Kole, Oyam and a few subcounties in Apac district. The soils in West Nile are ideal for tobacco growing. In the wetlands and riverbanks, soils are sandy and black with isolated brown layer of clay loam. This covers about 60% of the cultivable land. The sandy loams and sandy clays provide good aeration and drainage are good for the crop.

Tobacco curing, crop cultivation and the demand for wood for multiple uses are destructive to wetland vegetation, wildlife habitat, food-chain support and human recreation. Tree felling, to clear land for cultivation and to provide fuelwood, contributes to soil erosion, declining soil fertility, reduced crop yields and wetland siltation. It is estimated that 7.8kg of wood is needed to cure 1kg of tobacco. Even though multinationals like British American Tobacco (BAT) replant trees, more often than not indigenous species such as the Shea butter and Mahogany trees are replaced with exotic ones such as Eucaplytus. Tobacco cultivation also involves the use of insecticides and fertilizers which often pollute wetland waters. For instance, during the three month period from seedbed to transplanting into the field, 16 applications of pesticide are recommended and this has implications on human and environmental health.

Wetland Management Plans for Kole-Apac-Okole have been developed to address some of these issues. This initiative by the government to shoulder its social and environmental responsibilities for the people in this area is a step in the right direction. However, more generally, there is a great need to raise the knowledge of wetland resources users on the need to balance improvement of livelihoods through wetlands resource use with conservation.

(Mackenzie, 1970), (Panos, 1994), (GOU, 2014), (Sejjaka, 2004)

Figure 8.5: Tobacco growing areas in Uganda

Pece-Tochi Wetland System

PECE-TOCHI WETLAND SYSTEM

The wetland system starts in Gulu Municipality in the Divisions of Laroo, Pece, Layibi and partly Bar Dege. It crosses the subcounties of Ongako, Bobi, Koro, Layibi Division and Lakwana in Gulu District and Abok Subcounty in Oyam District. As it flows through Oyam District, it is joined by other seasonal streams from Nwoya District eventually ending in the Victoria Nile. This wetland system has many tributaries such as Ocen, Irem, Okoroo, Amiene, Akoko, Oloi and Akao in Minakulu Subcounty; and Apiojok, Ayami and Achet that flow through Otwal, Iceme and Achaba Subcounties. About half the wetlands are permanent such as Alee, Minakulu and Apiojok, while the rest are seasonal (figure 8.6). Open water is common in Alee and Apiojok while the Tochi system is mostly covered with grasses (GOU, 2014).

The catchment vegetation is of vital importance to the three districts. Communities use them for building poles, raw materials for crafts, firewood, medicine and to hang their bee hives. Much of the Pece-Tochi wetland system falls within the Karuma Wildlife Reserve and the vegetation here is primarily savannah woodland punctuated by bushes, grassland and farmlands. Over 70 percent of vegetation within the Pece-Tochi wetland system is classified as dry *Acacia-Combretum-Terminalia* thickets. Agriculture provides livelihood for about 82% of the people. Fish farming, horticulture (tomatoes, cabbage and other green vegetables) and livestock dominate in Oyam District. Rice cultivation, settlement, brick making and sand quarrying are prominent in Oyam and Gulu Districts.

Major threats to the wetland

Tochi, has in recent years, been severely encroached upon and much of it converted into agricultural lands. Crop farming is a fundamental factor underlying the escalating level of the degradation of the wetlands. The wetland passes through the tobacco growing areas of the mid-north and in some places tobacco farmers cultivate up to the riverbank. In addition to land for cultivation, management and processing of tobacco involves the use of chemicals and woody biomass which is detrimental to the environment (Nature Uganda, 2013).

This continued expansion of tobacco growing is leading to watershed destruction and siltation of the wetland. For instance a biodiversity

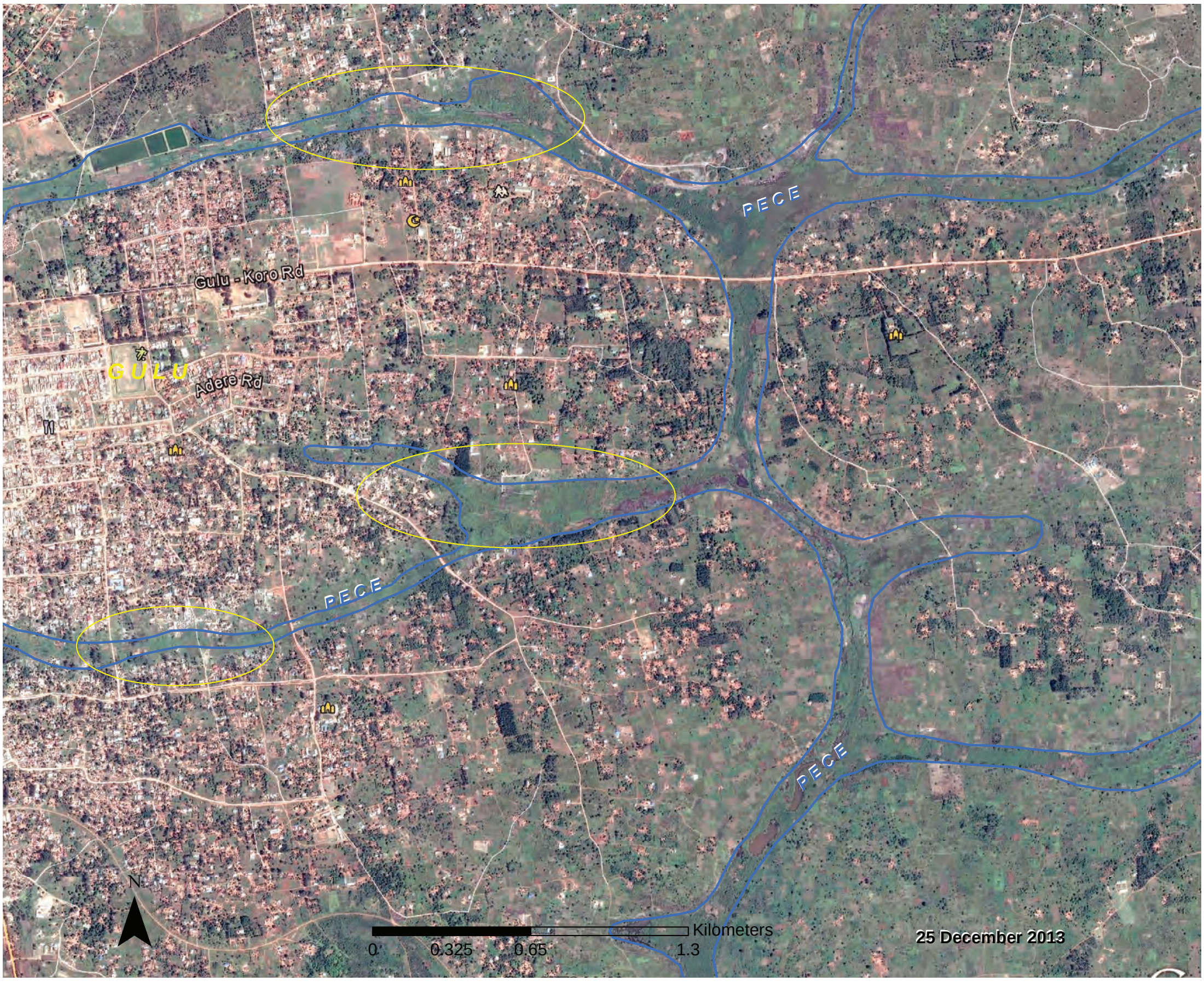
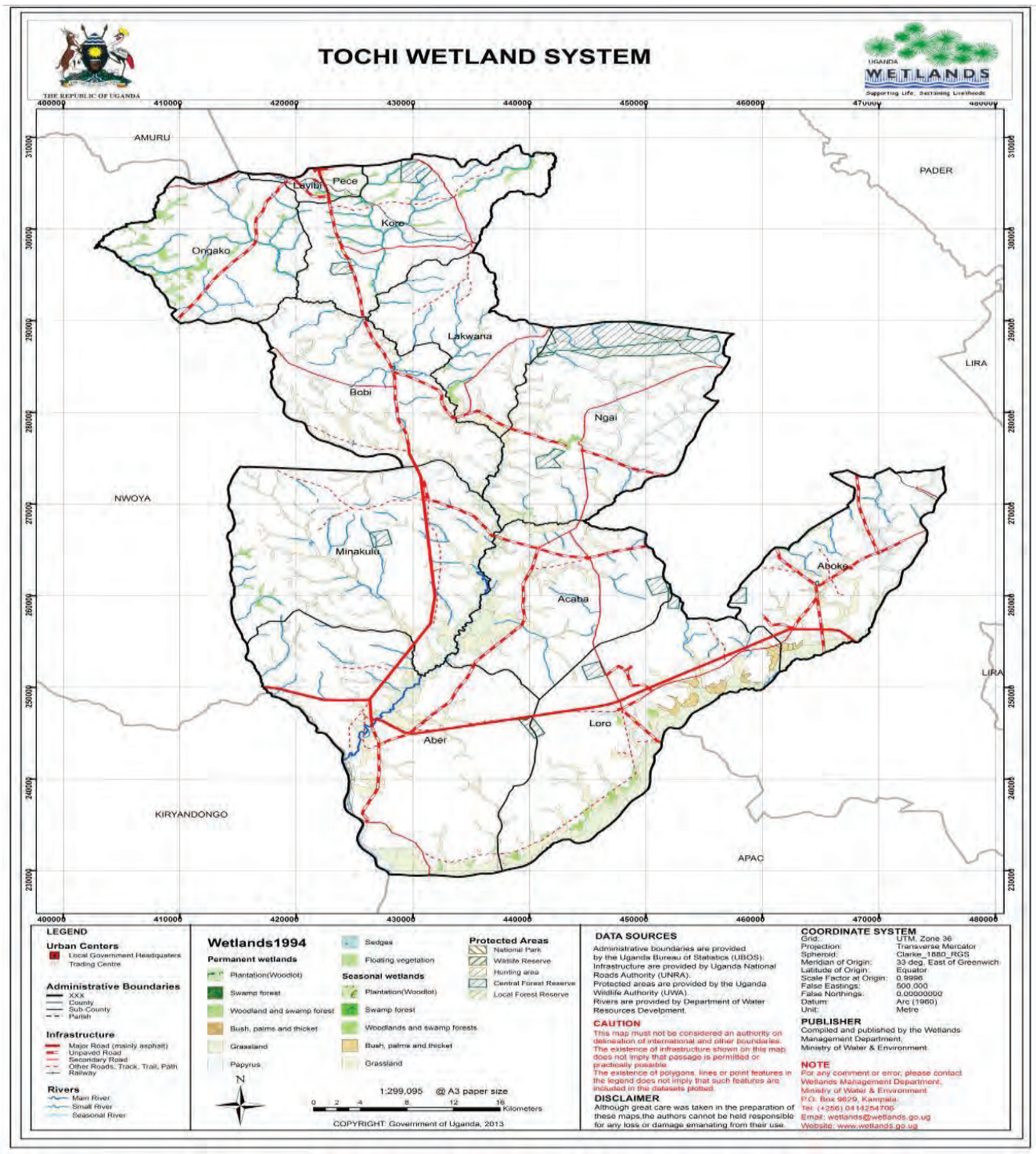


Figure 8.6: Tochi wetland system



(WMD, 2008)

Channelization of water in Pece wetland-lower section of Tochi wetland system

assessment estimates an average of 8 trees/ ha highlighting low biomass potential (Nature Uganda 2013). The situation is compounded by poor public awareness, limited livelihood options, land shortages, insecurity, population displacement and poverty. A significant portion of the Tochi wetland system is being considered for sugarcane growing and other large scale investments aimed at catalyzing economic development in the region. As demand for water is likely to increase, prudent management of the wetland system is crucial to ensure the sustainable supply of water for the industrial development.

Tobacco plant

Wildlife biodiversity at Paraa within Murchison Falls Protected Area in Nwoya District

Nile Delta Wetland System

NILE DELTA WETLAND SYSTEM

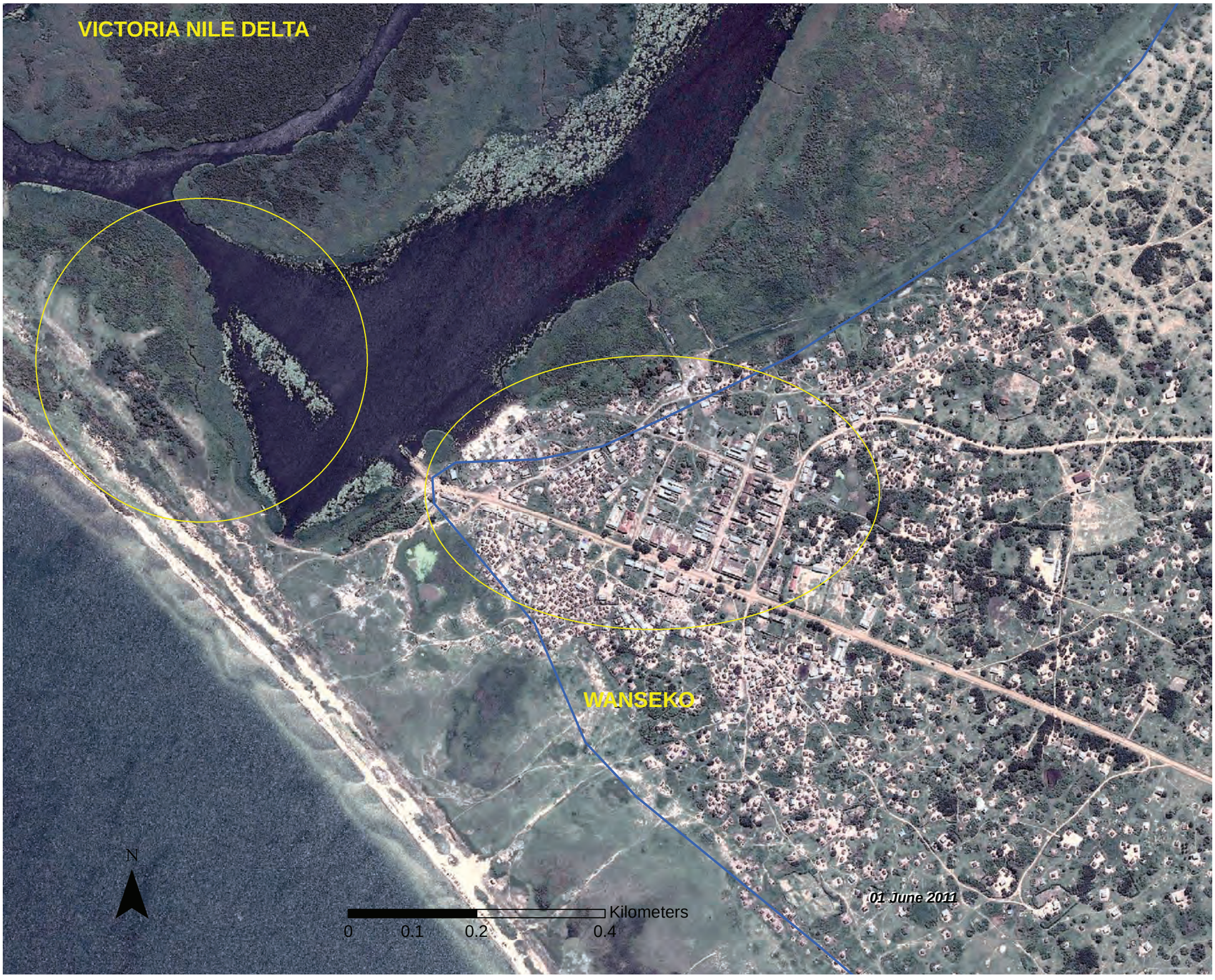
Murchison Falls-Albert Delta Wetland System is a Ramsar site that was listed on 15th September 2006. The wetland measures approximately 17,293ha and is located in Nwoya and Buliisa Districts stretching from the top of Murchison Falls, where the River Nile flows through a rock cleft some 6m wide, to the delta at its confluence with Lake Albert. Most of the wetland area lies within the Murchison Falls National Park except the southern section that lies within private land. The park covers an area of about 3,893km^2 and it is known to be one of Uganda's well protected areas. It is subjugated by woodland, wetland, savannah as well as tropical forest that is a habitat to over 76 mammal species and over 450 different bird species. The wetland is one of the most pristine aquatic ecosystems in Uganda mainly because of its remote location and conservation status.

