NILE-SEC
NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

NBI Technical Reports: Wetlands and Biodiversity Series

Economic Assessment of the Ecosystem Services of the Semliki Delta Transboundary Wetland in Uganda and the Democratic Republic of Congo

WRM/WBS-2020-05

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of:
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
of the Federal Republic of Germany

Document Sheet

This Technical Report series publishes results of work that has been commissioned by the member states through the three NBI Centers (Secretariat based in Entebbe- Uganda, the Eastern Nile Technical Regional Office based in Addis Ababa - Ethiopia and the Nile Equatorial Lakes Subsidiary Action Program Coordination Unit based in Kigali - Rwanda. The content there-in has been reviewed and validated by the Member States through the Technical Advisory Committee and/or regional expert working groups appointed by the respective Technical Advisory Committees.

The purpose of the technical report series is to support informed stakeholder dialogue and decision making in order to achieve sustainable socio-economic development through equitable utilization of, and benefit from, the shared Nile Basin water resources.

Document	
Citation	NBI Technical Reports- WRM 2020 - 05 Economic Assessment of the Ecosystem Services of the Semliki Delta Transboundary Wetland in Uganda and the Democratic Republic of Congo 2020
Title	Economic Assessment of the Ecosystem Services of the Semliki Delta Transboundary Wetland in Uganda and the Democratic Republic of Congo
Series Number	Water Resources Management 2020-05
Responsible and Review	
Responsible NBI Center	Nile-Secretariat
Responsible NBI	Dr. Abdulkarim Seid and Mr. Leonard Akwany
Document Review Process	Nile Basin Initiative Wetlands Task Team and Lead Consultant (March 2020)
Final Version endorsed	Nile Basin Initiative Wetlands Task Team and Lead Consultant (May 2020)
Author / Consultant	
Consultant Firm	Individual Consultant
Authors	Mr.Telly Eugene Muramira
Project	
Funding Source	German Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU)
Project Name	Biodiversity Conservation and Sustainable Utilization of Ecosystem Services of Wetlands of Transboundary Relevance in the Nile Basin
Project Number	15_IV_045_Afrika_G_Biodiversitätsschutz Nil-Becken

Table of Contents

Executive Summary

1.1. Introduction

This study was commissioned by the Nile Basin Initiative with financial support from the German Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU) under its International Climate Initiative. The study is part of the global initiative on the Economics of Ecosystems and Biodiversity (TEEB) whose principle objective is to mainstream the value of biodiversity and ecosystem services into decision making by including nature's values.

1.2. Purpose and Framework for the Economic Valuation

The purpose of the study was to identify, quantify and value the key ecosystem services generated by the Semuliki Delta Trans-boundary wetland with a view to stimulating management and funding interventions necessary for the maintenance, restoration or even enhancement of the integrity and productivity of the wetland. The target audience and key stakeholders to the study therefore related to this broad purpose of the study and included local community representatives, local and central government authorities in Uganda and the Democratic Republic of Congo, development partners and the international community.

1.3. The Semuliki Delta Trans-boundary Wetland

The study area measured about 500 square kilometres and was located on the border between Uganda and the Democratic Republic of Congo (DRC). The area comprised of the Semuliki flats in Rwebisengo, Bweramule and Kanara sub-counties on the Ugandan side and parts of Nyacucu, Kalyabugongo, Buguma, Rubungura, Kikoga and Nyanzige Groupings in Ituri Province on the DRC side.

The study area has unique physic-geographical characteristics and supports a variety of species of mammals, birds, reptiles, amphibians and fish populations. It also has a variety of wetland plants including sedges, phragmites and palms of considerable socio-economic significance. Wetlands in the delta were particularly important because of very hot and dry weather conditions in the area during the dry season months of December to March.

1.4. Key Ecosystem Services Generated by the Delta

The Semuliki Delta Trans-boundary wetland generates several ecosystem services. Key among them are provisioning services like dry season grazing, water supply for domestic and livestock use, and fishing; regulating services like water flow control, waste and climate regulation; supporting services like primary production, nutrient and water cycling and cultural services like spiritual enrichment, recreation and aesthetic values.

The ecosystems services from the delta immensely contribute to household incomes and the wellbeing of the people and their livestock. There were however several threats to the long-term supply of these key ecosystem services. The major threats included population pressure, unsustainable land use practices like overgrazing, river bank, lakeshore and wetland degradation, siltation of the river and eventually the lake, pollution of the water system and the resultant deterioration of the quality and quantity of the water in the area and invasive plant species. The root causes of the above mentioned threats include weak institutional capacity for water resources management and weak or lack of sound

governance for water resources management and cross cross-cutting issues including climate change and variability; high illiteracy rates and rampant poverty and disease in the area.

1.5. Methodology and Approach to the Study

The values of the various ecosystem services from the delta were estimated using both primary and secondary data. Market analysis, effect on production and benefits transfer approaches were used to generate value for fish, papyrus and other craft materials, medicinal plants and food materials, fuel-wood, dry season grazing, water supply, fish breeding and spawning and carbon sequestration. Changes in the productivity of the delta for key ecosystem services was modeled to depict the behavior of the wetland under a business as usual (BAU) and a wetland conservation and wise use (WCWU) scenario.

1.6. Study Findings: the Economic Value of Wetland Goods and Services

The delta supports many social and economic development activities involving both the public and private sectors. The overall per capita contribution of the wetland provisioning services to this development effort was Ushs 4,017,958 (USD 1,100) per capita in direct household incomes, well above the national GDP per capita value for Uganda estimated at USD770 in 2019. This income opportunity was probably responsible for the urban growth and population influx into the delta beyond that due to security driven internal displacements from and within the DRC.

The delta is endowed with natural resources including fisheries, wetland plants and water supplies. This study estimated baseline fish supplies of about 5.1 metric tonnes valued at Ushs 25, 590,150,000 per annum, papyrus and other crafts materials valued at Ushs 1,594,208,000; medicinal plants and food materials valued at Ushs 1,639,327,200; fuel-wood supplies valued at Ushs 1,706,010,000; dry season grazing valued at Ushs 42,349,787,500; water supply for domestic and livestock use val ued at Ushs 13,534,740,000; fish breeding and spawning valued at Ushs 1,149,750,000 and carbon sequestration valued at Ushs 3,214,920,000.

An analysis of the distribution of wetland benefits indicated that most went to the local community (about Ushs 1,728,285 per hectare per year) and the international community. Little or no revenue trickled to the district or even central government explaining government's despondence under the business as usual scenario.

The study noted that government currently invests nearly zero resources in the management of the delta. The Local Government allocation to wetland management was dismal and therefore left the delta exposed to over-exploitation in view of the large income opportunity in the delta. There was however, a downside to the opportunities in the area as many respondents reported crocodile attacks that often resulted in the death of human beings and livestock. The cost of wildlife attacks on livestock was in the range of Ushs 314,550,000 per year across the delta.

The study modeled the cost of continued wetland degradation under the business as usual (BAU) scenario and imputed the implied investment needs under a Wetland Conservation and Wise Use (WCWU) scenario. The model applied a 3.74 percent decline in wetland productivity as indicated by NEMA (2017). The total and net present value of wetland production under the BAU scenario declined by more than half from Ushs 90,778,892,700 to Ushs 42,353,740,752 in 20 years and cost the local, national and even global economy up to Ushs 163,630,346,864 in present value terms.

The large decline in productivity of the wetland and the implied costs to the economy justified a range of management interventions to reverse the situation. The Wetland Conservation and Wise Use scenario was hence proposed to invest up to Ushs 3,077,538,000 per year over the next 20 years starting in 2020 implying a total projected investment cost of Ushs 61,550,760,000 or Ushs 25,774,286,852 in Net Present Value terms. The proposed investment options included improving livestock breeds, growing and trade in improved fodder, hay and silage, fish farming, production of high value wetland products, wetland resource marketing, improved local infrastructure including roads, schools and community markets.

1.7. Conclusion and Recommendations

The study noted that undeterred degradation of the delta costs the local, regional and global economy considerable amounts of money and must be reversed. The study therefore provides as business case and justification, implementation of a wetland management plan and allocation of the requisite financial resources in the delta. The study therefore recommended the need to:

(i) develop a Semuliki delta trans-boundary wetland management plan that builds an economic case for wetland conservation and wise use, with a specific "green" water infrastructure theme;
(ii) promote investments that reduce resource use pressure on the delta's resources including improved livestock breeds, improved livestock feed systems, fish farming, production and marketing of high value wetland products;
(iii) Develop investment proposals to support sustainable development interventions and business support systems covering access to credit, cooperatives, markets, infrastructure, tourism, livestock and fisheries improvement and utilities;
(iv) Develop and implement smart water for production models to mitigate the impacts of climate change;
(v) Recognize and enhance the delta's role as green infrastructure that protects inter-connected ecosystems, ecological corridors and natural landscapes.
(vi) Establish a Semuliki delta trans-boundary wetland management committee to advocate for and mobilise resources for the management of the wetland;

1. INTRODUCTION TO THE CASE STUDY

1.1. Background

The Economic Assessment of the Biodiversity and Ecosystem Services of the Semuliki Delta Trans-boundary Wetland was commissioned by the Nile Basin Initiative with financial support from the German Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU) under its International Climate Initiative. The study was inspired by the global initiative on the Economics of Ecosystems and Biodiversity (TEEB) whose principal objective is to mainstream the value of biodiversity and ecosystem services into decision making by including nature's values. The purpose of the study, in the broad framework of "Biodiversity Conservation and Sustainable Utilisation of Ecosystem Services of Wetlands of Trans-boundary Relevance in the Nile Basin", was to build a knowledge base on trans-boundary wetland biodiversity and ecosystem services economic values to provide the "business case" and economic justification for green infrastructure investment through wetland management and conservation investment planning.

The TEEB initiative proposes a structured approach to valuation that helps decision makers recognize the wide range of benefits provided by ecosystems and biodiversity, demonstrates their values in economic terms and where appropriate captures those values in decision making. This TEEB study, coordinated by the Nile Basin Initiative (NBI), has the goal of raising awareness about the importance of wetland ecosystem services of Nile Basin Wetlands to regional, national, sectoral and local level development processes. It seeks to build the economic case for wetland conservation and wise use, with a specific "green" water infrastructure theme that brings wetland ecosystem values to the attention of river basin planners and managers, hence promoting better informed, more effective, inclusive, equitable and sustainable conservation and development decision making in the Nile River Basin.

The site level case study identified, evaluated and assessed the social and economic values of the Semuliki Delta Trans-boundary Wetland in Uganda and the Democratic Republic of Congo as a green water infrastructure for key sectors, stakeholders and site. The study focused on a number of wetland goods and services including dry season grazing and the production of meat and milk, fishing activities, harvesting and use of water reeds, wild-foods and beverages, fish breeding and spawning and carbon

sequestration values to assess the economic contribution of the Semuliki delta to livelihoods and proposed a number of incentive measures to promote conservation investment planning and the sustenance of these critical outputs of the wetland.

