



## LAKE OL' BOLOSSAT INTEGRATED MANAGEMENT PLAN 2020-2030



**CRITICAL ECOSYSTEM**  
PARTNERSHIP FUND



## **@2020 National Environment Management Authority, Kenya**

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### **i) Government institutions**

National Environment Management Authority, Water Resources Authority, Kenya Wildlife Service, Kenya Forest Service, County Government of Nyandarua, National Museums of Kenya, Ministry of Agriculture Livestock and Fisheries, Ministry of Environment and Forestry, National Environment Complaints Committee, County Wildlife Conservation and Compensation Committee, University of Nairobi, University of Eldoret, County Environmental Committee, National Land Commission and Ministry of Interior and Coordination of National Government


### **ii) Civil Society Organizations**

East Africa Wild Life Society, BirdLife International, Back to Basics, Cranes Conservation Volunteers, Nyahururu Bird Club, Rurii Upendo Women Group, Self Help Group (SGH), Gakoe Environment SHG, Ol’Bolossat CFA, Karima Care Orphans, Rurie Dam, Nyahururu Thomson’s Falls Nursery, Green Plan, Mutathi SHG, Friends of Lake Ol’Bolossat Association, Mungano SGH, Kirima-Muruai CFA, Iria-ini SHG, Tree is Life, Green Society, Lake Ol’Bolossat Conservation Network, Kirima Men Lake View CBO, Lake Ol’ Bolossat Water Resource Users Association, Amoseli SHG, Mugithi Women SHG, Ol’Bolossat Disabled SHG, Makereka Youth Group, Friends of Kinangop Plateau,

### **iii) Private Sector**

Samawati Hotel, Kichakani Paradise Resort, Nyahururu Water and Sanitation Company, Thomson’s Falls Lodge, Nyandarua Tree Growers Association, Ndaragwa Tree Growers Association

### **iv) Local Community**



Representatives from Shamata, Rurii, Weru, Igwa Miti, Central, Gatimu and Kiriita administrative wards of Nyandarua and Laikipia Counties including the minority communities.

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## LIST OF ACRONYMS

AEWA	African-Eurasian Waterbird Agreement
CBD	Convention on Biological Diversity
CBOs	Community Based Organizations
CDTF	Community Development Trust Fund
CEPA	Communication, Education and Public Awareness
CEPF	Critical Ecosystem Partnership Fund
CETRAD	Centre for Training and Integrated Research in ASAL Development
CFA	Community Forest Association
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on Migratory Species
CoG	Council of Governors
CSOs	Civil Society Organizations
CCV	Cranes Conservation Volunteers
DRSRS	Department of Resource Survey and Remote Sensing
EA	Environmental Audit
EAWLS	East Africa Wild Life Society
EMCA	Environmental Management and Coordination Act
ENSDA	Ewaso Ngiro Development Authority
ESIA	Environmental and Social Impact Assessment
FoLO	Friends of Lake Ol' Bolossat
GIS	Geographic Information System
GoK	Government of Kenya
IBA	Important Bird Area
IMP	Integrated Management Plan
IUCN	International Union Conservation of Nature
KALRO	Kenya Agricultural Livestock and Research Organization
KBA	Key Biodiversity Area
KATO	Kenya Association of Tour Operators
KEPHIS	Kenya Plant health inspectorate Service
KFS	Kenya Forest Services
KMD	Kenya Meteorological Department
KNBS	Kenya National Bureau of Statistics
KTB	Kenya Tourism Board
KWS	Kenya Wildlife Service
LOCNET	Lake Ol' Bolossat Conservation Network
LPRT	Local Plan Review Team
MEF	Ministry of Environment and Forestry
MoALF	Ministry of Agriculture, Livestock & Fisheries
MoWSI	Ministry of Water sanitation & Irrigation
NBC	Nyahururu Bird Club

NCC	Nyandarua County Council
CGN	County Government of Nyandarua
NECC	National Environment Complaints Committee
NEMA	National Environment Management Authority
NGOs	Non-Governmental Organizations
NLC	National Land Commission
NMK	National Museums of Kenya
NYAWASCO	Nyahururu Water and Sanitation Company
PFM	Participatory Forest Management
PIC	Plan Implementation Committee
REDD	Reducing Emissions from Deforestation and Degradation
RIT	Regional Implementation Team
SDF	State Department of Fisheries
SDGs	Sustainable Development Goals
TNA	Training Need Assessment
WCMA	Wildlife Conservation and Management Act
WCMD	Wildlife Conservation and Management Department
WRA	Water Resources Authority
WRUAs	Water Resource Users Associations
WWD	World Wetlands Day
WWF	World Wide Fund for Nature




## PREFACE

The County Government of Nyandarua is mandated by the Constitution of Kenya, 2010 to undertake requisite environmental conservation and management functions. Article 42 of Chapter 4, *the Bill of Rights*, confers every person right to a clean and health environment, including the right of the environment protected for the benefit of present and future generations through legislative and other measures. Part 2 of Chapter 5 focuses on obligations on the environment and Natural resources. Section 69 (2) indicate that every person has a duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources.

In advancing this constitutional and statutory mandate, the County Government of Nyandarua has partnered with various stakeholders to prepare the Lake Ol' Bolossat Integrated Management Plan of 2020-2030. Preparation of this plan was through a consultative process and was greatly informed by provisions in existing policy and legislative instruments among others; the Kenya Vision 2030, Medium Term Plan III and the Nyandarua County Integrated Development Plan II 2018-2020.

The idea for developing this plan was prompted by the realization of inadequacies and gaps in the existing plans in guiding the sustainable conservation and utilization of the Lake Ol' Bolossat, a resource and ecosystem of local, national and global importance. The aim of the plan is to ensure that this valuable resource is tapped into, converted into a socio-economic venture, well managed and conserved for posterity.

Lake Ol' Bolossat is the only lake in the Kenya highlands and it is situated in Nyandarua County. The lake borders four Sub-Counties namely: Ol Jorok, Ol'kalou, Ndaragwa and Kipipiri. The lake is an important ecosystem not only for Nyandarua County but also regionally, nationally and globally. Different physiological features and diverse species of flora and fauna characterize the lake. One of the peculiar features is that the lake has both fresh and saline water, and the waters do not mix at any one time. It is an internationally recognized Wetland as a Key Biodiversity Area (KBA), and Kenya's 61<sup>st</sup> Important Birds Area (IBA), with over three hundred bird species. It is a breeding site for endemic and endangered birds and an international flight corridor for migratory



birds. The lake is home to over 800 hippopotamuses, and other aqua life with mudfish being the dominant species, making it an important hub for nature and wildlife tourism.

The Lake's resources and ecosystem has other numerous benefits; - it is a source of water; regulates ecosystem services; supports tourism establishments; and livelihoods of downstream communities. This Lake is the source of the Ewaso Ng'iro River, which flows and joins Enkare Narok creating a great riverine habitat for wildlife before joining the Lorian swamp where the waters go underground to emerge in Somalia and eventually flows into the Indian Ocean. This water resource supports livelihoods in five Counties namely Nyandarua, Laikipia, Samburu, Isiolo and Wajir. It also supports tourism-related activities in these Counties including among others the scenic 75 meters Thomson falls, hotels and globally renowned conservancies such as Ol-pajeta and Lewa. It is one of the most richly mysterious ecosystem that humanity must preserve for the present and future generations.

The County Government in partnership with key stakeholders; national government departments, lead agencies, Community-Based Organizations (CBOs), academia, national and international Non-Governmental Organizations (NGOs) have undertaken and also planned a number of ecofriendly, social and economic transformative initiatives within and around the Lake.

My Government has embarked on a massive campaign to market the Lake as a conservation area as well as a prime eco-friendly investment destination. The State Ministry of Agriculture, through His Excellency the President, allocated over 120 million for a feasibility studies to determine quantum of the organic fertilizer /bio-deposits over millions of years from inflows from the Aberdare Ecosystem and beyond. Investment also target high-end infrastructure among others star-rated hotels, water sports, cable cars, domestic homes and carbon credit.

Publicity and marketing initiatives have led to the promising recognition and actions. The Lake featured in the 13<sup>th</sup> meeting of Conference of Parties for the Ramsar Convention on Wetlands (COP13) in Dubai where it was proposed as the seventh Ramsar site in Kenya. The Lake also featured in the International Blue Economy Conference which was held in Nairobi in November 2018. In February of 2018, the Lake was gazetted as a Wetland Protected Area under Environmental Management and Conservation Act Cap 387 of 1999. Currently, the County

Government in collaboration with other stakeholders is working to ensure that the lake is gazetted as a Natural Reserve under the Wildlife Conservation and Management Act, 2013.

The journey in developing this Plan has taken nearly two (2) years. The process involved a multi-stakeholder approach, widespread consultations and ownership, collection and collating of information and data, drafting, validation and finalization.

The Plan identifies priority interventions under seven management programmes; Biodiversity management, Eco-tourism management, Water resources management, Human-wildlife conflict management, Education and community awareness, Agriculture, Livestock and Fisheries management as well as Forestry resources management. Successful implementation of this Plan will facilitate rehabilitation of degraded areas; enhance ecological integrity, conservation and sustainable utilization of the Lake for the current and future generations.

Mobilization of sufficient resources to achieve such an arduous task is always a challenge. I thank most sincerely, NEMA, KFS, KWS, the East African Wild Life Society, Lake Ol’Bolossat Conservation Group (LOCCOG), the Local Plan Review Team (LPRT) and all other stakeholders, who have partnered with this County in the development of this Plan. My government recognizes and fully supports this Plan as a major road map towards conservation of this lake ecosystem and all the resources therein. I call upon all stakeholders including the National Government, neighboring Counties, beneficiaries, NGOs, private sector, development partners, researchers, experts, CBOS, and the local communities to support its full implementation.



**H.E FRANCIS KIMEMIA, EGH, CBS  
GOVERNOR**

## FOREWORD

EMCA Cap 387 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 meters. Wetlands ecosystems are critical for supporting human wellbeing with both tangible and intangible benefits such as ecosystem services, cultural values and economic values.

Lake Ol’Bolossat is a significant ecosystem that requires collaborative management among all stakeholders. The preparation, planning and implementation process of the Lake Ol’Bolossat Integrated Management Plan (IMP) recognizes the existence of the current wetland legal framework including wetland policy, EMCA Cap 387 and wetland regulations among other national and international legal frameworks which have direct impact to sustainable conservation, management and utilization of the Lake.

The lake is a valuable resource to the local people who have built an intricate connection with it over the years. The major economic activities around the lake is crop farming, livestock keeping, fishing and tourism. Despite the value of the lake ecosystem in advancing human wellbeing and biodiversity conservation, the lake is currently threatened by anthropogenic activities which includes deforestation, increase in human population and infrastructural development projects.

This revised edition of Lake Ol’Bolossat Integrated Management Plan has proposed a broad range of measures and actions within the implementation matrix that will not only address the environmental issues but also achieve the objectives of Vision 2030. The authority is committed to guide implementation of the management plan and therefore I call upon all the stakeholders to support the implementation process in order to realize sustainable utilization of Lake Ol’Bolossat.



**MR. JOHN KONCHELLA**  
**CHAIRMAN, BOARD OF MANAGEMENT – NEMA**

## ACKNOWLEDGEMENT

The National Environment Management Authority (NEMA) gratefully acknowledges the financial support provided by the Critical Ecosystem Partnership Fund (CEPF) through East Africa Wild Life Society for the preparation of this Lake Ol’Bolossat Integrated Management Plan.

I also wish to acknowledge the significant role played by various stakeholders including national government institutions, the County Government of Nyandarua, NGOs, Private sector, Experts, and local communities who participated during the development of this Plan. These stakeholders provided the much needed information that resulted into finalization of the management plan. My appreciations also go to Dr. Thenya Thuita (Lead consultant) and Jabes Okumu (EAWLS) who spearheaded the Plan development process. Further gratitude goes to the NEMA officers particularly Mr. Stephen Katua, Mr. Dan Ashitiva and Ms. Caroline Muriuki who provided overall supervision, technical inputs and undertook compilation of the final management plan.

Lastly, I wish to appreciate the NEMA board of management for its unwavering support throughout the management planning process. It is my sincere hope that this management plan will go a long way in addressing the challenges facing Lake Ol’Bolossat and promoting conservation and sustainable utilization of the resource. NEMA looks forward to full implementation of this management plan in attaining ecological integrity and social economic development for Lake Ol’Bolossat and its basin.



**MAMO B. MAMO**  
**DIRECTOR GENERAL, NEMA**

## EXECUTIVE SUMMARY

Lake Ol’Bolossat is the only lake in the central parts of Kenya, lying on the tilted Kinangop Plateau at the base of Satima escarpment in Nyandarua County. The catchment area of Lake Ol’Bolossat is approximately 4800 km<sup>2</sup>. The area encompasses Nyandarua range, Satima escarpment, and Ndundori Hills. It is a shallow, slightly alkaline lake surrounded by extensive swamp land vegetation with a maximum depth of 2 meters. The wetland comprises of 80% marsh, 15% open water and 5% dry land. Lake Ol’Bolossat serves as a catchment for Ewaso Ng’iro River.

This management plan was developed through a consultative process in the various administrative wards (Shamata, Central, Kiriita Igwamiti, Gatimu, Weru and Rurii) around the Lake. The process was funded by the Critical Ecosystem Partnership Fund through a grant to East African Wild Life Society (EAWLS). This integrated management plan presented here aims at providing an ecosystem-based approach in the management of environmental problems and rehabilitation of degraded sites. This purpose is in line with EMCA 2018 section 42 (1) on protection of wetland (2) on gazettelement declaration and (3) preparation of management plan and co-management. It is expected that with the approval of this management plan, CFA and KFS will execute the re-negotiated Forest Management Agreement (FMA).

The **vision** of this integrated management plan is “*A well-managed and protected Lake Ol’ Bolossat and its catchment area providing a sustainable and ecologically balanced ecosystem for the present and future generations.*”

The overall objective of this management plan is to “*promote environmental conservation of Lake Ol’ Bolossat and its catchment for sustainable development while maintaining the values and ecological functions through the involvement and participation of stakeholders*”.

This plan has identified a number of management programmes that indicates what has been achieved and also what needs to be done, these include;

- Biodiversity management.
- Ecotourism management.
- Water resources management.
- Land resource management.
- Socio-economic development

- Governance improvement.
- Climate change mitigation and adaptation

### **Participation, monitoring and evaluation**

The programmes provide actions and measures that address the following issues:

- Human-wildlife conflicts because of poaching and fragmentation of riparian land through settlements and sub-divisions
- Lack of clearly defined boundary access
- Illegal fishing and wildlife poaching
- Degradation of the catchment vegetation
- Deforestation of catchment areas and riverbanks
- Wildlife damage to crops
- Lack of a clear grazing plan or arrangement
- Water pollution and poor water usage including breakage/leaking pipes
- Illegal abstraction of river and lake water
- Water shortages

Each of the programmes has specific objectives and activities that are built on the relevant legal framework, wetland ecology, the socio-economic considerations of the area, the views and aspirations of the local communities and EAWLS. The programmes seek to build structures that promote involvement of the Lake Ol' Bolossat stakeholders in the management of the wetland. Other than being specific, the objectives are interrelated and address various issues related to the different sub-programmes of the management plan.

A financial management mechanism has been prepared to enhance implementation along with monitoring and evaluation of the implementation of the Plan so as to achieve the proposed goals, targeted activities and assessment of the achievements. This should be in line with government financial management guidelines. Stakeholders led by CGN and NEMA could agree on modalities within the limits of these financial guidelines. At all levels of planning, implementation, monitoring and evaluation, the plan will be guided by the following principles throughout the plan period: Gender equity, Transparency and Community Representation in project Management.

## CHAPTER 1: INTRODUCTION

### 1.1 Location, Size and Ecological characteristics

Lake Ol' Bolossat is located approximately 195 Km north of Nairobi. It is located at  $^{\circ}5'17.33''S$ ,  $36^{\circ}25'4.60''E$  in Nyandarua County. It is situated in Ndaragwa, Ol' Joro Orok and Ol' Kalou administrative sub-counties. The Lake with an area of  $43.3 \text{ Km}^2$  lies at an average altitude of 2,340 m above sea level in a wedge shaped rift valley floor sloping eastwards and northwards (Figure 1).

The Lake can be accessed through the following roads and airstrip:

- Nairobi – Gilgil – Ol' Kalou – Rurii
- Nakuru – Subukia - Nyahururu
- Nakuru – Ol' Kalou – Rurii
- Nakuru – Charagita – Ol' Joro Orok
- Nyeri – Nyahururu
- Rumuruti – Nyahururu
- Nyahururu airstrip

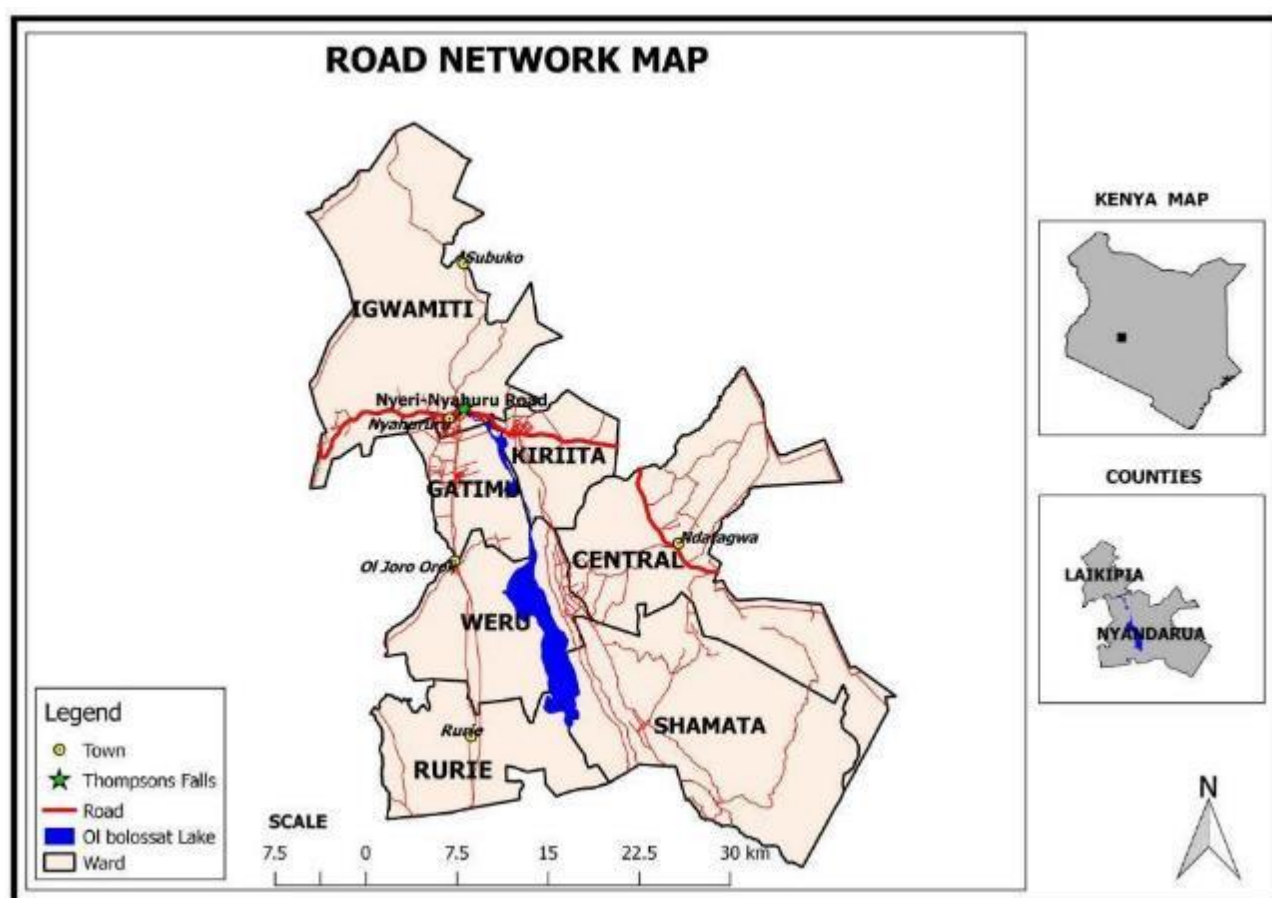


Figure 1: Location of Lake Ol' Bolossat in Nyandarua County



Lake Ol' Bolossat is Kenya's highest altitude lake of its magnitude and the only one in the central highlands, lying on the tilted Kinangop plateau at the base of Satima escarpment in the northern parts of Nyandarua County with the equator crossing in the northern part near Nyahururu. The catchment area of Lake Ol' Bolossat is approximately 4800 km<sup>2</sup>. The area encompasses Nyandarua Mountains (Aberdares) and Satima escarpment to the East and Ndundori Hills to the West. It is a shallow, slightly alkaline lake surrounded by extensive swamp land vegetation with a maximum depth of 2 meters. It is characterized by a wide range of habitat, complex natural processes as well as diverse socio-economic activities. The wetland comprises of 80% marsh, 15% open water and 5% dry land (Lake Ol' Bolossat Management Plan, 2008-2013). The marshes filter and purify the water. The riparian area makes an important fallback grazing area for the surrounding community especially during the dry season, when the livestock number rise especially due to pastoralists from the northern area of Samburu and Laikipia. However, the area is used for grazing throughout the year.