The confluence of the Victoria Nile and River Semliki/Lake Albert forms a unique ecosystem, where the flow of water spreads out and slows down, depositing sediments into expanses of wetlands and shallow

water. This enhances the productivity of the ecosystems increasing species numbers and richness. At this delta, popularly known as the Murchison Falls-Albert Delta, a shallow area was formed that is now important for waterbirds, especially the Shoebill, Pelicans, Darters and various heron species.The wetland also supports large mammals. These includes the hippo, giraffe, warthog, buffalo, Uganda Kob, hartebeest and elephants. The Nile corridor of the Murchison has a big collection of water birds such as the shoebill stork and also the Nile crocodile. In addition, the delta is an important spawning and breeding ground for the Lake Albert fisheries. Most of the fishermen at Wanseko Landing site interviewed in July 2015 acknowledged that indeed the fishery of Lake Albert and Albert Nile is restocked by those from the delta.

The banks of the delta are dominated by rolling savannas and tall grass with increasingly thick bush, woodlands and forest patches in the higher and wetter areas to the south and east. This forms a feeding and watering refuge for wildlife in the National Park especially during dry seasons. Large numbers of wildlife are frequently seen heading to and from the delta. The delta, therefore, contributes significantly to sustenance of wildlife and this has made Murchison Falls National Park one of the main tourist and recreation areas in Uganda

The Delta is also of social and cultural importance to the people of the area who are mostly Bagungu, Alur and to a smaller extent Banyoro. Their main economic activity is livestock grazing and fishing, with fish exported to other parts of Northern Uganda and the DRC.



BIBLIOGRAPHY

EIPL. (2011). Karuma Hyrdo Power Plant Environment Impact and Social Assessment Main Report II. Kampala: Energy Infratech Pvt. Ltd. (EIPL).

GOU. (2014). Gulu-Oyam Tochi Wetland Management Plan. Kampala: Government of Uganda (GOU).

Mackenzie, M. K. (1970, April). The Geography of Tobacco Production in West Nile District. East. Afr.Geogr. Rev , p.31-37.

Nature Uganda. (2013). Uganda Biodiversity assessment report 2013. Kampala: Unpublished.

Panos. (1994, September). The Environmental Costs of Tobacco Production. Extract from Panos Media Briefing: Tobacco - The Smoke Blows South.

Sejjaka, S. (2004). From Seed to Leaf: British American Tobacco and Supplier Relations in Uganda. (F. Bird, & S. Herman, Eds.) International Business and The Challenges of Poverty in Developing Areas .

UBOS. (2014). National Population and Housing Census. Provision Results. November 2014 Revised Edition. Kampala: Uganda Bureau of Statistics (UBOS).

Chapter

9

WETLANDS AND CLIMATE CHANGE

INTRODUCTION

Wetlands are vulnerable to climate change and variability, because they occur in that zone in-between water and land. Any slight change in rainfall and groundwater levels can therefore have a major impact on a wetland ecosystem, for example drying up or change in the ecology leading to loss of the wetland characteristics and giving way to change in landuse such as cultivation and settlements.

WETLANDS AND THE CLIMATE SYSTEM

Wetlands play an important role in carbon sequestration, the water cycle and in the emissions of greenhouse gases. The combination of high productivity and anaerobic soils make wetlands particularly good at storing carbon. However, wetlands degradation tends to increase the release of greenhouse gases. In countries with a tropical climate such as Uganda, hydrological processes such as rainfall, depth of the water table and the extent of wetland area are believed to be among the dominant drivers of wetland methane (CH4) emissions (Bousquet, et al., 2011).

Photo credit: NEMA

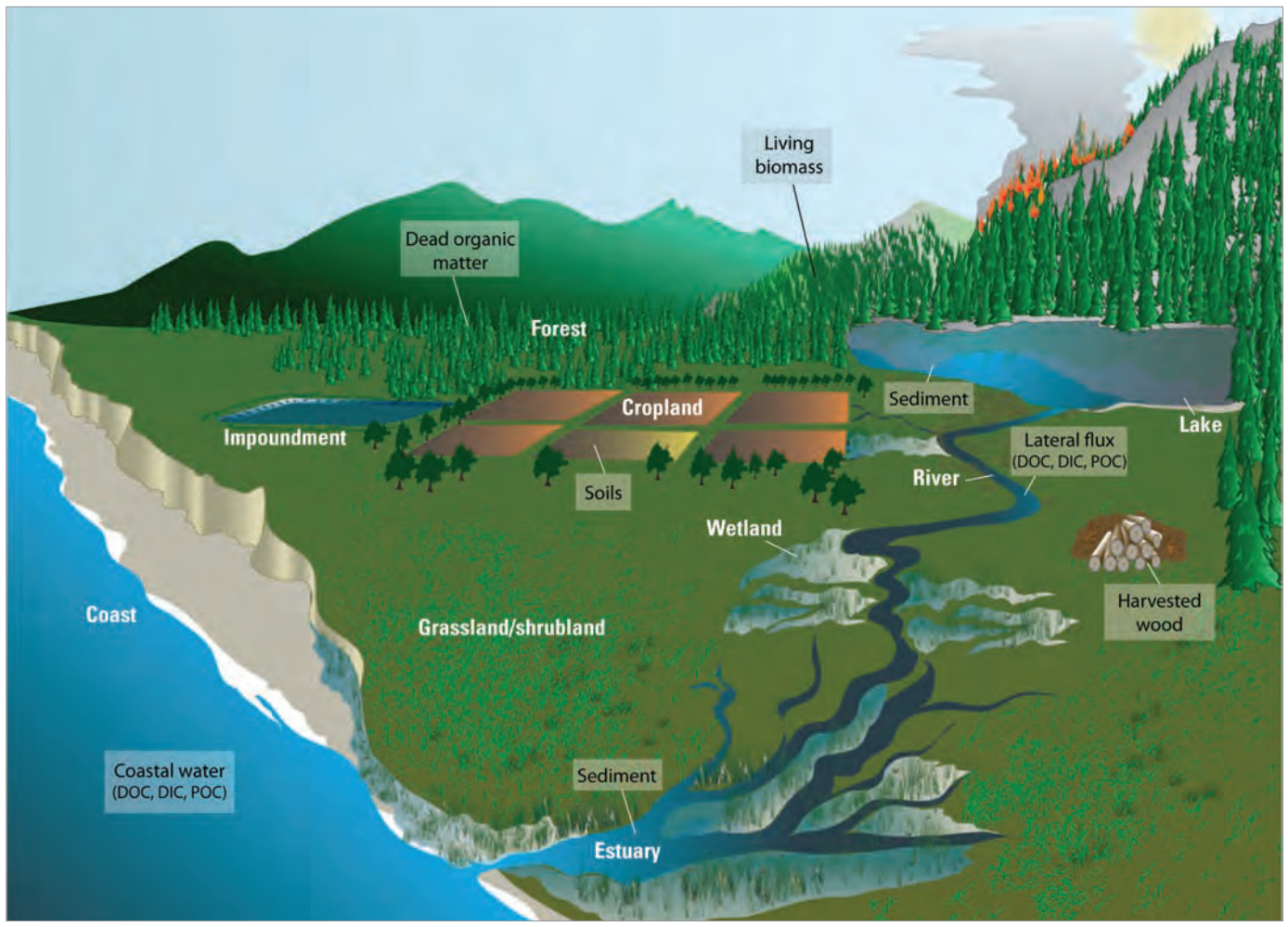
Kigezi Landslides assesment

Carbon sequestration

Carbon sequestration is the capture and storage of carbon over a long time. Sediments in wetlands capture and store carbon over long periods and once the sediments are exposed to the atmosphere through clearing or burning of the vegetation, the carbon in the mud is oxidized to carbon dioxide which is a greenhouse gas. Carbon is also stored in the short term in existing wetland biomass (plants, animals) and dissolved components in the surface and groundwater; and it is equally quickly released on decomposition of the vegetation (Wylynko, 1999). The level of carbon storage is determined by, among others, the wetland type, depth of wetland soil, slope, temperature and the land use in the surrounding areas.

All wetlands are capable of sequestering and storing carbon through photosynthesis and accumulation of organic matter in sediments, soils and the biomass of plants. In general, the plants in wetlands tend to grow at a faster rate than they decompose and this contributes to a net annual carbon sink. This is because the anaerobic conditions provided by the water logging of the wetland soils slows decomposition rates, leading to the accumulation and storage of large amounts of organic carbon in wetland sediments (Wylynko, 1999). Figure 9.1 shows the process of biological carbon sequestration.

Figure 9.1: Biological carbon sequestration



Zhu et. al. (2010) ed.

Degraded section of Kyeirungu wetland in Buhweju District

Emissions of greenhouse gases

As carbon cycles through wetlands it is gradually converted into methane (CH_4) and emitted back to the atmosphere (Whiting & Chanton, 2001) through a process involving anaerobic mineralization (Laanbroek, 2010). Between 20 and 39% of global methane emissions come from natural wetlands (Denman, et al., 2007). The disturbance of wetland soils (peat) through agriculture, logging, burning, erosion or overgrazing leads to the release of nitrous oxide and carbon-dioxide (which are greenhouse gases) into the atmosphere. Burning, especially, leads to the release of carbon dioxide, methane and nitrous oxide (Lloyd and others 2013). Large-scale agriculture in the wetlands in eastern Uganda and small scale agriculture in the valleys of the southwest have led to considerable loss of wetland area. The resulting drainage and oxidation has led to the erosion of the peat substrate of many of the wetland systems, and the degradation is continuing (IMCG, 2004).

Uganda ranks 22nd in the world and fourth in Africa after Sudan, Congo and Zambia in terms of actual occurrence of peatland. Peatland covers an area of 13,640 km^2, about half the current total area covered by wetlands in the country (Joosten, 2010). But as seen in the foregoing chapters many of the wetlands and indeed some of the high altitude peatlands are under threat. Emissions from peatland are on the increase. In 1990, Uganda was estimated to emit 16 Mton of carbon-dioxide from drained peatland increasing to 20 Mton in 2008. By 2008, Uganda was the 12th largest emitter of carbon-dioxide from degraded wetlands (Joosten, 2010). Some of the seasonally saturated dambo wetlands, for instance those that occur along Rivers Mayanja and Lugogo, are thought to be a substantial source of methane (Hansen, Denisson, Graves, & Brown, 2008).

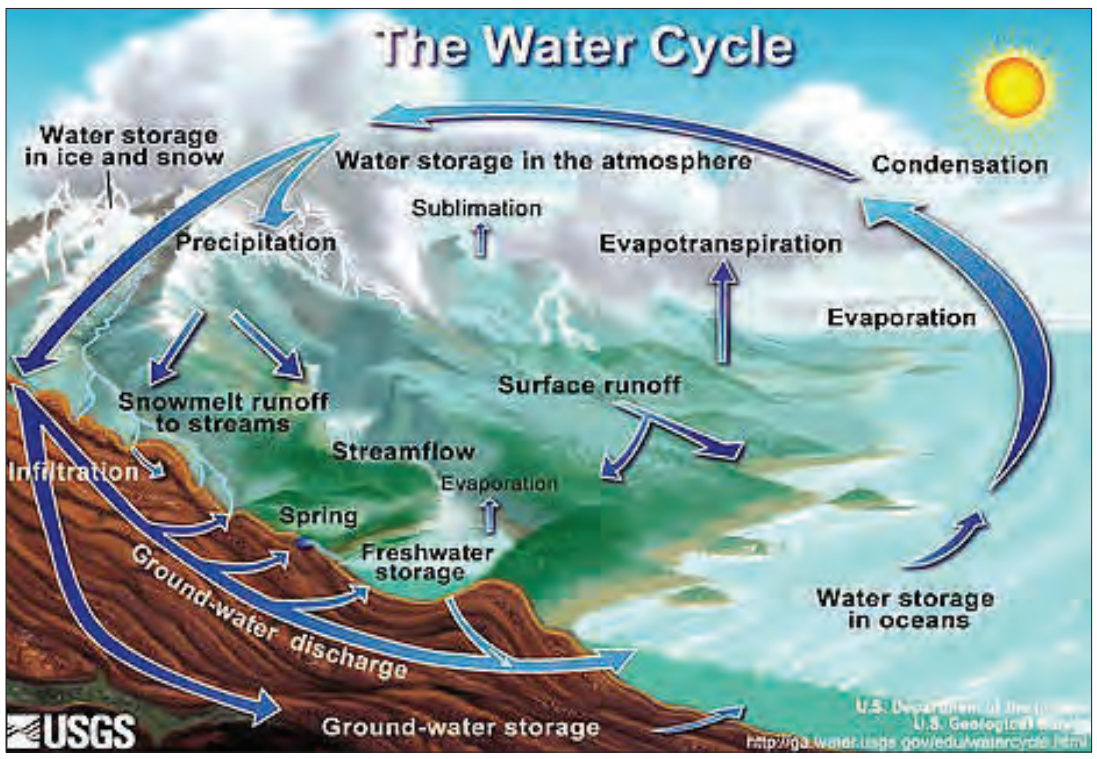
Cattle grazing in Lake Mburo National Park

Wetlands in the hydrological cycle

Wetlands will form when water accumulates in a low-lying area with impeded drainage. Water in wetlands comes from precipitation, surface water and ground water and these are delivered to the wetlands during the regular movement of water in the hydrosphere (EUROWET, 2005). A number of water bodies in Uganda such as Lake Victoria are replenished mainly through rainfall. For instance, 87% of the annual volume of water entering Lake Victoria is from rainfall, while 13% is from inflows (Mwiturubani, undated).

Some of the hydrological functions of wetlands include storage of water from surface runoff. This is then released slowly into the environment. Some of it seeps into the ground contributing to groundwater recharge. This helps to reduce flood damage from heavy rains, minimizes erosion, maintains aquifers and ensures that streams continue to flow during dry seasons. Wetlands also protect river banks and lakeshores from erosion and collapse (Carter, 1997). In Uganda, the role of wetlands in flood control was valued at US$ 1,702,934,880 per hectare per year; and in water regulation and recharge at US$ 7,056,360 per hectare per year (Kakuru, Turyahabwe, & Mugisha, 2013).

Figure 9.2: The water cycle



(USGS, 2015)

Residents wade through a flooded area in Napak District

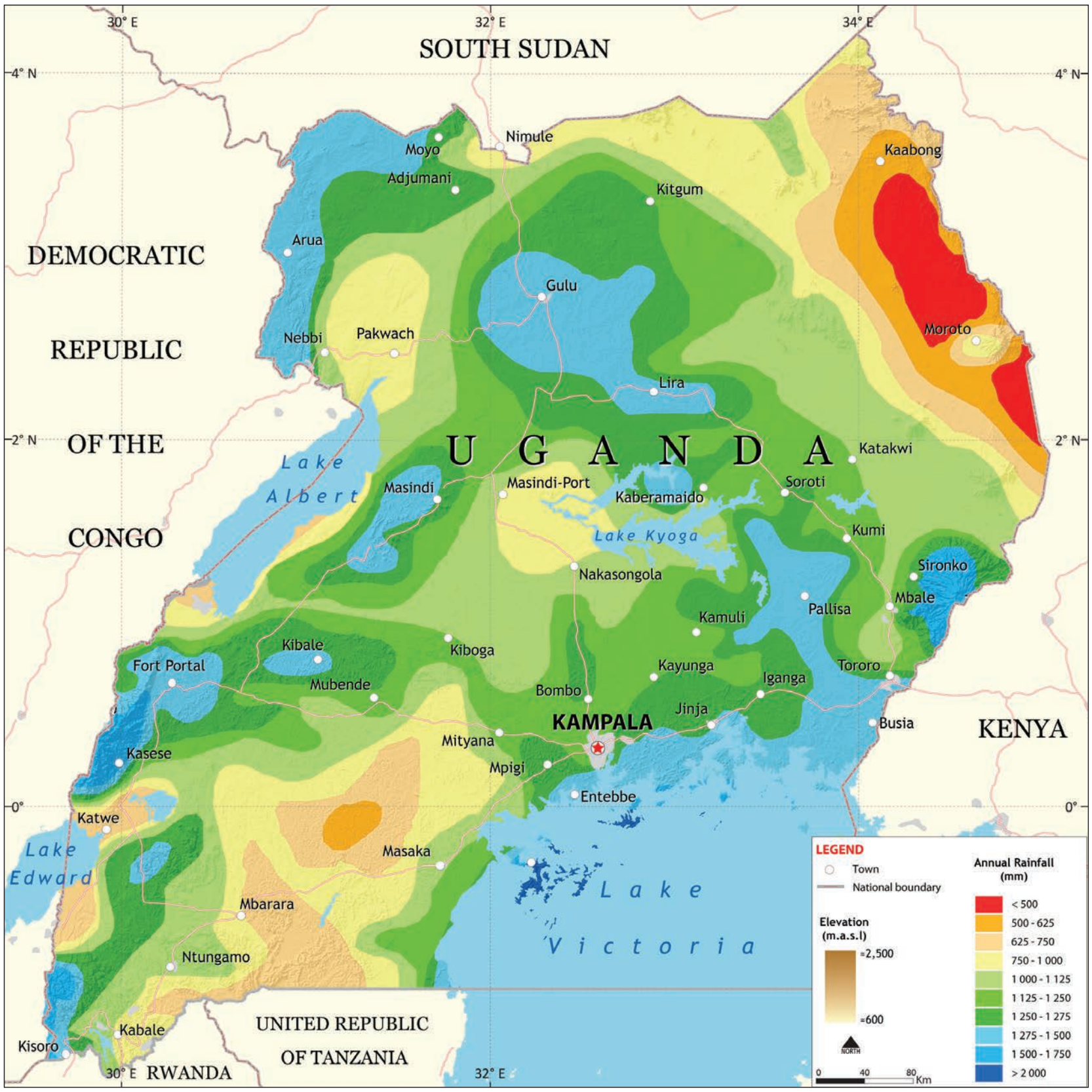
CLIMATE CHANGE PROJECTIONS IN UGANDA

Rainfall

Uganda has a humid equatorial climate that is greatly influenced by the mountainous topography and the presence of large water bodies such as Lake Victoria and the River Nile leading to variations in precipitation (Figure 9.3) and temperature across the country. The rainfall seasons are also linked to the seasonal migration of primary humid air masses and convergence zones over Africa that shift toward a northerly location in August and to the south in January (USAID, 2013).