1.2. Purpose of the Study

The purpose of the study was to identify, quantify and value the key ecosystem services generated by the Semuliki Delta trans-boundary wetland with a view to stimulating management and funding interventions necessary for the maintenance, restoration or even enhancement of the integrity and productivity of the wetland. The goal of the study was to identify, quantify and value the key ecosystem services generated by the trans-boundary wetland with a view to integrating them into the Semuliki Delta Wetland Management Plan. The specific objectives of the study included the following:

(i) Identifying and quantifying the ecosystem services generated by the Semuliki Delta trans-boundary Wetland;

(ii) Determining the economic value of the ecosystem services generated by the Semuliki Delta trans-boundary wetland;

(iii) Identifying and assessing, using a participatory approach, the priority social, economic and environmental issues in the wetland system;

(iv) Carrying out stakeholder mapping/identification, analysis and engagement to determine those who enjoy the benefits or suffer the costs of wetland degradation and loss;

(v) Generating recommendations and a way forward for integration into the Semuliki Delta Trans-boundary wetland management plan.

1.3. Target Audience and Key Stakeholders

The target audience and key stakeholders to this study related to the broad purpose of the study which was to generate information to guide the preparation of the Semuliki Delta Trans-boundary Wetland Management Plan in general but to also provide justification for investments and funding interventions for the restoration and enhancement of the integrity of the Semuliki Delta Trans-boundary wetland in particular. The study also aimed to influence the land and resource use decisions around the wetland by popularizing the value of the wetland to the local community, local and central

government and the international community including development partners. The target audience and key stakeholders to the study therefore included the following:

(i) The Ministry of Finance, Planning and Economic Development in Uganda and its counterpart ministry in the DRC who secure national and development funding for management plans

(ii) Wetlands International and Nature Uganda who have been engaged to prepare the wetland monograph and management plan;

(iii) Ministry of Water and Environment LEAF II project, the Department of Wetlands Management, Albert Water Management Zone;

(iv) Development Partners including GIZ, Nile Basin Initiative, WWF;

(v) Local Governments including Ntoroko District Local Government and the relevant lower local governments of Rwebisengo and Rwamabale Sub-Counties and Masaka Parish among others;

(vi) The counterpart local governments on the DRC side;

(vii) The Semuliki River Catchment Management Committee (CMC) as established to implement the Semuliki Catchment Management Plan.

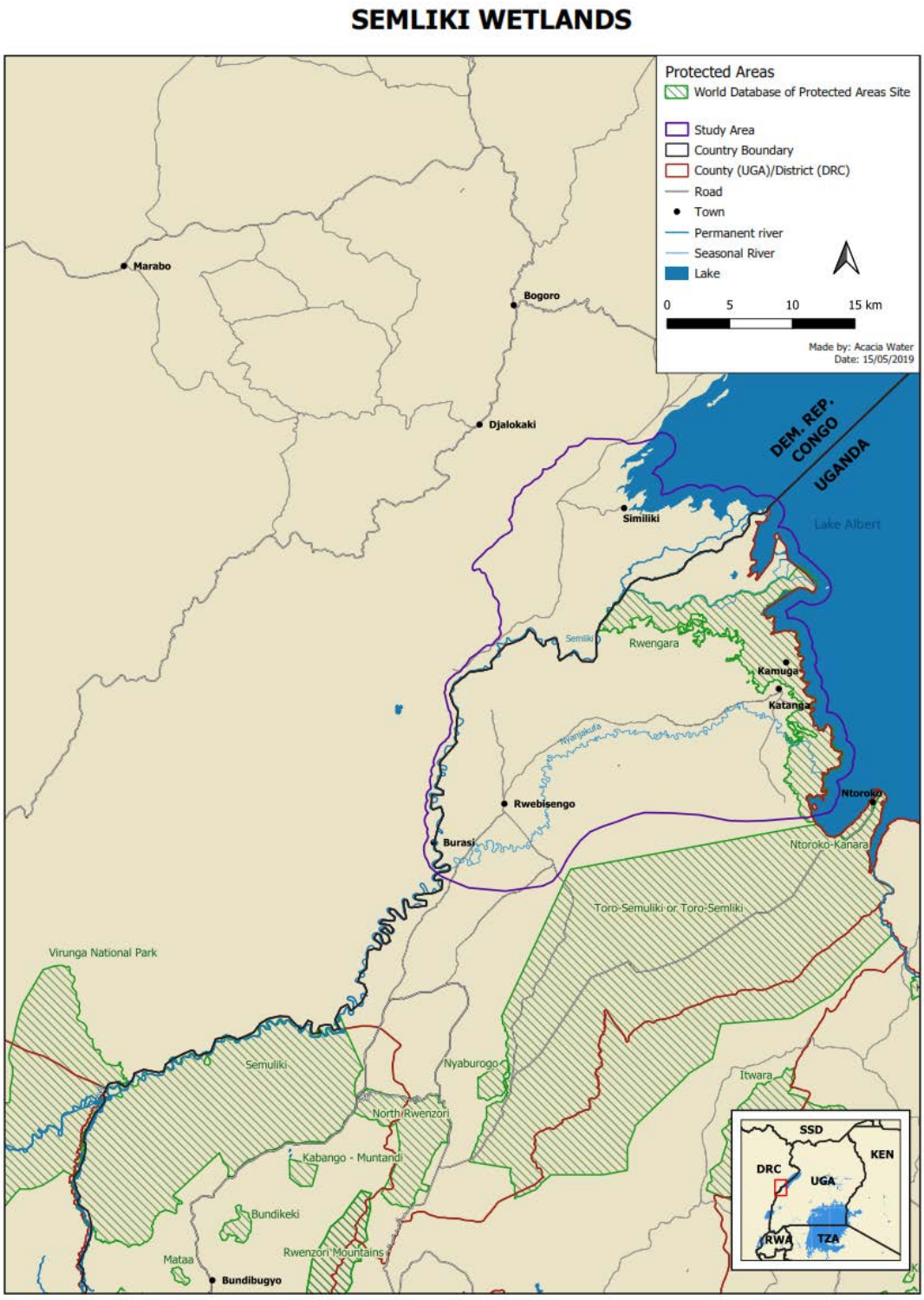
2. BACKGROUND TO THE SEMULIKI DELTA TRANSBOUNDARY WETLAND

2.1. Location and Size

The Semuliki Delta trans-boundary wetland is a stretch of wetland ecosystem located on the border between Uganda and the Democratic Republic of Congo (DRC). The wetland is associated with River Semuliki that drains the western landscape of the Rwenzori Mountains as well as the eastern parts of the DRC including parts of Ituri, Orientale and North Kivu provinces north of Semuliki National Park and south of Lake Albert (MoWE, 2016a).

The designated study area is 60 kilometres long and 15 kilometres wide and measures about 500 km2 (50,000ha). It comprises of parts of the Semuliki flats in Rwebisengo, Bweramule and Kanara Sub-Counties on the Uganda side and parts of Nyacucu, Kalyabugongo, Buguma, Rubungura, Kikoga and Nyanzige Groupings in Ituri province on the DRC side. The north most reach of the study area comprises of the delta-shaped river mouth where the river enters Lake Albert in Orientale Province north of Rukwanzi Island and south east of Bunia including a 1 km buffer zone along the shores of Lake Albert (MoWE, 2016a). The area has both seasonal and permanent wetlands and open water in the river and lake.

The Semuliki Delta Trans-boundary Wetland is a geographic cross-road and comprises of a transition between the tropical rainforest in the highlands and dry savannah grassland in the rift valley, wetlands and open water and extensive flat plains punctuated by deep river valleys. This unique geography supports a variety of species including the Congo forest elephant, hippopotamus, crocodiles and the East African grassland species including buffalos, elephants and various species of antelope including the Bay Duiker (*Cephalophus dorsalis*) and the Pygmy flying squirrel (*Idiuus zenkeri*) that are endemic to this area (UWA, 2012). The area is also host to various bird species including the Nkulengu Rail (*Himantornis haematopus*), the Swamp Bulbul (*Thescelocichia leucopleura*), Lemon-bellied Crombec (*Sylvietta denti*), Yellow-throated Cuckoo (*Chrysococcyx flavigularis*) and various species of hornbill (UWA, 2012). Common tree species include the African Iron wood (*Cynometra alexandri*), *Acacia spp* and scattered *Albizzia* trees while *Sedges, Phragmites* and *Borassus* palms (*Borassus aethiopum*) form part of the wetland vegetation along the river and adjoining streams (MoWE, 2016b).



Map 1: Delineation of the Semuliki Project Area on the border between Uganda and the DRC. Adopted from the Draft Semuliki Delta Wetland Management Plan

2.2. Topography and Climate

The Semliki Delta Trans-boundary Wetland lies in the western arm of the East African Rift Valley and is part of the Semuliki Valley located at the base of the Albertine Rift at an altitude of about 600-1000 metres above sea level. The topography is dominated by the Rwenzori Mountains which form the border between DRC and Uganda. The range is about 120 kilometres long and 65 kilometres wide and comprises six massifs separated by deep gorges. There are six peaks in excess of 4,600m, the highest point being Mount Stanley (5,109). The Semliki Delta wetland system is very flat with a mean altitude of around 625 meters above sea level. The escarpment bordering the west side of the Semuliki Delta rises up to more than 1,700 meters amsl.

The Semuliki Delta Trans-boundary Wetland experiences very hot and dry weather during the dry season months of December to March but is wholly or partially inundated during the rain season months of April to May and October to December making it a hard to reach area. The streamflow of Semliki River is mainly determined by direct rain and indirect snowmelt from the glaciers of the Rwenzori Mountain range. The amount of water in the wetland system therefore closely depends on the influence of climate change on the hydrological regimes in the Rwenzoris (NEMA, 2007).

2.3. Human Settlements and Economic Activities in the Study Area

The study area falls within the four sub-counties of Butungama, Bweramule, Kanara and Rwebisengo in Ntoroko District in Western Uganda and parts of Nyacucu, Kalyabugongo, Buguma, Rubungura, Kikoga and Nyanzige Groupings in Ituri province on the DRC side. Seventeen of the twenty parishes in the four sub-counties are located within the delta. Only the four parishes of Bugando in Bweramule sub-county, Kimara and Rwangara in Kanara sub-county and Majumba in Rwebisengo sub-county fall outside the delta.

The 2014 National Census and Household Survey enumerated the population in the four sub-counties at 41,877 and projected it to slightly decline to 41,353 by 2017. The same census projected the total number of households in the delta in 2017 at 4,769. The population on the DRC side was 4,450 persons living in 967 homesteads (pers. Comm Chief Mugenyi Area Chefferie, Bahema Sud).

Table 1. Semuliki Delta Administrative areas & Population Distribution by Sub-county-Uganda

S/county	No. Of Parishes	No. Of Villages	Male	Female	Population	House Holds	Popn. Density
Rwebisengo SC	5	20	2,448	2,252	4,700	829	10.7
Kanara SC	6	22	4,413	3,887	8,300	1,898	34.4
Butungama SC	6	26	5,419	5,081	10,500	1,590	45.3
Bweramule SC	5	21	3,255	3,245	6,500	1,150	47.2
	22	89	15,535	14,465	30,000	5,467	34.4

Source: ***District Planning Unit (2017projections)***

The area has a large population of livestock including cattle, sheep and goats. Cattle grazing is a major economic activity along the river banks on both sides of the river leading to severe trampling particularly around watering points. The cattle herd and the associated environmental problems have been exercebated by the influx of Hema pastoralists fleeing political instability on the DRC side (MoWE, 2016b). Many people engage in fishing alongside their main occupation of cattle grazing. Harvesting of water reeds is also an important economic activity (MoWE, 2016b).

The Semuliki Delta Trans-boundary wetland is therefore a highly productive ecosystem supplying various ecosystem goods and services. In order for the ecosystem to continue performing its roles, its integrity needs to be maintained, restored or even enhanced through various ecosystem management interventions. This study undertook an economic assessment of the ecosystem services generated by the Semuliki Delta Trans-boundary wetland as an input to the development of the Semuliki Delta Trans-boundary wetland management plan.