Lake Ol' Bolossat serves as a catchment for Ewaso Ng'iro River and supports important functions and lifelines of communities living in the arid and semi-arid parts of North Eastern Kenya covering Laikipia, Samburu, Isiolo and Wajir Counties. Lorian swamp in Wajir County marks the end of this drainage system. The thriving tourism industry in Samburu, Shaba and Buffalo Springs National Reserves is largely made possible by the flow of the Ewaso Ng'iro River, which gets water from Aberdares through Lake Ol' Bolossat and Pesi River, and Mt Kenya drainage system with rivers such as Nanyuki and Sirimon.

### **1.1.1 Linkage between Lake Ol' Bolossat and Ewaso Ng'iro Basin**

The main swamps that are found in Ewaso Ng'iro North drainage basin are Ol' Bolossat, Ewaso Narok, Pesi, Marura, Moyok, and Lorian. Other smaller swamps include Mutara and Ngare Nyiro that have little documented information (Thenya and Gichuki, 2001) (Figure 2).

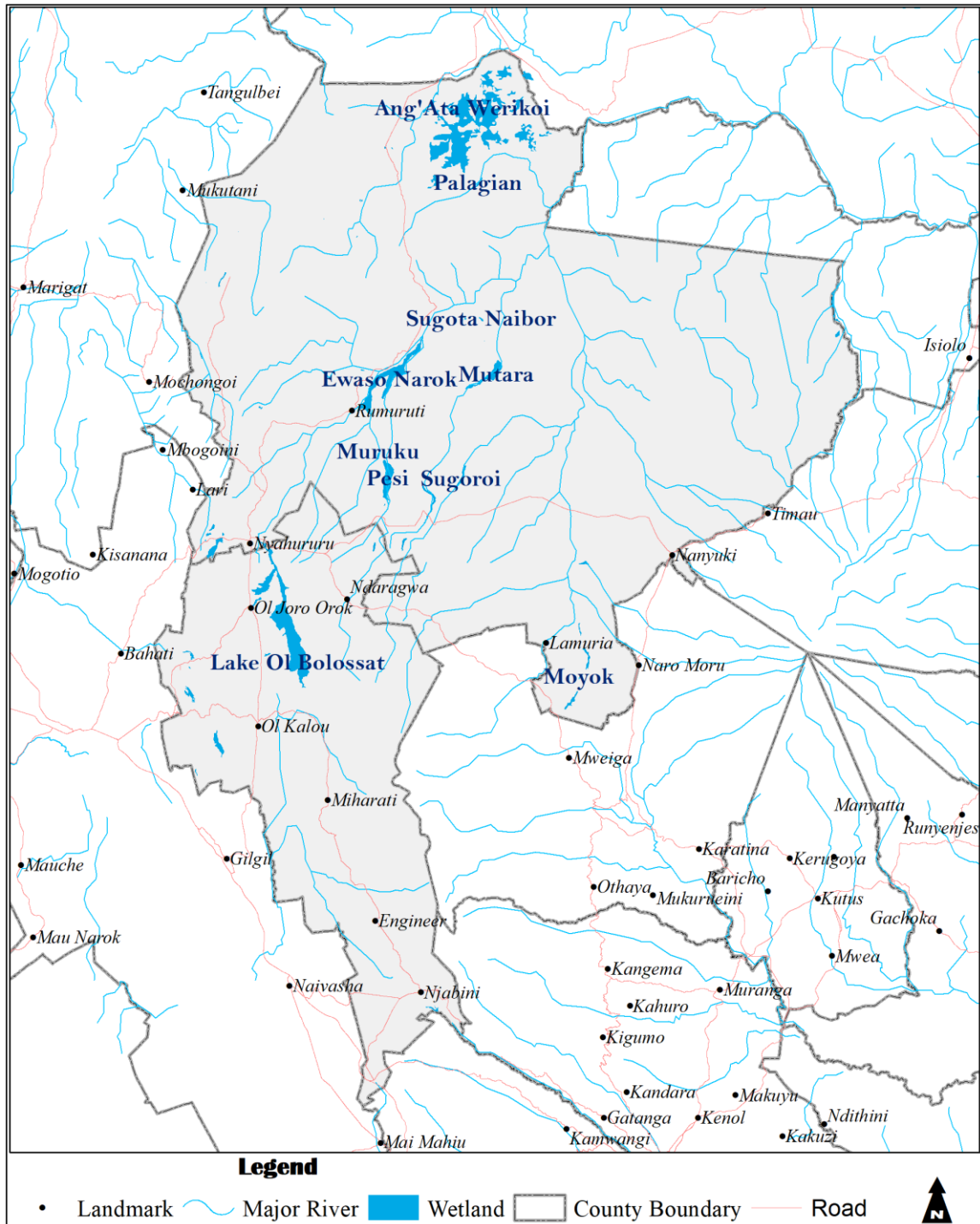


Figure 2: Distribution of Wetlands in Upper Ewaso Ng'iro Drainage

(Source: NEMA, GIS)

In spite of the aridity that characterizes the region, Ewaso Ng'iro North Drainage Basin with its head waters in Lake Ol' Bolossat in Nyandarua County has numerous wetlands in Laikipia County, which are partly attributed to geology, tectonic earth movements and topography. The dryland wetlands, like these ones found in Ewaso Ng'iro North Basin, depict the concept of 'Island

biogeography’ of isolated ecosystems. They have a unique flora and fauna distinctively different from adjacent dryland ecosystem, for example they are mainly dominated by macrophytes such as *Cypress papyrus* and allied genera, very much dependent on the water system except for the Lorian swamp, which is *Typha* dominated (Pratt *et al.*, 1978; Thenya, 1998; Thenya *et al.*, 2011).

### **1.2 Demography, cultural, ethnic and social groupings**

The estimated population in Nyandarua County is 638,289 persons as at the last national population census of 2019. This comprised of 315,022 males and 323,247 females (KNBS, 2019). The county is serviced by several government hospitals; Nyahururu, Ngano. Ol Kalou -JM Kariuki Memorial district hospital, Engineer District Hospital. Mission hospital funded by church and NGO, Dispensary i.e. Mirangine Health Centre and a number of private hospitals.

The learning infrastructures are located within close proximity to the study area which surrounds Lake Ol’ Bolossat with an average range of 1.5km. The furthest school is located about 7km from the area. There are about 39 Early Childhood Development schools, 30 primary schools and 24 secondary schools with most being 2-4 km from the study area. The average expenditure on literacy level is approximate Ksh 67,000 per annum from the socio-economic survey.

### ***Community Institutions***

The social groupings found around the lake include:

- Ziwani Women Group,
- Mukindu Community Development Group
- Lower Baari women group,
- Mukindu Women Empowerment Group
- Community Forest Association- Ol’ Bolossat forest,
- Kangubiri Self-Help Group
- Women Unit Group,
- Makereka Lake Ol’ Bolossat group cohort
- Lake Ol’ Bolossat Makereka Youth Fishing and Tourism
- Iria-Ini Group,
- Makereka Welfare Group
- Juhudi Kilimo Group Hand-in-Hand,
- Kianduba Women Empowerment Group

Some of the benefits associated with being a member of a group include cash lending services, sources of technical information and training, social welfare and provision of household goods. There is however lack of awareness among community members which has hindered membership to community development groups.

### **1.3 Topography, Hydrology and Soils**

#### **1.3.1 Topography**

Lake Ol' Bolossat lies in a wedge-shaped (fault) valley known as '*Ongata Pusi*' located in Ewaso Ng'iro drainage basin. Ewaso Ng'iro drainage basin rises to 2600 m Above Sea Level (ASL) in the south and falls to below 1000 M ASL in the north. The lake is one of a series of rift valley benches aligned on a north-south direction at a higher elevation than the other Rift Valley Lakes (2,340 M ASL). On the eastern side, the lake borders the steep Satima escarpment (2,550 M). The faulting activity in the area resulted into a complex drainage system that separates major drainage basins – the southern tip of the Lake is 6 Kilometres from River Malewa upstream that drains to Lake Naivasha in the Rift Valley. Lake Ol' Bolossat is an internal drainage basin whose swamps have a high salt content possible due to high evaporation rate and partly due to nature of sediments that constitute the area (Krhoda, 1992). The riparian grasslands offer a year-round livestock grazing land for surrounding communities.

#### **1.3.2 Hydrological dynamics**

The hydrology of Lake Ol' Bolossat is influenced by the effects of long-term and seasonal variations in weather and water inflow from the surrounding highlands. The lake water level is highest during the rains, especially in July/August. The mean water depth is 1.0 m varying from 0.73 m in the south, through 1.20 m in the central part to 1.83 m in the northern part. Lake Ol' Bolossat however, has open water fluctuations in dry years with open water appearing as a series of pools separated by emergent macrophytes. The system loses water through the continuous flow of Ewaso Narok River and evapotranspiration. Evapotranspiration from the abundant swamp vegetation also contributes to this seasonality.

The depth of Lake Ol' Bolossat average at 0.75m but ranges between 0.20 to 1.6m deep. The eastern side of the lake is much shallower than the western side. The average depth of water in the shore is less than 0.30 m; while the open water is 1m but this ranges from 0.30m to 1.60m. Comparing from south and north, the southern part of the lake is relatively deeper. The southern

area has an average depth of 0.76m (range 0.2 - 1.35 m), the central area 0.70 m (range 0.3 – 1.6m) and the northern part has an average depth of 0.66m (range 0.3 – 1.5m). Thus, from the north, the depth of the lake increases to the south causing waters to recede to the south during severe dry seasons (Terer *et al*, 2019).

The lake catchment area includes Satima escarpments to the east and Ndundori –Tumaini ridge to the West. The Lake receives water from four rivers, these are Simba & Nyakariang’a rivers in Ol’ Joro Orok area and Chamuka and Equator rivers near Nyahururu town. Oraimutia river is a tributary of River Chamuka from Sabugo highlands in Nyahururu, which is now heavily deforested and settled. Ewaso Ng’iro River draws its head waters from Lake Ol’ Bolossat, which flows out through Nyahururu falls (formerly Thomson Falls). Lake Ol’ Bolossat is an internal drainage basin and plays an important role in containing the excess water from Satima escarpment to the East and the Ndundori-Tumaini ridge to the west.

Lake Ol’ Bolossat drainage system comprises of the springs and streams along the Satima escarpment, open water, Wellmont, Ol’ Joro Orok and Ol’ Bolossat swamps, Ewaso Narok River, the numerous springs along the upper reaches of Ewaso Narok River, and springs and streams on the western side of the catchment. The springs and streams from the Satima escarpment and to a lesser extent by streams that flow from the Ndundori hills on the western side recharge the Lake. Most streams flow for a distance and then disappear underground recharging the Lake as sub-surface flow.

### ***1.3.3 Physical-chemical conditions***

According to Thenya *et al.*, (2011), the ecosystem pH range between 6.7 to 8.3 with an average pH at 7.68 on the eastern side with slightly higher values near Nyahururu falls and Manguo pools. The values decline towards the southern direction as water levels reduce and the ecosystem is characterised by marshy land (Table 1).

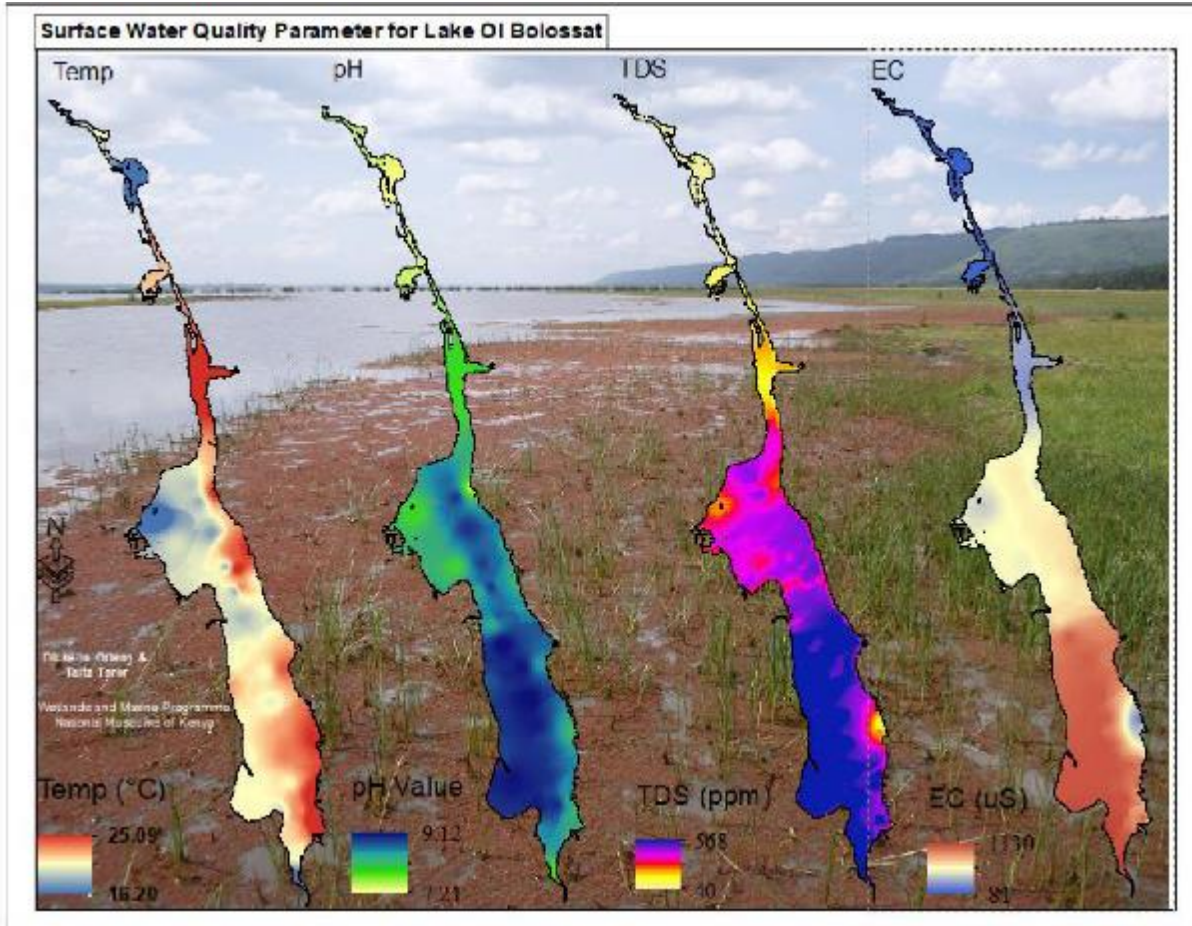
**Table 1: Water Characteristic on Eastern Side of the Swamp**

<b>Western side - along Ol' Kalou – Nyahururu highway</b>						
<b>Local names</b>	<b>pH</b>	<b>Electrical Conductivity (EC) 25° C ds/m</b>	<b>Sodium (Na)</b>	<b>Potassium (K)</b>	<b>Calcium (Ca)</b>	<b>Magnesium (Mg)</b>
Mukindu	8.97	739	11.00	0.04	0.02	0.07
Mugathika	7.42	112.3	1.68	0.12	0.02	0.07
Bahati	7.19	55.7	0.04	0.12	0.02	0.04
Karandi (Kichakani)	8.78	655	10.15	0.80	0.02	0.06
Karandi (Kichakani)	8.12	520	8.13	0.57	0.05	0.10
Fuleni	8.42	47.8	0.40	0.07	0.01	0.02
Gatumbiro	7.59	231	2.25	0.21	0.20	0.33
Njunu swamp	7.92	37.8	0.03	0.07	0.02	0.03
Githiuro	6.59	65	0.67	0.07	0.02	0.05
<b>Mean</b>	<b>7.89</b>	<b>273.73</b>	<b>3.24</b>	<b>0.20</b>	<b>0.04</b>	<b>0.08</b>
<b>Eastern side - along Satima Escarpment</b>						
Kirima	7.74	271	2.08	0.30	0.11	0.27
Gakoe	7.2	185.9	0.80	0.23	0.04	0.37
Iria-Ini	8.05	288	3.68	0.30	0.02	0.09
Ngurumo	7.86	211	2.65	0.32	0.04	0.05
Githungucu	8.43	68.6	0.42	0.08	0.23	0.09
Baari	6.9	87.8	0.72	0.20	0.08	0.06
Mairo Inya (Ziwani)	7.32	168.9	2.08	0.09	0.06	0.13
<b>Mean</b>	<b>7.64</b>	<b>183.03</b>	<b>1.78</b>	<b>0.22</b>	<b>0.08</b>	<b>0.15</b>

(Source: Thenya *et al.*, 2011)

The water pH values recorded by Terer *et al.*, (2011) indicate higher alkalinity, which corresponds to higher conductivity was recorded in the same study. According to Terer *et al.*, (2019) Lake Ol' Bolossat average pH is 8.37 with the measurements ranging from 7.21 in the northern part of the lake to 9.12 in the central area of the lake (Figure 3). The southern area of the lake has an average pH of 8.47 with the range of 7.64 to 9.03, the central area of the lake has pH of 8.54 (range 7.75 – 9.12) while, the northern part has an average pH of 7.85 (range 7.21 – 8.87).

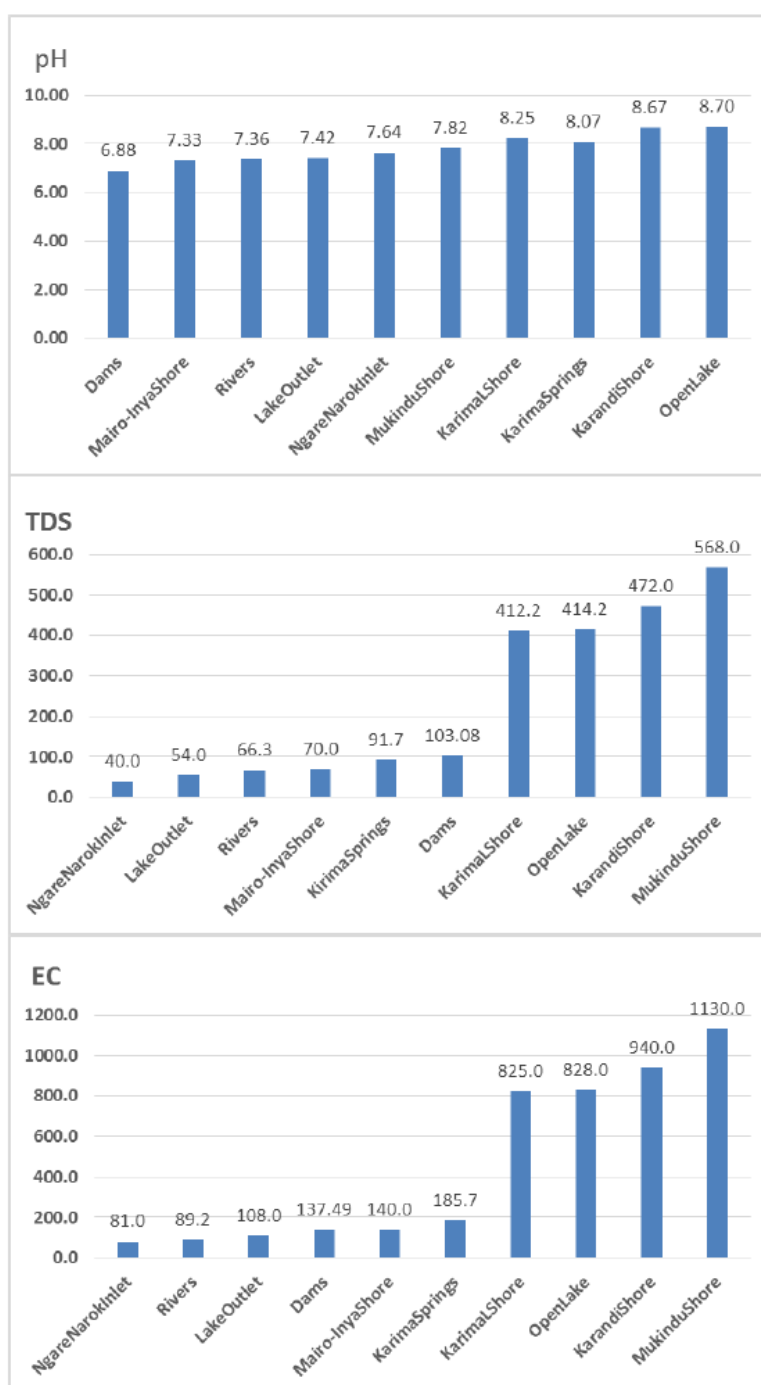




**Figure 3 : The spatial model for water quality conditions for Lake Ol' Bolossat in September 2019.**  
(Source: Terer *et al.*, 2019)

According to Terer *et al.*, (2019), the mean electrical conductivity (EC) for the lake is 701  $\mu\text{S}$  with the measurements ranging from a minimum of 81  $\mu\text{S}$  in the northern part to 1130  $\mu\text{S}$  in the southern area according to Terer *et al.*, 2019. The southern area has an average EC of 829  $\mu\text{S}$  with a range of 124 – 1130  $\mu\text{S}$ , the central area has 677  $\mu\text{S}$  (range 78 – 1009  $\mu\text{S}$ ) and the northern part has an average EC of 335 (range 81 – 644  $\mu\text{S}$ ). The southern part of the lake has higher EC than other parts of the lake and generally decreases in mean values to the northern part which is substantially diluted by the streams entering the lake.