Precipitation is highest around Lake Victoria with annual averages ranging from 1200-2000 mm; while Karamoja region receives the lowest mean annual rainfall of between 300-650 mm (USAID, 2013). The southern part of Uganda has two rainy seasons gradually merging into one rainy season as we move northwards and eastwards.

Figure 9.3: Annual rainfall in Uganda



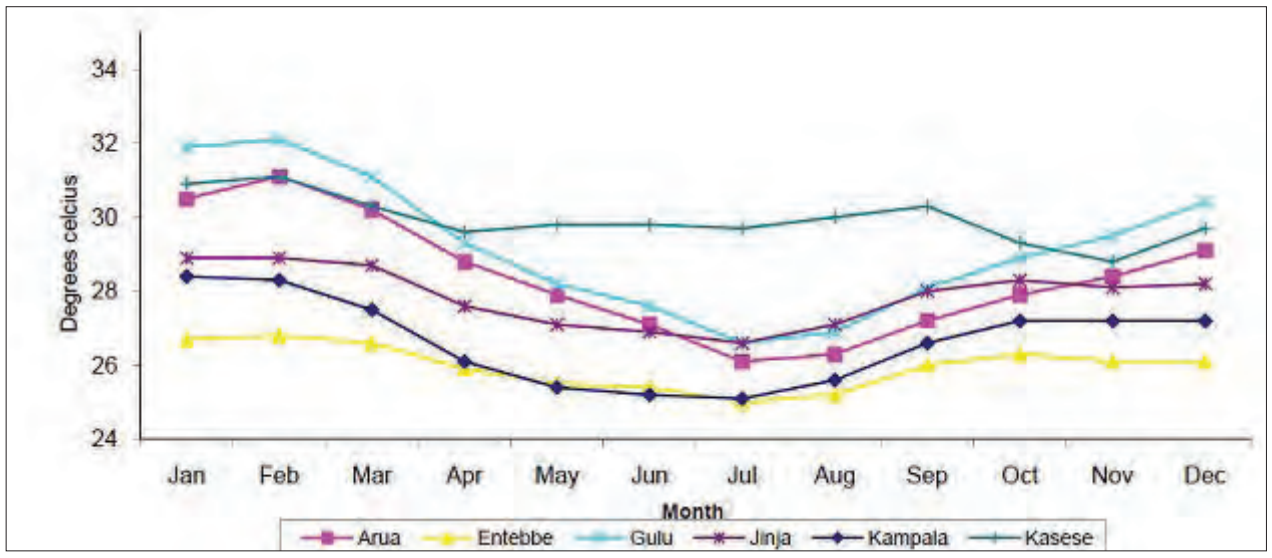
(USAID, 2013)

Temperature

Temperatures are generally moderate with the data indicating ranges between 14-31°C in 2014 (UBOS, 2015). The north and northeast tends to be the hottest part of the country while the coolest are the highland areas in the south west and mountainous areas such as Elgon and Rwenzori.

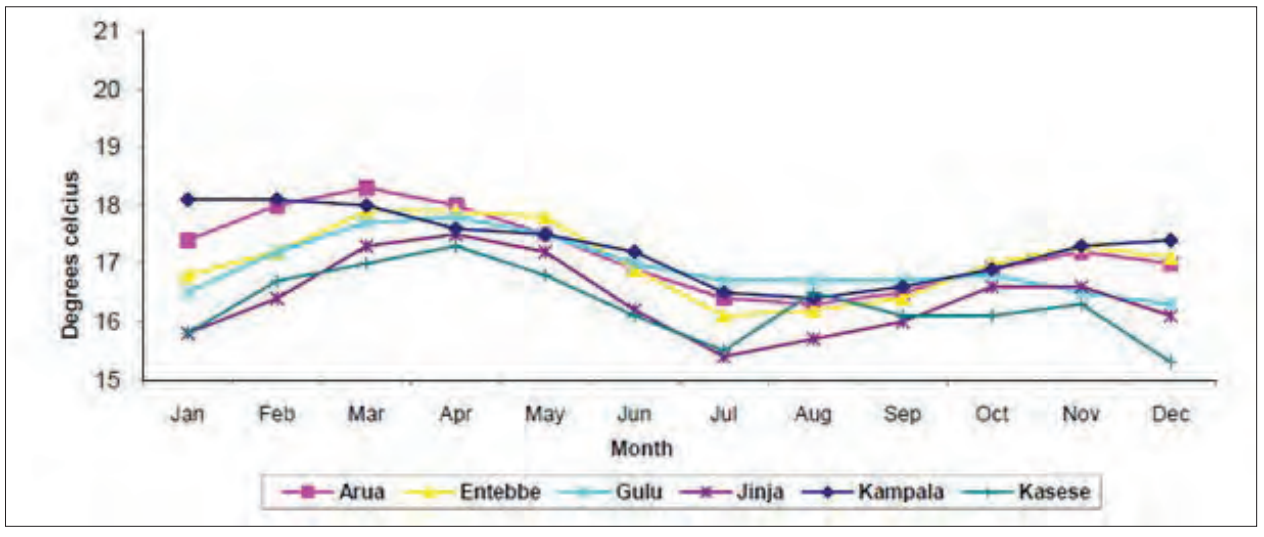
According to UBOS (2015), the long term average maximum temperature in 2014 at selected sites showed high temperatures at the beginning of the year (January to February) declining as the year progresses towards June and then increasing for the last five months of the year (Figure 9.4). A similar trend is noticed with the trend for the long term mean minimum temperature (Figure 9.5).

Figure 9.4: Long term mean maximum temperature for selected centres, 2014



(UBOS, 2015)

Figure 9.5: Long term mean minimum temperature for selected centres, 2014



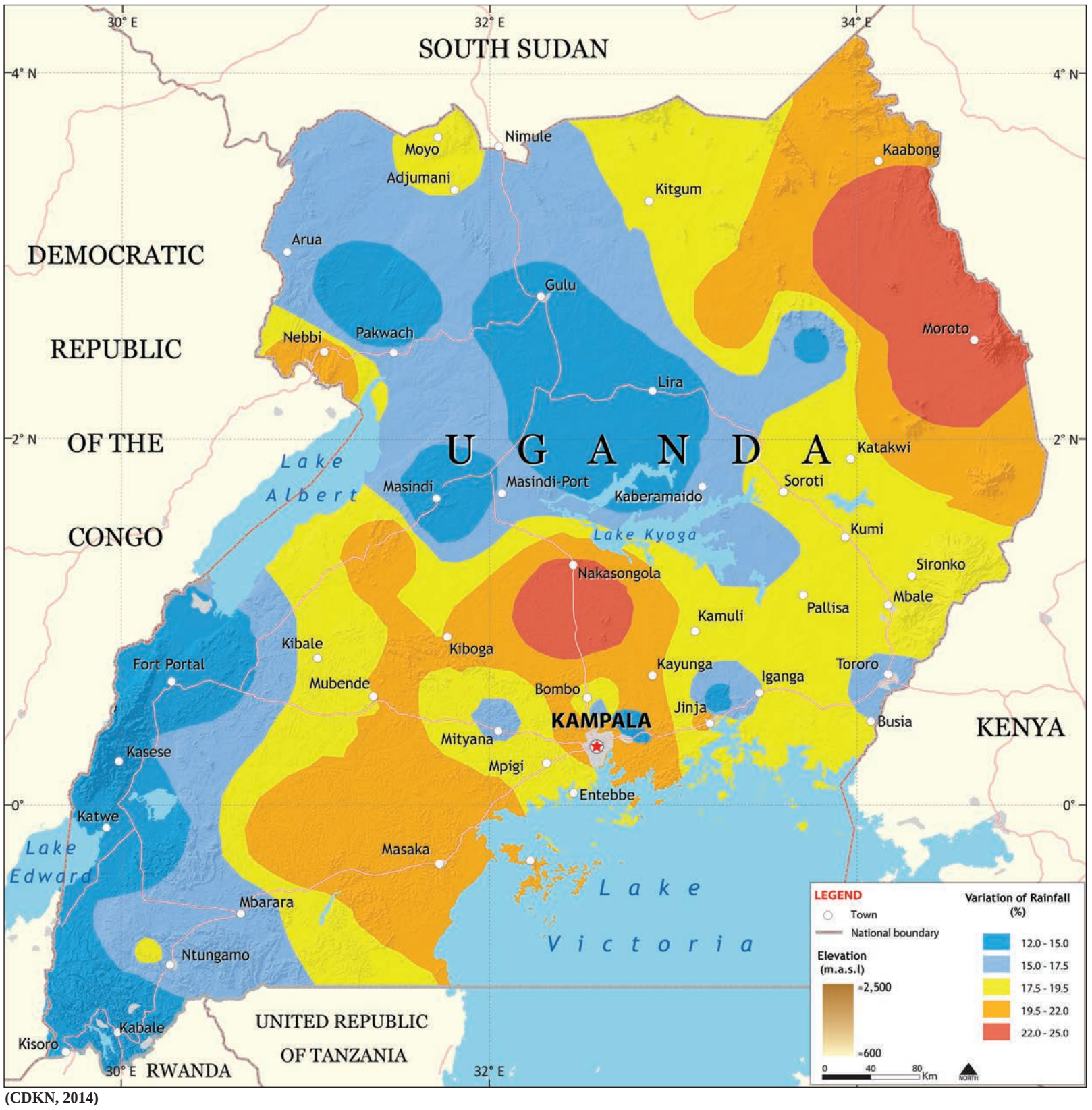
(UBOS, 2015)

Contemporary implications of climate change

Analysis of historical (1951-2010) and future data (2015-2045) indicate no signification change in average annual rainfall. However there are indications that the December-February period may experience an increase in rainfall (USAID, 2013). Since this is usually the dry season, there will be implications on agriculture with respect to post harvest activities that involve drying and storage. Accompanying the rains may be a concomitant increase in the frequency of extreme events like storms and flooding.

Calculations of inter-annual variability of rainfall indicate that areas where the percentages of the coefficient of variation is higher than 20% are more likely to experience more frequent and severe droughts or floods (CDKN, 2014). Figure 9.6 shows that areas in the northeastern parts of the Lake Kyoga basin around Kotido and Kangole Meteorological Station and around Kakooge station in the Victoria Nile drainage basin are at risk of experiencing more frequent and severe droughts (CDKN, 2014). In the Lake Edward basin, coefficient of variation is low averaging 14.8% indicating a more stable rainfall outlook (CDKN, 2014).

Figure 9.6: Percentage of the coeffient of variation in inter-annual rainfall as calculated at 36 rainfall stations across Uganda over the period 1940 to 2009



(CDKN, 2014)

Between 1951 and 2010, the data shows a notable increase of between 0.5-1.2°C for minimum temperatures and between 0.6-0.9°C for maximum temperatures. The warming trend is likely to continue with some data showing it might reach as high as 2°C by 2030 (USAID, 2013) (Nsubuga, Olwoch, & Rautenbach, 2014). There will be impacts felt in the agriculture sector with higher than normal incidences of disease and pest infestations. Research indicates that the increases in annual temperature from 1990 onwards is already having an impact on the ground water systems in the upper Ssezibwa catchment with negative trends on the river discharge (Nyenje & Batelaan, 2009). Falling water levels in River Rwizi, one of most important catchments of Lake Victoria, has been attributed to declining rainfall in the catchment and wetlands degradation affecting water supply to Mbarara municipality especially during the dry season (MWE, 2013). River Mpanga in the Lake Edward basin is also being affected by reduction in rainfall and increased temperatures (Baastel, 2013). Declines in water levels will have implications on land use, wetlands resource use, household food production, income generation, fish catch, water supply, water quality and biodiversity changes (Obiero, Raburu, Okeyo-Owuor, & Raburu, 2012).

THE IMPACTS OF CLIMATE CHANGE AND VARIABILITY ON UGANDA'S WETLANDS

People, poverty and politics

Many of the stresses on wetlands are caused by human activities and the need to make a living and provide for basic necessities in life. Unfortunately these lead to over-exploitation, affecting the ability of the ecological character of the wetland exposing the people to local impacts such as flooding and others in the face of extreme events brought on by climate change. Urban wetlands, which typically feature high concentrations of populations and buildings, are particularly susceptible.

Wetland systems and the services they provide are an integral part of the livelihood strategy of riparian communities; and the livelihood systems are often unique to the overall ecological character of the wetland. Poverty, may lead to a tendency to over-extract resources leading to wetland degradation. The communities become enveloped in a 'poverty trap' that can be linked to declining a wetland resource base as well as other social, economic and political contexts (Chandrasekhar, 2013).

Land tenure, political and livelihood interests affect the way wetlands are used. For instance there is a tendency to compromise on wetland conservation in favour of food production, income generation and political interests. So even where the communities are aware of environmental policy requirements, they are protected by politicians and continue encroaching on the wetlands (Were, Isabirye, Poesen, Maertens, Deckers, & Mathijs, 2013). This was the case when a market was established in a wetland in Wandegeya in Kampala city, despite the fact that it is illegal to lease out wetlands (Apunyo, Undated).

Poverty (Box 9.1) is driving much of the rural-urban migration. Once in the urban areas, unemployment and lack of livelihood options pushes people into the wetlands to make a living. The wetlands prove attractive because they are highly productive areas seemingly free of encumbrances; where land is cheap; and even when legal protection is obvious institutional weaknesses and political interference often combine to allow continued wetland encroachment and degradation (Byaruhanga & Ssozi, 2012). The urban poor end up occupying land informally and at times illegally – mostly in the wetlands where tenure is unclear.

The housing in these areas is of poor structure, damp (due to erection in water logged areas), have poor sanitation exposing residents to water borne disease such as cholera and create the potential for conflict since housing is built in road reserves hindering access for any planned developments. For example, 26% of people in urban areas live in houses constructed of mud or other semi-permanent materials of which 56% of which are single rooms (UBOS, 2014). In Kampala, the situation is even worse with 70.2% of residents living in tenements (*mizigo*) of which 68% are single rooms (UBOS, 2010). These tenements are usually built without adequate sanitation and drainage and usually in fragile areas such as wetlands, making them prone to flooding. Although 87.4% in Kampala use pit latrines (UBOS 2010), open disposal of human waste is common in the slum areas and together with poor maintenance of the sewer system and storm water networks, has created avenues for contamination of the water supply network, wetlands, streams, rivers and lakes (Nyakaana, Sengendo, & Lwasa, 2007).