2.4. Key Ecosystem Services Generated by the Wetland

The Semuliki Delta trans-boundary wetland supports a large population of livestock particularly through dry season grazing. It also has a thriving fishery supplying both subsistence fisherfolk and commercial fishermen within the wetland and the open water in River Semuliki and Lake Albert. Many fish species breed and spawn in the wetland while others breed in Lake Albert but move to the river and wetland area for the later part of their life cycle.

The set of goods and services generated by ecosystems some of which are indicated above, are collectively termed ecosystem services. Such services, including those that contribute to environmental health and economic production, can be valued in a variety of ways, both as parts of the market system and the economy and outside the traditional economy (Emerton, 1998).

The first category, comprising mostly goods like water, fodder, various foods and fuels may be assessed values based on their direct contribution to the economy and the market system. Such ecosystem services also termed provisioning services relate to the ecosystem's ability to directly provide goods for direct use by households either as food including game meat, crops, wild foods and spices or raw materials including lumber, skins, fuel-wood, organic matter, fodder and mulch; genetic resources, water, biogenic minerals, medicinal resources including pharmaceutical resources. Provisioning services also include energy resources and fuels like peat; ornamental resources, biomass including fashion, handicrafts, jewelry, pets, worship and decorations like feathers, orchids, butterflies, aquarium fish, shells to mention but a few Emerton, 1998).

Most provisioning services have market prices and derive market based values. Some provisioning services however, don't directly participate in the market system, and hence have no market value or price. Assessing their value, though built around the market system, involves computations based on substitutes or compliments using market analysis (Emerton, 1998).

The second category of ecosystem services are regulating services. These include the ecosystem's capacity to control climate and diseases in a fairly direct and immediate way. Some regulatory services include water flow control and purification, erosion control, waste regulation, climate regulation and natural hazard regulation covering mitigation of droughts, storms and floods. Supporting services on the other hand have indirect but also longer term impacts on the functioning of the whole ecosystem. Ecosystem services even when they seem provisioning or regulatory like erosion control become supporting in the long-term. Typical examples of supporting services include primary production,

nutrient cycling and water cycling, Supporting services are typically necessary for the production of all other ecosystem services (LVBC, 2015).

Cultural services include a range of non-material benefits people get from the ecosystem. They encompass spiritual enrichment, cognitive development, reflection, recreation and aesthetic experience. They hence touch on issues of cultural diversity, knowledge systems, educational values, social relations, sense of place, cultural heritage and various aspects of cultural and eco-tourism (LVBC, 2015).

This study focused on about thirteen priority ecosystem services including fisheries resources, papyrus and other craft materials including water reeds, grass, thatch; medicinal plants and food materials including palm wine, fuel wood, dry season grazing of livestock, water supply for domestic and livestock use, fish breeding, nursery function and productivity and carbon sequestration. Other equally important ecosystem services like flood control, regulation of water quality and quantity, ecotourism and aesthetic, religious and educational values were not computed because of lack of secondary data and the requisite time to generate primary data.

Table 2: Key Ecosystem Services Evaluated during the Study

Ecosystem Service	Methods/Approaches Used to Evaluate	Reason Service was Selected
Fisheries resources	Field Survey and Market Analysis- average HH use of the provisioning service and market prices derived through the HH survey	Important to community nutrition needs and HH incomes. Major livelihood activity
Wetland reeds (phragmites)	Field Survey and Market Analysis - average HH use of the provisioning service and market prices derived through the HH survey	Part of an important cultural practice of reed fencing. Widely exploited and is a major livelihood activity.
Wetland vegetation for thatch	Field Survey and Market Analysis - average HH use of the provisioning service and market prices derived through the HH survey	Important input to local housing and is widely used.

Wetland vegetation for handicrafts	Field Survey and Market Analysis - average HH use of the provisioning service and market prices derived through the HH survey	Part of an important cultural practice of basket weaving and marriage gifts. It is also an important livelihood activity especially for women
Medicinal plants	Field Survey, Key Informant Interviews and Market Analysis	Was critical to healthcare and treatment of ailments in the remote delta environment. Increasingly important livelihood activity.
Palm wine	Field Survey, Key Informant Interviews and Market Analysis – personal observation and assessment of sales in major outlets	This is an important local beverage and is part of the cultural package for dowry. Potential for product development and incomes.
Fuel-wood	Field Survey and Market Analysis - average HH use of the provisioning service and market prices derived through the HH survey	Important for nutrition security and livelihoods. Used by all HH in the delta.
Dry season grazing (value addition through beef, milk, sheep/goats)	Field Survey, Population and HH data Analysis and Market Analysis	Was a major economic activity in the delta.
Water supply for domestic and livestock use	Field Survey, Population and HH data analysis and price analysis	Critical ecosystem service especially during the dry season.
Fish breeding and nursery function	GIS mapping, benefits transfer	Important service for sustaining the unique fisheries of Lake Albert.
Carbon sequestration	Benefits transfer	The delta is a fragile ecosystem and is prone to the impacts of climate change. There are deposits of peat in the delta.

2.5. Threats to the Semuliki Delta Trans-boundary Wetland

The major threats to the Semuliki delta trans-boundary wetland include increasing human and livestock population pressure, unsustainable land use practices including overgrazing, river bank,

lakeshore and wetland degradation, siltation of the river and eventually the lake, pollution of the water system and the resultant deterioration of the quality and quantity of the water in the area and invasive plant species. The root causes of the above mentioned threats include weak institutional capacity for water resources management and weak or lack of sound governance for water resources management and cross cross-cutting issues including climate change and variability; high illiteracy rates and rampant poverty and disease in the area.

3. METHODOLOGY AND APPROACH TO THE STUDY

3.1. Literature Review

The detailed methodology involved an initial review of literature to understand the study area covering its hydro-geology, vegetation and human settlements. The review aimed at understanding the relationship between households, the environment and livelihoods and constructed a conceptual framework based on household use and consumption of wetland resources to impute a value for the Semuliki Delta Trans-boundary wetland. The review noted that wetlands produce both tangible and non-tangible goods, services and factors of production that support a variety of community livelihoods and peoples' well-being (Bishop, 1995). Most tangible goods like fish and fuel-wood are assessed an obvious economic value by the market. Some, like medicines, handicraft materials and wild meat are however under assessed, or not valued at all because they are not commercialised. Most non-tangible goods and services on the other hand are never assessed an economic value by the conventional market. They are non-traded and not commercialised. These are assessed economic values through a special procedure called economic valuation.

Economic valuation refers to techniques and methods used to assign economic values to the goods and services from environmental resources including wetlands. The key purpose of economic valuation is to correct the prices of natural resources so that they correspond to the true economic value household derive from using them. The techniques for valuing wetland assets are divided into two groups. The first group involves adducing the value of wetland assets by asking people the value they attach to the various wetland goods and services. This group of techniques is also called the Contingent Valuation Methodology (CVM). The second category of methods are the production function approach. This category of methods envisages situations where the well-being or utility of individuals is produced by a production process in which both private goods (x_1…..x_2) and wetland resources (Q) are used as inputs in generating an output (q).

$q = \phi (x_1 \ldots, x_2, Q)$.

In some applications ϕ may be a real physical production function, and q may be measurable, while in other cases q is simply a factor contributing to the well-being of the individual. If Q is wetland pasture and x's represent purchased and hired inputs in livestock production as well as the farmer's own labour, q would be measured by livestock output and we would speak of ϕ as a household production function. The value of the contribution of the wetland is then assessed as a fraction of the market price of the output.

3.3. Field Surveys, Meetings and Key Informant Interviews

The study involved a methods development workshop during which stakeholders discussed and agreed on a range of approaches and methods that would be used to collect the data necessary for the computation of the values of various wetland goods and services. The workshop also agreed on a number of wetland goods and services that were to be assessed based on the following criteria:

(i) Whether the ecosystems service was important and relevant to key national economic imperatives including household incomes, economic development and human well-being;

(ii) Whether the ecosystems service addressed underlying development and poverty issues in the study area;

(iii) Whether the ecosystem service was important and relevant to a large number of households;

(iv) The likelihood of obtaining sufficient good quality data to enable computation of economic values.

The other factors that were considered were whether the ecosystem service was particularly important or widespread or generated significant local benefits. Table 2 below includes the list of ecosystem services that were valued, the methods used, key data needs and important biophysical interactions in the wetland system.

Table 3: Summary of Wetland Goods and Services- Semuliki Delta Trans-boundary Wetland

Ecosystem Service	**Valuation Method**	**Key Data Needs**	**Information on biophysical linkages and causality**
Fisheries resources as table fish or for bait	Market pricing	User population, harvest/catch volumes, prices of sale and labour input, harvest frequency, taxes and levies	Biophysical information on sustainable yield
Non fish wetland products including medicines, papyrus and other craft materials, wild foods, sand, clay and fuel-wood	Market pricing and Substitute pricing	User population, harvest/catch volumes, prices of sale and labour input, harvest frequency, taxes and levies	Vegetation cover and distribution, proximity to settlements (using GIS generate a demand gradient based on distance from the wetland)
Dry season grazing and provision of fodder	Effect on production-contribution to annual livestock production; replacement cost or cost of alternative feeds	Number of livestock in the wetland; time in wetland, productivity, forage volumes	Carrying capacity; growth rates/response
Water supply for human consumption	Availability; flow regulation, quality and the associated	% contribution of wetland to water availability	Contribution of wetland to water availability rather

	savings in time, effort and distance		than total value of water in the wetland
Water supply for livestock	Availability; flow regulation, quality and the associated savings in time, effort and distance	% contribution of wetland to water availability	Contribution of wetland to water availability rather than total value of water in the wetland
Farming (fringe)	Market pricing	User population, harvest volumes, prices of sale and labour input, harvest frequency, taxes and levies	Biophysical information on yields
Flood control	Benefits transfer with a validation; avertive expenditure like on elevated pit latrines; mitigative expenditure	Cost of avertive/mitigative materials and cost of labour	Which % of the wetland contributes to the service; flood risk and impacted population
Fish breeding and nursery function and productivity	Effect on production	Catch in Lake Albert, segregated species in catch, value of various catches; % contributed by wetland (wetland dependent)	Fisheries biology and catch composition/ by species; volume and weight; wetland dependence for breeding and nursing, distance to open water

Regulation of water quality and quantity	Benefits transfer with validation, look at water use/user population versus water treatment costs	Water user population	Water quality data, profile the cost of water treatment
Carbon sequestration	Market price	Areas under different vegetation types; above and below ground biomass; alternative land uses; land use change over time	Voluntary market price of carbon
Habitat value	Benefits transfer with a validation	Animal populations and biodiversity richness	Potential tourism value
Ecotourism	Benefits transfer with a validation using CVM approaches	Tourist attractions	Potential tourism value
Aesthetic, religious and educational values	CVM approaches	Beneficiary population and attributes	Stated preference approaches

Field interviews, meetings and key informant interviews were undertaken on at-least ten (10) respondents per sub-county using a structured questionnaire for the Ugandan side. The respondents were selected using purposive random sampling techniques to improve representation. Key informant discussions substituted for interviews on the DRC side due to insecurity and restricted accessibility. Focus group discussions were also conducted to determine the type, quantity, frequency and price of wetland resources households used in the area.