These figures are slightly higher than those recorded in Thenya *et al.*, (2011), which ranged between 150 to 106-300  $\mu\text{S}/\text{cm}$  although both studies were done in dry season. The eastern side had slightly higher EC values, an average of 273  $\mu\text{S}$  relative to 183  $\mu\text{S}$  on the western side (Figure 4).




**Figure 4: Figures from top to bottom showing pH, TDS and EC of Lake Ol' Bolossat and wetlands**

(Source: Terer *et al.*, 2019)

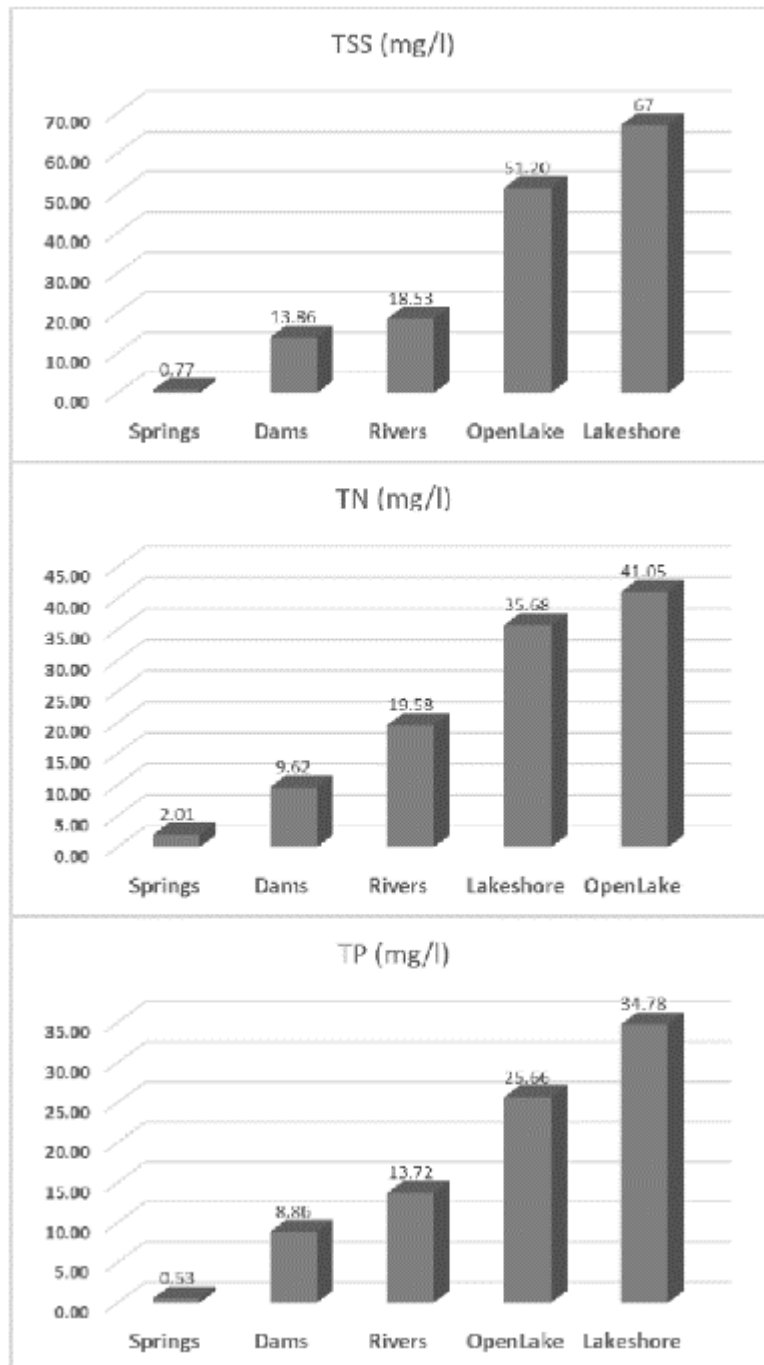
The higher EC values at Makindu and 263 Iria-ini correspond well with high pH on both sides of the ecosystem. The effect of Hippopotamus was quite visible especially near the Nyahururu falls with high phosphorous value of 0.35 ppm. The effect of volcanically influenced geology was visible from the high sodium levels in both the western and eastern side where pH values were also high. The comparison of pH, total dissolved solids (TDS) and electrical conductivity (EC)





among wetlands in Lake Ol' Bolossat Basin is shown in Fig 5. Rivers, river inlets, lake outlet and shoreline with subsurface inlet maintained pH value of 7 (pure water), dams were slightly acidic while open lake, some lake shores and springs had slightly higher pH (Figure 5). Both TDS and EC were lower for other wetland sites including one shoreline site (Mairo-Inya). Open lake, Mukindu, Karima and Karandi shores had higher EC and TDS suggesting the causes may be internal.

The mean total suspended solids (TSS), total nitrates (TN) and total phosphates (TP) in the order from the lowest to the highest were springs, dams, rivers and the lake (Figure 5). The concentrations of both nutrients exceeds their natural levels ranges (TN: < 1 mg/l, TP: 0.005-0.05 mg/l) for all the wetlands types (springs- TN/TP: 2.01/0.53 mg/l to open lake –TN/TP: 41.05/25.66 mg/l, (Figure 5) suggesting anthropogenic influence such as land degradation, agricultural and urban wastes. However, springs were within the freshwater ranges for nitrates of 0.1 to 4 mg/l.



**Figure 5: Figures from top to bottom showing total suspended solids, total nitrates and total phosphates of Lake Ol' Bolossat wetlands**

(Source: Terer *et al.*, 2019)

#### **1.3.4 Soils**

The Satima escarpment is composed mainly of igneous rocks with a few areas having metamorphic rock strata. The soils are grey loams dominated mainly by andosols and phaeozems while soil in the Lake basin is black cotton, which is poorly drained, dominated by nitosols and xerosols. On the western side, there are andosols and phaeozems.

#### **1.4 Climate and Agro-ecological zones**

The climate is sub-humid and is strongly influenced by local topography due to the surrounding highlands. The mean annual rainfall, recorded at Nyahururu at the northern part is 975 mm increasing southwards and westwards (GoK, 1994). Rainfall is bi-modal with peaks in April–June and October–November. The instability of the air near the equator causes rain especially from July to September between the sub-humid periods of April–June and September. Over 60% of the annual rainfall is received in the first wet season. Annual rainfall ranges between 500-1000 mm while temperatures vary between 20-37 °C annually. The mean temperature is 23.50°C. There are major diurnal variations resulting in incidences of frost in January and September.

#### **1.5 Historical perspective of development and conservation**

Prior to the Second World War in 1945, the Lake and its surroundings were used as a dry season grazing area by Maasai pastoralists as they moved between Laikipia and Narok. After the war, the entire area and its catchment were allocated to three retired British Army soldiers and thereafter, further sub-divided to settle more decommissioned British Army soldiers. The settlers used the land for livestock rearing and large-scale crop farming. Just before independence, a number of the settlers vacated the land, to pave way for African settlers under the Settlement Fund Trustees. The land was further sub-divided for more settlement under five settlement schemes namely: Ol' Joro Orok, Kirima, Muruai, Salient and Ol' Bolossat. A buffer zone was demarcated between the lake and the settled areas; however, an additional settlement scheme initiated in 1993 settled people on this buffer zone. As a result, some peoples' land runs well into the high water mark level of the Lake. The first settlement in the area post-independence was done in 1980 and it was called Ol Kalou Salient Scheme. About 140,000 acres of land was allocated for settlement purpose with the wetland occupying about 4,000 acres. The then County Council of Nyandarua negotiated with the Ministry of Lands and Settlement to allocate another 6,000 acres as riparian land. This was done and about 54 families who had been allocated that land were resettled elsewhere. Some of the settlement schemes in the area are shown on Table 2.

**Table 2: Settlement Schemes within the Ol' Bolossat Area**

<b>Name of Settlement Scheme</b>	<b>Plots within the Lake Region</b>	<b>Plot with Title Deeds</b>	<b>Plots under SFT</b>	<b>Ground Occupation</b>
Ol' Bolossat	560	183 (33%)	377 (67%)	56 (10%)
Kirima Plot No. 298 (Sub-division 376 Plots)	376	86 (23%)	290 (77%)	8 (2%)
Rest of Kirima Scheme	30% of 703	281 (40%)	422 (60%)	598 (85%)
Muruai Ext Plot No. 96. Sub-division Into 23 Parcels	23%	2	21%	1%
Rest of Muruai	20% (465 Plots)	140 (30%)	326 (70%)	372 (80%)
Ol Joro Orok Salient	20% (17,000 Plots)	11,900 (70%)	5,100 (30%)	13,600 (80%)

### **1.6 The planning context-policy framework**

The development of this plan is backed and streamlined with the Constitution of Kenya and appropriate enabling Acts of Parliament that provide for management, utilization and conservation of wetlands resources. The existing national laws, policies and frameworks that back the plan are: Constitution of Kenya 2010; Kenya Vision 2030; EMCA cap 387 (Section 42 and 43); Wetlands Conservation and Management Policy; Wetlands regulations (2009); Fisheries Act (cap 378); Wildlife Conservation and Management Act (2013); Water Act (2002); Water Resource Management Rules (2007); Forest Act (2005); County Integrated Development Plans for Nyandarua County among others. The management plan is also backed by relevant international legal agreements that govern wetlands resources including the Ramsar Convention, Convention on Biological Diversity (CBD) among others. Chapter 3 has provided a detailed review of policy, legal and institutional framework backing the management plan development and their relevance in conservation and sustainable management of Lake Ol' Bolossat basin.

The management plan builds on development and environmental conservation initiatives being spearheaded by the national and county governments, NGOs, CBOs and other stakeholders in the basin. The Plan attempts to establish a viable and sustainable management system for the wetland in order to meet the needs of primary, secondary and tertiary stakeholders. This Plan has taken due cognizance of existing stakeholders, institutions and sectoral policies. The wetland was gazetted

as a Wetland Protected Area in July 2018 vide the Legal Notice No. 179 of 2018 pursuant to EMCA No. 8 of 1999.

### **1.7 Past conservation initiatives and planning considerations**

The need to protect Lake Ol' Bolossat and its watershed was recognized by both the then local and the central governments. In 1982, Nyandarua County Council (NCC) submitted a proposal to establish a protected area to the former Wildlife Conservation and Management Department (WCMD) now Kenya Wildlife Service (KWS). This was meant to conserve wildlife and generate revenue from tourism. At the same time, Ewaso Ng'iro Development Authority (ENDA) initiated an afforestation programme to conserve the lake as an important catchment area for River Ewaso Ng'iro. In spite of these positive steps, limited progress has been made to check the degradation of the lake.

The main problem that hinders progress in environmental conservation of the lake and its catchments is land tenure system and ownership. The lake basin is an important common grazing ground for the local community who are opposed to its sub-division and allocation to new settlers before their own land needs are met. Lack of adequate information on the lake's biological resources, political goodwill, funding constraints has also contributed to the limited progress made in the conservation of this lake. Inadequate appreciation of the full economic value of a conserved and sustainably managed Lake Ol' Bolossat has contributed to the degradation of the lake.

In the past, conservation planning was undertaken in isolation of the local community. This approach has changed with the recognition of local communities as key players and partners for the success of any conservation initiative. The success of this Plan depends on the goodwill of the people taking into account the prevailing cultural, social and economic needs of the local community, and most importantly, the ecological value and integrity of the Lake basin.

In 1998, KWS and other stakeholders held an inception workshop aimed at creating awareness for a wider stakeholder participation and involvement in integrated management planning process for the lake. A participatory rural appraisal was conducted where community development needs and aspirations were identified and prioritized by the community. At the same time, studies were initiated to establish and quantify the resource base and resource use conflicts and threats in Lake Ecosystem. Consultations were then held with relevant Government Departments and other stakeholders, resulting into establishment of an Integrated Management Planning Committee.

### **1.8 Scope of the plan**


Lake Ol' Bolossat is a fragile and vulnerable ecosystem that is facing ever-increasing threats from human activities in its catchment and basin. To sustainably conserve the Lake, issues from within the catchment and the basin should be considered. In order to address these issues, it is important that the plan area covers both the catchment and the basin. The Nyahururu – Ol' Kalou tarmac road to the west and the Satima escarpment to the east, Manguo swamp to the north and Kariamu Trading Center to the south delineates the plan area. This plan area has been delineated so as to ensure the long-term survival of Lake Ol' Bolossat. The lake is linked hydrologically, ecologically and economically to the escarpment to the east and the plains to the west. In addition to this, the plan area was based on identified immediate threats and ease and effectiveness of plan implementation.

This management plan covers the area drained by all surface rivers flowing into Lake Ol' Bolossat. The area has unique geological, physio-geographic and climatic features ranging from fault lines, escarpments, highlands, and associated habitat types that have to be taken into consideration in the drawing up and implementation of this plan.

The wetland integrated management plan presented here aims at providing an ecosystem-based approach in management of environmental problems and rehabilitation of degraded sites. The approach has inbuilt mechanisms for involving stakeholders and other actors in the Lake Ol' Bolossat catchment. The plan highlights environmental and development issues and suggests management strategies to address these issues. It further identifies activities, resources and provides mechanism for inter-agency networking. To achieve this, the plan calls for a stakeholder implementation committee, with the necessary technical skills to oversee and coordinate the suggested activities. It has identified the uni-sectoral approach in former initiatives contributing to low success rates, which it resolves through networking, joint resource mobilization under the central goal of maintaining the ecological integrity and sustainable development of the Ol' Bolossat basin. All agencies and individuals in the Ol' Bolossat basin are free to undertake activities suggested in this document to achieve the overall goal and mission of the plan.

### **1.9 Management plan development approach**

The management planning process adopted a multipronged approach through effective stakeholder engagement processes. These included community level consultations, expert based field assessments and observations, focus group discussions, interviews and discussions with opinion



leaders, stakeholder workshops, expert working group sessions, GIS and remote sensing techniques for mapping of Plan boundary and biodiversity.

The first step into the planning process took place on 31<sup>st</sup> October 2018, where an expert inception meeting was held in Nairobi, Ngong Hills Hotel with representatives from both National and County Governments, CSOs and academia. The next step was formation of Local Planning Review Team (LPRT), the EAWLS spearheaded this by holding a series of public consultative meetings (barazas) between 4<sup>th</sup> and 21<sup>st</sup> November 2018 in the various administrative wards (Shamata, Central, Kereita, Igwamiti, Gatimu, Weru and Rurii) around Lake Ol' Bolossat where members of environmental and conservation organisations from the local community were requested to appoint a representative to the LPRT.

On 4<sup>th</sup> December 2018, another meeting was held at Thomson Falls Lodge in Nyahururu where the appointed members of LPRT were invited to discuss and agree on the process led by the consultant. The team was taken through the necessary steps and also the World Bank safeguards including grievance redress mechanism. During the meeting, the stakeholders who participated included LPRT and representatives from CEPF Regional Implementation Team (RIT), EAWLS and government agencies including CGN, Water Resources Authority, Kenya Forest Service, NEMA and KWS. It was noted in the meeting that there were omissions in terms of representation the wards around the Lake. The team agreed on the LPRT membership adjustments and members of the LPRT present and EAWLS field officer (Community Liaison Officer) were tasked to include other members such as minority groups.

The next meeting was held on 20<sup>th</sup> December 2018 at Thomson Falls Lodge, Nyahururu. During the meeting, the steps in the management planning process and World Bank safeguards were revisited. The consultant took the LPRT through the content of the expired IMP, and through group work and plenary discussions, the team identified what had been achieved and activities that had not been done including challenges encountered. During the meeting, it was agreed that socioeconomic survey be conducted to understand the current socioeconomic status of the people living the vicinity of the Lake. In order to conduct the survey, LPRT members agreed that each ward would discuss and nominate enumerators to collect data from the respective wards to ensure ownership. The selected enumerators were trained on data collection tools and methods by a GIS data technician on the 25<sup>th</sup> January 2019 with quality check from EAWLS representatives.

The next meeting was held on 8<sup>th</sup>-9<sup>th</sup> March, 2019 at Thompson’s Falls Lodge, Nyahururu to discuss the socio-economic report and get feedback from the LPRT on the report. In addition, during the meeting the potential wetland programmes and targets were generated by the LPRT along with a stakeholders list and an organogram. The LPRT was organised in groups of 5-8 people so that members could participate effectively.

This was followed by selection of habitat mapping team from the LPRT of five people with a good knowledge of the ecosystem. The habitat mapping took place between 18<sup>th</sup> -21<sup>st</sup> March 2019. Based on the data collected, various maps for the ecosystem were generated for use in the next meeting which took place on 27<sup>th</sup> -28<sup>th</sup> March 2019. This meeting focused on discussing the draft plan.

EAWLS in partnership with National Museums of Kenya (NMK), conducted a baseline biodiversity assessment and the report findings were used to further improve the information on biodiversity of the Lake and the recommendations used to improve the implementation matrix and Monitoring and Evaluation for the Plan. The updated Plan was subjected to validation by County stakeholders in the first week of November 2019. To finalize the Plan, it was subjected to an online validation by the national stakeholders and wetlands experts, and from the comments received, the final version was produced. Thereafter, through consultations between NEMA, CGN and EAWLS, the plan was signed off by the designated authorities (NEMA chair of the Board, NEMA Director General and the Governor, Nyandarua County).

### **1.10 Implementation of the previous plan 2008 - 2013**

The first management plan of the Lake was launched and implemented from 2010 to 2015. The Plan, however, was not fully implemented due to financial constraints among other factors such as lack of legal status, inadequate capacity and lack of proper coordination among stakeholders. The implementation status of the previous management plan is highlighted in Table 3 below:



**Table 3: Implementation status of the 1<sup>st</sup> integrated management plan 2008-2013**

Activity	Achievements	Comments
<b>Water management programme</b>		
Strengthening of water resource user's associations	<ul style="list-style-type: none"> <li>• Formation of Lake Ol' Bolossat WRUA as of December 2012.</li> <li>• Constitution in place</li> <li>• Proposal on sub-catchment management plan</li> <li>• Inventory of water resources undertaken</li> <li>• Equator WRUA and Oraimutia development sub-catchment management plan, undertook inventory and riparian protection</li> <li>• Awareness creation to members and community on water use, reduction in water pollution</li> <li>• Awareness creation with WRUA in 2017 on resource mobilisation carried out by Kenya Wetlands Health Organization</li> <li>• The 3 WRUA involved in water conflict resolution</li> <li>• Protection and rehabilitation of Njunu and Mbobo springs by FoLO; fencing, water pans, animal watering point, cattle trough and tree planting</li> <li>• Protection of chapalungu and Muruai springs protected by NEMA</li> <li>• Demarcate riparian buffer zones- <b>done by NEMA</b></li> </ul>	<p>The proposed WRUA faced a lot of opposition</p> <p>Unable to access funding from County Government- WSTF stopped proposals</p> <p>Encroachment into the lake</p> <p>CETRAD to fund water level monitoring and processing equipment</p>
Streamlining the issues of water abstraction, storage and delivery	<ul style="list-style-type: none"> <li>• Involvement of WRUAs in water abstraction permits</li> <li>• Water quality testing by WRMA at Primarosa that indicated increased levels of mercury.</li> <li>• Supported the construction of roof catchment and water storage facilities in some schools</li> </ul>	
Implement guidelines for water use and a code of conduct for water users	<ul style="list-style-type: none"> <li>• Awareness creation undertaken</li> </ul>	Awareness creation ongoing
Implementation of public health Act on pit latrines, and sewage disposal	<ul style="list-style-type: none"> <li>• Train farmers on safe and appropriate use of agro-chemicals- <b>done by private companies.</b></li> <li>• Develop a water quantity and quality monitoring program-<b>ongoing by Ministry of Water</b></li> </ul>	

Activity	Achievements	Comments
Support the construction of an efficient sewage treatment plant	<ul style="list-style-type: none"> <li>Sewerage treatment plant being implemented in Ol Kalaou town by the national government, other areas not yet due to finances.</li> </ul>	Still a challenge. Most discharge ends up in the lake
Enforce regulations that prevent encroachment into riparian zones so as to reduce degradation of the water resources	<ul style="list-style-type: none"> <li>Awareness creation on importance of lake and riparian areas</li> <li>Undertake reforestation of the catchment area</li> </ul>	Yet to demarcate one side of the lake boundary
Support the construction of a sewage system for Manguo area		Not yet done, lack of finance
Identify and support the restoration of degraded areas in the catchment	<ul style="list-style-type: none"> <li>2 springs identified in the upper catchment by Tree is Life Trust</li> </ul>	
Undertake soil conservation measures including terraces, nappier grass strips, cut-off drains and infiltration drain	<ul style="list-style-type: none"> <li>Not yet done owing to financial constraint</li> </ul>	Overgrazing resulting from livestock numbers Water over abstraction
Practice appropriate farming methods to prevent land degradation	<ul style="list-style-type: none"> <li>Awareness to farmers ongoing on the appropriate farming methods</li> </ul>	
Develop a water quantity and quality monitoring program	<ul style="list-style-type: none"> <li>Primarosa made to comply by WRMA</li> <li>Acquiring effluent discharge control plan for all abstractors and dischargers</li> </ul>	
Support the Ministry of Water and Irrigation to enforce the Water Act	<ul style="list-style-type: none"> <li>WRUAs formed and supported</li> </ul>	
Enhance awareness on sustainable water resource use	<ul style="list-style-type: none"> <li>Awareness ongoing</li> </ul>	
<b>Agriculture and livestock management</b>		