Historical policy failures have also contributed to wetlands degradation. For example where land use policy promoted the establishment of commercial and industrial developments in wetlands as in the case of Kampala city. These areas become vulnerable to flooding during periods of increased rainfall with social and economic impacts. For example flooding caused by high rainfall in May 2012 caused massive flooding in the extensively flat Pian-Upe-Bisina-Opeta wetland area cutting off the Moroto-Mbale Road (through Nakapiripirit) leaving travelers and traders stranded leading to losses in income.

Indigenous people and traditions are also at risk. The permanent high altitude Muchuya swamp located in the Echuya Forest Reserve stands at 2,300masl. Its key ecosystem goods and services are watershed values, tourism and high quality bamboo (*Yushania alpine*) and indigenous people (Batwa). The Batwa are at increased vulnerability to climate change due to their marginal social status. For instance extreme drought and unpredictable rains could increase the risk of food insecurity leading to poor health outcomes and affecting their resource-based livelihoods.

Land use and the economy

(CDKN, 2014) predicts a significant decline in total precipitation over Lake Victoria (-20% from present) which combined with about 1.5-2°C temperature increase will impact Lake Victoria water levels with possible economic losses. These conditions are likely to expose more of the soils in wetlands making it easier for the wetlands to be reclaimed and drained for agriculture. So there is likely to be an intensification of agricultural and other land use activities like livestock grazing and exploitation of wetland resources within the swamp area. This will be fuelled by the population which grew at an annual rate of 2.88% between 1969 and 2014 (UBOS, 2014).

Agriculture is central to Uganda's economy with the sector contributing 24.7% to GDP at current market prices in 2014 and 72% of the working population engaged in the sector in 2012/13 (UBOS, 2015). It is also the mainstay of people in the rural areas (UBOS, 2015). The increasing number of people moving into the wetlands for livelihood support will put more pressure on the already fragile wetlands. For instance around the Lake Kyoga plains households derive 50% of the household food supply directly from the wetlands and the balance from money earned from sale of crops grown in the wetland (Turyahabwe, Kakuru, Tweheyo, & Tumusiime, 2013). The drier conditions that are predicted will have economic implications. For instance a drought in 2008 caused losses of approximately 3% of the value of all food and cash crops that year; and in 2010, the country lost 16% of the total annual value of these crops due to extreme weather (CDKN, 2014).

The receding water or shifting water courses may also increase boundary disagreements among people, communities and with neighbouring countries. Already there are border disputes with the DRC over the changing course of the Semliki river as it enters Lake Albert (see Chapter 4). As a result of the serious erosion and breakage of the riverbanks, land is advancing on the Ugandan side of the river valley. This land is promptly claimed for agriculture and other land uses. The increased rainfall due to climate change will likely promote this phenomenon leading to potential for greater conflict (NEMA, 2009).

Box 9.1: Status of poverty in Uganda

Poverty remains an issue in the country with about 6.7 million people living in poverty. Between 2009/10 and 2012/13, the proportion of the poor population reduced from 24.5% to 19.7%. When disaggregated by location, the poor in the rural areas represent 22.8% of the population compared to only 9.3 % in the urban areas. The rural areas with about 77.4% of the population constitute 89.3 percent of national poverty. The population defined as chronically poor is about 18% and the proportion of chronically poor people in the rural areas is 21%. This sizeable population is particularly vulnerable to the effects of climate change because they are unprepared for adaptation and often live in fragile ecosystems like wetlands and semi arid areas.

Source: (UBOS, 2015)

(Photo credit: UNRA 2013)

Sustainable construction of Kampala-Entebbe Expressway over Nambigirwa wetland

Water resources and water supply

Although there is a dearth of information in this area, the impacts of climate change on the wetlands environment in Uganda can be inferred from knowledge of the interlinkages between wetlands and the hydrological cycle. The existence of water gives wetlands their natural properties. Hydrological factors such as the water table level and soil moisture will ultimately determine the impacts of climate change on the wetlands itself but the water balance will be a strong indicator of a change in the ability of the wetland for water storage (Acreman & Miller, 2007).

The water balance of Lake Victoria (and by proxy, its wetlands) is primarily dominated by rainfall; and to a lesser extent temperature. So declines or increases in precipitation, driven by climate change, are likely to affect the lake levels and outflow from it; and increases in temperature which may affect the rates of evaporation and evapotranspiration will also influence the water balance of the lake and its associated wetland ecosystems (UNEP 2013). Some of these changes may result in the modification of wetland processes, species composition and ecological functions (Acreman & Miller, 2007). Box 9.2 highlights some of the policy provisions for sustaining the water balance of wetlands.

Wetlands are central in ensuring stability in water supply and in many parts of the country are the only source of water for domestic and livestock use. The literature indicates that the gross annual value of domestic water use from wetlands is estimated at US$13.9 million; while the total economic value of water from wetland areas for livestock consumption was estimated to be worth US$ 34 million per annum (Kakuru, Turyahabwe, & Mugisha, 2013).

Climate change predictions of reduced rainfall and increased temperature will affect the availability of water in the face of growing population and associated water demand. Nationwide demand for water is expected to grow from 408 MCM per year in 2010 to 3,963 MCM per annum in 2050. Water deficits are likely and the unmet need is expected to increase from 3.7 to 1,651 MCM/year over the same time frame (Baastel, 2013). The water shortages during these drought periods have serious impacts on the economy. For instance, two droughts in the last ten years 2005-6 and 2010-11 have led to losses amounting to US $250 million and US$ 1,174 million respectively (Baastel, 2013). Protection of water catchment areas is therefore crucial to retain water and to ensure sufficient water supply throughout the year.

Box 9.2: The Wetlands Policy: Provisions for maintaining the water balance of wetlands

(a) Users of a wetland must ensure that the overall water balance is maintained so that the surface does not dry out. Ridging and trenching may be performed within the wetland, allowing for the growth of crops requiring drier soils, as long as the water level does not fall below about 0.5m from the top of the ridges. A wetland shall under no circumstances be drained.

(b) Bunding of fields to control the water level within the wetland must similarly ensure that the water table does not fall below about 0.5m of the soil surface.

(GOU, 1995)

Climate change is also likely to result in increased water use in irrigation water use. If conditions become drier, there is likely to be increased demand for groundwater, which could negatively affect groundwater-dominated wetlands. In many wetlands that have shrunk mainly because of human activity, climate change is likely to exacerbate the shrinkage if it results in reduced net water availability. By 2012, 8,716 ha of dry land and 2,421 ha of wetlands was formally equipped for irrigation. But about 53,346 ha of fringe wetlands are informally non-equipped and farming is ongoing especially in Budaka, Butaleja, Iganga, Pallisa and Tororo (FAO, 2015). Figure 9.7 shows irrigated areas in Uganda.

An irrigation Demo in GEDI, Kaliro District

Photo credit: Kaliro DLG

Figure 9.7:Irrigated areas in Uganda

Impacts on environmental services

Chapter 1 highlights some of the regulatory functions provided by wetlands such as climate regulation, soil erosion control, water purification, habitat for pollinators and other biodiversity among others. Degraded wetlands can no longer perform their flood attenuation function. The impacts of floods cause massive destruction to infrastructure with implications to the economy and to households. Wetland regulatory functions of flood control and water regulation and recharge in Uganda have been valued at US$ 1.7 billion and US$7.1 million per hectare per year respectively; while the value of micro-climate regulation is estimated at US$62 million per annum (Kakuru, Turyahabwe, & Mugisha, 2013).

The clearing of vegetation in the hills has increased water runoff, and the encroachment of human settlements onto wetlands has increased exposure to flooding and reduced the capacity of these ecosystems to capture, store and dissipate surface water run-off. The water purification ability of wetlands has been affected. For instance some lakes, such as Lake Victoria have declining water quality due to pollution from numerous point sources (see Chapter 2). The situation is compounded by lake shore degradation which has reduced the natural ability of the wetlands to remove nutrients and other contaminants from the water. Costs for treating water at the Gaba Water Works which supplies Kampala have gone up from US$ 0.3 to 0.9 per cubic meter of water between 2007 and 2010 (figure 9.8) (MWE, 2013).

Insufficient, poorly designed and poorly maintained developments contributes to the high vulnerability of urban and rural infrastructure to heavy rains. Heavy rains cause sharp rises in lake levels, widespread flooding leading to extensive soil erosion and the washing away of key infrastructure. For example, the heavy Ẽl Nino rains of 1997-98 led to a rise in the Lake Kyoga water levels and caused the dislodgement of previously firmly anchored floating papyrus swamps or sudds. As highlighted in Chapter 3, these sudds caused a blockage at the outlet to the lake causing a further rise in lake levels. Homes and farms were flooded, people were displaced, economic activities around the lake shores disrupted and there was an increase in water-related diseases such as malaria.

Deaths from malaria in Uganda are the third highest in Africa. The disease accounts for 25-40% of Health Centre out-patient visits and for 50% of in-patient paediatric deaths see figure 9.9 (USAID, 2015).

Figure 9.9: Malaria morbidity rates in Uganda 1990-2002

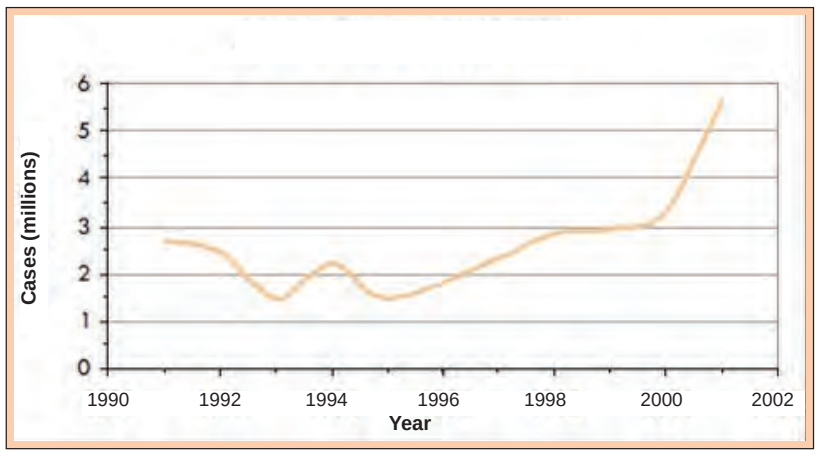
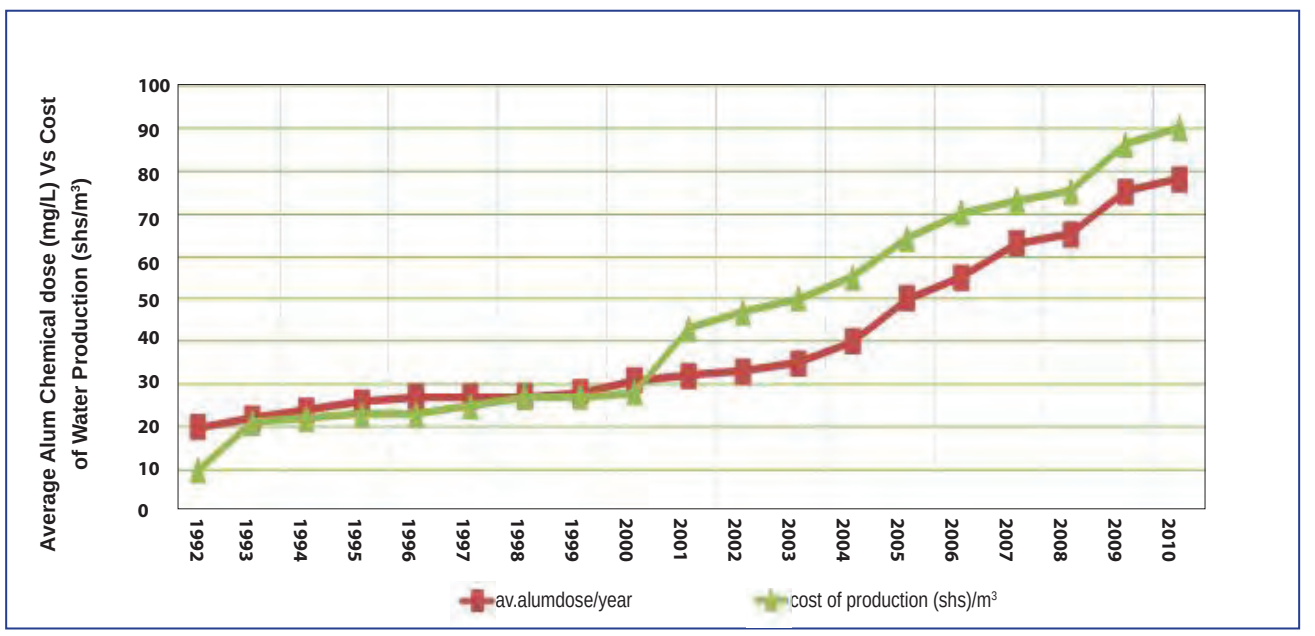


Figure 9.8: Trends in the cost and use of chemicals by National Water & Sewerage Corporation (1992-2010)



(NWSC, 2010)

Effects on biodiversity

Uganda has a rich array of biodiversity, which are used for food, medicinal purposes, tourist, aesthetic and various traditional practices. Wetlands as habitat to biodiversity is valued at US$ 103 million per year; while their recreation/aesthetic value is US$ 115million and cultural value US$ 414 million (Kakuru, Turyahabwe, & Mugisha, 2013). There are high concentrations of biodiversity in the protected areas such as forests, grasslands and aquatic habitats including wetlands some of which will be impact by changes to the climate (Figure 9.10).

The changes in the weather that accompany climate change and climate variability such as decreases in rainfall, together with land degradation and increases in population threaten the biodiversity of Uganda's wetlands. Some of these impacts may include shifts to the distribution of plants or animals; disturbance to the ecological balance between species; habitat degradation due to increased prevalence of invasive species; and, an increase on the occurrence of wild fires. As a result, the overall availability of ecosystem-specific goods and services that support human livelihoods is expected to be adversely affected.

Changes to the water balance of a wetland will influence the important ecological functions that it plays. For instance as habitat to the endangered Shoebill (*Balaeniceps rex*) and Fox's weaver (*Ploceus spekeoides*) and fish species of the Cichlidae family; and, as a stopover for migratory birds.

Figure 9.10: Uganda's protected wildlife areas

RECOMMENDATIONS

The presence of water gives the wetlands their unique characteristics and therefore a deep understanding of the hydrological processes is central to the wetlands wise-use concept. To that end, research in this area is of paramount importance to inform decision making.

Further, wetlands should be treated as hotspots for climate change mitigation in any future climate agreements. For a start, Uganda is on the right track by bringing to a halt any encroachment onto wetlands and by rehabilitating any wetlands that have been degraded and by trying to provide options for the maintenance of productive land use under wet conditions (paludiculture).

The Uganda National Climate Change Policy of 2012 provides a coordinated approach to addressing climate change issues in the country and should be fully implemented. For instance, the policy priority for wetlands is to promote long-term wetland conservation and restoration of degraded wetlands so that they can continue to provide global services, including mitigating climate change, while supporting the sustainable development needs of communities and the country. To address these challenges, the climate change policy aims to strengthen the existing national wetland policy to prevent wetland degradation and encroachment; promote and intensify wetland protection and restoration of degraded wetlands; strengthen collaborative and participatory management of wetland resources; strengthen existing wetland research and encourage conservation and restoration of ecosystems critically threatened by climate change (MWE, 2012).

Gorrila in Bwindi Impenetrable National Park

BIBLIOGRAPHY

Acreman, M. C., & Miller, F. (2007). *Hydrological Impact Assessment of Wetlands*. Wallingford, UK: International Symposium on Groundwater Sustainability (ISGWAS).

Apunyo, R. (Undated). *Managing Wetlands With Changing Times – Uganda's Experience*. Kampala: Makerere Institute of Social Research (MISR).

Baastel. (2013). E*conomic Assessment of the Impacts of Climate Change in Uganda. National level assessment. Climate change and water*. Kampala: Baastel.

Carter, V. (1997, March 7). USGS. Retrieved February 1, 2016, from Technical Aspects of Wetlands. Wetland Hydrology, Water Quality, and Associated Functions: https://water.usgs.gov/nwsum/WSP2425/hydrology.html

CDKN. (2014). *Economic assessment of the impacts of climate change in Uganda. Regional scale climate change projections of annual, seasonal, and monthly near-surface temperatures and rainfall in Uganda*. Kampala: Climate Change Unit, Ministry of Water and Environment, Climate and Development Knowledge Network (CDKN).