Key information on the population including number of households, household size, livestock types and numbers, productivity including milk yield per animal, prices of milk and livestock, uses of other goods from wetlands including fish, water reeds and palm wine was obtained from district reports in Ntoroko and key informant interviews of Local Council Chairpersons for Uganda and the area Chefferie for the DRC side. Benefits transfer techniques were however, used to compute the value of fish spawning and breeding and carbon sequestration.

Data on the economic value of the delta for dry season grazing was collected by estimating the number of households that rely on the wetland for that purpose. This was computed from detailed population information in the Ntoroko district development plan and administrative information for Uganda and the DRC respectively, Total livestock units per household, milk production, livestock prices and periodic sales were estimated through the field survey. Combinations of field surveys, review of official documents and key informant interviews helped generate information on the other wetland ecosystem services assessed in this study.

3.4. Data Analysis

The data and information generated in the study was collated and captured into an MS EXCEL spreadsheet to generate mean monthly and annual physical productivity and use of the various wetland ecosystem services per household. The annual physical productivity of the wetland was then translated into the annual economic production equivalent using market analysis. This was further translated into annual income implications for the wetland neighbouring and dwelling communities in the villages in Uganda and the DRC. The total annual income implication was derived by multiplying the mean economic production equivalent of the wetland by the total beneficiary households. The only cost implication of managing the wetland that was identified and computed was lost livestock due to crocodile attacks. No costs beyond this were identified or costed as they were non-existent. An extended C-B analysis was however, not undertaken to determine the net value and savings the

wetland generated to the wetland neighbouring and dwelling households due to lack of reliable time series data.

3.5. Scenario Modelling and Key Assumptions

The study proposed two dynamic models to assess the impact of investment interventions in the wetland. The first scenario also termed Business As Usual (BAU) assessed the changes in the wetland ecosystem under a regime of zero management intervention and no dedicated ecosystem management plan. This scenario, using the results of this valuation as the baseline saw decline of the ecological functions and values of the wetland as more degradation took place. The second scenario, described as Wetland Conservation and Wise Use (WCWU) envisaged the development, financing and effective implementation of a trans-boundary wetland management plan that led to the recovery and eventual improvement of the ecosystem and growth in the quantity and quality of the ecosystem services the wetland generates to households and the general public.

The study assumed three key outcomes, one that development of the Semuliki Delta Trans-boundary wetland management plan would stimulate fund flows into the management of this important ecosystem, two that a number of key conservation parameters and biophysical indicators would improve in response to the management plan interventions and three that this would aggregately increase the economic value of the wetland.

4. STUDY FINDINGS: THE ECONOMIC VALUE OF WETLAND GOODS AND SERVICES

4.1 The Economic Importance of the Semuliki Delta Trans-boundary Wetland

The Semuliki Delta Wetland system supports many economic development activities involving both the public and private sectors. These include small scale cattle grazing, rearing of sheep and goats, fishing, trading and urbanization and artisanal mining especially on the DRC side. The per capita contribution of wetland provisioning services was Ushs 4,017,958 or about USD 1,100 in direct household incomes. This was well above the national GDP per capita estimate for Uganda of USD770 in 2019 (IMF, 2019). This income opportunity is probably responsible for the rapid transformations in the delta. There were many upcoming urban growth centres and road construction projects in the area with the overall impact of drawing more settlements into the delta. The notable urban growth centres in the delta included Rwebisengo, Kibuku, Ntoroko or Kanara, Nyakasenyi and Kyabukunguru on the Ugandan side and Nyacucu, Kalyabugongo and Kikoga on the DRC side.

The urban growth centres, this study noted, have increased demand pressure on local wetland resources like fuel-wood, water and fencing and construction materials including water reeds, sand and clay (MoWE, 2016b). Recent influx of displaced persons from the DRC led to the increase of both people and livestock in the delta on the Ugandan side. The total livestock population was estimated at over 119,225 heads of cattle, 94,840 goats and 7,124 sheep accounting for over 67 percent, 70 percent, and 46 percent of the respective categories of livestock units in Ntoroko District. The livestock numbers on the DRC side were 24,150 cattle, 800 goats and 10,000 sheep.

The delta is very rich in fish biodiversity and is considered one of the most productive water systems in the Albertine graben. The most widely distributed fish species in the area included Oreochromis niloticus (Nile tilapia or ngege), Bagrus docmak (catfish or semutundu), Protopterus aethiopicus (lungfish or mamba) and Clarias gariepinus (mudfish or emalle) and several species of haplochromine species (nkejje). Some species like Alestes baremose (Angara), Malapterus electricus (electric cat fish),

Hydrocynus forskali (tiger fish or ngassa), Distichodus niloticus and Brycynus nurse (muzri) are endemic to the delta, Lake Albert and a few other rivers that directly flow into the lake. Other fish species of less commercial importance but high nutritional value occurring in small numbers include Barbus spp, Mormyrus spp and Labeo spp (NaFIRRI, 2012). Some of these fish species including Barbus atrianalis and Clarias gariepinus are anandromus and migrate upstream into rivers and streams including River Semuliki to breed and spawn in riverine wetlands. There are also fish species that breed in the open deep waters. Their juveniles swim to shallow, sheltered, food-rich and less predation prone areas (NaFIRRI, 2012).

4.2. Wetland Goods

4.2.1. Fisheries Resources

This study assessed the value of fisheries based on household fish consumption and fishing activities. Fishing is informally done alongside cattle grazing in the sub-counties of Butungama, Rwebisengo and Kanara and the Groupement (Groupings) of Nyacucu, Kalyabugongo, Buguma, Rubungura, Kikoga and Nyanzige and along River Semuliki and in Lake Albert. The informal fisherfolk catch fish mainly for home consumption but ocassionally sell off excess catches. Some people howver, engange in fishing formally and pay for the necessary local licences and permits. This category of fisherfolk are about 8,000 persons in number with about 470 boats and use nets, hooks, baskets or spears as fishing gear. The key fish species caught include tilapia, cat fish, mud fish, hydrocynus, Alestes spp, Brachynus and various haplochromine species.

Photo 1: Fishing Activities at Rwangara Landing Site in the Semuliki Delta

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

Table 4: Fish Catch Estimates Based on Household Information

Sub-county-Uganda	No. of delta dependent HHs	Daily Catch Estimate (kgs)	Annual Catch Estimate (kgs)
Butungama	1,981	5,943	2,169,195
Kanara	896	2,688	981,120
Rwebisengo	831	2,493	909,945
Sub-Total	3,708	11,124	4,060,260

Groupement-DRC			
Nyacucu	108	324	118,260
Kalyabugongo	217	651	237,615
Buguma	87	261	95,265
Rubungura	141	423	154,395
Kikoga	370	1,110	405,150
Nyanzige	43	129	47,085
Sub-Total	966	2,898	1,057,770
Grand Total	4,674	14,022	5,118,030

The total catch estimate translated to a household catch value of Ushs 25,590,150,000 per annum for the market price of Ushs 5,000 per kilogram at the landing site. The economic value of this fishery considerably increases when you consider the associated intermediate activities and industries including salting and sun-drying of fish, transportation and distribution to various markets including Fort portal, Bundibugyo and the DRC and the associated employment implications. The value of fish bait was not estimated as this was not an important economic activity in the area.

4.2.2. Papyrus and other Craft Materials

This category of wetland resources include water reeds (*Phragmites australis*), various sedges including papyrus (*Cyperus papyrus*) and typha (*Typha latifolia*). They are water tolerant, fast growing, herbaceous perennial plants with a very wide range of traditional but also modern uses. They are used as food, in medicinal applications and for thatching, weaving, fencing and in various arts and crafts and music instruments. The most used reed in the delta was *Phragmites australis* (*engoro* in the local dialect) for fencing and other construction. The value of the delta for supplying papyrus and other craft materials was computed in two parts. The first part used household survey data on the harvest, use and sale of water reeds (*Phragmites australis*). The second part used benefits transfer to estimate the aggregate use value of sedges and typha for thatch and handicraft materials.

The study noted that water reeds were harvested for sale or own use by households. The estimation of harvest volumes was therefore based on the total number of beneficiary households and the number of times they harvest or buy water reeds in a year. This survey estimated that about five thousand seven hundred thirty five (5,735) households were involved in harvesting or using water reeds in the four sub-counties of Butungama, Bweramule, Kanara and Rwebisengo and the six Groupings of Nyacucu, Kalyabugongo, Buguma, Rubungura, Kikoga and Nyanzige. The rate of use was estimated at 2,000 reeds per household per annum valued at approximately Ushs 229,400,000 in gross value terms.

Photo 2: Use of Water Reeds for Outdoor Fencing

The value of the delta for supplying sedges and papyrus for thatching and other uses was computed using benefits transfer techniques. Previous studies in similar wetland areas in Uganda suggest that around a quarter of the population use typha or papyrus for thatching their houses and for other handicrafts (Emerton et al 1999; Emerton and Muramira, 1999, Akweteireho et al, 2011). The studies estimated that the annual use value of papyrus and sedges for thatch was USD 149 per household per annum and USD 171 per household per annum for handicrafts and other uses. The annual use value of the Semuliki Delta Trans-boundary Wetland for the two categories of ecosystem services was therefore Ushs 635,488,725 and Ushs 729,319,275 respectively.

4.2.3. Medicinal Plants and Food Materials

Many wetland adjacent communities in the study area indicated that wetlands are important sources of medicinal plants and remedies and food for household health and food security. Wetland sourced medicinal plants were used to treat a range of disorders and hence significantly contributed to the socio-economic status and well-being of wetland dependent communities. Wetlands are recognized as an important habitat and source of many medicinal plants (Horwitz and Finlayson, 2011; Kumar et al, 2011; Leaman, 2016). The value of the wetland for wild medicines and remedies was determined using benefits transfer techniques. The World Health Organisation estimated that about 80 percent of the population in developing countries largely depend on herbal medicines and remedies for treating various diseases (WHO, 1995, Tabuti et al, 2003). Other studies estimated that the use of medicinal plants and remedies saved households up to USD90 per annum (Kakuru et al. 2013; Kateyo et al. 2014; MWE 2015). Data from these studies suggested that the total use value of wild medicines and remedies in the delta was in the range of Ushs 1,228,327,200 per annum.

In addition to medicinal plants and animals and fish, wetlands provide a variety of fruits, roots, tubers, leafy material and bush meat for food. Some of the food is in the form of beverages. This study valued the production of alcoholic beverages from palm trees as one of the provisioning ecosystem services of the Semuliki Delta Trans-boundary wetland. The value of palm wine produced in the delta was estimated using consumption data computed for the two major outlet categories including local retail bars and weekly livestock markets (vandus). Photo 4 shows people enjoying palm wine at a local bar in Rwebisengo while Tables 5 and 6 include palm wine sale data for local retail bars and weekly livestock markets (Vandus) respectively.

Photo 3: Local Palm Wine Bar in Rwebisengo in the Semuliki Delta

Table 5: Consumption Data for Local Retail Outlets/Bars

Location	No of bars	Daily Sales (L)	Price/L	Total Value Annual Sales
Rwebisengo	2	120	2000	87,600,000
Nyakasenyi	1	60	2000	43,000,000
Kyabukunguru	1	60	2000	43,000,000
Kibuku	1	60	2000	43,000,000
TOTAL	5	300	Na	219,000,000

Table 6: Consumption Data in Local Livestock Markets (Vandus)

Location	Total Sales/Market Day in Litres	Market days/month	Price/L	Total Value Annual Sales
Rwebisengo	2000	1	2000	48,000,000
Nyakasenyi	2000	1	2000	48,000,000
Kyabukunguru	2000	1	2000	48,000,000
Kibuku	2000	1	2000	48,000,000
TOTAL	8000	4	Na	192,000,000

Local palm wine is not an important product of the delta on the DRC side because of limited number of palm trees. The total value of palm wine consumed in the delta per annum was therefore Ushs 411,000,000.