Activity	Achievements	Comments
Identify and map areas vulnerable to soil erosion and develop soil conservation measures	<ul style="list-style-type: none"> <li>Not undertaken due to lack of funds</li> <li>Reforestation of the escarpment and introduce farm forestry in the basin in Kirima (2011)</li> </ul>	
Enhance appropriate agro-forestry activities on individual farms	<ul style="list-style-type: none"> <li>Established agro-forestry activities on individual farms in Gatimu and Shamata</li> <li>Ongoing agroforestry activities on individual farms done at personal initiative level at a very low level</li> </ul>	
Undertake reforestation of the catchment and encourage farm forestry in the basin preferably indigenous species	<ul style="list-style-type: none"> <li>6,000 seedlings planted in Chapalungu and Muruai</li> <li>20,000 indigenous and 30,000 exotic seedling planted by FoLO in Kirima escarpment and in public schools</li> <li>Community tree planting initiatives</li> </ul>	Tree planting initiatives ongoing Exotic seedlings should be avoided in the catchment
Popularize and educate farmers on organic farming and safe use of agro-chemicals	<ul style="list-style-type: none"> <li>Field days to train farmers on organic farming, conservation farming and safe agro-chemical use by TiLT and County Government</li> <li>Awareness on safe disposal of agro-chemical containers</li> </ul>	Awareness still on course.
Carry out research on the irrigation potential of the plan area	<ul style="list-style-type: none"> <li>Not yet done</li> </ul>	Need funds to undertake extensive hydrological survey
Enhance alternative income generating activities (bee keeping, fish farming, poultry keeping etc)	<ul style="list-style-type: none"> <li>9 incubators for chick hatching and green fish farming by TiLT</li> <li>FoLO: capacity building on smart agriculture. The following were issued to farmers:               <ol style="list-style-type: none"> <li>11 green houses</li> <li>110 beehives of the langstroth type</li> <li>125 dairy goats (does) and 5 bucks distributed</li> <li>10 fish ponds</li> <li>14 tree nurseries</li> </ol> </li> <li>Jikos to support rearing of chicks</li> <li>Establishment of a fish association to promote fish farming</li> <li>Laikipia–Nyandarua Alliance promoting wool weaving, incubators, energy saving jikos, tree nurseries and greenhouses</li> <li>Plans to promote commercial fishing from the lake</li> </ul>	-need to promote boating as an alternative livelihood

Activity	Achievements	Comments
	<ul style="list-style-type: none"> <li>• Introduction of bee keeping and fish farming in 2009 though not sustained</li> </ul>	
Promote fish farming activities	<ul style="list-style-type: none"> <li>• Fish eating campaigns and radio and TV programmes to promote fish farming.</li> </ul>	The campaigns ongoing
Plant trees that can minimize the effects of frost on both the escarpment and on individual farms	<ul style="list-style-type: none"> <li>• Promotion campaigns by TiLT Vetiver and lemon grass planted in the riparian area</li> <li>• County implementation transition plan developed by KFS to promote tree cover</li> </ul>	Tree planting ongoing across the county
Expand zero grazing through extension services	<ul style="list-style-type: none"> <li>• Promotion of biogas by TiLT</li> <li>• ASDSP promoting dairy value chain</li> <li>• KAPAP supporting dairy farmers in collection and processing of milk</li> </ul>	Zero grazing training and support being undertaken under the climate smart agriculture in Kiriita wards
Train farmers on irrigation management systems	<ul style="list-style-type: none"> <li>• Demonstration and kitchen gardens promoted by TiLT</li> </ul>	
Train farmers who practice agriculture principles of horticultural crop production	<ul style="list-style-type: none"> <li>• Multi-purpose fruit trees - avocados, mangoes and lemons promoted by TiLT</li> <li>• Demonstartions on green house and drip irrigation by WRUAs</li> <li>• Exposure tours for farmers</li> <li>• Vermiculture gardens promotion</li> <li>• Ongoing farmer education on organic farming during field days e.g. Ol' Joro Orok farmer training centre</li> </ul>	There is need to educate farmers on organic farming
Educate and train farmers to adopt recommended livestock stocking rates	<ul style="list-style-type: none"> <li>• Awareness and training ongoing</li> </ul>	There is need to enhance training and awareness programme
Train farmers on nursery management, seed handling, sowing, pricking and tree crop management	<ul style="list-style-type: none"> <li>• Not done</li> </ul>	
<b>Forestry management</b>		
Support existing reforestation groups and	<ul style="list-style-type: none"> <li>• Support to Ndaragwa, South Marmanet and Ol'Bolossat CFAs by Tilt, KFS and Lainya</li> </ul>	

Activity	Achievements	Comments
encourage formation of new ones	<ul style="list-style-type: none"> <li>Formation of groups among the communities living in the neighbouring escarpment of Kirima in 2009</li> </ul>	
Support establishment of tree nurseries by institutions and individuals	<ul style="list-style-type: none"> <li>OI Joro Orok and Inoro primary schools</li> <li>6 primary (Rurii, Gatumbiro, OI Joro Orok, OI'Bolossat, Manguo and Gatitu); 2 secondary schools (OI Joro Orok and Nyandarua)</li> <li>Support to 12 community tree nurseries around the lake by FoLO</li> </ul>	Private nurseries being promoted.
Support agro-forestry and reforestation groups to undertake tree planting on the escarpment	<ul style="list-style-type: none"> <li>Trees planted by FoLO</li> <li>Tree planting by agro-forestry and reforestation groups in the escarpment through support from KFS in Gatimu</li> </ul>	
Establish and maintain firebreaks between the farms and the escarpment	<ul style="list-style-type: none"> <li>Creation of awareness on farm management, fire seasons to minimize firebreaks</li> <li>Planting fire tolerant tree species e.g. Mexican gold ash</li> </ul>	Ongoing
Support enforcement of the Forest Act	<ul style="list-style-type: none"> <li>Involvement of other stakeholders to enforce the act and policy</li> </ul>	Awareness being created on the same.
Awareness and capacity building among community members in prevention and firefighting techniques	<ul style="list-style-type: none"> <li>CFAs trained in firefighting</li> <li>Firefighting equipment in place</li> </ul>	Ongoing
Support rehabilitation and expansion of indigenous forests	<ul style="list-style-type: none"> <li>Management plans for gazetted forests</li> <li>Promotion of rehabilitation of degraded areas</li> <li>Creation of awareness on the importance of the Ndundori forests to the survival of the lake</li> </ul>	Rehabilitation through tree planting underway, the programmed requires more funding.
Identify, support and promote alternative sources of energy	<ul style="list-style-type: none"> <li>Promotion of biogas, solar lamps, briquettes by TiLT</li> <li>Promotion of energy saving jikos (kuni mbili) by KFS and FoLO</li> <li>Promotion of woodlots among farmers</li> <li>Green school programme; energy jikos and woodlots</li> <li>Fireless and solar cookers</li> <li>Individual initiative on promotion of alternative energy sources e.g. use of electricity and biogas by Ministry of Agriculture</li> </ul>	6 kgs gas cylinders being distributed to communities in Shamata and Kiriita ward as an intervention. More funding required to reach as many.
<b>Human–wildlife conflict management</b>		

Activity	Achievements	Comments
Enforce the Wildlife Act	<ul style="list-style-type: none"> <li>Review of Wildlife Act in 2013</li> <li>Compensation Committee established to oversee compensation</li> <li>Training of compensation committee members</li> <li>Banning of bird shooting as of WCMA (2013).</li> <li>Poaching of birds has reduced due to awareness programme to the poachers</li> </ul>	Need to educate the community on compensation claim processes
Support identification, design and construct barriers to control hippopotamus	<ul style="list-style-type: none"> <li>Barrier constructed in Githungucu, Ol Kalou and Mirangine</li> </ul>	Support being offered by KWS to reduce
Undertake studies to determine the number of hippopotamus that can be supported by the ecosystem	<ul style="list-style-type: none"> <li>Hippopotamus census undertaken in 2012 approx. 815</li> </ul>	Need for a buffer zone to separate settlements and wildlife Creation of awareness to community and school children
Conduct continuous problem animal surveillance and control to reduce conflict	<ul style="list-style-type: none"> <li>Establishment of electronic alarm system to receive incidence on NRM- by TiLT</li> </ul>	Ongoing
Establish appropriate stocking rates for livestock	<ul style="list-style-type: none"> <li>To consult Livestock Office</li> </ul>	
Support community-based conservation projects	<ul style="list-style-type: none"> <li>Construction of schools</li> <li>Training of youth groups on elephant dung paper by KWS</li> <li>TiLT: advocacy using murals, environmental games and school competitions to promote conservation</li> <li>KFS: promote and support nature-based enterprises-bee keeping and ecotourism</li> <li>Nyahururu Bird Club training (from 9 to 30) bird guides.</li> <li>Education and creation of awareness on human-wildlife conflict resolution</li> <li>Community-based projects related to conservation e.g. Manguo Primary build 4 classes and train community on wildlife as community wildlife rangers</li> <li>Cranes Conservation Volunteers: data collection and dissemination, annual cranes Census, (ongoing)</li> </ul>	Ongoing

Activity	Achievements	Comments
	<ul style="list-style-type: none"> <li>Training fishermen on [poultry farming, 2 poultry house build at Bahati village and 200 chicks donated plus 40 hens to four individuals each receiving 10</li> </ul>	
Define a buffer zone around the lake and the marshes and resolve the land issues	<ul style="list-style-type: none"> <li>Riparian reserve delineated</li> </ul>	Ongoing
<b>Infrastructure development</b>		
Solicit resources for provision and improvement of infrastructure for socio-economic development	<ul style="list-style-type: none"> <li>Signage to the lake</li> <li>General improvement of roads status and feeder roads except for Mukindu, Mugathika and Kirima villages</li> <li>Road drainage poorly done on improved roads.</li> <li>Narrow roads following encroachment on road reserves</li> <li>FoLO (with CDTF finance) managed to buy energy-saving jikos.</li> </ul>	Signage installed others earmarked
Improve the operation of existing health facilities and support primary health care	<ul style="list-style-type: none"> <li>Construction of Baari, Rurii, Ol Joro Orok and Gatimu dispensaries</li> <li>Upgrade of JM Ol Kalou memorial hospital to level 4</li> </ul>	Dispensaries being supported.
Solicit funding for upgrading, drainage works and gravelling of 7 access roads and 1 viewing tract	<ul style="list-style-type: none"> <li>Improvement of access roads to the lake</li> <li>Recommends upgrading of Kariamu-Kibathi road to bitumen to run parallel to Ol Kalou-Nyahururu highway.</li> <li>More roads towards the lake have been upgraded by County government (2013-2018) although there is a need to do more to improve transportation</li> </ul>	Road improvement with the county machineries project underway.
Expedite Rural Electrification	<ul style="list-style-type: none"> <li>Rural electrification programmes underway. Schools and homesteads connected to the grid</li> <li>Rural electrification largely improved</li> </ul>	Awaiting Transformers being supplied by the national government.
Rehabilitate Nyahururu sewerage treatment works	<ul style="list-style-type: none"> <li>Sewerage plant rehabilitated and expanded</li> </ul>	Underway
<b>Socio-economic development</b>		
Support the application of post-harvest technologies	<ul style="list-style-type: none"> <li>Training of farmers on post-harvest handling</li> <li>County putting a packhouse/cold storage at Ol Kalou</li> </ul>	Need to construct demonstration structures

Activity	Achievements	Comments
Support diversification of food and cash crops	<ul style="list-style-type: none"> <li>Awareness creation on alternative enterprises; stevia and canola</li> </ul>	Ongoing
Develop mechanisms for resource mobilization to support the socio-economic activities	<ul style="list-style-type: none"> <li>Capacity building on agricultural commercialization by ASDSP</li> <li>Farmer field schools by KFS to capacity build on resource mobilization</li> </ul>	Ongoing but needs to be funded more to enhance it.
Support initiatives that promote equitable distribution of benefits and decision making across gender e.g. formation of youth groups, women groups and conservation and enterprise groups	<ul style="list-style-type: none"> <li>Ragoat women group and Uhoini youth group in Kasuku supported by TiLT</li> <li>Gatumbiro women support group supported by Uwezo Fund</li> <li>25 groups supported by FoLO on goat rearing</li> </ul>	More needs to be done hence needs financing.
Support formation of groups for effective marketing (Agriculture, Tourism, Livestock Development)	<ul style="list-style-type: none"> <li>A number of saccos formed to assist in marketing of produce; umoja, Nyala SACCOs</li> <li>ASDSP- formed cooperative on 3 value chains-potato, dairy and fish</li> <li>Department of cooperative facilitating group formation</li> <li>KAPAP; value chain, group marketing and acquisition- dairy, peas and potatoes</li> </ul>	The saccos and groups being supported in Kiriita ward under the climate smart agriculture, more groups need to be supported hence more funding required,
<b>Tourism management</b>		
Support the development of a eco-tourism activities and tourist lodge, campsites, cycling and horse-riding tracts, picnic site and hippo view points	<ul style="list-style-type: none"> <li>Bandas and nature trail by Lainya and KFS respectively in Ndaragwa forest</li> <li>Golf course and resort in Kipipiri by Mount Kipipiri investors</li> <li>Proposed hotel in Kirima area and Ol Kalou (Kapten)</li> <li>Royal gardens in Ol Kalou, Hippo point and Panari in Nyahururu; and Hippo lodge and Kichakani in Kasuku <ul style="list-style-type: none"> <li>Private Campsite established at Kichakani</li> <li>Campsite/cycling and horse riding in Kianjata (private)</li> </ul> </li> <li>Promotion of tourism and opening up of access roads to the lake by the County Government</li> <li>Bird watchers within the lake</li> </ul>	<p>Trails done in Ndaragwa.</p> <p>Hotels being supported by the county government.</p> <p>Formation of the Nyandarua County Tourism Association underway.</p>



Activity	Achievements	Comments
	<ul style="list-style-type: none"> <li>Plans to build a leisure park are underway</li> <li>Plans to conversion of colonial buildings into museums</li> </ul>	
Publicize the tourism potential of the area by producing brochures, maps and posters about the lake as well as other publicity channels	<ul style="list-style-type: none"> <li>Efforts by County Government</li> <li>Booklet by George Muigai Cranes conservation volunteers “Nyoni na Andu”</li> <li>Banners and documentary by FoLO</li> <li>Brochures by Nature Kenya</li> <li>Vernacular birds conservation brochures, posters and leaflets by Cranes Conservation Volunteers</li> </ul>	Nyandarua tourism digital Mobile marketing application developed, other publications including TV series being undertaken.
Undertake training for tour guides around the area	<ul style="list-style-type: none"> <li>NABU (BirdLife Germany) training Crane Conservation Volunteers on monitoring of the Endangered Grey Crowned Crane.</li> <li>Nine local community bird guides trained and developed skills to a competent level – conducted by Wanyoike Wamiti (2008-2009), funding from Rufford Small Grant</li> </ul>	Training for the same in the plan.
Produce a tourism business plan	<ul style="list-style-type: none"> <li>Draft plan developed</li> <li>There is an increased traffic of tourists to the Lake especially domestic tourists and school groups.</li> </ul>	Strategy in place
Inventorize other potential attractions such as boating, sport fishing, bird watching, duck shooting, rock climbing, nature trails, nature photography and hiking	<ul style="list-style-type: none"> <li>Hiking sites at Kipipiri,</li> <li>Historical caves in Aberdares</li> <li>Thomson falls is a tourist attraction site</li> <li>South Marmanet hiking and nature trails, maternity site for elephants, falls and curving stones/soapstone, Sandal wood among other resources</li> <li>Lake Ol’ Bolossat Marathon by the County Government of</li> <li>Nyandarua</li> </ul>	<p>Nyahururu is within a tourist circuit.</p> <p>The Lake Ol’ Bolossat marathon can be a good avenue to promote activities of conservation.</p>
<b>Biodiversity and research</b>		
Inventorize and map out changes in the Lake and its catchments	<ul style="list-style-type: none"> <li>KWS has developed maps</li> <li>Nature Kenya, Nyahururu Bird Club, KWS, KFS, TILT and the County Government of Nyandarua, Laikipia Wildlife Forum and County administration, involved in monitoring, security provision during research and lake inventory development</li> </ul>	Maps in place and in use

Activity	Achievements	Comments
	<ul style="list-style-type: none"> <li>A study by completed (2014) by Mwangi <i>et al.</i>, (University of Nairobi) through CETRAD on community perceptions on land degradation, land use and land cover and spatial soil loss using USLE and GIS</li> </ul>	
Monitor water quantity and quality as per the Water Act	<ul style="list-style-type: none"> <li>WRMA and KWS regular monitoring and sampling of water quantity and quality the at Thomson falls River gauging station (RGS) and at the Lake.</li> </ul>	Ongoing
Monitor and evaluate plant and animal species dynamics	<ul style="list-style-type: none"> <li>KWS, Nyahururu bird club conducts regular monitoring of birds and other biodiversity in the lake.</li> </ul>	Ongoing
Evaluate the impacts of management interventions	<ul style="list-style-type: none"> <li>KWS quarterly reports determines the impacts of the interventions</li> <li>MSc level study conducted and completed (2017/16) on conservation aspects of Grey Crowned Crane (Mary Waweru, University of Eldoret).</li> <li>Ongoing PhD research on Grey Crowned Crane (Wanyoike Wamiti, University of Nairobi).</li> <li>Waterbird census being carried out by NMK, KWS and Nature Kenya</li> </ul>	KWS and other interested parties to do more research
Research on conflict resolution between hippos and humans	<ul style="list-style-type: none"> <li>KWS conducted, documented and information is available</li> <li>Human-Wildlife conflict mitigation committees and procedures for compensation established by KWS, County Government and Ministry of Interior and national coordination.</li> </ul>	Research ongoing and there is a proposal to gazette the lake under Kenya wildlife and management act as a strategy to deal with the conflict.
Assess the causes and impacts of hydrological changes in the plan area	<ul style="list-style-type: none"> <li>Observation and students research on land use changes impacts on the lake.</li> <li>Feasibility study Report by KWS.</li> </ul>	Research and study ongoing, feasibility study to be conducted.
Research on the linkages between socio-economic, demographic trends and land use changes	<ul style="list-style-type: none"> <li>CETRAD population research on the lake and its environs and other student research reports</li> <li>County Government research reports.</li> </ul>	Plans underway
Investigate appropriate methods of controlling invasive species and mitigate underlying causes	<ul style="list-style-type: none"> <li>Consult the stakeholder especially KALRO.</li> </ul>	Consultation done and analysis of the water done.

Activity	Achievements	Comments
Conduct EIA's before infrastructure development and EA's for existing activities	<ul style="list-style-type: none"> <li>EIA reports available at NEMA Nyandarua and Laikipia and lead agencies like KWS, KFS and WARMA</li> </ul>	It's a component in the Planned in the coming feasibility study.
Determine the status and economic viability of Coypu rats		Underway
Research on Indigenous knowledge	<ul style="list-style-type: none"> <li>Knowledge has not been documented.</li> <li>Wakanyuri had written a book on indigenous knowledge.</li> <li>Karuri Gakure used to collect soda ash from the lake for barter trade.</li> </ul>	Underway
<b>Education, Awareness and Capacity building</b>		
Undertake training needs assessment for the Plan Implementation committee and Implementation committees	<ul style="list-style-type: none"> <li>KWS research Department trained the committees.</li> </ul>	Compensation committee in place.
Undertake training workshops for the PIC	<ul style="list-style-type: none"> <li>KWS research Department trained the committees.</li> </ul>	Compensation committee in place. Training ongoing
Undertake field education tours for the Implementation committee and the community	<ul style="list-style-type: none"> <li>KWS and PIC visited the site.</li> <li>FoLO, KFS, TILT, KWS and Nyahururu Bird Club conducts exposure tours for the community.</li> <li>Cranes Conservation Volunteers has conducted 3 trainings for over 20 community members each on the plight of the Grey Crowned Crane (October and November 2018).</li> </ul>	Ongoing
Conduct training based on the training needs assessment for the community members	<ul style="list-style-type: none"> <li>KFS, KWS, FoLO, ASDSP, TiLT, WRMA, KMD conducts trainings including weather advisories.</li> <li>Nyahururu Bird Club conducts awareness on fire risk on the catchment.</li> <li>Various number of groups have been registered where 3 seminars have been done by NBC and CCV</li> <li>Children have been given sponsorship through CCV since 2017</li> </ul>	<p>Ongoing</p> <p>Sponsorships have benefited over 60 pupils</p>

Activity	Achievements	Comments
Create awareness on the importance of the Ndundori and Satima forests for the survival of the lake	<ul style="list-style-type: none"> <li>KWS, KFS are doing sensitization in the area.</li> <li>EAWLS provided energy-saving jikos and training to local community</li> </ul>	Ongoing
Educate and create awareness on human – wildlife conflict resolution	<ul style="list-style-type: none"> <li>KWS is conducting awareness on compensation and conflict resolution</li> <li>Cranes Conservation Volunteers zoning Grey Crowned Crane breeding territories against livestock and people access during Cranes breeding season, in collaboration with the local community</li> </ul>	Awareness and community support ongoing.
Undertake education and awareness on impact of increased population on a limited economic base	<ul style="list-style-type: none"> <li>Social department registering herbalists and training them.</li> <li>KFS and KWS planting and training medicinal trees.</li> </ul>	On course
Educate and support the community on application of wise use principles in natural resource utilization	<ul style="list-style-type: none"> <li>KWS, WARMA, KFS, TILT, FoLO and Nyahururu Bird Club conduct regular trainings on resource utilization</li> </ul>	Ongoing but had not been smooth due to financial constraints.
Conduct education and awareness to discourage subdivision of land	<ul style="list-style-type: none"> <li>Department of Agriculture creates awareness</li> </ul>	Real estate development is a major challenge to control land subdivision, Need for a legislation to inhibit land subdivision -Need for farm planning
Conduct education and awareness to diversify the economic base (alternative livelihoods)	<ul style="list-style-type: none"> <li>KWS, WARMA, Agriculture Dept, KFS, TILT, FOLO and Nyahururu bird club promoting alternative livelihoods activities such as greenhouse farming, Daily poultry etc</li> <li>Alternative livelihood to reformed poachers around Lake Ol' Bolossat - 10 trained in poultry rearing as alternative livelihood by Cranes Conservation Volunteers</li> </ul>	More training required, financial constrains has been a hindrance.
<b>Riparian Land Management</b>		
Delineate the lake boundaries and then produce topographical maps demarcating the areas quoted below	<ul style="list-style-type: none"> <li>NEMA and KWS developed a map with delineation boundaries</li> </ul>	Not yet done due to financial constraints.