Chandrasekhar, A. (2013). *The economics of ecosystems and biodiversity*. Retrieved February 13, 2016, from Connecting the dots from wetlands to poverty alleviation: http://www.teebweb.org/connecting-the-dots-from-wetlands-to-poverty-alleviation/

(2007). Couplings between changes in the climate system and biogeochemistry. In K. L. Denman, G. Brasseur, A. Chidthaisong, P. Ciais, P. M. Cox, R. E. Dickinson, et al., S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, et al. (Eds.), *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge/New York, UK/New York: Cambridge University Press.

EUROWET. (2005). *Significance of wetlands in the water cycle. Integration of European wetland research in sustainable management of the water cycle*. Brussels: EUROWET.

FAO. (2015). Aquastat. Retrieved February 13, 2016, from Uganda: http://www.fao.org/nr/water/aquastat/countries_regions/uga/index.stm

GOU. (1995). *Uganda National Wetlands Policy. Kampala: Ministry of Environment Protection, Government of Uganda (GOU).*

Hansen, M. K., Denission, P. E., Graves, S. A., & Brown, D. J. (2008). Ugandan Dambo Wetland Classification using Multispectral and Topographic Remote Sensing Data. ASPRS *2008 Annual Conference*. Portland, Oregon: American Society for Photogrammetry and Remote Sensing (ASPRS).

IMCG. (2004, January 31). Retrieved February 1, 2016, from Uganda: http://www.imcg.net/media/download_gallery/gpd/africa/uganda.pdf

Joosten, H. (2010). *The Global Peatland CO2 Picture. Peatland status and drainage related emissions in all countries of the world*. Ede: Wetlands International.

Kakuru, W., Turyahabwe, N., & Mugisha, J. (2013). Total Economic Value of Wetlands Products and Services in Uganda. *The Scientific World Journal. Hindawi Publishing Corporation.* , 1-13.

MWE. (2012). Uganda National Climate Change Policy. Kampala: Climate Change Unit, Ministry of Water and Environment (MWE).

MWE. (2013). *Framework and Guidelines for Water Source Protection. Volume 1: Framework for Water Source Protection*. Kampala: Ministry of Water and Environment (MWE).

Mwiturubani, D. A. (undated). *Climate change and access to water resources in the Lake Victoria basin*. Pretoria: Institute of Security Studies.

NEMA. (2009). *Uganda - Atlas of our changing environment*. Kampala: National Environment Management Authority (NEMA).

Nsubuga, F. W., Olwoch, J. M., & Rautenbach, C. J. (2014). Variability properties of daily and monthly observed near-surface temperatures in Uganda 1960-2008. *International Journal of Climatology , 34*, 303-314.

Nyakaana, J. B., Sengendo, H., & Lwasa, S. (2007). *Population, Urban Development and the Environment in Uganda: The Case of Kampala City and its Environs*. Kampala: Makerere University.

Nyenje, P. M., & Batelaan, O. (2009). Estimating the impacts of climate change on groundwater recharge and baseflow in the upper Ssezibwa catchment in Uganda. *Hydrological sciences journal , 54* (4), 713-726.

Obiero, K. O., Raburu, P. O., Okeyo-Owuor, J. B., & Raburu, E. A. (2012). Community perceptions on the impact of the recession of Lake Victoria waters on Nyando wetlands. *Scientific Research and Essays , 7* (16), 1647-1661.

STRP. (2002). *New guidelines for management planning for Ramsar sites and other wetlands. Wetlands: Water. Life, and Culture*. Gland, Switzerland: Scientific and Technical Review Panel of the Ramsar Convention on Wetlands (STRP).

Turyahabwe, N., Kakuru, W., Tweheyo, M., & Tumusiime, D. M. (2013). Contribution of wetland resources to household food security in Uganda. *Agriculture and Food Security 2:5* .

UBOS. (2014). *National Population and Housing Census. Provisional Results*. Kampala: Uganda Bureau of Statistics (UBOS).

UBOS. (2012). *Statistical Abstract 2012*. Kampala: Uganda Bureau of Statistics (UBOS).

UBOS. (2015). *Statistical Abstract 2015*. Kampala: Uganda Bureau of Statistics (UBOS).

UBOS. (2010). *Uganda National Household Survey 2009/2010*. Kampala: Uganda Bureau of Statistics (UBOS).

USAID. (2013). *Uganda climate change vulnerability assessment*. Kampala: USAID African and Latin American Resilience to Climate Change (ARCC). United States Aid for International Development (USAID).

USAID. (2015). *Presidents Malaria Initiative, Uganda. Malaria Operational Plan FY 2015*. Kampala: United States Agency for International Development (USAID).

USGS. (2015). *USGS Water Science School. Retrieved from The Water Cycle*: http://water.usgs.gov/edu/watercycle.html

Were, A. N., Isabirye, M., Poesen, J., Maertens, M., Deckers, J., & Mathijs, E. (2013). Decentralised Governance of Wetland Resources in the Lake Victoria Basin of Uganda. *Natural Resources , 4*, 55-64.

Whiting, G. J., & Chanton, J. P. (2001). Greenhouse carbon balance of wetlands: methane emission versus carbon sequestration. *Tellus*, 521–528.

Wylynko, D. (Ed.). (1999). *Prairie wetlands and carbon sequestration: Assessing sinks under the Kyoto Protocol*. Manitoba, Canada: Institute for Sustainable Development, Ducks Unlimited Canada and Wetlands International Canada.

Zhu, Zhiliang, ed., Bergamaschi, Brian, Bernknopf, Richard, Clow, David, Dye, Dennis, Faulkner, Stephen, Forney, William, Gleason, Robert, Hawbaker, Todd, Liu, Jinxun, Liu, Shuguang, Prisley, Stephen, Reed, Bradley, Reeves, Matthew, Rollins, Matthew, Sleeter, Benjamin, Sohl, Terry, Stackpoole, Sarah, Stehman, Stephen, Striegl, Robert, Wein, Anne, and Zhu, Zhiliang, 2010, A method for assessing carbon stocks, carbon sequestration, and greenhouse-gas fluxes in ecosystems of the United States under present conditions and future scenarios: U.S. Geological Survey Scientific Investigations Report 2010–5233, 188 p

Photo credit: C. Sebukeera

Local fish processing at Wanseko landing site, Buliisa District

Chapter

10

CHALLENGES AND OPPORTUNITIES

INTRODUCTION

As Uganda strives for development and middle income country status, its wetlands are facing ever growing challenges. This chapter highlights some of these challenges including poverty, land degradation and the fast growing population. These issues can constrain the capacity of the wetlands to help meet national development goals such as Vision 2040. Vision 2040 aims to grow key sectors of the economy including oil and gas, tourism, minerals, ICT business, human resources, trade, water resources, industry and agriculture as a means of developing the country. It also aims to improve the wellbeing of every Ugandan by ensuring access to basic rights such as health, education, housing, food and energy. The sustainable use of our wetlands is central to the attainment of these goals and indeed Vision 2040 underscores the need for sustainable development through the safeguarding of natural resources such as wetlands and forests (GOU, 2007).

This chapter highlights clear opportunities that Uganda can undertake to achieve the aspirations of the Vision 2040. These include addressing the poverty challenge, ensuring food security, providing access to energy security through hydropower, enhancing access to water and improving the management of wetlands.

Water transport on Lake Victoria between Bukakata and Luuka

ADDRESSING THE POVERTY CHALLENGE

The Challenge

Poverty can lead to overexploitation of wetland resources that the riparian communities depend on for their livelihoods and wellbeing.

The Situation

Poverty is still an issue with 6.7 million Ugandans living in poverty. Overuse of environmental resources exacerbates poverty in rural areas.

The Constraints

Demographic factors, including armed conflict and rural-urban migration are contributing factors to poverty in wetlands.

The Opportunities

Programmes to address poverty such as increasing household income, promoting equity, good governance and reducing the population growth rate should be implemented. There are opportunities to address wetlands degradation and poverty through sustainable urban planning.

The Challenge

Poverty can lead to overexploitation of wetland resources that the riparian communities depend on for their livelihood and wellbeing. In Chapter 1 and throughout this Atlas, it has been clear how Uganda's wetlands are important for the provisioning, regulating, cultural and supporting services they provide. These important functions such as providing water, energy and food; ecosystem functions such as climate regulation, water purification and soil erosion control; and the opportunities for industry such as minerals, forest products, tourism and agriculture are all assets that can be used for wealth creation. Despite this, poverty is still an issue. The combination of lack of alternative livelihood options, low economic resources and growing population numbers, poor people are often forced to overexploit the wetland resources.

The Situation

Poverty is still an issue with 6.7 million Ugandans living in poverty. The average Gross National Income (GNI) is US $500 per capita at 2010 constant prices. This is rather low and the poverty situation is further amplified around wetland riparian communities for several reasons. Wetlands are ecologically fragile areas and the huge populations encroaching on them can result in a negative feedback scenario where more resources are harvested to maintain income levels resulting in even more degradation. There has been progress in reducing the poverty prevalence from 31.1% in 2005/6 to 25.4% in 2009/10 and 19.7% in 2012/13. The MDG target on reducing poverty was 28% by 2015, which was successfully achieved two years early (UBOS, 2015). But there is still work to be done.

A rural homestead set up in a wetland

Inspection of a degraded riverbank by a NEMA delegation

Overuse of environmental resources exacerbates poverty in rural areas making the situation even worse for already poor households. Excessive use of wetlands for agriculture makes the land less productive, affecting household consumption and hence overall poverty and wellbeing. At times, this may be fuelled by policy decisions with unintended outcomes. For example, as discussed in Chapter 5, the policy decision to reclaim and drain wetlands in Kigezi (Kabale, Kanungu, Kisoro and Rukungiri Districts) was intended to increase agricultural production and wellbeing through the provision of additional land. However, it resulted in the decimation of many wetlands. As a result, the Nomuremu-Rushebeya-Rushoma-Kanyabaha and Kalimbanya-Nyakasa-Kashambya wetlands system are now just one of the few surviving wetland systems in that area.

The Constraints

Demographic factors such as population growth and migration to urban areas together with poverty limits people's choices pushing them into wetlands. Population growth in this country is 2.88% and is amongst the highest worldwide. Future projections predict continued growth with estimates in 2025 averaging 46.5 million people (UBOS, 2014)..

Rural-urban migration has led to the creation of informal settlements within urban centers and their peripheries. Kampala has traditionally been the city of choice for many migrants but recent data indicates that some smaller towns are growing even faster. The annual growth rate of Kampala in 2014 was 2% and it had 25% of the total national urban population. However, by the last Census in 2014, the growth rates in Wakiso, Mukono, Hoima and Masindi were even higher at 11.9%, 10.4%, 10.7% and 10.1% respectively (UBOS, 2014). Although some of this growth is attributed to boundary changes, a large proportion are economic migrants and the hardships of urban lifestyle and unemployment pushes them to utilize the marginal areas such as wetlands for settlements and livelihoods sustenance. There are certain factors that predispose some areas to population increase. For instance being the primate city encourages many migrants to Kampala and this has led to the rapid expansion of the city as highlighted in Chapter 2. As a result, there has been massive encroachment on wetlands and green belts for establishment of settlements and factories. The high cost of housing and land has pushed people into occupying land informally, and many times illegally, in the wetlands. Social services are poor increasing the pressures on the wetlands.

Armed conflict, social insecurity and mass displacement of people from rural areas to more secure urban areas are also major issue fuelling poverty. The armed conflict in the northern part of the country can partly be attributed to imbalances in access to livelihood opportunities and natural resources and has led to displacement. It is estimated that more than 1.4 million people have been displaced as a result of insecurity causing increased poverty, sanitary problems and pressure on land and forests (Drakenberg, Undated). This disrupts their livelihoods and promotes food insecurity and poverty through the abandonment of farm land, subsequent over-reliance on food aid and environmental resources including wetlands. Refugee and other camps set up to accommodate displaced people and the Government's policy of self-reliance promotes agriculture putting pressure on the natural resources leading to soil degradation and forest encroachment. In Isingiro district, the Lake Nakivale wetlands system (Chapter 2) is being impacted by change of land use from pastoralist to crop farming as a result of the establishment of refugee settlements. In Chapter 7, the Achwa drainage basin which has seen many incidents of civil strife and displacement of people has lost much forest cover and now species that traditionally provided livelihood options like the Shea Butter tree are being cut down for charcoal and firewood. Deforestation has negative impacts on wetlands including siltation.

The Opportunities

Programmes to address poverty such as increasing household income, promoting equity, good governance and reducing the population growth rate should be implemented. The National Development Plan has a target of reducing the poverty rate from 19.7% to 14.2% and includes programmes to increase household incomes and promote equity that should be implemented. Interventions include providing employment and educational opportunities, improving infrastructure for markets, improving health and sanitation services, reducing crime, overcrowding and pollution. It will also involve improving good governance and providing a setting for more equitable distribution of benefits from economic development. Elimination of corruption at all levels will indirectly reduce poverty as laws will be enforced and there will be more resources available to build capacity and carry out government programmes to enforce the law and improve wetlands management in general. Lastly, the high population growth rate will need to be reduced. Although there has been success in reducing the poverty prevalence countrywide, the high population growth means that absolute number of poor people hardly reduces. As indicated earlier about 6.7 million people are poor and another 43% of the population is highly vulnerable to falling into poverty (NPA, 2015).

There are opportunities to address wetlands degradation and poverty through urban planning that would consider employment creation and better standards of living. Industrial and commercial developments are necessary for economic growth however they need to be balanced with wetland and environmental protection. Selective law enforcement, political interference, business interests and inappropriate policy decisions have led to factories, farms and other developments being constructed in wetlands and green spaces. For instance the 1972 Kampala Development Plan allocated land for industrial development in many of the major wetland areas such as Ntinda, Nakawa, Kinawataka and Port Bell (Omolo-Okalebo, 2011). It is possible to have a tradeoff between wetlands protection and urban development if the available policies and legal instruments governing their management are enforced. Furthermore, the government should investment in low cost housing for the urban poor so as to facilitate the relocation of wetland dwellers. Coupled with better employment opportunities, this should reduce the current stress on wetlands.

IMPROVE FOOD SECURITY

The Challenge

Uganda lost about 30% of its wetlands between 1994 and 2009 and much of this has been attributed to agricultural activities. During times of environmental stress such as drought, people increase food production by expanding cultivation in fragile areas including wetlands.

The Constraints

More land will be needed for agriculture in order to support the growing population in the future. However, uncertainty surrounding land tenure in wetlands contributes to the continued encroachment and degradation of the wetlands. Insecurity and conflict has led to wetlands degradation as displaced people perceive the wetlands as cheap unencumbered land.

The Situation

Food insecurity currently affects about 1.4 million people in Uganda and the national prevalence of food energy deficiency is 37%. Low agricultural productivity is a major cause of food insecurity.

The Opportunity

Wetlands provide food and other agricultural products such as fuel and fibre directly through agricultural production activities. Government should invest in agriculture in support of economic growth, livelihood sustainability and food security. Improving farming practices within wetlands will enhance wise use and sustainability of the wetlands. The functions and economic values of wetlands must be considered in planning for the production of food and other agricultural products.