4.2.4. Fuelwood

Various studies have discussed the use of firewood as a primary source of domestic cooking fuel (Bush et al. 2004; Muramira T.E. 2011; NEMA 2017 and UBoS 2010). The studies indicate that between 77 to 90 percent of Ugandan households use firewood or charcoal for cooking. This has exerted very high pressure on wood resources even in the wood land areas in the country. This study estimated that 100 percent of the households in the Semuliki delta depended on wetland sourced fuel wood for their domestic cooking needs. Field interviews indicated that households on average used a head-load of fuelwood valued at Ushs 2000 every two days for domestic cooking purposes. This compared very well with previous studies that estimated domestic fuel-wood consumption values of USD 45 cents per household for the same time (Muramira T.E 2011; Akweteireho et al, 2011; Kateyo et al. 2014). Based on field data and benefits transfer techniques therefore, the total household use value of fuelwood sourced from the Semuliki Delta wetland was estimated at Ushs 1,706,010,000 per annum.

4.2.5. Dry season grazing

The Semuliki Delta Trans-boundary wetland supports livestock including cattle, goats, sheep, local chicken. The major livestock populations however, are cattle with 99 percent being indigenous local breeds. Eighty three percent of the milk produced by the cattle is consumed at household level while only 16.8 percent is sold in the town councils of Rwebisengo, Kanara, Kibuku and Karugutu. Cattle, goats, sheep and chicken are also sold in open air livestock markets (Vandus) usually for subsequent slaughter and sale of meat to generate income for the households. Table 3 below indicates the total livestock units for the three key categories of livestock in the delta.

Table 7: Total Livestock Units in the Delta on the Ugandan and DRC side 2018

Sub-County-Uganda	Cattle	Goats	Sheep
Butungama	49,525	39,620	2,972
Bweramule	26,525	21,220	1,591
Kanara	22,400	17,380	1,344
Rwebisengo	20,775	16,620	1,247
SUB TOTAL	119,225	94,480	7,124
Groupement-DRC			
Nyacucu	2,700	100	1,300
Kalyabugongo	5,425	190	2,500
Buguma	2,175	80	900
Rubungura	3,525	160	1,662
Kikoga	9,250	200	3,000
Nyanzige	1,075	70	638
SUB TOTAL	24,150	800	10,000
GROSS TOTAL	143,375	95,280	17,124

This survey established that on average, 20 percent of individual cattle herds in the delta are milking at any one moment. The average milk yield per animal is 1.6 litres per day. For a total cattle population of 143,375 in the delta, 28,675 cows are therefore milking at any one time to give a total milk yield of 45,880 litres per day. Particularly in the extreme dry period of January, February and March, this yield is sustained by dry season grazing in the delta. During this period, milk prices also increase from the usual ushs 1,000 per litre during the rains to Ushs 2,000 per litre generating a total of Ushs 8,373,100,000 in milk production values for the first dry quarter of the year (3 months of January, February and March).

Photo 4: Livestock in the Semuliki Delta Trans-boundary Wetland

The other value is associated with sale of cattle for meat. Whereas many local herdsmen detest selling off their cattle because of prestige and cultural beliefs, cattle are sold to generate income to pay for education, health care, food and other essential household needs. This survey established that cattle keepers in the delta sustain an average annual off-take of 50 percent of the herd to leave the milking mothers and young stock to renew the herd. The average price of cattle in the cattle markets was Ushs 1,700,000 per head of cattle but prices ranged from Ushs One million for heifers to Two million five hundred thousand for bulls. The value of the annual off-take of cattle at the average price of Ushs 1,700,000 was Ushs 121.9 billion. If a quarter of this value is attributed to the dry season grazing

provision of the wetland, then the beef production value of the wetland is Ushs 30,467,187,500 per year.

Goats and sheep are also sold in the open air livestock markets in the area (vandus). The average price of goats and sheep was Ushs 250,000. A sustainable off-take of 50 percent of the total goat and sheep stock was indicated generating a total sale value of Ushs 14,038,000,000 per annum. If the same argument of 25 percent attribution of value to dry season grazing is upheld, the total goat and sheep sale value attributed to dry season grazing was Ushs 3,509,500,000 per year for the delta.

4.2.6. Water supplies for domestic and livestock use

The economic value of the delta for fresh water storage and supply was estimated using data collected on household dependence on wetlands for the purpose. Wetlands were the only source of water for domestic use at both the household and community level in the delta particularly in the dry months of January, February and March. In the rainy season, people had the option to tap rain water and use it for their domestic water supply. This option ceased during the dry season and all water supplies reverted to wetlands. The average consumption of water per household per day was estimated at 3 (20 litre) jerrycans costing Ushs 500 each implying a household use value of water supplies of Ushs 630,990,000 each year. Field data on water supplies for livestock use on the other hand indicated that about 143,375 heads of cattle entirely depended on the wetland for their water supply in the dry months of January, February and March. For the consumption rate of 2 jerrycans per livestock unit per day, the total value of water supplies for livestock was estimated at Ushs 12,903,750,000 each year.

4.5. Wetland Services

This economic assessment initially targeted to estimate economic values for six categories of wetland regulating, supporting and cultural ecosystem services including flood control and attenuation, fish breeding and nursery function, regulation of water quality and quantity, carbon sequestration, habitat values and ecotourism, aesthetic, religious and educational values. Data constraints, time and other resource limitations however, precluded the assessment of some ecosystem services. Data limitations also prevented proper and accurate delineation and attribution of some wetland functions to generate

plausible results. Ecoturism, aesthetic, religious and educational values required a vibrant tourism visitation environment and time and other resources to undertake a Contingent Valuation exercise. These were all not possible. The assessment therefore used benefits transfer techniques to impute values for fish breeding and nursery function and carbon sequestration which are presented below.

4.3.1. Fish breeding and spawning values

Many fish species in Lake Albert and the Semuliki delta system including Alestes baremose (Angara), Malapterus electricus (electric cat fish), Hydrocynus forskali (tiger fish or ngassa), Distichodus niloticus and Brycynus nurse (muzri) spawn and breed in the shallow waters of Lake Albert and the riverine wetlands connecting to the lake. Others like Barbus atrianalis and Clarias gariepinus migrate upstream into rivers and streams to spawn and breed while others spawn and breed in the open deep waters of the lake, but have their juveniles to migrate to the shallow, sheltered, food-rich and less predation prone areas in the delta for part of their growth cycle.

Photo 5: Fish Breeding Rivulets in the Delta

The spawning and breeding function of the delta was estimated using benefits transfer from a study by Kakuru, Turyahabwe and Mugisha (2013) referring to Turpie (2000) in which he estimated the value of the habitat-fishery linkage of wetlands to be US$ 6.3 per hectare per year. The fish breeding

and spawning value related mostly to the productivity and recharge of fish populations in the wider open lake as opposed to catch improvements in the wetland system. This ecosystem supporting service is therefore discernible from the fish provisioning one and is not double counting. The annual fish spawning and breeding value of the delta was estimated at Ushs 1,149,750,000 for the 50,000 hectares of wetland (Exchange rate of 3650/USD).

4.3.2. Carbon sequestration values

Wetlands are an important carbon sink and play a key role in climate regulation. Their ability to sequester carbon in now considered in national GHG emissions assessments and private initiatives as a potential source of revenue to manage carbon-balanced landscapes and pay for ecosystem services. This is even more important since the Semuliki delta is known to have peat deposits of commercial value.

Previous studies indicate that 50-90 percent of wetland carbon is found in the soil and remains sequestered for hundreds of years (Barbier, 2017). Carbon in the plant biomass is stored for several decades. The value of ecosystems as carbon sinks is associated with the measure of all damage caused by an increase in GHG emissions over time. The true price of carbon however would be that established by markets for carbon credits for trade or storage compensation. As there is no "global market" for carbon credits, prices vary considerably across markets and are driven by policies. Barbier (2017) estimated the value of wetland sequestered carbon at USD 413 per hectare in NPV terms. This study however used annual sequestration rates estimated by previous studies in Uganda of 4.8 tC/ha/year for papyrus swamps and the price of USD7.03/tCO_2e for issued credits from Climate, Community and Biodiversity Standard (CCBA), Verified Carbon Standard (VCS) and Reduced Emissions from Deforestation and Forest Degradation (REDD+) projects and a factor of 3.67 to convert between tC and tCO_2e (see MWE, 2015, Mitsch et al. 2012; Chidumayo 2013; LTS 2013). This gave the annual carbon sequestration value of the delta at about Ushs 3,214,920,000.

5. SUMMARY OF WETLAND ECONOMIC VALUES AND THEIR DISTRIBUTION

5.1 Summary of Wetland Economic Values

Table 7 below lists the key wetland goods and services derived from the Semuliki Delta Wetland System.

Wetland Goods/Services	Economic Value Ushs/ha/yr	Equivalent US$ /ha/yr Exchange rate 3650/USD	Per capita Value of Wetland ES (Ushs/person/year)	Total Value for the Delta (50,000ha) Ushs
Fisheries Resources	511,803	140.22	1,189,852	25,590,150,000
Papyrus and other craft materials(total for water reeds, thatch and handicrafts)	31,884	8.74	74,125	1,594,208,000
• Water reeds	4,588	1.26	10,666	229,400,000
• Thatch	12,710	3.5	29,548	635,488,725
• Handicrafts	14,586	4.0	33,911	729,319,275
Medicinal Plants and Food Materials (total for medicinal plants and palm wine	32,787	9.0	76,223	1,639,327,200
• Medicinal plants	24,567	6.7	57,113	1,228,327,200
• Palm wine	8,220	2.25	19,110	411,000,000
Fuel-wood	34,120	9.35	79,323	1,706,010,000

Dry season grazing (Total Milk Values, Beef, Goats and Sheep)	846,996	232	1,969,117	42,349,787,500
• Milk values	167,462	45.88	389,320	8,373,100,000
• Beef values	609,344	167	1,416,617	30,467,187,500
• Sheep and goats	70,190	19	163,180	3,509,500,000
Water Supply for Domestic and Livestock Use	270,695	74.2	629,318	13,534,740,000
• Domestic Supplies	12,620	3.5	29,339	630,990,000
• Livestock Supplies	258,075	70.7	599,979	12,903,750,000
Fish breeding and spawning	22,995	6.3	53,459	1,149,750,000
Carbon sequestration values (excluding avoided CO_2emissions)	64,298	17.62	149,483	3,214,920,000