Activity	Achievements	Comments
Identify and ear mark land to be reserved for the Lake, riparian reserve, fragile ecosystem and wildlife conservation areas	<ul style="list-style-type: none"> <li>NEMA and KWS developed a map.</li> <li>The County Government of Nyandarua and KFS have identified the area as a fragile ecosystem to be protected.</li> </ul>	The lake is saline and fresh in some parts. Abstraction of fresh water is a major concern.
Inventory to determine the status of ownership of riparian land	<ul style="list-style-type: none"> <li>The map gives details on the plot numbers</li> <li>Plot owners inventory needs to be developed.</li> </ul>	Being established but requires more support from the national government.
Initiate recovery process to nullify and repossess all the grabbed land	<ul style="list-style-type: none"> <li>Not Done</li> </ul>	Not yet done awaiting survey.
Physical planning, survey and Gazettement of areas identified	<ul style="list-style-type: none"> <li>Survey not done, Gazettement done following the original boundaries.</li> </ul>	Survey not yet done

## CHAPTER 2: ECOLOGICAL AND SOCIO-ECONOMIC FEATURES

### 2.1 Ecological features

#### 2.1.1 Naturalness

The eastern side of the lake is bound by Satima escarpment, along the edge of the Aberdare ranges creating a beautiful scenery and wilderness experience. The water from the basin drains into Ewaso Ng'iro North River through Nyahururu (Thompson) falls. The basin and water mass presents a majestic, photographic scenery as viewed from Satima escarpment (Subuku towards Shamata viewpoints) and even better from the top of the Aberdares National Park (Satima peak). The outlet/source of the Malewa River that drains to Lake Naivasha is clearly visible from the southern parts of the Lake (clearly visible from Kaka) as it leaves the ranges through a deep cut gorge valley.

#### 2.1.2 Fragility

The steep escarpment and human activities make the Lake vulnerable to siltation and landslides due to the nature of soils. The small size of the catchment and lack of major rivers predisposes the Lake to seasonal dry outs as recorded in 1960, 1984, 1987, 1994, 2000 and 2001.


#### 2.1.3 Rarity

Lake Ol' Bolossat is the only natural Lake in the central highlands of Kenya. The lake water is generally saline but discharges fresh water into Ewaso Ng'iro River through Nyahururu falls.

### 2.2 Biodiversity

The lake ecosystem supports diverse habitats hence rich in biodiversity. Numerous species of animals, indigenous plants, and microorganisms are found in Lake Ol' Bolossat, many of which have not been documented though well known to local people. The lake is well known for its large concentration of hippopotami and high diversity resident and migratory waterbirds from Europe and Northern Asia. Except for its bird life, however, there is limited information about its aquatic invertebrates, fish, amphibians, reptiles, mammals, fungi and plant species as well as other aspects of its biodiversity.

Generally, the lake basin is characterized by different vegetation types including; *Themeda-Pennisetum* grasslands, disturbed patches of forest with *Juniperus procera* and *Cussonia spicata*, reeds, swamps and floating macrophytes (Wamiti *et al.*, 2008). In the open waters floating and



submerged macrophytes occur with some aquatic weeds having invaded the lake. The Lake is also a unique and less studied herpetofauna biodiversity area with ability to produce diverse and rare species owing to its affinity to Aberdare Forest where some Kenyan endemic species have been found. Lake Ol' Bolossat wetland ecosystem had significant diversity of fish species. Six fish species assessed were of least concern. However, the presence of introduced species in the lake was of concern (Terer *et al.*, 2019).

The lake's ecological integrity and its biodiversity has also been impacted by anthropogenic activities at the catchment as well as at the basin. Climate change, intense farming on the watershed and in the basin, increase in water extraction from rivers and springs draining into the lake are some of the factors that have contributed towards shrinkage of the lake in the recent past. In a study by Terer *et al.*, (2019), the size of Lake Ol' Bolossat, its floodplains and forested area have significantly shrunk by 68%, 26% and 30% respectively between the 1989 and 2010, while farmlands and built-up area increased by about 31% and 33% respectively.

### **2.2.1 Birds**

The Lake and surrounding areas including Satima escarpment, Lake basin, Uaso Narok Forest Reserve, agricultural lands and urban centres have an estimated 300 species of birds (Wamiti, 2010). Waterbirds are the most conspicuous among birds in the area where over 100 species have been recorded (Wamiti, *pers. comm.*, 2019). Among the waterfowls, the most abundant groups are Afrotropical ducks and geese, Rails, gallinules, coots, ibises and spoonbills (Fig 6), while the most abundant species are Red-knobbed Coot, Egyptian Goose, Sacred Ibis and Yellow-billed Duck.





**Figure 6: African Spoonbill (*Platalea alba*) a local breeding resident at Lake Ol’Bolossat**

(Photo Credit: W. Wamiti)

Several Palearctic and Afrotropical migrant species have also been recorded, some of which are listed by the African-Eurasian Waterbird Agreement (AEWA) under the Bonn Convention on Migratory Species. These include the White Storks (*Ciconia ciconia*) (Fig 7), which are commonly seen in grasslands and croplands (especially in ploughed fields). They eat small animals like eat rodents and a variety of invertebrates.



**Figure 7: White Stork *Ciconia Ciconia* on the grassland at L. Ol’Bolossat**

(Photo Credit: W. Wamiti)

The lake is a breeding site for Red-knobbed Coot (*Felica cristata*), African Jacana (*Actophilornis africanus*), Blacksmith Plover (*Vanellus armatus*), Black-winged Plover (*V. melanopterus*), African Snipe (*Gallinago nigripennis*), Yellow-billed Duck (*Anas undulata*), Red-billed Teal (*A.*



*erythrohychna*), Purple Swampphen (*Porphyrio porphyrio*) and Grey Crowned Crane (*Balearica regulorum*) (Fig 8) (Wamiti *et al.*, 2010).



**Figure 8: Endangered Grey Crowned Crane *Balearica regulorum***

(Photo Credit: W. Wamiti)

On the western side, the riparian grasslands around the Lake as well as some private farms have Kenyan endemic and Endangered Sharpe's Longclaw (*Macronyx sharpei*) and the East African Endemic and Near-Threatened Jackson's Widowbird (*Euplectes jacksoni*). Wamiti & Njoroge, 2019 (in Terer *et al.*, 2019) recorded Sharpe's Longclaw in Kirima, Ngurumo and Kianjata. Suitable habitat for this species however also exists at Kibathi, Githungucu, Kanguu, Gatumbiro and Mukindu/Mugathika villages.

Lake Ol' Bolossat was listed as Kenya's 61st Important Bird Area in March 2008 (Wamiti *et al.*, 2008). This followed the confirmation of globally-threatened species such Sharpe's Longclaw and Jackson's Widowbird. Wamiti *et al.* (2008) have shown other species of conservation concern that have been recorded in the Lake. During a survey conducted in 2019 (Terer *et al.*, 2019) a total of 293 bird species represented by 68 families were recorded, the most diverse groups being diurnal birds of prey (24 species), ducks and geese (20 species), sandpipers (14 species) and herons and allies (13 species). A majority of these are resident (206 species) while the rest (87 species) are of

various migration status. The latter group uses Lake Ol’Bolossat as a stopover site for feeding, resting or as a wintering ground. Seventeen of the waterbird species are listed as species of conservation concern by the African-Eurasian Waterbird Agreement. The forested springs at the base of Satima escarpment have unique bird species including 6 forest specialists (species that depend on and require an intact, undisturbed natural forest habitat), 27 forest generalists and 40 forest visitors (Wamiti & Njoroge, 2019). Sixteen of the species are listed as globally-threatened on the IUCN Red List of Threatened Species including two endangered residents with a breeding population. These are Grey Crowned Crane *Balearica regulorum* and Sharpe’s Longclaw *Macronyx sharpei*. The year 2019 countrywide cranes census recorded 1,115 individuals. Lake Ol’ Bolossat holds the second largest population of this African endemic species.

### 2.2.2 Mammals

The number of hippopotamus (Fig 9) recorded at Lake Ol’ Bolossat from 1987 to 1989, ranged between 89 and 176 (Lake Ol’ Bolossat Management Plan 2008 -2013). The maximum number coincided with wet seasons while the minimum number coincided with dry seasons. The distribution of hippos in the lake is dependent on biomass distribution of green herbage on the riparian area (Paul, 2014). Terer *et al.*, (2019) recorded a total of 131 mammal individuals representing 7 species and 5 families including hippopotamus, marsh mongoose, cape hare, stripped grass mouse, brush-furred mouse, coypu and southern tree hyrax.



Figure 9: Photos Taken at L. Ol’Bolossat; On the Leftt, Adult Hippopotamus (*Hippopotamus amphibious*): on the Right, Coypu (*Myocastor coypus*).

(Photo Credit W. Wamiti)

### 2.2.3 Fish

The marshes and swamps around the lake are known to support 7 species of fish such as the native catfish *Protopterus amphibious*, *Enteromius paludinosus*, *Clarias gariepinus*, *E. neumayeri* and *Oreochromis spilurus* while introduced species include *Pseudocrenilabrus multicolor victoriae*, *Oreochromis niloticus* and *Poecilia reticulata* (Terer *et al*, 2019). Straightfin barb and Sabaki tilapia were found in all the aquatic habitat types (Open water, riverine and marshy areas) of Lake Ol' Bolossat. The straight fin barb was the most common species in all the habitats. Overall, fish are more abundant in marshy areas when compared to the open lake and riverine habitats.

Man-made wetlands in the Lake Ol' Bolossat region are stocked with several fish species such as tilapia and common carp (Okumu, 2017), the two species being also raised by the community around the Lake. It is noted here that only a few of the local fishermen have the right fishing gear. Instead, they rely on a hired office net (seine net) which to some extents limits the exploitation of the Lake's fisheries resources.

### 2.2.4 Reptiles and Amphibians

During a survey conducted by Terer *et al.*, (2019), a total of 4 amphibians (all frogs) and 5 reptiles (3 snakes and 2 species of lizards) were recorded.

### 2.2.5 Fungi

Thirty-four (34) species of fungi represented by 18 families and 27 genera have been recorded in the riparian grasslands and neighbouring farmlands including in *Eucalyptus* sp. woodlots, bushes and scrub (Terer *et al.*, 2019). Woodrotter species dominated the ecosystem and followed by soil dwellers. Macrofungi community was relatively uncommon in the natural grassland and forest remnants compared to woodlots of exotic tree species and in the farmland. There was an apparent gradual replacement of native macrofungi community with exotic species, suggesting high levels of land degradation. Species in family Polyporaceae and Agaricaceae (mainly the puffball) dominated the Lake ecosystems. Woodrotters species (50%) dominated the ecosystem followed by ectomycorrhiza (17%) and cow-dung dwellers (15%). Termite cultivated species and soil dwellers had the lowest representation (9%). Only three species of macrofungi (*Termitomyces microcarpus*) were documented in natural forest remnants. Natural grassland around the lake was heavily grazed by livestock and mainly supported *Termitomyces*, puff balls (*Lycoperdon*), *Panaeolus* (cowdung), *Psilocybe* and *Agrocybe* species (on cowdung). Ectomycorrhiza species

(*Laccaria bicolor*, *Pisolithus arrhizus*, *Suillus granulatus*, *Scleroderma citrinum*) dominated exotic plantation of *Eucalyptus*, *Pinus* and *Acacia mearnsii*. *Termitomyces* species are a valuable source of food for the local community. They are harvested, washed with clean water and cooked as stew alongside fish and eaten with maize meal (Ugali). There is potential for mushroom production and improvement of the existing species and minimize the negative effects of harvesting the wild species for consumption and marketing. In conclusion, Lake Ol' Bolossat ecosystem supports a rich macro-fungi community with *Termitomyces* species serving as an important food source for local community. The fungi play an important role in water conservation and storage as well as facilitating nutrient cycling, which is necessary for growth of all plants, including agricultural crops.

### **2.2.6 Invertebrates**

Until recently, there have been only a few museum specimens from Lake Ol' Bolossat basin held at the invertebrates' national reference collection at the National Museums of Kenya (NMK). However, there is an interesting species of a grasshopper (*Orthoptera sp*) collected from around Ol' Kalou and neighbouring Aberdares and Kinangop Plateau. The lake ecosystem has recorded a total of 96 aquatic invertebrates with beetles (Coleoptera), aquatic bugs *Sigara sp* and *Anisops sp*, being the most abundant (Terer *et al.*, 2019). The northeastern and southwestern part of the lake had the highest species composition, abundance and diversity owing to the different microhabitats including the presence of springs and river inlets discharging water inflows into the lake, a suggestion of the importance of these areas during protection while developing the integrated management plan of the lake. The most frequent were the Water boatmen aquatic bug (*Sigara spp*) (12.8 %), followed by *Daphnia spp* (12.1%), the back swimmer bug *Anisops ares* (11.7%) while the least abundant species included some spiders in the Family Araneidae 2, Water scorpion aquatic bugs (*Lacotrephes spp*), Pronggills mayflies (Family Leptophlebiidae). Based on the SASS5 water quality index, the lake can be described as moderately polluted based on the presence of moderately sensitive to pollution tolerant species (17%) in the lake such as the Dragonfly larvae of Family Aeshenidae with an index of 8 and Mayfly *Caenis spp* with an index of 6 even though majority of the species (82%) were in the most tolerant to pollution category. On the other hand, the springs (southeastern part of the lake- Site 3) sources of water to the lake had species sensitive pollution which included the marsh beetle in the Family Helodidae with an index of 13 suggesting pristine status hence the need for their enhanced protection. The presence of the introduced and



invasive Louisiana crayfish *Procambarus clarkii* in the lake in high abundance suggest an ecological problem in the lake with likely unknown impacts on other aquatic biodiversity.

### 2.2.7 Plants

The area is rich in flora, with over 200 plant species. According to a survey by NMK (Terer *et al*, 2019), there are over 370 plant species classified into 255 genera belonging to 92 families. Species of conservation interests noted comprise of 4 orchids, one *Aloe* and one succulent *Euphorbia*, all in appendix II of CITES. The Lake and its catchment has six general categories of natural vegetation comprising of montane open grassland, montane acacia forest, cedar forest with thicket under growth, reed and swamp grass, *Themeda-Pennisetum* grassland mixture and floating aquatic macrophytes. There are human induced changes in the structure and composition in the natural vegetation. The escarpment is currently dominated by grasses, and shrubs such as *Grewia* spp., *Scutia* spp., *Rhus natalensis* and *Buddleia polystachya* which have replaced the natural vegetation (Wamiti *et al.*, 2007).

The main tree species projecting out of the escarpment are East African Cedar *Juniperus procera* (Kik. – Mutarakwa), Cabbage tree *Cussonia spicata*, pink ball tree *Dombeya goetzenii* (Mukeu), candelabra *Euphorbia cadelabrum*, Peacock flower *Albizia gummifera* – ‘Kik. - Mukurwe’), umbrella acacia *Acacia abyssinica* (Kik. Mugugu) and Croton *Croton megalocarpus* (Kik. - Mukinduri) which are actively cut for fuel wood (charcoal) and other domestic uses by the local farmers. Except for the gallery forests much of the escarpment is devoid of trees. A few exotic tree species such as *Eucalyptus*, *Cupressus* and silky oak *Grevillea robusta* (Kik - Mukima) have been planted on farmlands on the slope and at the bottom of the escarpment.

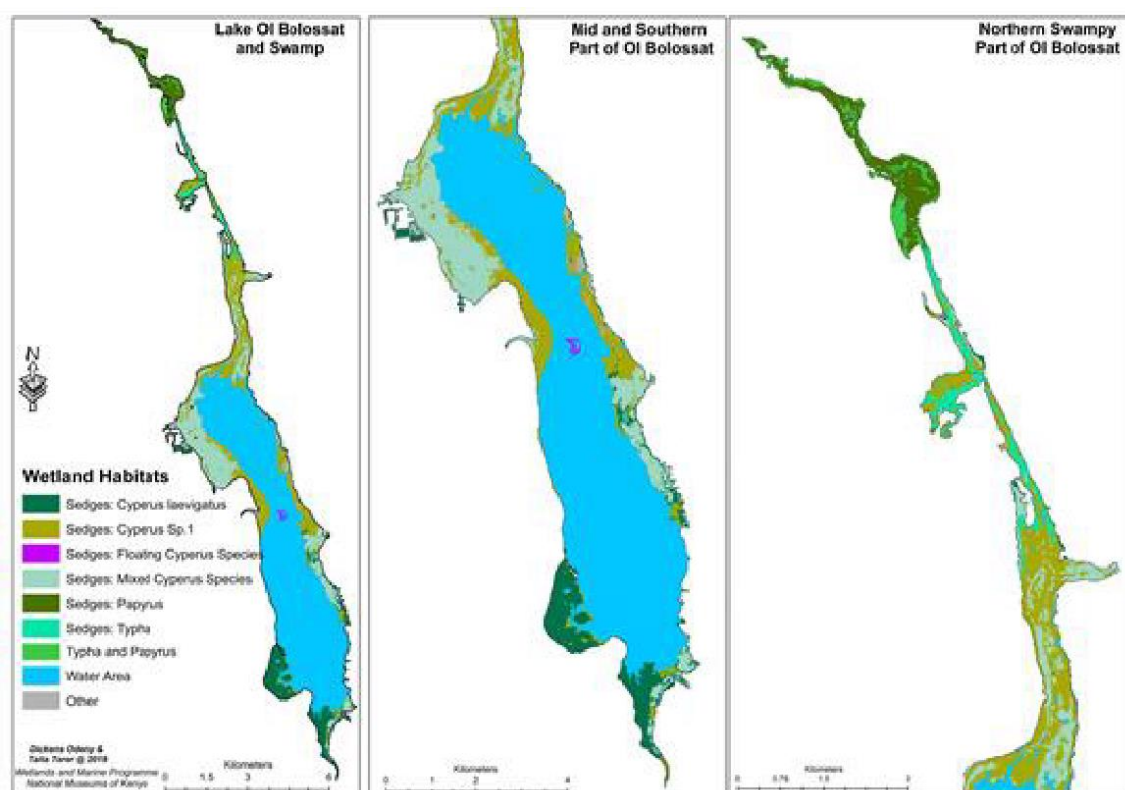
Montane and *Themeda-Pennisetum* grassland are well differentiated into short and tall grassland sections. The dominant tall grasses consist of pigeon grass (*Pennisetum sphacelata*), Red oat grass (*Themeda triandra*), *Sporobolus* spp and *Panicum* spp. The short grass zone, next to the marshes, is dominated by kikuyu grass (*Pennisetum clandestinum*), stink grass (*Eragrostis cilianensis*), feather top Rhodes grass (*Chloris virgata*) and *Setaria* spp. Those are particularly notable on the numerous mima mounds in the basin. Clover (*Trifolium simplifolia*) and *Oxalis* sp. also occur widely in the short grass zone.



Swamp vegetation include canary grass (*Phalaris arudinacca*), nut grass (*Cyperus rigidifolius*), *C. immensus* and *C. papyrus*, *Cirsium vulgare*, *Cyperus latifolia*. These form important grazing land in the marshes. The open water has a wide range of floating and submergent macrophytes such as Water lilies *Nymphaea caeruleae*, *Ludwiga stolonifera* and *Najas pectitus* (Wamiti *et al.*, 2007). Nitiritus aquatic weeds such as giant salvinia (*Salvinia molesta*) and *pistla stratiotes*, have invaded the lake (Thenya *et al.*, 2011). Submergent macrophytes such as saw-weed (*Najas pectinata*) and hornwort (*Ceratophyllum demersum*) occur in areas of the lake with clear water. Occasional burning of the escarpment has reduced the density of shrubs and grasses dominant in certain parts, especially in the north and south.