***Tilapia* is one of the local fish species found in wetlands**

The Challenge

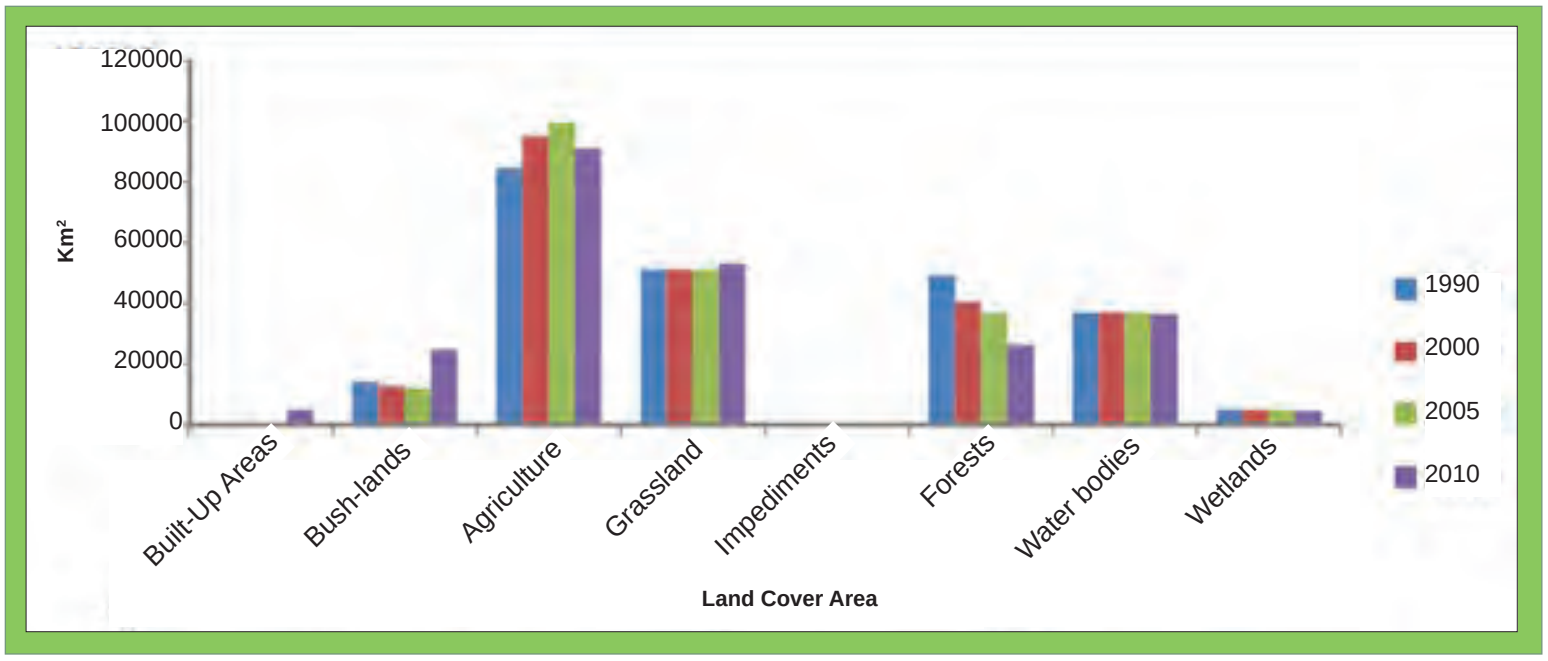
Uganda lost about 30% of its wetlands between 1994 and 2009 (WMD, 2009) and much of this has been attributed to agricultural activities. Population growth is leading to land shortages and causing land fragmentation and small farm sizes which affect crop yields. Land tenure is a major factor contributing to food insecurity in Uganda. Many landless people are pushed into the wetlands to cultivate. People who own land close to wetlands assume that the wetland belongs to them too; and when a wetland has been used by an individual for a long time, attempts by government to reclaim it end up in conflict. This uncertainty is contributing to degradation through poor agricultural activities, pollution of water through use of pesticides, herbicides, overgrazing and bad fishing methods as many times the users are not sure when they will be evicted.

During times of environmental stress such as drought, people increase food production by expanding cultivation in fragile areas including wetlands. Conversion for agriculture involves drainage, reclamation and soil improvement and these are affecting the ecological character of the wetlands especially when poorly done (RAMSAR, 2014).

The Constraints

More land will be needed for agriculture in order to support the growing population in the future. However, uncertainty surrounding land tenure in wetlands contributes to the continued encroachment and degradation of the wetlands. Overall, agriculture occupies the largest amount of land cover in the country at 38% (UBOS, 2015). Land area under agriculture has historically been increasing but of late has taken a downward trend. Between 1990 and 2000 land under agriculture increased by 12.4% and between 2000 and 2005 by 4.7%. Area planted for food crops stood at 918,000 hectares in 2014 (UBOS, 2015). Figure 10.1 shows land cover trends between 1990 and 2010.

Figure 10.1: Landcover area by type, 1990-2010km^2



(Source: UBOS, 2015)

Insecurity and conflict has led to wetlands degradation as displaced people perceive the wetlands as cheap unencumbered land. Over the years, there has been an incursion of refugees from neighbouring countries at different times over the past decades - DRC, Rwanda, Ethiopia, Eritrea, Sudan, Burundi and Somalia, among others. These refugees are settled under the self reliance strategy pioneered by the Government of Uganda and the United Nations High Commission for Refugees (UNHCR). This policy encourages refugees to become self-supporting and economically independent. However, some have ended up turning to wetlands for subsistence as these are often viewed as cheap, unencumbered resources. For instance the concentration of refugee settlements near wetlands like Ogujebe, Injudi, Telesi, Olua Mongulla, Maaji in Adjumani district in the Albert Nile drainage basin (chapter 6) are degraded as the refugees use the wetlands extensively for crop production, livestock grazing and firewood collection.

The Situation

Food insecurity currently affects about 1.4 million people in Uganda and the national prevalence of food energy deficiency is 37% (Turyahabwe, Kakuru, Tweheyo, & Tumusiime, 2013). Poor access to nutrition can be caused by lack of access to diversified foods, low nutrition content of foods and low use of fortified foods, seasonal fluctuation in food supply and diet quality and low agricultural productivity. There are health implications in situations where the availability, access to and use of food is not secure. For instance, in 2011, 33% of children under five were stunted. In the same year, 14% of children under five were underweight (UBOS, 2012). See Box 10.1 for key definitions. Inadequate nutrition is particularly detrimental to the key vulnerable populations of women, babies and children. It impairs educational achievement and economic productivity and is a health burden on families and the government in terms of treating related illnesses. Malnutrition is estimated to result in a loss of about 4.1% of GDP per annum while treatment of severe acute malnutrition costs more than US$120 per child (GOU, 2011).

Box 10.1: Key definitions

- Food security describes a situation where a household has physical and economic access to safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life.
- Stunting is a result of a child failing to receive adequate nutrition over a long time while also having a recurrent or chronic illness.
- Underweight is defined as a result of acute and chronic under-nutrition.

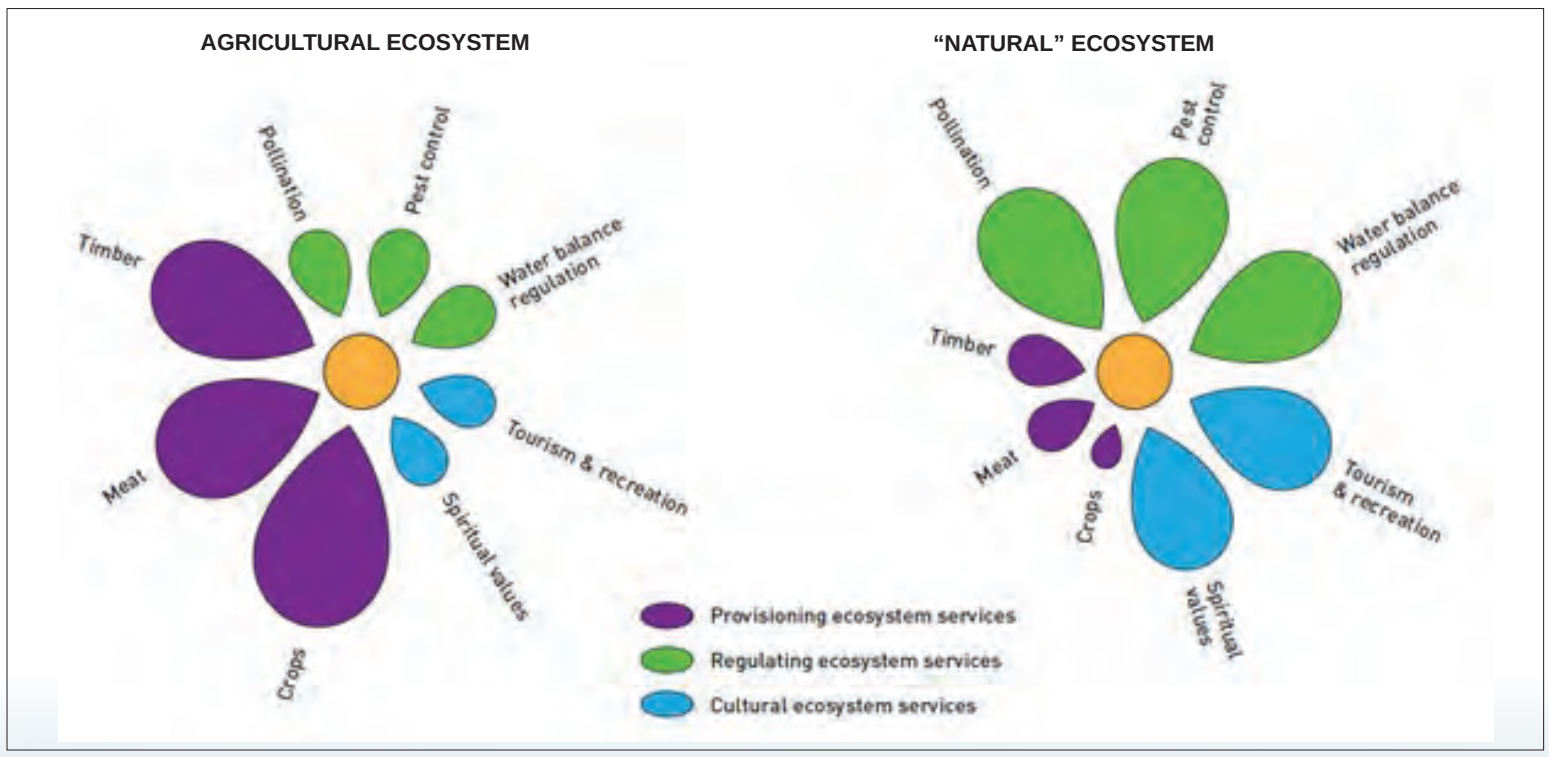
(FAO, 2001) (UBOS, 2012)

A refugee camp at Nakivale

Low agricultural productivity is a major cause of food insecurity (Pender, Nkonya, Jagger, Sserunkuma, & Ssali, 2003). Only about 30% of the 18 million ha of arable land is currently cultivated and the productivity of the land under cultivation is low and declining (Okello & Laker-Ojok, 2011). When people have trouble finding food because of insufficient agricultural production or income, they may become even more dependent on natural resources leading to soil depletion, deforestation, and wetlands degradation. Wetlands in the vicinity of areas with poor soils that have low potential for agriculture, with low or unpredictable rainfall and land scarcity are under the greatest threat degradation from agricultural activities. Research indicates that between 2000 and 2011 subsistence farming was the main form of land use accounting for environmental change in the wetlands of the Lake Kyoga basin, the Southwestern farmlands and the Lake Victoria crescent (Turyahabwe, Mwesigye, Tumusiime, Kakuru, & Barasa, 2013). In Uganda, where most agriculture is practiced at a subsistence level, agricultural intensification is achieved by expanding the land under agriculture instead of using modern inputs to boost production. This is the case in the wetlands in the Kyoga plains area where many farmers have switched to farming in the wetlands due to declined fertility of the upland agricultural areas.

Encroachment into wetlands has many effects. Changes to the water regime, water quality and the micro-climate can occur with concurrent impacts on the availability of wetland resources, crop production and public health. Although intensification is one way of increasing crop yields, technologies such as pesticides, fertilizers and other soil improvement techniques often end up totally destroying the ecological character and the ecosystem services of the wetlands (Figure 10.2). This can result in a negative feedback cycle where the harmful impacts lead to productivity losses leading to further expansion and transformation of wetland areas (Wood & van Halsema, 2008). Indeed in areas where widespread conversion of wetlands has taken place, the yields are not usually sustained as originally thought, with impacts on food security.

Figure 10.2:Agriculture generally increases provisioning ecosystem services at the expense of regulating and cultural services



(Agricultural Water management 97, 2010)

A fishing village at Wanseko landing site

The Opportunities

Wetlands provide food and other agricultural products such as fuel and fibre directly through agricultural production activities that take place within wetlands, such as in rice paddies, wetland grazing, horticulture and aquaculture in large floodplains, and cropping of small seasonal wetlands. Wetlands also support agriculture indirectly, for example by providing fertile soils and reliable supplies of good quality water. It provides an ideal opportunity to highlight the importance of wetlands in supporting agriculture, especially since many family farming operations rely on the soils, water, plants and animals found in wetlands to provide food security and improve their livelihoods.

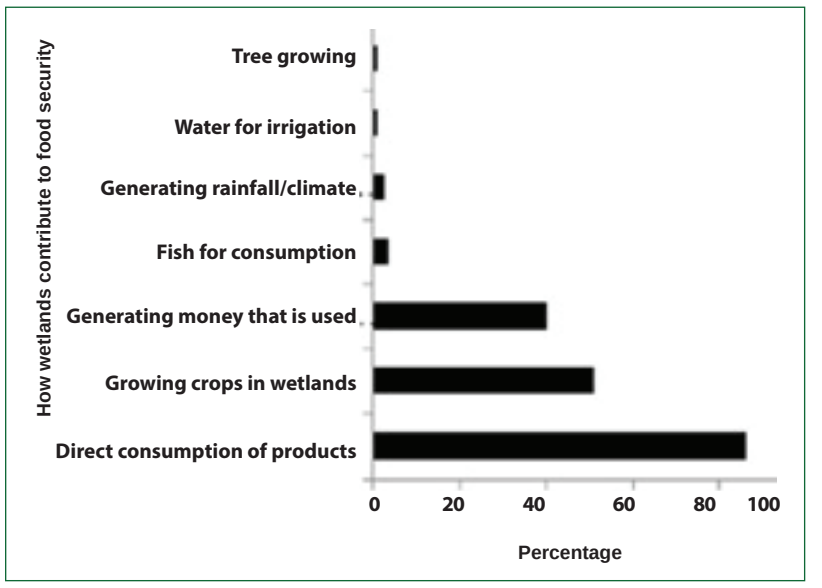
Wetlands agriculture provides an opportunity for development and poverty eradication, but care should be taken to make sure that other ecosystem services are not lost. They are the basis of food security, directly providing resources for consumption, indirectly supporting crop and livestock production, materials that are sold for purchasing food in emergency situations and services that support food production as shown in Figure 10.3. Besides, they also indirectly contribute to food security by providing services that foster food production such as weather modifications, nutrient retention and soil renewal through sedimentation.

Government should invest in agriculture in support of economic growth, livelihood sustainability and food sustainability. Investment in the agricultural sector needs to be increased, but channeled into facilitating services such as rural credit, strengthening of private sector input distribution, providing access to market information, encouraging market linkages, and strengthening of agricultural education. More focus is also needed on rural areas where the majority of the population lives. Over 50% of wetlands in Uganda are under some form of utilization by humans (Maclean, Tinch, Hassall, & Boar, 2003). Approximately 70% of households use the wetlands for crop production (Turyahabwe, Kakuru, Tweheyo, & Tumusiime, 2013).

Improving farming practices within wetlands will enhance wise use and sustainability of the wetlands. Wetlands, especially along rivers, are especially attractive for agriculture as the soils are fertile and water is in plenty. In 2012/2013 about 72% of the working population was involved in agriculture, thus agriculture was and still is a major driver of economic growth providing critical livelihood support for rural households (UBOS, 2014). Agriculture's contribution to GDP at 2014 rates was 20.9%.

There is a dearth of information to support the appropriate management of wetlands for food security. Currently, data on the impact of food-security related activities is lacking; there is also a lack of evidence-based data to guide the formulation of guidelines and policy development; and lack of tested technologies for most wetland agriculture-based activities. In the short term there may be an increase in food output from wetlands, however the long term effects include an increase in pollutants, decline in the natural filtering function and reduction in other ecosystem services. Any agricultural activity within a wetland will alter its ecological character to some extent. And although subsistence farmers may only cause small changes, these compound when many small farmers are involved.

Figure 10.3: Ways through which wetlands contribute directly to household food security in areas adjacent to wetlands in Uganda



(Turyahabwe, Kakuru, Tweheyo, & Tumusiime, 2013)

The absence of knowledge on the best agricultural practices to be applied within different types of wetlands and a lack of understanding on how to establish appropriate management arrangements that will adequately safeguard important ecosystem services within the wetlands needs to be addressed. Guidelines need to be developed to stipulate and guide the use and scale of appropriate technologies to sustain wetland services. Although guidelines have been developed for agricultural use of wetlands, these have not been widely implemented. It is strongly recommended that these guidelines be operationalised. In addition, a study is critically needed to assess the impacts of rice, tea and sugar cane growing on the wetlands in Uganda.