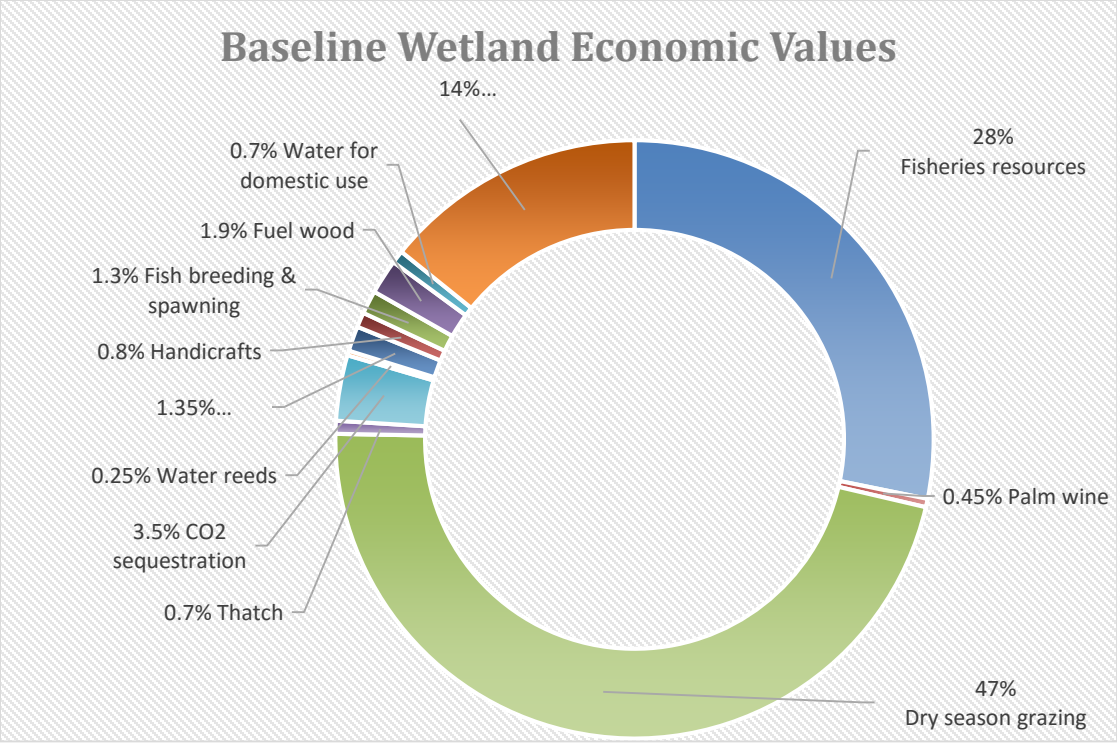


Figure 1: Baseline Wetland Economic Values in the Delta

5.2 The distribution of wetland benefits

An analysis of the distribution of the delta wetland benefits indicates that up to Ushs 1,728,285 per ha per year in gross terms accrued to the local community in the delta through direct and indirect use values. This value however, has to be shared with local authorities through taxes and levies including trading licenses, market dues and movement permits respectively. The average local tax rate in Uganda is about 6.4 % (SEATIN, 2018) implying that only Ushs 110,610/ha/yr goes to local authorities leaving about Ushs 1,617,675 to the household. Little or no revenue trickles to the district or even central government under the current management regimes in the delta explaining government's despondence on the issues of managing the delta.

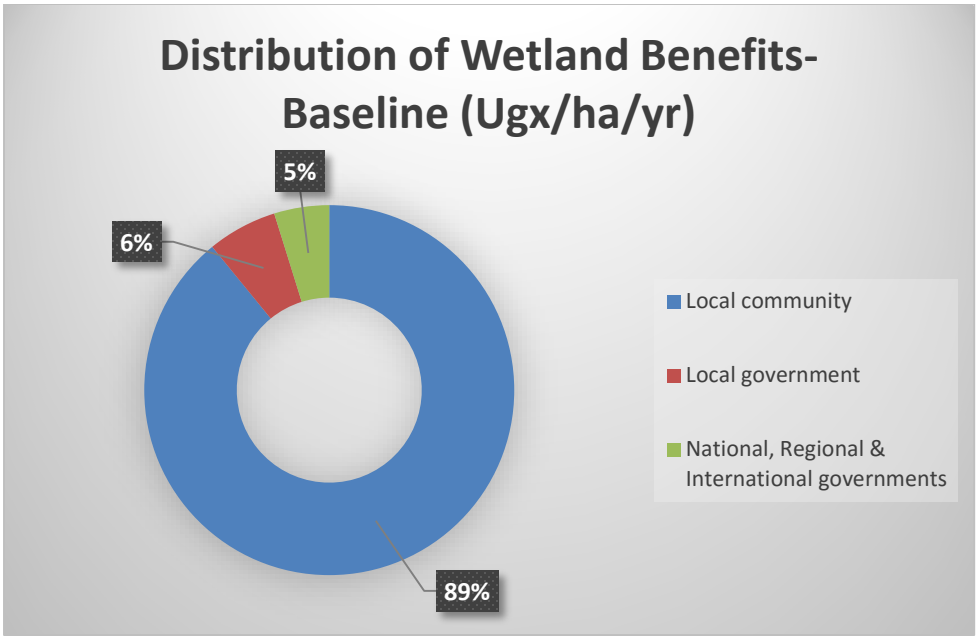


Figure 2: Distribution of Wetland Benefits- Baseline Values (Ushs/ha/year).

None use values including fish breeding and spawning and carbon sequestration totaled Ushs 87,293. The total value was modest because most of the other nonuse values like micro-climatic regulation, flood control, water regulation and discharge, habitat/refugia and recreation/ecotourism were not valued due to lack of data. Though rarely appreciated because of the difficulty of measuring them, non-use values contribute immensely to human well-being through their roles in ensuring ecosystem stability and productivity. They therefore provide a strong planning and policy justification for the conservation and sustainable utilization of wetlands. Nonuse values mostly accrue to off-site beneficiaries including the global community and national and regional governments. They constitute what are called global environmental benefits.

6. THE COST OF MANAGING THE WETLANDS OF THE SEMULIKI DELTA

The sustenance of the Semuliki delta trans-boundary wetland involves some costs. The major costs include the direct costs of managing the wetlands, the opportunity costs foregone and the associated economic losses associated with wildlife attacks and fatalities.

6.1. MANAGEMENT COST

These are the direct management costs expended on policing, protecting or improving the delta. They include management expenditure on staff, equipment, infrastructure, running costs and the costs of other physical inputs associated with managing wetland (Emerton and Muramira, 1999). No substantive resources are currently channeled to the management of the delta on both the Ugandan and DRC sides. The local government allocation in the Ntoroko District Local Government Annual Work Plan 2018/19 was dismal and focused on controlling extractive removal of sand and forest resources from the forestry and wildlife protected areas rather than the delta.

6.2. OPPORTUNITY COSTS

The opportunity cost of managing the Semuliki Delta Transboundary wetland is currently zero since it is not under any form of protection. The opportunity cost of managing a wetland represents the income and other benefits foregone by precluding or diminishing economic activities in a controlled wetland area or reserve. Opportunity costs arise because once wetland areas are strictly protected, they cannot be utilized to support various economic activities by households including cattle rearing and the cultivation of crops. Previous assessments by Emerton and Muramira (1999) estimated the average opportunity cost of maintaining biodiversity in Uganda at USD 69/ha/yr. If the Semuliki wetland delta is put under strict protection, the associated foregone income and other benefits (opportunity cost) would amount to a total of Ushs 12,592,500,000 per year.

6.3. WILDLIFE ATTACKS AND ASSOCIATED COSTS

The wetland is infested with crocodiles that attack and kill livestock and sometimes human beings. The frequency and severity of such attacks varies but it is estimated that crocodiles kill three goats or

sheep per day and kill or injure 2 cows a month across the delta. The loss attributed to crocodile attacks on livestock is in the range of Ushs 273,750,000 for goats and 40,800,000 for cattle or a total of Ushs 314,550,000 per annum across the delta.

7. THE COST OF WETLAND DEGRADATION

This study noted that Uganda's wetlands are under serious degradation pressure resulting from an increasingly higher population and its associated livelihood activities. Population pressure was noted as an important underlying cause of wetland degradation in the Semuliki Delta. The key proximate causes of degradation in the delta included expanding human settlements, over-grazing and trampling particularly at livestock watering points, unsustainable harvesting of wetland resources including water reeds and fish. The aggregate impact was a decline in the quality and productivity of the trans-boundary wetland. The findings confirmed recent concerns that Uganda's wetlands were reducing at an unprecedented rate. The NSOER 2017 estimated that Uganda loses 846km2 of wetland per annum resulting in a decline in wetland area from 13 percent of total land area in 1990 to 8.6 percent in 2015. The same report estimated the annual rate of wetland degradation at 3.74 percent per annum (NEMA 2017).

In order to assess the policy implications of the degradation of the delta, two wetland management scenarios were modeled. The first scenario, the Business As Usual (BAU) modelled continued wetland conversion, degradation and unsustainable exploitation under a regime of zero management intervention and no dedicated ecosystem management plan. This scenario, using the results of this valuation as the baseline saw decline of the ecological functions and values of the wetland as more degradation took place. The second scenario envisaged the development, financing and effective implementation of a trans-boundary wetland management plan that led to the recovery and eventual improvement of the ecosystem and growth in the quantity and quality of the ecosystem services the wetland generates to households and the general public. The WCSU scenario modeled a gradual investment targeting reversal of the wetland degradation rate of 3.74 percent per annum in the medium to long-term. For the delta of 50,000 hectares therefore, an average of 1334 hectares would need to be restored annually over the next 20 years at a previously computed cost of Ushs 2,307,000 per hectare (Prime Africa Consultants 2018).

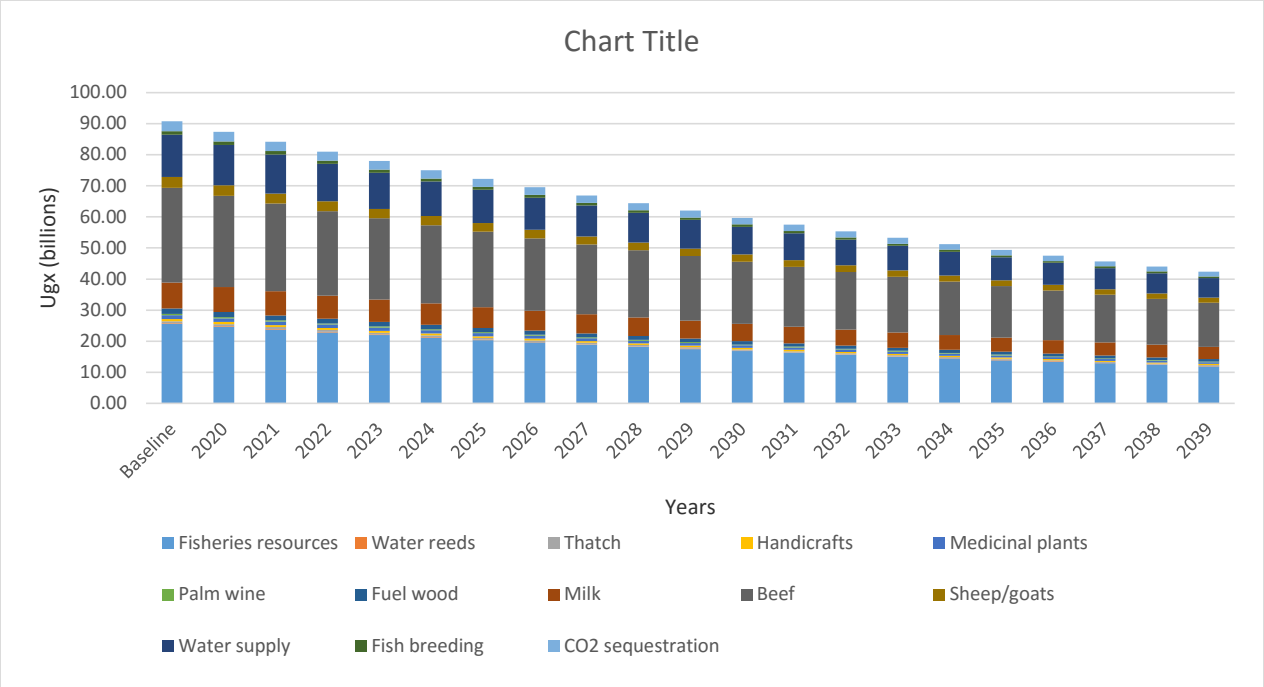


Figure 3: Impact of Degradation on Wetland Ecosystem Services

As indicated in Figure 3 above, the BAU and WCWU scenarios are modeled over a 20 year period using a linear decline in the value of wetland ecosystem services of 3.74 percent per annum. Prices are held constant in spite of scarcity pressure and inflation to simplify the analysis. Policies on land tenure and land use classification are also assumed constant to abstract shocks to the ecosystem. The annual loss in wetland production due to degradation is imputed as the cost of degradation. The present worth of the total estimate of degradation over a 20 year period is computed using a 12 percent discount rate which is the social cost of capital in Uganda.