### ***Micro-habitat occurrence and distribution in Lake Ol'Bolossat***

The major habitats (Figure 10) in Ol'Bolossat consist of the open lake and the swampy vegetation which constitute a total area of 3,989 ha. The open water occurrence is dominant to the south of the Ol'Bolossat covering 58% of the wetland. The vegetation habitat occurs around the open waters of the lake but dominant to the swampy northern part of the lake which generally forms 42% of the wetland. Vegetation habitat is characterised by different types of sedges which forms unique microhabitat around the open waters and in the northern area, an outlet of the lake. The unique formation of sedges is spatially dominated by the Mixed Cyperus Species (14%) and *Cyperus* sp.1 (14%), *Cyperus laevigatus* habitat forms 7%, Papyrus habitat 3%, Typha 2%, Typha and Papyrus habitat 2%, and the floating *Cyperus* habitat is less than 1%. Typha and Papyrus microhabitat are dominant in the northern part of the wetland. The latter is mostly distributed far north after Typha. These are areas where the lake outlet its water flow through restricted channel and the water flow speed is slow to moderate. Thus, the outlet of the lake forms a river/stream habitat which is rejuvenated by the outlets of the stream into the northern part of the wetland.



**Figure 10: Spatial distribution and cover of microhabitats in Lake Ol' Bolossat**

(Source: Terer *et al.*, 2019)

### 2.3 Socio-economic Aspects

A significant part of this basin is used for ranching mainly due to water limitations and has been used by nomadic pastoralist for a long time. However, there has been increasing incidences of cultivation with farming being restricted to areas along river systems, although this is shifting to drier areas with population increase (Thenya, 1998; Thenya, 2001; Thenya *et al.*, 2011).

The streams that feed the Lake provide water for domestic use and irrigation. The Lake ecosystem is a source of water for Nyahururu town that serves a population of over 36,000 (KNBS, 2019) and the communities living downstream. It is also an important livestock dry season grazing area. Anthropogenic disturbances such as catchment degradation, siltation, overgrazing, introduction of alien species, fires, encroachment on the riparian land, pollution and water abstraction are threatening the lake ecosystem values, functions and ecological integrity.

Given the increasing human population in the lake basin and its catchment, the pressure on the natural resources is high and is anticipated to increase (Paul, 2014). The current trend in land use practices in the lake basin and its catchment demands for an integrated approach to the conservation of natural resources and the overall local community development needs. The Lake catchment conversion into farming land and horticultural farming is on the increase especially at the foot of the Satima escarpment. The degradation of the catchment vegetation could lead to the drying up of the streams that drain into the lake if not checked. In addition, the use of water from these streams for irrigating horticultural farms combined with use of herbicides and pesticides on the farms threatens the lake biodiversity. Although the impacts of these are yet to be evaluated, it is known from other studies in other areas that catchment degradation, stream diversion, fertilizer and herbicide deposition affect wetland dynamics.

### **2.3.1 Land use around and in the Lake**

The area around the lake is mainly utilized for rain-fed farming (25%) and 10% irrigation meaning that there is more reliance on rain-fed than irrigation due to salty water and farmer's distance from the lake. Other uses of the lake include farm forestry (2%), camping 2% and hotels (2%). The main activities inside the lake is fishing, hunting, which could be illegal and recently (2018), trapping of the invasive/exotic Louisiana Cray Fish *Procambarus* sp. (Table 4).

**Table 4: Activities supported by Lake Ol' Bolossat**

<b>Activity</b>	<b>Percentage</b>
Fishing	77
Hunting	7
Farming	1
Trapping of lobster	5
Reed harvesting	3
Boat riding	2
Birdshooting/ hippo viewing	1
Quarrying	2
Tree planting	2
Grazing	1

According to the 2008-2013 management plan, the Fisheries department had done research as early as in 1972 to establish the suitability of the water for fisheries. It was noted that the water was turbid and therefore freshwater fish could not survive. However, mud fish could do well. While

some activities around the lake are destructive like hunting, most can be undertaken in a sustainable manner.

### 2.3.2 Crop and livestock farming

Several crops are grown around the lake with the most common being maize, vegetables and beans. The main reason for farming in the wetland is due to high crop production according to 10% of the respondents, fertile soils – 25% and water availability 55%. Women are more involved in farming at 26% compared to men at 8%, although both genders engage in crop production. Most of the produce are sold locally with brokers controlling about 36% of the market.

Crop production has been dropping in the last 40 years, which could mainly be attributed to reduction in soil fertility. This is supported by the fact that 73% and 84% of the respondents noted that they needed to add manure and fertilizer respectively while farming. The main type of manure used is cow dung and waste according while the main fertilizer in use is DAP in different forms including UREA and CAN. Other types include TSP, NPK and CAN. Availability of extension services is mainly from private section according to 48%, NGOs-3.4% and government 31%. During the dry season, water abstraction is practices to support irrigation agriculture of most crops (Figure 11)

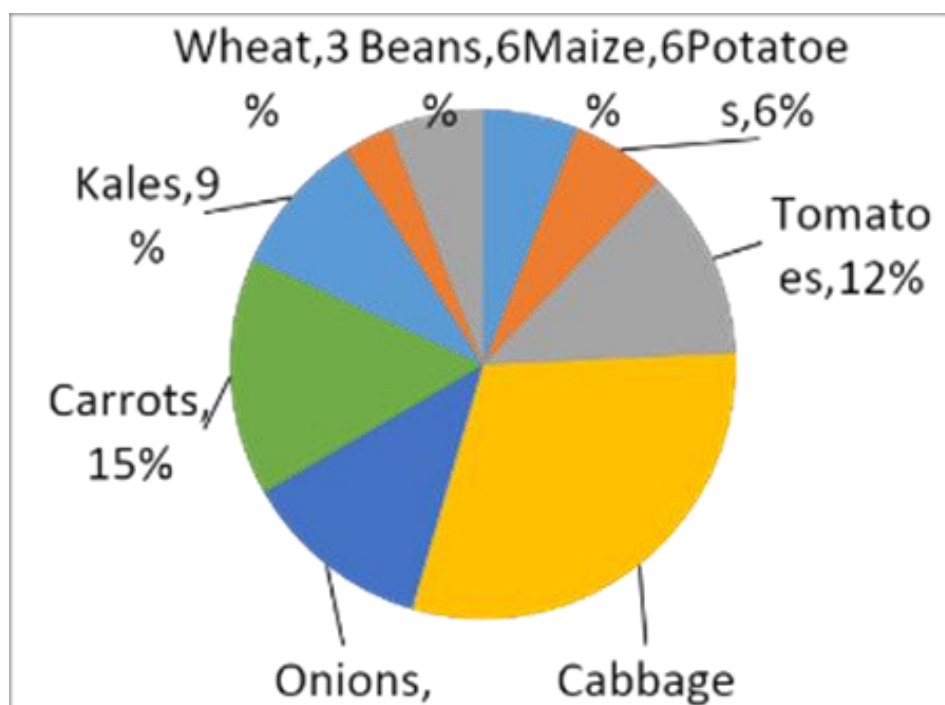


Figure 11: Crops grown under irrigation around Lake Ol' Bolossat

There are a number of irrigation schemes in the area around Ol' Bolossat that include Muruai scheme, Iria-ini Scheme, Kibathi village, Makereka Village, Ngurumo village, Migingo Farm, Shillo Farm, Bishop Gitungi, Umoja 2, Gakoe village and Kangubiri which are supported by drip, furrow, sprinkler and use of trenches irrigation methods.

While there is no payment for irrigation water, some of the reasons why irrigation is undertaken is due to associated high production, faster growth of crops, for commercial purposes, high quality products and ability to grow crops in dry seasons. Between men and women there is no clear distinction on who is responsible or involved in irrigation activities, although men are more likely to be involved due to the nature of heavy workload. Some of the challenges experienced include inadequate water supply, lack of finances to buy irrigation equipment, blocking of pipe, soil erosion, lack of source of labour, high cost of buying pipes and theft of pipes, poor quality of pipes and other irrigation equipment. Irrigation technical advice is like in other farming sector lead by private sector, followed by government and the NGOs.

About 70% of the community around the lake practice free range livestock farming while the remaining percentage practice zero grazing. The main source of fodder for livestock is on farm according to 33%, followed by grazing in the Lake area (13%) and purchasing fodder according to 9%. Fodder shortage is addressed through planting napier grass (*Pennisetum purpureum*) -10%, grazing along the lakes- 6%, purchasing–fodder 15%, reducing number of livestock-4% and storage of fodder 12%. Some of the challenges in sourcing fodder include wildlife encounter, time consuming and lack of funds to purchase the fodder.

Lake Ol' Bolossat is important in terms of providing grazing spaces (20%), adequate evergreen fodder (10%) and as a source of water 3%. Alternative source of water for livestock include, wells and the lake at 19% and 15% respectively. Other important sources especially in dry season include dams and piped water at 6% and 2% respectively, others are streams and rivers. Some of the major challenges in livestock production include pest and diseases. Some of the specific diseases that affect livestock include east coast fever, black quarter, foot and mouth among others. The main source of veterinary services is private sector according to 53%, with 43% providing no response, and government being cited as providing the same services at 3%.

### 2.3.3 Tourism

The lake catchment and basin are important for local and national socio-economic development especially subsistence farming where farmers keep a few animals and grow some crops. The escarpment that fringes the Lake to the east creates a beautiful scenery. The central location of the Lake with respect to the national tourist circuit and lying astride the equator together with the already famous Nyahururu (Thompson) Falls confers the site added advantages. The potential for tourism development is high but remains largely unexploited. According to 2008-2013 integrated management plan the former Nyandarua County Council had proposed to put up bandas and a tourist class hotel in addition to fencing the 10,000 acres of the lake area. The site is popular for bird shooting by international tourists, mainly Europeans. Bird shooting activities started in various dates between 1960s – 2018 with only 14% indicating that they benefit from the shooting with developments projects in schools.

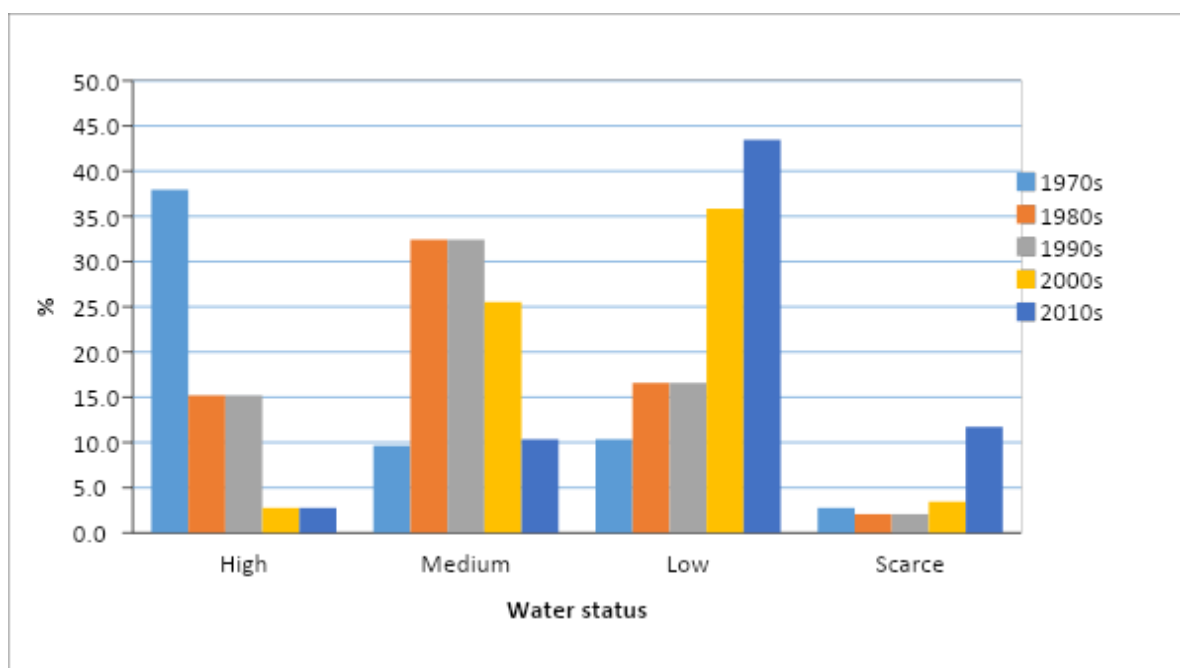
### 2.3.4 Source of Domestic water

The lake area serves as a source of domestic water to the surrounding community. The main source of household water in the area is shallow wells followed by piped water. Other sources include spring and borehole water and from streams/river sources (Table 5).

**Table 5: Waters Sources- springs, rivers and boreholes**

Springs location per village		Rivers location per village		Boreholes location per village
Ngurumo	Makereka	Chamuka	Kianjata	Mukindu Community borehole
Kanguyo	Ol' Bolossat	Nduthi	Ol' Joro Orok	Jerusalem borehole
Munanda	Kangubiri	Kurumbu	Madaraka	Colonial Government Development Borehole-Makindu
Makereka	Gakoe	Malewa	Karandi	Iriani borehole
Kanaro	Iriani	Ol' Joro Orok	Gakoe	Shillo farm-Gakoe
Simba	Ngomna	Manguo	Ol' Bolossat	
Nduthi	Kianjata	Simba	Gikingi	
Kurumbu	Gatumbiro	Ngarenaro	Wanjohi	
Mukoe	Ol' Joro Orok	Kanaro	Kaka	
Iriani	Gakoe	Kibathi	Gathanje	
Njunu	Theya	Gatimu	Chamuka	
		Nyakariang'a	Kiwanja	

From the current socio-economic survey conducted in 2019, domestic water levels have been declining from various water sources with high availability experienced in 1970s declining in the 2010s (Figure 12). This could be attributed to environmental changes mainly environmental degradation.

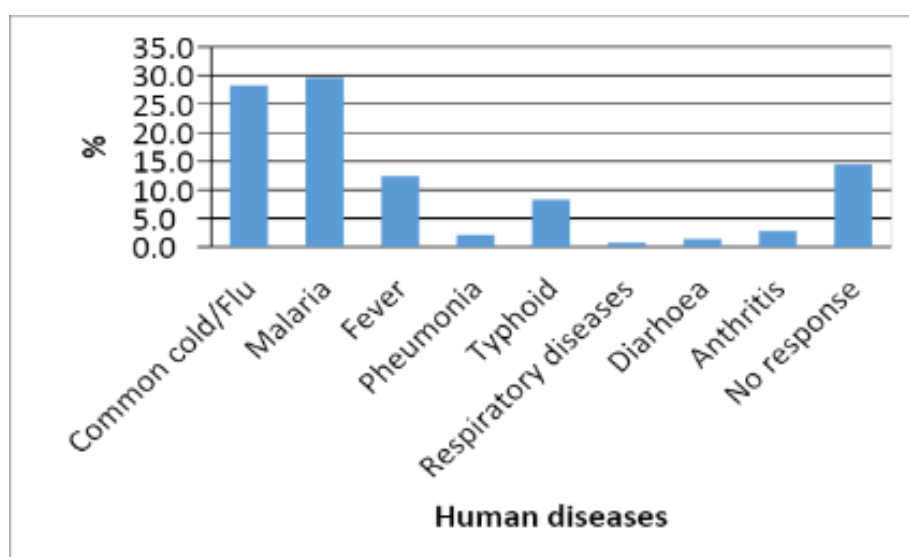


**Figure 12: Perceived changes in water levels**

### **2.3.5 Human health**

The most common human diseases in the area include common colds, fever, malaria among others, which worsen during the wet season (Figure 13). In terms of hygiene, 83% have pit latrines while 9% have flush toilets.

There are several health facilities in the area, these include Mukindu, Subuku and Gatimu (Table 6). These are important for helping to address the health issues associated with the wet conditions around Lake Ol' Bolossat.



**Figure 13: Human disease around Lake Ol' Bolossat**

Nyandarua North sub-county has adequate health facilities. There are two fully operational County Hospitals at Nyahururu and Ol Kalou. A number of private clinics, local dispensaries and health centers are available.

**Table 6: Health facilities in the area**

Health facility	Health facility
Mukindu Health clinic	Subuku dispensary
Lake Ol' Bolossat dispensary	Gatimu health care
Nyahururu Health centre	Chamuka dispensary
Weru dispensary	Manguo clinic
Rurii dispensary	Gatimu dispensary
Kirima dispensary	Nyahururu Referral
Baari dispensary	Iria-Ini dispensary
Kasuku dispensary	

### **2.3.6 Domestic energy**

The main source of domestic energy around Lake Ol' Bolossat is firewood according to 40% of the respondents or a combination of charcoal and firewood (Table 7). Clean energy use is in very small proportion and inspite of keeping livestock, biogas use is non-existence. Most of the firewood is gotten from forest ecosystems around the lake. These include a combination of Aberdare forest ecosystem but most coming from Ol' Bolossat, Uaso Narok and Ndaragwa forest.



There is also on-farm forestry that provide fuel for domestic use. In terms of availability of these energy sources, they are all moderate to low which indicates that the pressures on nearby ecosystems like forests and on farm woodlands are pressure to supply firewood. Some of the conservation measures should focus on the increased availability of domestic energy.

**Table 7: Sources of domestic energy**

Sources of domestic energy	%
Firewood Only	40.0
Cowdung	9.0
Firewood/Gas	4.1
Agriculture residues	1.4
Charcoal only	2.8
Cooking gas (LPG)	7.6
Electricity	0.7
Firewood/Residues	1.4
Firewood/charcoal	21.4
Fuelwood/Charcoal/residues	4.8
Paraffin	6.8

### **2.3.7 Infrastructure**

Infrastructure provides linkages between people and access to the exploitation and utilization of resources in order to enhance community welfare. Among critical issues in this sector are: poor state of roads, a dormant railway system, a predominant number of unclassified roads, inadequate post-primary education facilities, inadequate health facilities, inadequate land for public utilities, low installed telephone exchange capacity, over reliance on surface water sources and conventional sources of energy.

#### **Roads**

The road network in the area is in different status and has had improvement through grading from time to time but continuous maintenance is necessary (Table 8).

**Table 8: Roads to Lake Ol' Bolossat and Their Condition**

No.	Road Name	Length (Km)	Current condition	Requirements
1.	Ol Joro Orok - Stone City/Kanguu - Lake Ol' Bolossat	7	Fair	Gravelling and drainage improvement
2.	Rurii - Mukindu - Lake Ol' Bolossat	8	Fair	Culvert installation and spot improvement
3.	Kahii – Bahati Village – lake Ol' Bolossat	5	Poor	Requires Opening and full gravelling
4.	Kasuku – Karandi - Lake Ol' Bolossat (with branching to Fuleni IDP camp)	8.5	Good	Reshaping, Gravelling, drainage
5.	Chaka Reli – Gatumbiro/Quarry - Lake Ol' Bolossat	4	Poor	Reshaping, drainage, Gravelling
6.	Githunguchu – Muruai - Kirima, L. Ol' Bolossat- via Makereka view point (Kariamu-Makereka-Maili Tisa road)	12	Fair	Requires Opening and full gravelling Road is in good condition
6.	Nyahururu Airstrip – FTC - Lake Ol' Bolossat	7	Poor	Opening and full gravelling. Requires spacing towards the lake
7.	Bari Sec. School - Lake Ol' Bolossat	3	Poor	Requires Opening and full gravelling
8.	Lakeshore viewing road (follow boundary of the gazetted Protected Wetland Area)	80	None existence	Opening and full gravelling
9	Nyandarua Institute - Kianjata Primary - Lake Ol' Bolossat	6	Fair	Reshaping, drainage and gravelling
10	Huhurio – Kanjogu Primary - Lake Ol' Bolossat	4	None existence	Requires Opening and full gravelling
11	Kirima dispensary - Lake Ol' Bolossat Secondary - Lake Ol' Bolossat	4	Poor	Requires Opening and full gravelling
12	Gakoe Primary - Lake Ol' Bolossat	3	None existence	Requires Opening and full gravelling
14	Magu - Lake Ol' Bolossat	3	None existence	Requires Opening and full gravelling
15	Gitura - Lake Ol' Bolossat	9	Poor	Requires Opening and full gravelling
16	Kasuku-Karandi- L. Ol' Bolossat	7.3	good	
17	Rurii- Mukindu-L. Ol' Bolossat	7.6	Half-way good	
18	Baari Sec. School-L. Ol' Bolossat	1.7	Poor	Opening up and improvement (gravel compacting) required
19	Kirima Dispensary- L. Ol' Bolossat Sec- Lake	4.1		In a very poor state
20	Gathurima-L. Ol' Bolossat Sec-Lake	5		Done
21	Gakoe-L. Ol' Bolossat	3	Poor during rainy season	
22	Museveni-L. Ol' Bolossat	6	Very poor	
23	Ol Joro Orok-Primarosa-Stone City-Lake	7	Halfway good	
24	Nyandarua Institute-Kianjata Springs-Lake	4.8	Marrum	Opening up and compacting

No.	Road Name	Length (Km)	Current condition	Requirements
25	Iriaini Pry- L. Ol'Bolossat-Makereka-Ngurumo-Chapalungu	9	Poor state	
26	Kariamua-Makereka-Subuku-Mairi Tisa	30	Rough marrum	Tarmacking recommended

### ***Electricity***


The plan area is relatively well served with electricity. The recent electricity connection is at the nearby Ol Joro Orok Secondary and Canaan shopping centre (October 2007). There are a number of Rural Electrification projects in the area. The other nearby towns i.e. Kasuku, Rurii, Ol Kalou, Ol Joro Orok, Nyahururu town (which is the nearest commercial town) are well served by Electricity.