The functions and economic values of wetlands must be considered in planning for the production of food and other agricultural products. The integration of environmental costs and benefits into key economic indicators is a very challenging exercise. The process requires a lot of data collection and interpretation, yet most macro-economic measurements only consider and measure some direct use values of the wetlands resource base. They ignore non-tangible indirect use values yet these equally contribute to economic progress. The habitat value of a wetland system contributes to the fish production potential and economic performance of the sector. Macro-economic measures however, only account for the tradeable fish potential of such a system. This means that planning decisions easily ignore the quality and health concerns of the water ecosystem, even when they aim at improving fisheries productivity.

Integrating environmental values in all development plans will ensure that the contribution of wetland habitats and other environmental resources is accounted for and that any negative effects thereof are taken care of in good time.

PROVIDE ACCESS TO ENERGY SECURITY THROUGH HYDROPOWER

The Challenge

There is insufficient energy generation capacity, which has limited electricity supply leading to low access levels and hindering economic growth.

The Constraints

Energy security is hampered by low level of access to modern energy, inadequate infrastructure for generation, transmission and distribution and the unreliable, inefficient supply. High electricity costs continue to plague the sector hindering access across the country.

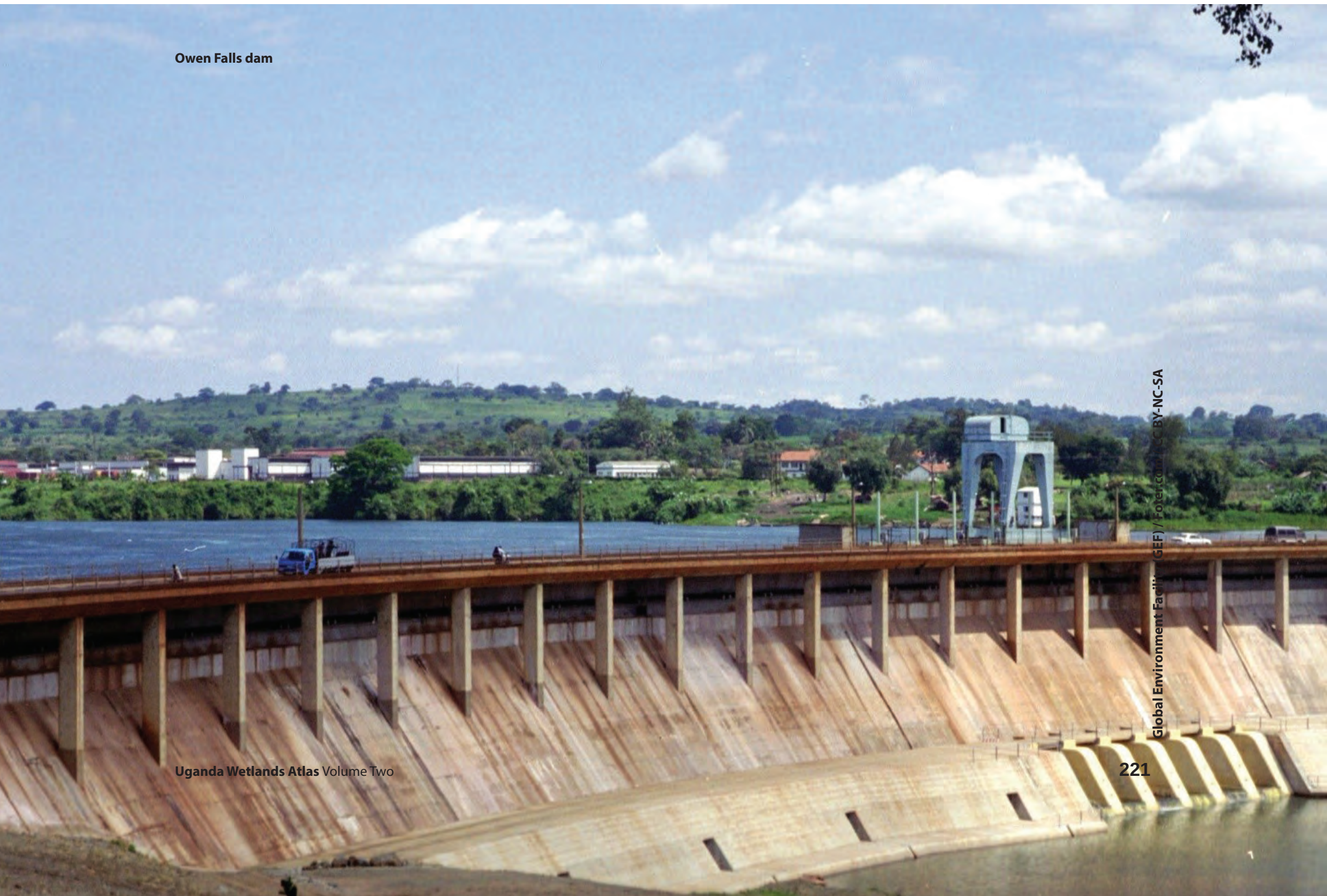
The Situation

Uganda's wetlands store vast amounts of water and are a potential source of clean energy. Electricity demand has been growing at an average of 10% per annum. Uganda has one of the lowest electrification rates.

The Opportunities

Through hydropower development, wetlands and the associated water bodies can contribute significantly to energy security. Rapid implementation of the rural electrification program will enhance electricity access. There is need to strengthen the institutional policy and legal framework emphasizing the linkages between the energy, environment and wetlands sectors.

Owen Falls dam



The Challenge

There is insufficient energy generation capacity, which has limited electricity supply leading to low access levels and hindering economic growth. Electricity generation capacity in 2013 was 852 MW (ERA, 2014) with most coming from hydropower. Current demand is growing at 10% per annum and is being fuelled by GDP growth averaging 5.2% since 2010. There is inadequate energy supply to meet this demand. For instance the actual total electricity capacity is 550 MW and the country's peak demand is about 489 MW. According to the NDP the peak power demand is rising at about 22.7% per annum.

The Constraints

Energy security is hampered by low level of access to modern energy, inadequate infrastructure for generation, transmission and distribution and the unreliable, inefficient supply. Access to modern fuels is low with only 3% of Ugandans using non-solid fuels; 2% of these are from the rural areas and 10% in urban areas in 2012 (World Bank, 2015). Although a Modern Energy Service Programme (2011) is being implemented and will involve the promotion of renewable-energy-based technology for households, institutions, commercial buildings and small-scale industries, more efforts are still needed.

High electricity costs continue to plague the sector hindering access across the country. The end user tariff for domestic consumers is at Ug.Sh 520 (UMEME - Q4,2014) and is one of the highest in East Africa, limiting access to all. So people continue to depend on traditional forms of energy.

Biomass, which is cheap, is still the most important source of energy for the majority of the Ugandan population providing about 90% of the total primary energy consumption. Electricity is contributing only 1.4% to the national energy balance. Forests, including swamp forests are under serious threat to supply woodfuel for energy.

The Situation

Uganda's wetlands store vast amounts of water and are a potential source of clean energy. It is estimated that 2,000MW could be exploited from hydropower in the country. Hydropower accounts for about 84% of the total installed electricity capacity of 852MW (ERA, 2014).

Electricity demand has been growing at an average of 10% per annum. Increased electricity consumption is being fueled by population growth and economic growth (mostly in the commercial and industrial sector). Between 1969 and 2014, the population increased almost four-fold at a rate of 3.03% (UBOS, 2014). Per capita electricity consumption is 61.03 kWh per person and is growing at about 10% per annum (MEMD, 2014). GDP growth has averaged 5.6% between 2010 and 2013.

Uganda has one of the lowest electrification rates with only 18% of people with access to electricity in 2012 with only 8% in rural areas and 71% in urban areas. The energy access deficit was estimated as 28.5 million people (World Bank, 2015). In the past years this lead to occasional load shedding since the supply did not increase proportionally.

The Opportunities

Through hydropower development, wetlands and the associated water bodies can contribute significantly to energy security, through increased power generation, transmission and distribution. Electricity is currently generated from hydroelectric power stations located at Bujagali (250MW), Kiira (90MW – this is the old Owen Falls Dam) and Nalubaale (180 MW) Power Stations. Others along the River Nile include 600 MW Karuma, Ayago (240/300 MW), Arianga (400MW) and Isimba (180MW). There are also numerous mini and micro power stations around the country which either contribute to the national power grid or directly serve specific communities. For example, Kisiizi

Oil development in the Albertine graben

Hospital mini hydropower plant which is located in the Rushebeya-Kanyabaha area serves the hospital and a portion of the immediate community. There are opportunities to enhance energy security through improved wetlands management and this should be taken seriously by energy operators as in the case of the Kisiizi Power Board which is actively involved in watershed management activities as detailed in the Rushebeya Kanyabaha Community Wetland Management Plan (2001-2005).

*Rapid implementation of the rural electrification programm will enhance electricity acces*s. One of the major reasons hindering access to electricity in the rural areas is the lack of resources to extend the grid to the rural areas. The existing grid has not been extended for almost 40 years (Figure 10.4). Some efforts at addressing this deficit include the Rural Electrification Strategy and Plan 2001-2010; the Rural and Urban Poor Electricity Access Programme 2001; and the Energy for Rural Transformation programme 2002-2013. This will have multiple positive outcomes as the power sector currently attracts the largest private sector investments in the country. The sector is also a major source of employment.

Figure 10.4: Existing power transmission grid coverage and generation site by 2014

(NPA, 2015)

Strengthen the institutional policy and legal framework emphasizing the linkages between the energy, environment and wetlands sectors. There are international efforts to streamline and motivate environmental managers for innovative yet sustainable energy development from wetlands. For instance, COP 11 in July 2012 in Bucharest adopted Resolution XI.10 on wetlands and energy. The resolution provides a wide-ranging framework to address the implications of energy policies, plans and activities on wetlands. Some countries, for instance those in the Danube Basin, have already gone ahead and developed guidelines for sustainable hydropower development. These emphasize the need for sustainability and also recognise that the varied uses of hydropower infrastructure such as flood control and water supply may weigh more in favour of energy infrastructure development. At all times, however, strategic environmental assessment should guide the process of such investments. In addition, rehabilitation of existing hydropower facilities should endeavour to minimize negative impacts on the aquatic ecosystems including wetlands. Box 10.2 highlights some of the guiding principles.

Box 10.2: Guiding principles for upgrading existing hydropower developments

A number of hydropower facilities are being upgraded in Uganda. The Ramsar Secretariat suggests a four step approach as follows:

1. First is the need to identify stretches of river where hydropower development is forbidden by national legislation
2. Assess the suitability of all other portions of the river following a matrix outline provided.
3. Implement site specific mitigation measures considering the need to maintain fish migration and ecological water flows and to avoid ecologically damaging hydropeaking (artificial water level fluctuations)
4. Other issues highlighted for consideration include sedimentation, maintaining groundwater conditions and restoration of areas neighbouring the water bodies including wetland habitats.

(Ramsar, 2013)

IMPROVING THE MANAGEMENT OF WETLANDS

The Challenge

Wetlands continue to be degraded despite the existence of laws and policies such as the Wetlands Policy 1995 and the Environment Act 1995.

The Situation

The multitude of land ownership systems complicates land administration in Uganda. Demarcation of wetlands boundaries is unclear. There is a disconnect between urban planning, land use and modern wetland conservation goals.

The Constraints

Weak institutions are one of the biggest obstacles to achieving sustainable wetlands management. And these are further constrained by a lack of capacity at the local government level.

The Opportunities

The legal framework should be strengthened through the development of a fully fledged Wetlands law. Institutions should be strengthened to manage and enforce the provisions for wetlands by addressing issues of staffing, funding and poor coordination between sectors. Promote compliance through education and incentives. Develop a wetlands information system to support evidence-based decision making.

The challenge

Wetlands continue to be degraded despite the existence of laws and policies such as the Wetlands Policy 1995 and the Environment Act 1995. People are aware of the provisions of the laws, but compliance is still a challenge. According to (Glass, 2007), awareness of wise-use issues is high in Kabale district, but people still continue to encroach and exploit the resources. While this could be blamed on poverty and tenure insecurity issues, that drive them to exploit the wetlands, the same cannot be said for the commercial developers. In some cases developers, such as road contractors, do not adhere to provisions of Environment Impact Assessment certificates and thus impact negatively on wetlands. For instance it is common practice to find materials have been dumped in wetlands. And reports indicate that there have been reports of many instances of dumping of materials in wetlands at awkward hours.

The situation

The multitude of land ownership systems complicates land administration in Uganda. According to the law, wetlands cannot be legally owned by individuals. However historical policies of the 1960s and 70s encouraged individuals to use wetlands for agriculture. Many of these leases are still valid with the local governments and people are reluctant to relinquish these as they claim legal tenure of their land. The matter is further complicated by the Land Act 1998 which allows individuals, families or communities holding land under customary tenure to acquire a certificate of customary ownership for that land. The certificate may then be registered and converted into freehold tenure which is tantamount to private property as it may be mortgaged or sold on the market. Many wetlands end up being traded in this manner.

Demarcation of wetlands boundaries is unclear. Given the transitional position between 'dry' land and water, the wetland boundaries may fluctuate from time to time. Many encroachers use this as an excuse to trespass on the wetlands. This challenge has prompted the government to clearly define the wetland boundaries using fixed boundary markers using remote sensing and Geographic Information Systems (GIS) tools. The boundaries will then be legally gazetted to guide land allocation, regulated use and access.

There is a disconnect between urban planning, land use and modern wetland conservation goals. Although some urban areas have development plans, they seem not to be implemented. For instance, despite the existence of a Physical Development Plan for Kampala, residential, commercial and industrial infrastructure are being erected in areas that are not planned for them. There is also a growing trend of unplanned settlements which is driven by the high cost of land, inadequate supply of affordable housing and high rates of poverty (Nyakaana, Sengendo, & Lwasa, 2007).

The challenge could partly be due to the fact that water plays such a central role in wetlands and also connects in a multitude of ways across sectors; and therefore transferring terrestrial conservation approaches to wetlands management proves particularly challenging (Chandrasekhar, 2013). A deep understanding of wetland ecosystems from the science-policy-livelihoods angle would probably support the wise use of wetlands better. Just as riparian communities adapt their livelihood systems to the overall ecological character of the wetland so should management approaches adapt in order to optimize development outcomes.

The Constraints

Weak institutions are one of the biggest obstacles to achieving sustainable wetlands management. In many cases, the very institutions responsible for protecting and enforcing the law are the very ones that violate the legal provisions. For instance at both Central and Local Government level, there have been instances of wetlands abuse under the guise of providing communities with opportunities for poverty reduction and economic growth.

Lack of capacity at the Local Government level is a fundamental weakness of the decentralized system of governance that currently exists in the country. The Decentralisation Act was passed in 1997, but the local authorities have still not fully translated the authority vested in them for natural resources management into meaningful action especially as far as wetlands management is concerned. The Local Governments are supposed to manage wetlands according to established laws and legislation including the Constitution of 1995, the National Environment Act 1995 and the Wetlands Policy 1995, among others. Technical officers mandated to implement wetland management activities have been appointed by the districts as provided for in the Local Governments Act, 1997. However, their capacity to effectively deliver is constrained by inadequate funds and political interference.

A community sensitization meeting for restoration of Enengo ecosystem (Bushenyi district)

The Opportunities

The legal framework should be strengthened through the development of a fully fledged Wetlands law. A Wetlands Management Bill is currently being finalised. However, the main opportunity for improving the legal provisions has to be an effective and robust grassroots enforcement mechanism. A laxity of local governments to fulfil their delegated mandates allows space for wetlands encroachment. There still remains a fundamental weakness in the sense that local authorities have not translated the authority for natural resources management vested in them into meaningful action as far as wetland resources are concerned. It is unlikely that structures at the centre will change, and therefore it is imperative that the local governments take up their roles on matters of wetland management, planning and enforcement, including stopping wetland abuse through community policing. The approach adopted by the Wetlands Management Department for community wetland management planning needs to be strengthened to cope with the demand on the ground. The Cabinet Directive of 2014 is an opportunity to address the issue of land ownership in wetlands (box 10.3).

Opportunities to integrate wetland concerns into the planning and decision making of other sectors. Wetland resources form an integral part of the environment and their management must be pursued in the context of an interaction between conservation and national development strategies and activities. To achieve this, the Wetlands Management Department, NEMA and all stakeholders including the Uganda Land Commission and District Land Boards must coordinate their work processes and harmonise land use planning, stop the leasing out of wetlands and the rampant reclamation and drainage practices that exist. Furthermore, wetland advisory and coordination functions of all the relevant stakeholders must be streamlined. For example the WMD should collaborate closely with the Water Resources Management Department that is implementing integrated water resources management within the drainage basins as many of the water bodies have wetlands along their fringes. Catchment management plans at the sub-basin level should also be developed and implemented.