Table 8: Total and Net Present Value of the Costs of Wetland Degradation 2020 - 2040

Wetland Goods/Services	Baseline Value Ushs	2039 Value (Ushs)	Total Cost Over 20 Years (Ushs)	Net Present Value of Cost (Ushs)
Fisheries Resources	25,590,150,000	11,939,605,527	160,465,724,368	42,213,880,429

Papyrus and other craft materials(water reeds)	229,400,000	107,031,241	1,438,476,803	378,421,548
Papyrus and other craft materials (thatch)	635,488,725	296,500,204	3,984,898,820	1,048,311,364
Papyrus and other craft materials (handicrafts)	729,319,275	340,278,756	4,573,273,147	1,203,667,368
Medicinal Plants and Food Materials (Medicinal plants)	1,228,327,200	573,101,065	7,702,354,770	2,027,482,251
Medicinal Plants and Food Materials (Palm Wine)	411,000,000	191,760,418	2,577,218,685	678,398,396
Fuel-wood	1,706,010,000	795,973,702	10,697,714,959	2,815,947,571
Dry season grazing (Milk Values)	8,373,100,000	3,906,640,291	52,504,403,321	13,815,629,736
Dry season grazing (Beef values)	30,467,187,500	14,215,086,676	191,047,700,442	50,289,272,984
Dry season grazing (sheep and goats)	3,509,500,000	1,637,428,683	22,026,688,497	5,798,543,183
Water Supply for Domestic and Livestock Use	13,534,740,000	6,314,908,530	85,171,009,283	22,340,501,061

Fish breeding and spawning	1,149,750,000	536,439,273	7,209,628,180	1,897,782,383
Carbon sequestration values (excluding avoided CO_2emissions)	3,214,920,000	1,499,986,386	20,159,493,656	5,306,561,019
TOTAL	**90,778,892,700**	**42,353,740,752**	**569,558,584,931**	**163,630,346,864**

Based on recent studies on the cost of wetland restoration in Uganda (Prime Africa Consultants, 2018), the WCWU scenario is then the least cost investment allocation of Ushs 61,550,760,000 over 20 years or Ushs 3,077,538,000 per year to offset the costs of degradation of Ushs 163,630,346,864 over a 20 year period starting in 2020. The proposed cost translated into Ushs 25,774,286,852 in net present value terms (NPV at 12 percent interest rate). Both total and NPV costs of restoration were much lower than the respective costs of wetland degradation as indicated in Table 8 above, justifying the proposed level of investment.

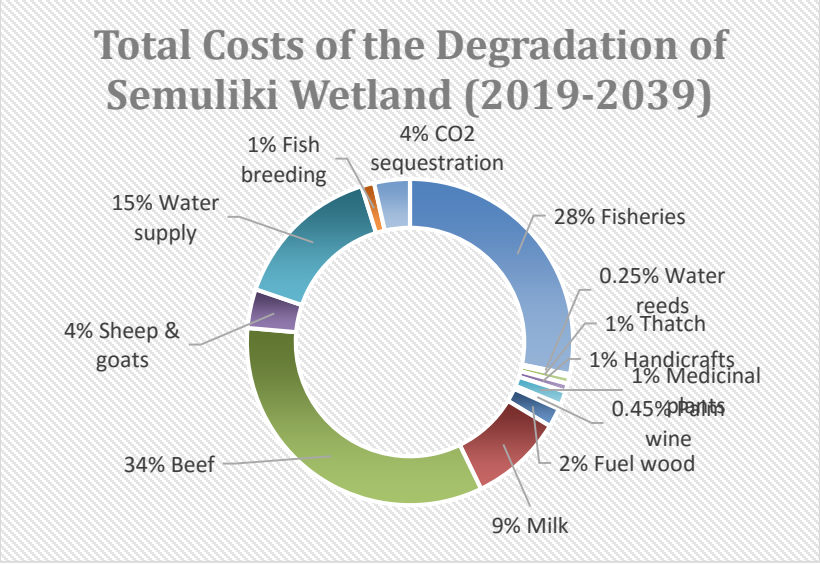


Figure 4: Total Costs of the Degradation of the Semuliki Wetland System

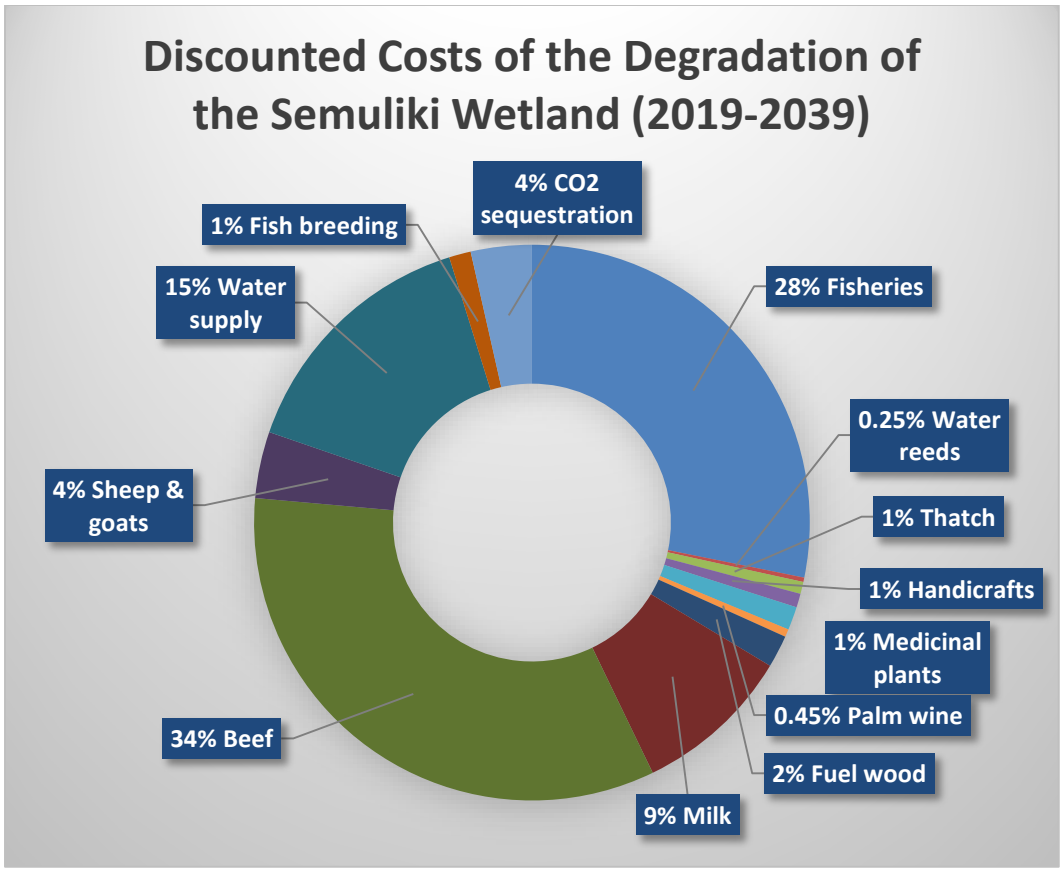


Figure 5: Discounted Costs of the Degradation of the Semuliki Wetland System 2019-2039

8. ECONOMIC ISSUES IN WETLAND MANAGEMENT

8.1 Financing Wetland Management

The Semuliki Delta trans-boundary wetland though a very productive landscape is a very remote area that is little known to most policy and decision makers in both the broader government but also the environment and natural resource sector. Little research interest has been directed at the landscape resulting in paucity of data and information on the issues in the delta. The trans-boundary wetland has hence slipped through the interests of the two national jurisdictions of Uganda and the DRC prior to this current effort.

Livestock and fishing activities dominate the economy of the delta particularly in the dry cattle and fishing zones of greater Rwebisengo, Kanara and Butungama on the Ugandan side and Nyacucu, Kalyabugongo, Buguma, Rubungura, Kikoga and Nyanzige on the DRC side. Table 7 highlights the range of values the wetland generates to both the local and international community. The range and profile of values justify the need to invest in the management of the delta. The implied cost of degradation including lost ecosystem productivity, intensified human-wildlife conflicts and higher opportunity cost of use of the delta further justifies management intervention in the delta. This study provides estimates of the level of resource allocation that could reverse degradation of the delta and further justifies provision of funds to undertake projects and programs that implement both wise use and green water infrastructure concepts in the delta.

8.2. Providing Incentives for Sustainable Resource Use

The key degradation pressures in the wetland include over-grazing and trampling of river banks at livestock watering points, uncontrolled harvesting of water reeds and over-fishing. The three pressures result from the open access use regimes in the delta. Individuals or groups of individuals competitively exploit the resources in the delta with little regard for their sustainable use and conservation.

The delta may be more sustainably used to supply regulatory ecosystem services as demonstrated by their superior values in this study. This implies that households have to alter the way they graze, fish

or harvest water reeds from the delta and adopt practices that reduce their environmental footprint. They can for instance invest outside the delta or improve the sustainability of current wetland activities or introduce new ones. They can engage in fish farming, rearing of improved livestock breeds, growing and trade in improved fodder and silage, the production of high value water reed products and engage in wetland resource marketing (Emerton et al, 1998). This however, comes with improved management of the delta and investment of government resources to develop infrastructure including roads, schools and markets.

Improving the management of the delta however, may imply excluding some users or uses. This will take away current livelihood opportunities from some people. In order to restore their well-being, some economic incentives will need to be provided to cover the opportunity cost resulting from exclusion and to encourage sustainable utilisation. Because sanctions against unsustainable or undesirable wetland use are inequitable, and unlikely to be enforceable, the main potential for ensuring local support for wetland management lies in making available alternative, economically preferable, sources of income and subsistence products (Emerton et al, 1998).

Ultimately it may however be preferable in both conservation and development terms to decrease, rather than increase, local reliance on the wetland. Higher levels of wetland exploitation run the risk of becoming unsustainable. Wetland resources are also often seen as inferior goods by users − they are not preferred activities, but rather provide low return, fallback sources of income and subsistence to groups who have no alternative employment or income opportunities. Efforts may be better directed to diverting local livelihoods away from wetland resources to more profitable and sustainable activities, rather than expanding and adding value to existing utilization (Emerton et al, 1998).