### ***Water supply***

Water supply network is poor and in some areas, it is non-existent. Some trading centers like Ol Joro Orok and Ol Kalou are served with boreholes whose pumping units are old and require regular repairs and maintenance, which are very expensive. Water supply is inadequate for the increasing population. Ol Joro Orok Township is supplied with water from Oraimutia river water project. Threats to water supply include catchment degradation due to a lot of farming activities being undertaken along the riverbank and around the springs.

### ***Education facilities***

The number of primary schools in the plan area is adequate although post-primary school institutions are inadequate to accommodate the high number of primary school graduates. Most of the primary schools in the plan area are semi-permanent and lack basic facilities. There are 6 public Primary Schools that is Ngurumo Primary, Makereka, Iria-ini, Gakoe, Ol'Bolossat, Kahindu and Lake Ol'Bolossat secondary school bordering the lake. Other primary schools not necessarily bordering the Lake but within reach of the Lake: Baari, Githungucu, Muruai, Subuku, Kanjogu, Mukindu, Kianduba, Kahingo, Gatumbiro, Kanguu, Kianjata and Kibathi. While public secondary schools include: Baari, Githungucu, Subuku, Mukindu, Kahingo, Gatumbiro, Kanguu and Kianjata.



The infrastructures in most of these schools are of temporary construction apart from Ol' Bolossat Primary School, all the others are not very old. The major problem in all these schools is construction especially the pit-latrines due to the type of soil in the area. The soil is so loose that the pit-latrines collapse almost immediately after construction. The water table is also very high which also affects the construction of the schools' facilities.

### ***2.3.8 Human-wildlife conflict***

According to 57% of the respondents, farmers experience crop damage by wildlife with most damage being experienced in maize according to 35%, followed by potatoes -7%, vegetables 4% and peas 3%. Other crops that also experience damage include soybeans, fresh beans, onions and wheat. The most problematic animal is hippopotamus according to 50% of the respondents. Others include porcupine 3%, moles and crown cranes at 2% respectively. Between the men and women, men are mainly involved in guarding crops according to 21% of the respondents with the rainy season having almost equal share of crop damage according to 20% and 19% wet and dry season respectively. It is notable that 18% noted this is a year-round problem, meaning that there is no safe season. Other problems experienced in farming in the area include soil acidity, poor infrastructures and crop pests and diseases among others.

## CHAPTER 3: REVIEW OF POLICY, LEGAL AND INSTITUTIONAL FRAMEWORKS

### 3.1 National Policy and Legal Framework

The preparation, planning and implementation process of the Lake Ol' Bolossat IMP recognizes and takes into cognizance existence of the current wetland legal framework including wetland policy, EMCA Cap 387 and wetland regulations among other legal frameworks which have direct impact to sustainable conservation, management and utilization of Lake Ol' Bolossat. A highlight of some of the relevant national legal framework is provided in Table 9 below:

**Table 9: National legal instruments relevant to management of Lake Ol' Bolossat**

Legal framework	Focus	Relevance to wetland ecosystems
The Constitution of Kenya (2010)	Devolved County Government and the National Government	Chapter 5 focus on environment and participation
Land Policy 2009	Sections 3.4 provisions provided below provide for land use planning 4.3.1 (131a): To sustainably manage land based natural resources, the Government shall encourage preparation of participatory environmental action plans by communities	Land use planning at the local level  Management plan preparation as part of local planning
Land Act 2012	Legislative structure for land governance and rights in Kenya, largely aligned with that required by the Constitution. Define land types (public, community and private)	Lake Ol' Bolossat is public land
National Land Commission Act 2012	Provide broad functions and authorities in land governance Advise government on land title registration, initiating claims for historic injustices, encouraging the application of alternative and traditional dispute resolution mechanisms, managing and administering all unregistered trust land and unregistered community land on behalf of the county government, developing and maintaining an effective land information management system at national and county levels, and monitoring and oversight over land use planning	Useful in handling land issues in areas around Lake Ol' Bolossat including boundary placement and adjustments
Wetland conservation and management Policy 2014	Wetland resources management in the country	Useful in guiding management of Lake Ol' Bolossat
Environmental Management and Coordination Act of 1999 (revised 2015)	Overarching law on environmental management in Kenya. Provides for environmental and social impact assessment (ESIA) and annual audit	Custodian of gazetted wetland, formulate wetland regulation Guides on environmental impact assessment for activities such as

Legal framework	Focus	Relevance to wetland ecosystems
		tourism development that needs ESIA
Forest Policy 1994	Forest development in the country	Provides for participatory approach that capture water catchment conservation and on farm intervention
Forest Act 2016	Forest resources management created Kenya Forest Service. Section 42 provides for PFM and PFMP preparation Provides for preparation and gazettement of rules and regulations such as Participation in Sustainable Forest Management rules 2009, Forests (Charcoal) rules 2009, Forests (Harvesting) rules 2009	Preparation of management plans that captures water catchment conservation and on farm forestry intervention. Captures formation of community forest association (CFA) that are critical in wetland conservation
Wildlife Conservation and Management Act, 2013	Management of wildlife resources in gazetted and community areas framework for conserving, in perpetuity Kenya's rich diversity of species, habitats and ecosystems for the wellbeing of its people and the global community	Lake Ol' Bolossat neighbours Aberdare ranges that is a critical habitat for wildlife species including birds Act allows for stakeholder consultation in relation to benefit sharing
Water Act 2016	Framework for water resources management including community participation under water resources uses association	Lake Ol' Bolossat is a water source and has a number of water users associations. Water resources management guided by the Act
Agriculture Laws, 2013	Framework for management and investment in crops, livestock and fisheries	Important for farming initiative around Lake Ol' Bolossat including soil erosion management
National Climate Change Response Strategy (NCCRS)	Engagement in handling climate change aspects such as weather information release and advice to resources managers and community Investment in carbon business including REDD+	Climate change is likely to continue affecting Lake Ol' Bolossat
National Energy Policy and Energy Act 2006	Framework for management and energy sources including promotion of energy savings, alternative energy sources, Provide an enabling environment for the provision of energy service	Promotion of sustainable energy sources that has reduced impact on the wetland ecosystem in Lake Ol' Bolossat
National Tourism Act of 2012	framework for ecotourism management	Promotion of sustainable tourism activities around lake Ol' Bolossat

### 3.2 Multilateral Environmental Agreements Relevant to Management of the Lake

Kenya has ratified a number of international agreements, protocols and Conventions that impact on wetlands conservation. They form part of Kenyan laws under article 2 (5) (6) of Constitution of 2010. The key international agreements and conventions that are considered most important for conservation of Lake Ol' Bolossat are summarized in Table 10 below

**Table 10: International legal instruments relevant to management of Lake Ol' Bolossat**

Convention/Agreement	Focus Area
The Ramsar Convention	Framework for international cooperation for the conservation and wise use of wetlands and their resources
Convention on Biological Diversity	Conservation of biological diversity, sustainable use of its components and the fair and equitable sharing of benefits arising from the use of genetic resources
The Convention on Migratory Species (CMS)	Conservation of terrestrial, marine and avian migratory species
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Regulation of trade in species which are endangered, or which may become endangered if their exploitation is not controlled
United Nations Framework Convention on Climate Change (UNFCCC 1992)	Climate Change mitigation and adaption
African Convention on the Conservation of Nature and Natural Resources, 1968 (as revised in 2003).	Natural Resource Conservation

## CHAPTER 4: STAKEHOLDERS ANALYSIS

### 4.1 Stakeholder mapping and Identification

Lake Ol' Bolossat, just like many other wetland ecosystems in the country, has many stakeholders with diverse resource-specific interests and stakes, which are often conflicting and competing. It is these competing interests and stakes that often characterise the numerous conflicts resource-use conflicts in the delta. The list of stakeholders and analysis provided herein is subject to periodic review as new stakeholders and interest emerge over time. The following section analysis the roles to be played by each stakeholder (Table 11).

**Table 11: Roles and Responsibilities of stakeholders**

Stakeholders organization	Roles and Responsibilities	Activities carried out in and around Lake Ol' Bolossat ecosystem
<b>Government Institutions (National Level)</b>		
National Environment Management Authority (NEMA)	Supervision and co-ordination over all matters relating to the environment and the principal instrument of Government in the implementation of all policies relating to environment.	In charge of wetland management, Coordinates EIA, environment auditing, environmental planning and coordination and supervision
Kenya Forest Service	Forest Policy implementation, management and protection of gazetted forest reserves, management of forest plantations and promotion of on-farm forestry and Ecotourism	Day-to-day management and coordination of forestry activities, issuing permits and reforestation, on-farm extension
Kenya Wildlife Service	Wildlife Policy implementation, and protection of wildlife and their habitats	Manage and Protect wildlife
Kenya Forestry Research Institute	Research for sustainable development of forests and allied natural resources	Undertake forestry related research
Forests Conservancy Committees (FCC)	Oversee proper and efficient management of forests in their areas of jurisdiction	Supervision of forestry activities
Ministry of Agriculture, Livestock and Fisheries	Promotion of sustainable agriculture Awareness creation Agroforestry Supervision and Soil and water conservation	Provision of technical advice to farmers
Ministry of Water and Irrigation	Policy coordination Coordinate water activities	Monitor policy implementation



Stakeholders organization	Roles and Responsibilities	Activities carried out in and around Lake Ol' Bolossat ecosystem
Water Resources Authority	Awareness creation Water conservation Rehabilitation of forest Protection and conservation of water catchments areas Promotion of irrigation Coordination of water trust funds Control of pollution of water bodies. Involvement of stakeholders in the management of water resources (IWRM).	Protection of water resources Coordination of WRUAs activities Water allocation management
County administration/ internal security	Law enforcement Provision of security Awareness creation	Law and order enforcement for devolved functions like water and forestry. Assist in enforcement of sector legislation including arrest
Ministry of Livestock	Awareness creation Livelihood improvement through livestock production	Provision of technical information and advice on livestock
Ministry of Lands	Adjudication of land	Adjudication of land and protection of water catchments
KeNHA, KeRRA	Construction and maintenance of roads	Construction and maintenance of roads
Ministry of Cooperatives	Registration and supervision of cooperatives	Marketing of produce, human settlement and provision of savings and credit facilities
Ministry of Planning	Planning and overseeing implementation of Vision 2030	Coordination of planning
Ministry of Energy	Provide energy	Promotion of alternative and efficient energy technologies,
Ministry of Education	Awareness creation and education	Education activities coordination
Department for Social Services	Registration and regulation of groups	Registration of groups Records of CBOs
<b>Government (Local institutions)</b>		
County Government of Nyandarua	Management of natural resources within their jurisdiction on behalf of local communities. Coordination of environmental matters at the county level. Development of lake Ol' Bolossat as an ecotourism site	Collect local taxes on traded products Coordination of environmental issues. Develop the necessary infrastructure to support tourism activities around the area.
<b>Non-Government institutions</b>		

Stakeholders organization	Roles and Responsibilities	Activities carried out in and around Lake Ol' Bolossat ecosystem
Community Forests Associations (CFA) like Ol' Bolossat forest	Participation in conservation and management of a state or local authority forest	Participation in forestry related activities
Private sector (e.g. Sawmilling companies)	Establishment of plantations, woodlots and conservation of indigenous forests	Tree planting and harvesting
NGOs, e.g. Kenya Forests Working Group	Research, advocacy, awareness and promotion of local communities' engagement in forest management and conservation	Provision of technical information, Training CFA on participatory forest management Advocacy and capacity building and monitoring
East Africa Wildlife Society (EAWLS)	Environmental resources governance advocacy Training on natural resources	Advocacy and capacity building and monitoring
Nature Kenya	Important Bird Area Monitoring Capacity building of stakeholders on sustainable natural resources management. Advocacy for ecological sustainability	Important Bird Area monitoring in partnership with NMK, KFS, KWS and local communities. Building capacity of local communities among other stakeholders in sustainable conservation. Lobbying and Advocacy
Greenbelt Movement	Training on natural resources Tree planting	Tree planting in forest and on farm Working with communities on tree planting
WRUA	Water resources management Community organisation on water issues	Management of water Control water use by community
Lake Ol' Bolossat Conservation Network (LOCNET)-Shamata Ward	Tree planting, Bee keeping, soil erosion control measures	Conservation activities around the Lake Awareness on lake importance
Nyahururu Bird Club	Promoting awareness on bird conservation	Protection of important bird habitat Advice of protection of key bird habitats in conjunction with relevant government authorities
Crane Conservation Volunteers	Research and conservation of Grey Crowned Crane and other threatened biodiversity around Lake Ol' Bolossat	Research, awareness and conservation of the cranes
Save Lake Ol' Bolossat Green Society (LOGS)	A joint initiative driven by Back to Basics (BTB) NGO together with Lake Ol' Bolossat Scenery Self Help Group.	Community based project on environmental conservation

Stakeholders organization	Roles and Responsibilities	Activities carried out in and around Lake Ol' Bolossat ecosystem
Lake Ol' Bolossat Scenery Self Help Group	Environmental conservation	Conservation of Lake Ol' Bolossat
Back to Basics (BTB)	Support and position the Youth, women and children for success by engaging them in sustainable development through building on what works	Conservation of L. Ol' Bolossat Support to Ol' Bolossat Scenery Self Help Group
Nyahururu Water and Sewerage Company	Water supply to local residents	Support conservation of Lake Ol' Bolossat like research, tree planting, sponsorship in education and sports etc.
Learning institutions (Universities, Training Institute, Polytechnics)	Training of citizens on matters of academic	Involved in research and conservation activities around Lake Ol' Bolossat

Local community around the lake constitute important stakeholders that not only make use of the lake but also have some impact on the lake ecosystem. Some of these stakeholders are analyzed below.

Stakeholder	Interests	Positive Impacts	Negative Impacts	Mitigation Measure
Farmers	Food production (source of income, household consumption). Water for irrigation. Vegetation cover.	More rainfall.	Siltation. Water pollution. Water wastage. Reduction of lake water.	Terraces. Organic inputs. Water harvesting. Plant indigenous trees. Modern farming methods/
Grazers	Food for their animals. Water		Soil erosion. Human-animal conflict. Destruction of breeding zone for birds. Water pollution.	Encourage farmers to carry out zero-grazing. Water harvesting for their animals.
Fishermen	To get enough fish for food and income.		Reduction of fish in the lake. Water pollution.	Increasing of fingerlings. Licensing of fishermen. Using approved nets.
Hoteliers	Source of income. Attracting visitors to the lake.	They bring revenue.	They pollute the environment.	Installation of dustbins.

Stakeholder	Interests	Positive Impacts	Negative Impacts	Mitigation Measure
		Creation of jobs.		
Quarry operators, sand harvesters and salt lick harvesters.	Source of income. Provide salt for their animals.	Creation of jobs. They get minerals for their animals.	Degradation of the environment.	Provide other alternative sources of income. Educate them on the need to conserve the environment. Control and enforcement measures.
Bee keepers	Source of income. Medicinal uses. Source of food.	Source of income. Pollination of plants. Improved health.	Destruction of the environment through fire. Causes death. Poor pricing.	Modern beekeeping hives. Modern harvesting technology. Creation of value additions.
Firewood collectors	Fuel for home consumption.		Destruction of the environment.	Introduce energy saving jikos.
Papyrus harvesters	Source of income. Thatching of homestead. Food for animals.	Improve livelihoods. Affordable building materials.	Destruction of bird breeding zones. Human-animal conflict.	Introduce alternative building materials. Planting napier grass in their homes.
Hunters and gatherers	Food. Source of income.		Destruction of plant life and animal population.	Monitoring and enforcement. Education. Provide alternative employment opportunities.

## CHAPTER 5: ISSUES AND THREATS FACING LAKE OL' BOLOSSAT

### Problem Analysis

Lake Ol' Bolossat is rare since it is the only Lake in the central parts of Kenya. However, being located in high potential area and without clear management, the lake ecosystem has suffered ecologically over the years, due to a number of issues and threats resulting from human activities. The following are the issues and threats identified as impacting on the lake:

1. Biodiversity loss and habitat degradation due to over-dependence and over-exploitation of natural resources
2. Low uptake of eco-tourism as an alternative source of livelihood among the communities that rely on the lake
3. Deteriorating water quality and quantity in the lake and surrounding water bodies due to encroachment on the riparian and water abstraction
4. Land-use changes and unplanned developments. The main land issues include land tenure issues, encroachment of riparian areas, conflicting land needs between farmers and pastoralist
5. Social-economic issues as a result of population increase in the lake basin. This is mainly driven by the changing lifestyle of the pastoralists who have adopted semi-pastoralism with both sedentary settlements and movement of livestock during the wet season.
6. Governance issues: Although there exists relevant legislative framework and several government agencies with varying mandates on management of the lake, conservation and development efforts in the lake basin are largely uncoordinated.
7. Climate variability and change: The lake basin experiences wide fluctuations in climatic conditions including pronounced flooding and droughts.

### The Management Zones

#### Zonation

To address the above issues, the management plan proposes zonation of Lake Ol' Bolossat ecosystem. The zoning is critical as it will guide the different management strategies and future planning of particular areas. It is also critical for ecosystem integrity, enhanced eco-tourism potential, reduced conflicts and provides for long-term guidelines for resource management.

The following have been considered while zoning the plan area:

- Land tenure and the various Legislations relating to or governing them

- Ecological habitats and integrity
- Various land use practises in and around the ecosystem
- Protection and conservation status of the ecosystem
- Stakeholder interests and activities

Zones reflect where the achievement of one or more management objectives takes priority over the others, and generally provides direction for daily management as well as long-term decision making. Table 12 below shows the criteria used in wetland zonation while Figure 7 presents the zonation map. The generation of zonation map (Figure 14) was a result of combined by LPRT members.

**Table 12: Criteria used in zonation of Lake Ol' Bolossat Ecosystem**

<b>Zone</b>	<b>Target Description</b>	<b>Characteristics and use</b>	<b>Management Objectives</b>
Open water, marshes and swamps	<p>Include the inside wetland and riparian land as defined by the National Wetland Policy and water resources authority.</p> <p>Access to these zones will only be for management purposes and authorized activities.</p> <p>Human activities are restricted except for research and other management related activities.</p>	<p>Critical habitats in the wetland, such as birds and hippopotamus breeding sites, areas sensitive to degradation, areas inhabited by hippopotamus or by birds outside of breeding season(s).</p> <p>Will be a conservation zone.</p>	To protect and maintain the ecological integrity of Lake ecosystem.
Flood plains	<p>Dry season grazing, conservation and visitor utility.</p> <p>The management plan seeks to harmonize and control these activities to avoid environmental degradation.</p>	Seasonal flood areas, not covered by water in dry season	Promote ecological compatible use like grazing but not farming
Springs and streams	Springs and streams which support the lake and the livelihoods of the people.	<p>Water sources</p> <p>These areas will be used for the conservation of water resources and other authorized water abstraction</p> <p>Planting of exotic trees and cultivation will be discouraged in these areas</p>	Management of water sources

Zone	Target Description	Characteristics and use	Management Objectives
Investments Zone	Areas for hotels, camps and other commercial activities, which must follow the due process of NEMA (EIA).	Outside the riparian zone and on people's private farms and urban commercial plots.	Promote compatible commercial activities that promote eco-tourism.
Intervention Zone	Farmlands between the floodplains and the escarpment.  In this area human-wildlife conflict will be minimised as much as possible.	The main land use is small-scale farming. Land use in this zone should maximise economic returns without compromising the ecological integrity of the lake ecosystem.	To promote community participation in activities that reduces forest pressure and enhance their livelihood



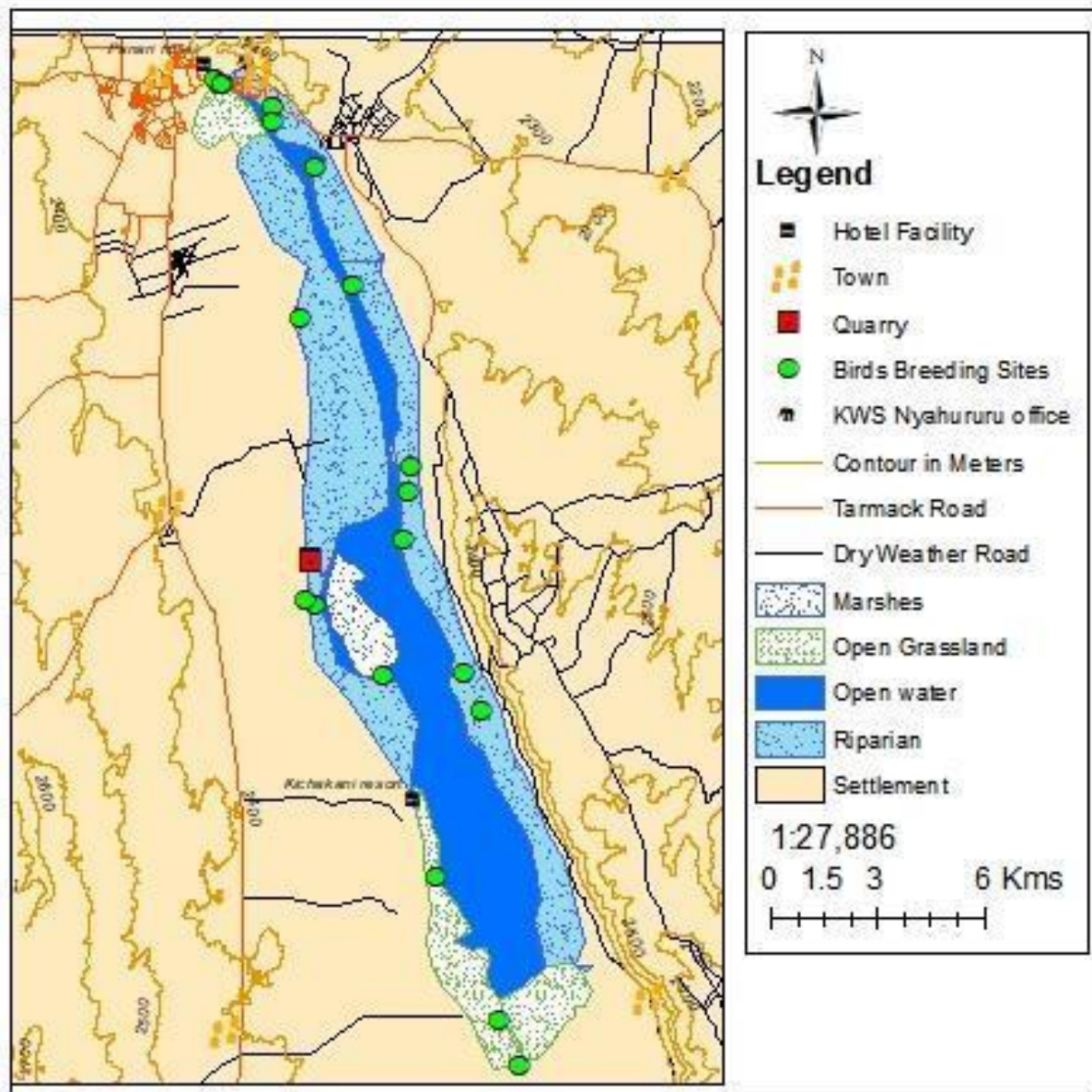


Figure 14: Management zone in Lake Ol' Bolossat



## CHAPTER 6: VISION, GOAL AND MANAGEMENT OBJECTIVES

### 6.1 Vision

The **vision** of this integrated management plan is “*A well-managed and protected Lake Ol’ Bolossat and its catchment area providing a sustainable and ecologically balanced ecosystem for the present and future generations*”.