Box 10.3: Cabinet Directives on Land Titles in Wetlands

On 16th April 2014, the Cabinet of the Republic of Uganda under Minute No. 114(CT 2014) while discussing Cabinet Paper No. CT(2012)172 on the cancellation of land titles in Wetlands as one of the measures to address the problem of Wetlands degradation, directed as follows:

1. All titles in wetlands on public land acquired unlawfully (after 1995) should be cancelled;
2. Land titles on critical ecosystems especially those on the 200m lakeshore protection zone should be regulated and that proprietors should be required to apply for and obtain Permits to undertake regulated activities as provided for in the law and that in addition, the degraded wetlands whose ecological functions were recoverable should be restored;
3. Wetlands portions on public land that had been reclaimed and converted for economic activities for public good and with approval from the controlling /regulating authorities such as NEMA and KCCA, should be declared vanquished and land titles issued therein should not be cancelled;
4. Clear operational procedures of handling cancellation of those titles in wetlands on public land be developed, and those procedures should be applied without discrimination;
5. The Ministry of Land Housing and Urban Development should commence cancellation of land titles issued after 1995 as soon as the Wetlands Atlas is in place starting with those within Kampala; and,
6. The Ministry of Land Housing and Urban Development and NEMA, in consultation with Local Governments and Police should take immediate steps to ensure that wetlands that are not yet degraded or encroached upon are fully protected and should produce a Wetland Atlas for the whole country.

Institutions should be strengthened to manage and enforce the provisions for wetlands by addressing issues of staffing, funding and poor coordination between sectors. Frameworks for cooperation should be the basis for sustainable wetlands management and development. Long-term success depends on detailed implementation at the local levels. Box 10.4 presents a success story of multi-sectoral collaboration in the management of Enyau wetland. It is also discussed in chapter 6.

Promote compliance through education and incentives. Compliance with the legal provisions does not automatically happen. Achieving it usually involves efforts to encourage and compel behaviour change. The efforts must motivate the regulated community to comply by removing barriers that prevent compliance, and overcoming existing factors that encourage non-compliance. Some of the tools that NEMA currently uses are inspections, compliance agreements (negotiations), educational programmes, technical assistance and where warranted, legal action.

Develop a wetlands information system to support evidence-based decision making for wetlands management. There is a dearth of knowledge on management issues regarding wetlands management. For instance the relationship between current consumptive practices and productivity is unknown and yet this can threaten future supplies of wetland products and services (WRI, 2009). A case in point are the River Kafu wetlands in Nakasongola District (Chapter 3) which are used for dry season pasture yet there is a serious lack of evidence-based information to ascertain the effects of livestock over-grazing on water and soil quality in wetlands in Uganda (Box 10.5). Studies are ongoing and it is hoped that this will provide the data foundation for the formulation of livestock grazing and other wetland resources-use guidelines. An online-based compilation of information on wetlands would greatly contribute to the efforts to manage wetlands. Information could include general information from Uganda's wetlands, databases, inventories, community wetlands plans, education and research, relevant institutional roles and responsibilities, licenses and permits, local, national and international policies and other information on the Wetlands Management Department and NEMA. It would be even more useful if it could easily integrate other existing information systems such as the land cover database (National Forest Authority), the Environment Information System (NEMA), and the National Statistical System (Uganda Bureau of Statistics).

Restoration of Kagera watershed

Box 10.4: Multi-stakeholder involvement in wetlands management

Protecting and managing the Enyau wetland in the greater Arua district in the Albert Nile catchment has proved quite a challenge. In some areas, the wetlands along the river are very narrow and in some areas they do not exist. In those areas, there is only the river bank and the management of river banks is not within the purview of the Wetlands Management Department. So although the WMD has been demarcating wetlands to enhance their protection, this has raised issues of the legality of demarcating the riverbanks. In such cases, it is ever more important to ensure the full participation of multi-sectoral stakeholders. Indeed Enyau wetlands has brought together the Arua District Local Government (DLG), the National Water and Sewerage Corporation (NWSC), Ministry of Water and Environment (MWE) among others. The Arua DLG invested in educating the community on sustainable use and management of wetlands and on the ongoing demarcation process. The NWSC mobilized and relocated the youth who had established car washing basy at the stream. MWE is in charge of marking and demarcating the boundary within the 30m distance legally prescribed for small streams such as Enyau wetland. The pillars and beacons have already been procured and delivered to the district waiting for preparation to do the survey, mark and plant the pillars and beacons along the boundary. However, the use of natural boundaries should also be explored.

A recommendation going forward is to ensure that these activities need to be followed up keenly by both the District and the Municipal Environment Officers. Lastly there is need to designate a focal person for the Environment Protection Police Unit to be based in Arua and coordinate security during sensitization and demarcation.

Box 10.5: Impacts of overgrazing on wetlands

The impacts of overgrazing include soil compaction, removal of vegetation and the destabilization of river banks or lake shores. This affects the ability of wetlands for filtering and flood control, water recharge and wildlife habitat. This has implications because more than 80% of Ugandans directly use water from wetlands for domestic purposes. The consumption of plant biomass leads to reduced height of wetland grass species. This reduces the replenishment rates of organic material. It also affects other wildlife such as birds whose young may suffer from reduced cover and less food. Reduction in vegetation also affects the water retention rate of the wetland. More water is retained when vegetation is at maximum or near maximum height. Other impacts include the trampling of plants including below ground biodiversity, nutrient inputs, bacterial contamination from urine and dung and the introduction and dispersal of seeds and other reproductive structures.

Source: (Kakuru, Turyahabwe, & Mugisha, 2013), (Corning, 2002).

IMPROVING ACCESS TO WATER

The Challenge

Human activities such as those that result in wastage of water, pollution and mass consumption are all putting pressure on the existing water resource.

The Situation

Wetlands degradation is leading to a decrease in water quality and availability. Economic development and population growth are placing unsustainable demands on water resources. International water politics is a threat to access to water.

The Constraints

Although access to water is improving, there is a big proportion of the population who are still unserved. Access to safe water is a major factor determining the health of wetland dependent communities.

The Opportunities

Improving and restoring wetlands can be a cost-effective way of meeting water targets and implementing successful policy. Investing in water-related ecosystem services and natural water infrastructure such as wetlands, will be central to enhancing access to water. A multi-sectoral approach to water resources management is required to improve access to water.

The Challenge

Human activities such as those that result in wastage of water, pollution and mass consumption are all putting pressure on the existing water resource. Furthermore environmental degradation within the catchments of many rivers is threatening the integrity of the rivers and wetlands. For instance the hilly and mountains landscape coupled with high population density in the Kagera river catchment, Lake Victoria basin (chapter 2) is threatening the Lake Victoria wetlands. The rapidly growing population, agricultural and livestock intensification and unsustainable land use practices have led to land degradation, deforestation and encroachment into wetlands with impacts on the water quality, the hydrological regime and water table recharge. Siltation from erosion in the catchment affects Lake Victoria through nutrient loading (NEMA, 2009). This is also the case with the Lake Mutanda wetlands in the Edward basin (chapter 5) where siltation, from soil erosion in the slopes flanking the lakes, is rapidly causing their disappearance. The use of agro-chemicals for tea plantations in the heavily populated Kisoro district is a pollution threat to Lakes Murehe and Mutanda and their wetlands.

The Constraints

Wetlands degradation is leading to a decrease in water quality and availability. Rapid population growth, deforestation, increased agricultural production; hydropower generation, urbanization and industrialization are leading to depletion and degradation of available water resources. Water shortages, water quality deterioration, flood and drought impacts are some of the problems, which require urgent attention and action.

Unsustainable use of water may impact water quality for users remote from the water sources. For instance upstream riparian users may pollute the water making it unsuitable for downstream users. An example is where sewage is released upstream of locations where water for human consumption is collected for use. Nakivubo wetland in the Lake Victoria basin (chapter 2) is one of the most critical wetlands in Kampala city. It acts as a buffer through which much of the city's industrial and domestic waste water flows before being discharged in Lake Victoria in the Inner Murchison Bay (IMB). The lower section of the IMB where the main inlet point of water for the city is located.

Economic development and population growth are placing unsustainable demands on water resources. Population is the main driver behind the ever-increasing demand for water and the chief factor responsible for land degradation and environmental pollution. As highlighted in chapter 2, industrial development is also presenting increasing demands for water. Industries such as Amos Dairies (UHT milk) at Nshara, Amos Dairies (cheese plant in Rushere), Nile Breweries Limited in Mbarara Municipality and the National Water and Sewerage Corporation (NWSC) have all increased their abstraction of water from the river to meet the increasing demand. These industries have been planned without evaluating the sustainability of the water resources mainly from River Rwizi.

International water politics is a threat to access to water. Uganda's water resources are part of the larger Nile river transboundary hydrological system. Potential conflicts exist as each of the Nile transboundary countries would wish to improve the quality of life, livelihoods and economic development of their citizens through utilization of the Nile waters. However this remains contentious since if unfettered access is allowed, demands of the riparian countries are likely to exceed available resources. This is limiting Uganda's unhindered access and use of water resources within her territorial boundaries.

The Situation

Although access to water is improving, there is a big proportion of the population who are still unserved. In urban areas access to safe water was 70% and in rural areas 65% in the 2013/14 financial year. Sanitation coverage increased from 51 to 70% from 2005/06 to 2013/14. The


Rainwater harvesting

proportion of people living within 1 km of an improved water source increased from 64% in 2013 to 65% in 2014, and the functionality rate of the existing water sources also increased (from 84 to 85%) during the same time frame (NPA, 2015).

Access to safe water is a major factor determining the health of wetland dependent communities. Unsafe water, poor sanitation and hygiene can leave communities vulnerable to water-related diseases including bacterial, parasitic and vector-borne diseases presenting a huge health burden. For instance bilharzia (Schistosomiasis) and river blindness (Onchocerciasis) are common in Kitgum, Lamwo and Pader district in the Achwa basin (chapter 7); River Wambabya in the Lake Albert basin (chapter 4) hosts the black fly vector of river blindness; and malaria which is endemic in 95% of the country is the leading cause of morbidity and mortality. Poor sanitation also leads to diseases such as typhoid, cholera and diarrhoeal disease. The slum areas in Kampala and districts along the western and northern borders of the country are also prone to cholera outbreaks. In 2014/15, there were cholera outbreaks in villages in Moyo and Namayingo districts along the shores of Nile River and Lake Victoria respectively (MOH, 2014). Displaced communities, semi-normadic populations and those living in slums are highly vulnerable (Bwire, Malimbo, Maskery, Kim, Mogasale, & Levin, 2013). If the development of water and sanitation infrastructure does not keep pace with the rapidly growing urban population, the health burden presented by water related diseases is likely to continue.

The Opportunities

Improving and restoring wetlands can be a cost-effective way of meeting water targets and implementing successful policy. It will also ensure water security and food and energy security, since water plays a key role in agriculture and energy production (see chapter 2). Wetlands have a central role in climate change adaption and their sustainable management in many cases is able to improve resilience to climate change by mitigating effects of climate change such as storms, droughts and floods. Well-preserved wetlands also contribute to social cohesion and economic stability by ensuring livelihood for local communities and the preservation of traditions and cultural identity. Better management of water and wetland resources also improves health outcomes and reduces transmission of malaria and other vector-borne and water-related diseases. The National Development Plan II includes a target to protect and restore water-related ecosystems including wetlands, river, aquifers and lakes by 2020 (NPA, 2015).

Investing in water-related ecosystem services and natural water infrastructure such as wetlands, will be central to enhancing access to water. For instance, improvements in water and sanitation can be achieved through wetland restoration. Healthy wetlands, lakes and rivers enhance access to clean and safe drinking water. Investments in water and wetlands management will thus provide long-term economic benefits, reduce overall costs, and may be cheaper than other technological solutions. There is an additional advantage in that healthy or restored wetlands can provide livelihoods for local communities through fisheries, tourism or harvesting of wetland resources.

A multi-sectoral approach to water resources management is required to improve access to water. However, to date, there is little coordination between the different departments. For example, the Ministry of Water and Environment is responsible for drinking water supplies and sanitation, water for production and water resources management; while the Ministry of Tourism is in charge of water for recreation and tourism. Planning of water continues to be carried out on a sectoral basis and there is no holistic approach to water resources development and use. There needs to be greater involvement of users and stakeholders in planning and decision making. Management of the sector especially water resources management continues to be a central government function and to be effective there needs to be more involvement of the decentralized structures all the way to the lowest decision making level. The institutional mechanisms for resolving water conflicts have not been fully utilized and hence water conflicts have continued unabated.

BIBLIOGRAPHY

Bwire, G., Malimbo, M., Maskery, B., Kim, Y. E., Mogasale, V., & Levin, A. (2013). The burden of cholera in Uganda. PLoS Negl Trop Dis , 7 (12).

Corning, R. V. (2002). Diminished Sweetwater River Flows From the High Cold Desert Region of Wyoming. Colorado: Colorado State University.

FAO. (2001). The State of Food Insecurity in the World 2001. Rome: Food and Agriculture Organization of the United Nations (FAO).

Gordon, L. J., Finlayson, C. M., & Falkenmark, M. (2010). Managing water in agriculture for food production and other ecosystem services. Agricultural Water management , 512-519.

GOU. (2011). Uganda Nutrition Action Plan 2011-2016. Scaling Up Multi-Sectoral Efforts to Establish a Strong Nutrition Foundation for Uganda's Development. Kampala: Government of Uganda (GOU).

GOU. (2007). Uganda Vision 2040. Kampala: Government of Uganda (GOU).

EA and World Bank. (2015). Sustainable Energy for All 2015—Progress Toward Sustainable Energy". Washington D.C.: International Energy Agency (IEA) and the World Bank.

Kakuru, W., Turyahabwe, N., & Mugisha, J. (2013). Total Economic Value of Wetlands Products and Services in Uganda. The Scientific World Journal. Hindawi Publishing Corporation. , 1-13.

Maclean, I., Tinch, R., Hassel, Hassall, M., & Boar, R. (2003). Social and economic use of wetland resources: A case study from Lake Bunyonyi, Uganda. CSERGE Working Paper ECM 03-09. East Anglia: Centre for Social and Economic Research on the Global Environment (CSERGE). University of East Anglia.

MOH. (2014). Annual Health Sector Performance Report for Financial Year 2014/15. Kampala: Ministry of Health (MOH).

NEMA. (2009). Uganda - Atlas of our changing environment. Kampala: National Environment Management Authority (NEMA).

NPA. (2015). Second National Development Plan 2015/16-2019/20. Kampala: National Planning Authority (NPA).

Okello, B., & Laker-Ojok, R. (2011). The Critical Triangle Relationship Between The Diversity Of Wetlands Utilization, The Enhancement Of Agricultural Productivity and Food Security In Uganda. Network Report 8. Kampala: International Food Policy Research Institute (IFPRI).

Pender, J., Nkonya, E., Jagger, P., Sserunkuma, D., & Ssali, H. (2003). Strategies to Increase Agricultural Productivity and Reduce Land Degradation: Evidence from Uganda. 25th International Conference of Agricultural Economists, August 16-23, 2003. Durban.

Ramsar. (2013, July 3). Ramsar. Retrieved 12 March, 2016, from Wetlands and hydropower: http://www.ramsar.org/news/wetlands-and-hydropower

RAMSAR. (2014). Wetlands and Agriculture: Partners for Growth. Gland: Ramsar Secretariat.

Turyahabwe, N., Kakuru, W., Tweheyo, M., & Tumusiime, D. M. (2013). Contribution of wetland resources to household food security in Uganda. Agriculture and Food Security 2:5 .

UBOS. (2014). National Population and Housing Census. Provision Results. November 2014 Revised Edition. Kampala: Uganda Bureau of Statistics (UBOS).

UBOS. (2012). Statistical Abstract 2012. Kampala: Uganda Bureau of Statistics (UBOS).

UBOS. (2015). Statistical Abstract 2015. Kampala: Uganda Bureau of Statistics (UBOS).

Wood, A., & van Halsema, G. (2008). Scoping agriculture-wetland interactions: Towards a sustainable multiple response strategy. FAO Water Report 33. Rome: Food and Agriculture Organisation of the United Nations (FAO).

World Bank. (2015). Global Tracking Framework 2015. Washington D.C.: World Bank.