8.3. Wetland Management Plan and Internalizing the Costs of Wetland Degradation

The key costs of wetland degradation in the Semuliki Delta include lost fish breeding and spawning benefits, lost carbon sequestration, water re-charge and storage and eventually lost fish production, lost livestock production and lost production of useful wetland vegetation including water reeds, papyrus and palms. These changes have serious implications for livelihoods. The Semuliki Wetland

Management Plan will therefore need to urgently address the threats to the wetland system while creating new socio-economic opportunities for local communities to preclude imminent environmental disasters in the delta.

The plan will hence adopt an integrated approach to wetland resource management that recognizes the natural resource potential in the delta including their economic and tourism appeal, catchment wide processes and their impacts, and people's livelihoods. The plan will therefore adopt management strategies that take into account the natural ecological linkages, conservation objectives and needs, investment opportunities, requisite research and development and essential government services and interventions and development partner engagements.

9. CONCLUSIONS AND RECOMMENDATIONS FOR POLICY MAKING

The Semuliki Delta Trans-boundary wetland plays a very important role in the economies of the two countries of Uganda and the DRC. The wetland's economic imperatives are seamless and influence local livelihoods, local community survival systems, local authorities, central government and the global community. This study recognized key provisioning services including provision of fish resources, support to dry season grazing and supply of water for both people and livestock among others. Key regulatory, supporting and cultural services were also encountered including CO2 sequestration and fish breeding and spawning services.

Though the delta is very productive, its importance is currently downplayed at all government levels. Its values are not visible and are not captured in decision making. This is because the delta's resources are mostly utilized at the subsistence level. The global values of the delta are also not quantified or valued or understood to attract the attention of planners and policy makers.

Hence undeterred degradation currently costs the local, regional and global economy considerable amounts of resources in excess of Ushs 163,630,346,864 in present value terms. This cost must be offset through targeted investments that will reduce pressure while improving the productivity of the Semuliki Delta Trans-boundary wetland. The study noted that investments in improved livestock breeds, growing and trade in improved fodder, hay and silage, fish farming, production of high value wetland products, wetland resource marketing, improved local infrastructure like roads, schools and community markets will go a long way in reducing wetland resource use pressure while improving the productivity of the delta.

The study therefore provides a business case and justification for the development, implementation of a wetland management plan and allocation of the requisite financial resources in the delta. The study therefore recommends the need to:

(vii) develop a Semuliki delta trans-boundary wetland management plan that builds an economic case for wetland conservation and wise use, with a specific "green" water infrastructure theme;

(viii) promote investments that reduce resource use pressure on the delta's resources including improved livestock breeds, improved livestock feed systems, fish farming, production and marketing of high value wetland products;

(ix) Develop investment proposals to support sustainable development interventions and business support systems covering access to credit, cooperatives, markets, infrastructure, tourism, livestock and fisheries improvement and utilities;

(x) Develop and implement smart water for production models to mitigate the impacts of climate change;

(xi) Recognize and enhance the delta's role as green infrastructure that protects inter-connected ecosystems, ecological corridors and natural landscapes.

(xii) Establish a Semuliki delta trans-boundary wetland management committee to advocate for and mobilise resources for the management of the wetland.

REFERENCES

1. Ackerman, F, and Heinzerling,L. (2002) *Pricing the Priceless: Cost-Benefit Analysis of Environmental Protection* (Georgetown Environmental Law & Policy Institute 2002), available at http://www.law.georgetown.edu/gelpi/papers/pricefnl.pdf.
2. Bush G., Nampindo S., Aguti C., and Plumptre, A. (2004). The Value of Uganda's Forests: A Livelihoods and Ecosystems Approach. Wildlife Conservation Society/ EU Forest Resources Management and Conservation Program/National Forestry Authority, Kampala, Uganda.
3. Emerton, L. 1998. Economic Tools for Valuing Wetlands in Eastern Africa. IUCN Nairobi Pp15.
4. IMF 2003. Uganda: Poverty Reduction Strategy Paper Annual Progress Report. September 2003. IMF Country Report No.03/301. International Monetary Fund. Washington DC.
5. IMF (2019). Uganda Forecast: Nominal Gross Domestic Product (GDP) per Capita. International Monetary Fund. Washington DC.
6. Lake Victoria Basin Commission 2015. Lake Victoria Basin Ecosystem Profile Assessment Report. PREPARED Project Technical Reports. LVBC Kisumu, Kenya.
7. Mugyenyi O., KaggwaR., Kisaame E., and Solomon S., 2011. Marginalisation of Environment and Natural Resources Sub-Sectors. Undermining the Economic Base and Entrenching Poverty in Uganda. ACODE Policy Briefing Paper Series No. 24, 2011. Kampala, Uganda.
8. Moyini, Y. 2001. The Role of Forests in the National Economy. The Case of Uganda. Paper Presented to the Regional Workshop on Valuing Forestry Resources, Mountain Village Resort, Arusha, 4-5, March. 2001.
9. Moyini, Y. and Muramira T. E. 2001. The Costs of Environmental Degradation and Loss to Uganda's Economy with Particular Reference to Poverty Eradication. Published by IUCN EARO and the Government of Uganda. July 2001, Kampala Uganda.
10. Muramira T. E. 1999. Economics for Environment and Natural Resource Management. A Developing Country Perspective. Earnest Publishers, Kampala, Uganda.
11. Muramira T. E. 2001. Valuation of the Impacts of Hydro-power Transmission: the Case of the AES Nile Independent Power Transmission Line Way Leave through Mabira Forest Reserve in Uganda. Paper Presented to the Regional Workshop on Valuing Forestry Resources, Mountain Village Resort, Arusha, 4-5, March. 2001.

12. Muramira T.E. 2004. Assessment of the Economic Value of the Wetlands of Bushenyi District in Western Uganda. Kampala, Uganda.
13. MoWE 2016. The Semuliki Catchment Management Plan. Ministry of Water and Environment, Kampala, Uganda.
14. NEMA 2002. State of the Environment Report for Uganda 2002. National Environment Management Authority (NEMA), Kampala, Uganda.
15. NEMA 2001. State of the Environment Report for Uganda 2001. National Environment Management Authority (NEMA), Kampala, Uganda.
16. NEMA 2009. Atlas of Our Changing Environment. National Environment Management Authority (NEMA), Kampala, Uganda.
17. Neumann, J.E., Amanya C., Strzepek K., M., 2018. Contribution of Water Resources Development and Environmental Management to Uganda's Economy. Guidelines for Benefit-Cost Analysis Project Working Paper No11. Kampala Uganda.
18. Prime Africa Consultants (2018). Assessment and Cost Analysis for Wetland Restoration under the Building Resilient Communities, Wetland Ecosystems and Associated Catchments in Uganda. Study by Prime Africa Consultants, Newlands, Pretoria, Republic of South Africa.
19. Uganda Wildlife Society and GRID Arendal 2010. Uganda's Environment and Natural Resources: Enhancing Parliament's Oversight.
20. UNDP 2017. The Uganda Green Growth Strategy 2017/18 – 2030/31. United Nations Development Program, Kampala Uganda.
21. Yaron G. and Moyini, Y. 2003. The Role of the Environment in Increasing Economic Growth and Reducing Poverty in Uganda. Technical Background Report for the Poverty Eradication Action Plan Revision, Ministry of Water, Lands and Environment, Kampala, Uganda.

ANNEX 1

Questionnaire for Household Heads

for the Valuation of the Semuliki Delta Trans-Boundary Wetland 2019

1. PERSONAL INFORMATION

(i) Name of respondent……..
(ii) Village LCI……
(iii) Parish…….. Sub County……..
(iv) Contact telephone……

2. SOCIO-ECONOMIC CHARACTERISATION

(v) Age of household head……
(vi) Sex of household head……
(vii) Highest level of education attainment……
(viii) Marital status……
(ix) Main occupation…….(if pastoral attempt to quantify number of livestock)..
(x) Income bracket……(weekly, monthly or annual)…….
(xi) Type of dwelling……Permanent, Semi-permanent, Transient)……

3. DEPENDENCE ON THE DELTA WETLAND GOODS AND SERVICES

(xii) What do you obtain from the wetland and how frequently?

Type of resource	Frequency/Week	Quantity (head-load)	Personal use or for Sale
Papyrus			
Roofing material			
Medicines			
Wild foods including honey and fruits etc			
Fodder			
Fuel			

Water			
Sand			
Clay			
Others			

(xiii) How do you use the wetland

Activity	Duration/year	Quantity	Benefit (income or output)
Bee keeping			
Fishing			
Hunting			
Grazing			
Cultivation (fringe)			

(xiv) How much do you spend to obtain a unit of wetland resource (head-load or otherwise)?

Wetland goods	Cost per head load (cash, time spent, distance etc)
Papyrus	
Roofing materials	
Medicines	
Wild foods including honey, fruits etc	
Fodder	

Fuel	
Water	
Sand	
Clay	

(xv) Do you consider wetlands to be beneficial to your household? Please explain.

(xvi) What problems do you associate with wetlands? Quantify.

Type of problem	Extent or quantity of the problem
Diseases like malaria, bilharzia or river blindness	
Vermin (baboons, mongooses, civets etc)	
Insecurity	

THANK YOU FOR PARTICIPATING

ANNEX II

LIST OF PERSONS CONSULTED

1.	Kamuhanda Herbert	District Natural Resources Officer	Ntoroko District
2.	Muhumuza Lameck	District Administration Official	Ntoroko District
3.	Kabagambe Zedekiah	Chairman LC1, Masaka Village	Butungama S/C
4.	Bamulinga Alfred	Resident, Masaka LC1	Butungama S/C
5.	Kaduku Eriphaz	Resident, Masaka LC1	Butungama S/C
6.	Kemigisa Zeinabu	Resident, Rwebisengo	Rwebisengo S/C
7.	Nyakwera Evelyn	Resident, Nyakasenyi	Butungama S/C
8.	Kanyoro John	Resident, Kanara	Kanara S/C
9.	Buswaza Gentrude	Resident, Masaka Village	Butungama S/C
10.	Kabagenyi Erinah	Resident, Masaka Village	Butungama S/C
11.	Musemeza Wilber	Resident, Masaka Village	Butungama S/C
12.	Ahebwa Abel	Resident, Rwebisengo	Rwebisengo S/C
13.	Kahwa Benjamin	Resident, Nyakasenyi	Butungama S/C
14.	Bandikubi Jane	Resident, Masaka Village	Butungama S/C
15.	Agaba Amos	Resident, Masaka Village	Butungama S/C
16.	Omukama Mugenyi	Chief, Bahema de Sud	Ituri Province DRC

ONE RIVER
ONE PEOPLE
ONE VISION

Nile Basin Initiative Secretariat
P.O. Box 192
Entebbe – Uganda
Tel: +256 414 321 424
+256 414 321 329
+256 417 705 000
Fax: +256 414 320 971
Email: nbisec@nilebasin.org
Website: http://www.nilebasin.org

Eastern Nile Technical Regional Office
Dessie Road
P.O. Box 27173-1000
Addis Ababa – Ethiopia
Tel: +251 116 461 130/32
Fax: +251 116 459 407
Email: entro@nilebasin.org
Website: http://ensap.nilebasin.org

Nile Equatorial Lakes Subsidiary Action Program Coordination Unit
Kigali City Tower
KCT, KN 2 St, Kigali
P.O. Box 6759, Kigali Rwanda
Tel: +250 788 307 334
Fax: +250 252 580 100
Email: nelsapcu@nilebasin.org
Website: http://nelsap.nilebasin.org

/Nile Basin Initiative

@nbiweb

ENTRO

NELSAP-CU