### 6.2 Overall Objective

The plan aims to promote environmental conservation of Lake Ol’ Bolossat and its catchment for sustainable development while maintaining the values and ecological functions through the involvement and participation of stakeholders.

### 6.3 Specific objectives

- i) To promote conservation and sustainable use of biodiversity resources
- ii) To improve water access, quantity and quality
- iii) To promote equitable access, sustainable use and management of land as a resource
- iv) To promote sustainable socio-economic development in the lake
- v) To improve governance in conservation and management of the lake
- vi) To promote climate change mitigation, adaptive capacity and resilience

### 6.4 Operational objectives

In order to achieve the overall goal and the management objectives, operational objectives have been identified under each management objective. The management plan operational objectives are:

#### **Biodiversity management**

- a) To promote rehabilitation and restoration of degraded biodiversity sites within the lake
- b) To promote sustainable fishing practices
- c) To promote wildlife conservation measures

#### **Eco-tourism management programme**

- a) Promote eco-tourism around the Lake.
- b) Develop capacity of CBOs and stakeholders to engage in ecotourism activities.
- c) To support tourism through enhanced communication and equitable share of benefits.
- d) To develop and install infrastructural support facilities to spur growth of Ecotourism activities around the lake.

- e) To gazette Lake Ol' Bolossat as a National reserve to promote conservation, address issues of human wildlife conflict and promote ecotourism activities.
- f) To promote the blue economy aspect by developing the lake fronts for economic and social prosperity along Lake Ol' Bolossat to enable the community to reap benefits from the lake.
- g) To support and capacity build the community birds and wildlife conservation groups

#### **Water resources management**

- a) To ensure adequate water flow regime to meet both environmental and socio-economic needs
- b) To ensure equitable flow of water within the river channels
- c) To ensure sustainable supply and availability of water
- d) To improve solid and effluent management along the lake Basin

#### **Land resources management**

- a) To promote sustainable land use practices
- b) To promote implementation of the management plan
- c) To address the land tenure systems

#### **Social-economic development**

- a) To integrate modern and traditional knowledge in the management of the lake
- b) To promote sustainable economic development and local livelihoods

#### **Governance improvement programme**

- a) To enhance institutional capacity for effective management of Lake Ol' Bolossat
- b) To improve knowledge and understanding of Lake Ol' Bolossat through research and monitoring
- c) To enhance communication, education and public participation and awareness

#### **Climate change mitigation and adaptation programme**

- a) To promote climate change mitigation measures
- b) To improve community adaptive capacity and resilience to climate change

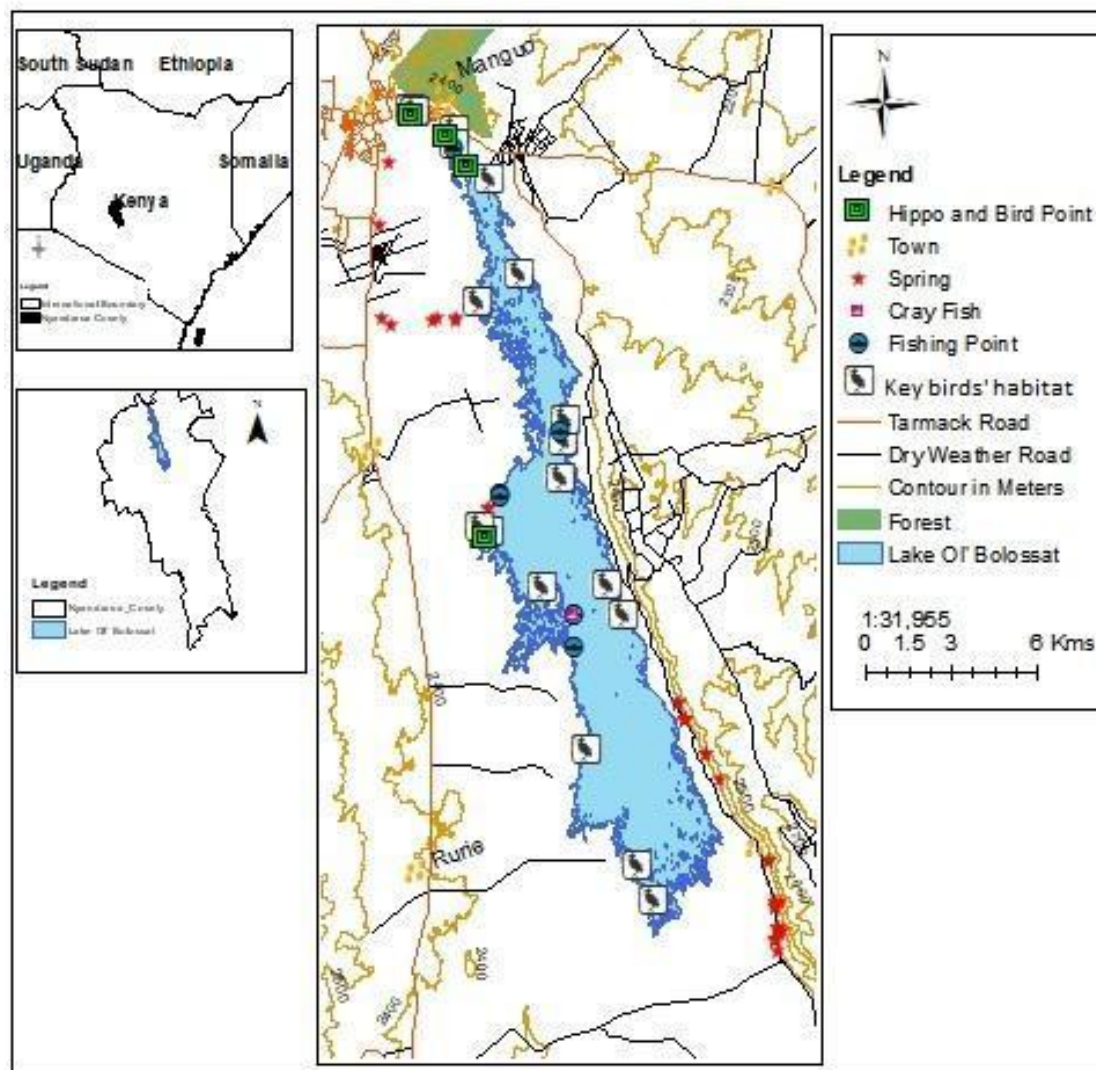
## CHAPTER 7: MANAGEMENT PROGRAMMES

### 7.1 Biodiversity Management Programme

#### Background

The Lake ecosystem is rich in biodiversity and is habitat for numerous species of birds, plants, invertebrates, mammals, reptiles, amphibians, and fish among other species. Plants and animals, water birds. According to recent survey by National Museums of Kenya (Terer *et al*, 2019), there are over 370 plant species classified into 255 genera belonging to 92 families. Species of conservation interests noted, comprise of 4 orchids, one *Aloe* and one succulent *Euphorbia*, all in appendix II of CITES. The swamps and the satima escarpment are important for plant diversity. Fish species include 7 species among the cray fish and mud fish, high numbers of hippopotamus close to 100 individuals have been sighted in 2019. A total of 96 aquatic invertebrates with Beetles (Coleoptera), aquatic bugs *Sigara sp* and *Anisops sp*, being the most abundant (Terer *et al*, 2019). Others species recorded were a total of 4 amphibians (all frogs) and 5 reptiles (3 snake and 2 lizard species). A total of 131 mammal individuals representing 7 species and 5 families were recorded in 2019 study including hippopotamus, marsh mongoose, cape hare, striped grass mouse, brush furred mouse, coypu and southern tree hyrax. 34 species of fungi represented by 18 families and 27 genera were recorded according to Terer *et al* (2019). In terms of birds there are 293 bird species. Some bird species are listed as rare and or threatened. The birds include several species of Palearctic and afrotropical migrant waterbird species.

The lake was listed as Kenya 61st Important bird Area (IBA) by the National Liaison Committee on IBAs lead by Nature Kenya on 26<sup>th</sup> March 2008. This was as result of confirmation of Sharpe's Longclaw and Jackson's Widowbird at the site both of which are endemic and near threatened species (Lake Ol' Bolossat Management Plan 2008 -2013). Others bird species include Maccoa duck, vulnerable Long tailed widowbird and white backed duck. It has various sites that are used as breeding sites for birds, and also insects, which should be preserved (Figure 15).



**Figure 15: Important ecological sites**

### **Management issues and challenges**

- Degraded biodiversity habitats due to overgrazing; overexploitation of fisheries and destruction of forests
- Unsustainable utilization of fisheries resources, weak enforcement of fishing regulations, lack of technological fishing and processing capacity
- Encroachment of wildlife migratory corridors and habitats
- Poor enforcement and compliance with Wildlife Conservation and Management Act 2013

### **Operational objectives**

- To promote rehabilitation and restoration of degraded biodiversity sites

- b) To promote sustainable fishing practices
- c) To promote wildlife conservation measures in the delta

## 7.2 Ecotourism Management Programme

### Background

The Lake ecosystem lies within close proximity of tourist attraction sites such as the Aberdare mountains along the route leading to Samburu, Nyeri, Laikipia, Naivasha and Nakuru and Thomson falls. The escarpment that fringes the lake to the East creates beautiful scenery. The central location of the lake close to Rift Valley crater escarpment with respect to the national tourist circuit and cutting across the equator confer the site an added advantage. It has numerous bird species that make it an ideal destination for ornithological ecology. The potential for tourism development is high but remains largely unexploited although some developments have already taken place (Figure 16).

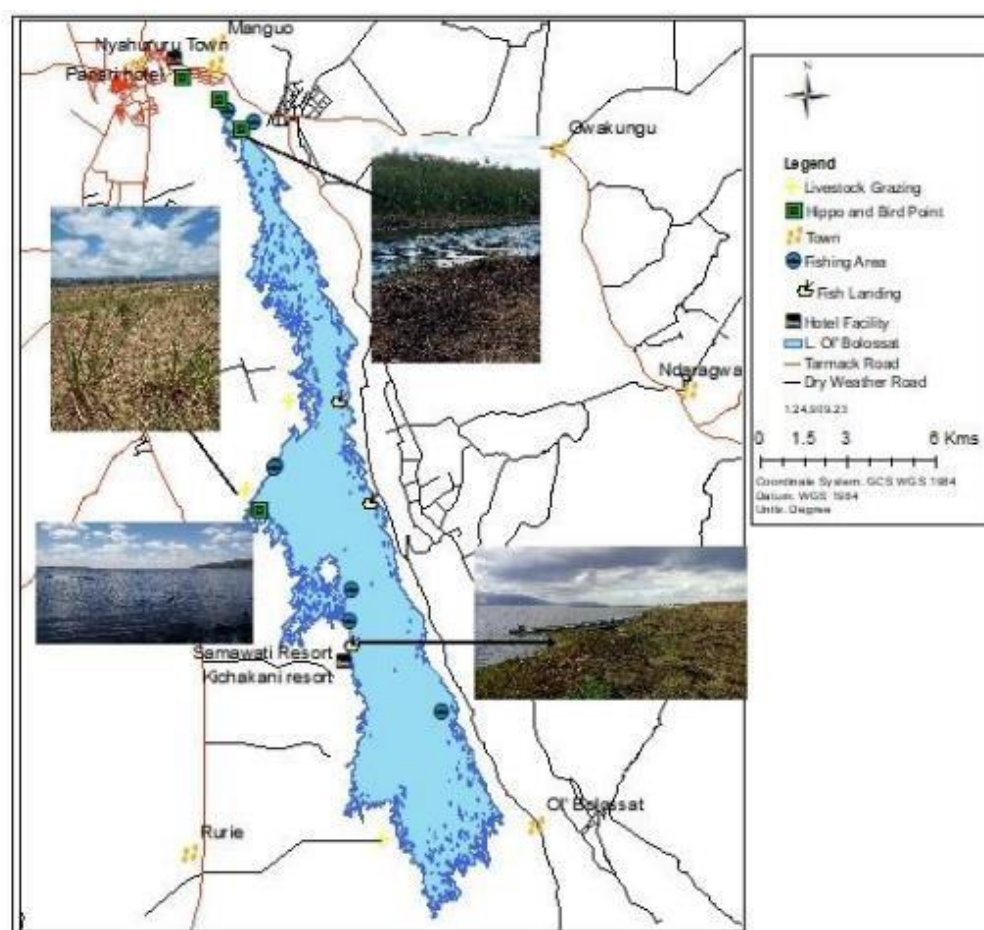


Figure 16: Relative location of potential eco-tourism sites

## Management Challenges

The following are the main challenges that are likely to be encountered in the implementation of the proposed management actions in this programme:

- Lack of financial resources to implement the proposed actions such as patrols, creation of awareness, monitoring, survey, meetings and trainings.
- Inadequate enforcement of laws and regulations especially in the absence of clear fence and boundary around the ecosystem.
- Lack of benefit sharing regulation mechanisms within the ecosystem such as exploitation of cray fish harvesting that is currently not coordinated.
- Influx of investor in absence or delayed zoning of the ecosystem as part of spatial plan.

## Programme Objectives

- 1) To develop and install infrastructural support facilities to spur growth of Ecotourism activities around the lake.
- 2) To gazette Lake Ol' Bolossat as a National reserve to promote conservation, address issues of human wildlife conflict and promote ecotourism activities.
- 3) To promote the blue economy aspect by developing the lake fronts for economic and social prosperity along Lake Ol' Bolossat to enable the community to reap benefits from the lake.
- 4) To support and capacity build the community birds and wildlife conservation groups


## 7.3 Water Resources Management

### Background

Water is an important natural resource to all forms of life and their existence. Water Resources Authority (WRA) is the lead agency in the management and regulation of water resources country wide since 2002. This is undertaken through decentralised and participatory approach based on catchment levels. Lake Ol' Bolossat falls within the larger Ewaso Ngiro North catchment area and in Engare Narok Melghis (Rumuruti) sub region. Lake Ol' Bolossat is the head waters of Ewaso Narok river which drains into Ewaso Ngiro River.

Lake Ol' Bolossat Water Resources Users Association (WRUA) was formed in 2012 with the mandate to conserve and protect the lake at the grassroot level with support of the stakeholders. There are many springs feeding the lake such as Nduthi from Satima escarpment and boreholes around the lake. The intakes around the ecosystems are managed by various community water



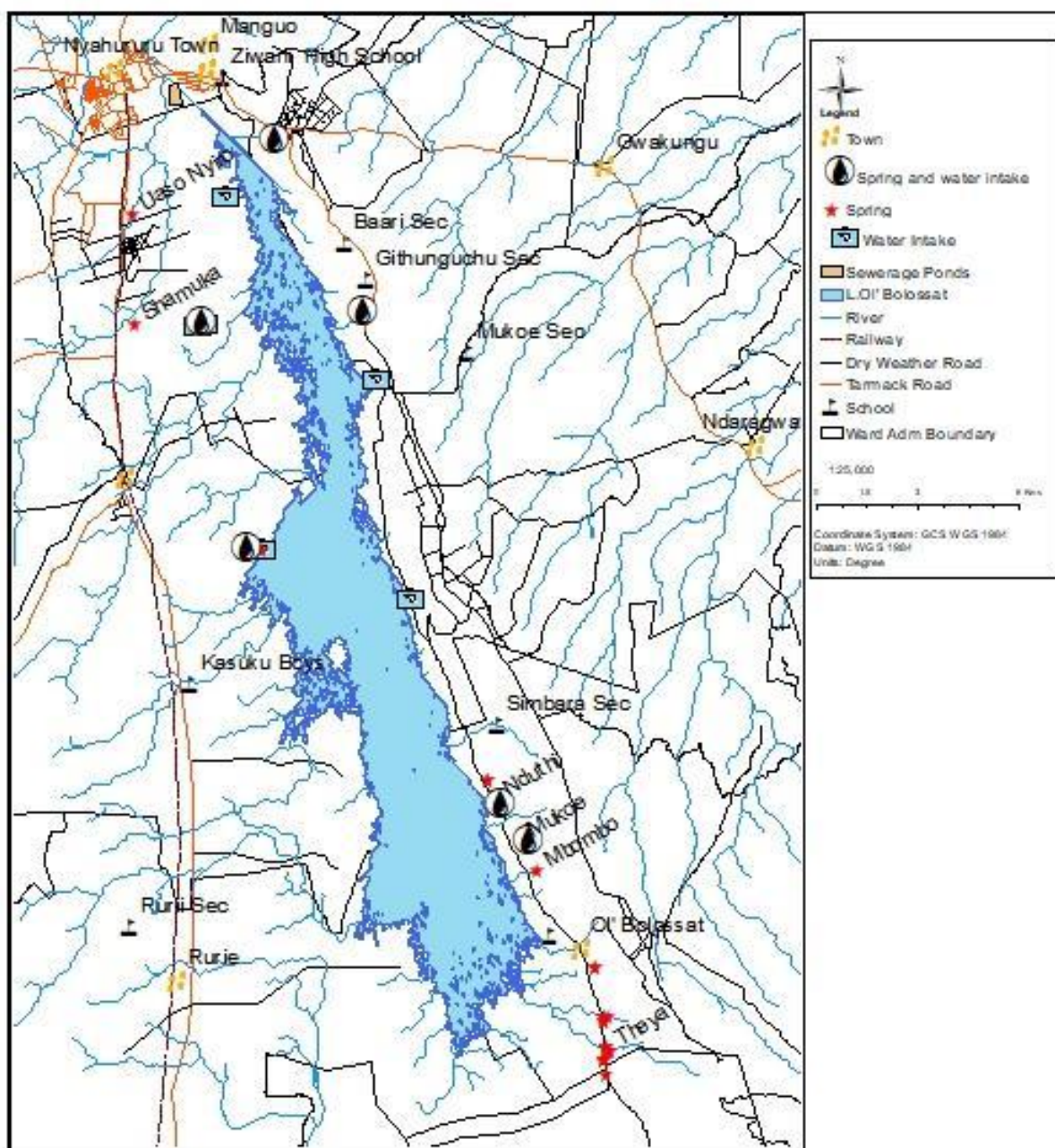


projects (Figure 17). Since 79% of the residents carry out rainwater harvesting there is need to install an Automatic weather station to quantify the amount of rainfall and other parameters in the catchment. Frequent water quality of rainwater samples should be taken to determine quality as this cannot be taken for granted given the number of people who rely on rainwater harvesting.

The plan should consider the following:

1. Introduce modern methods of monitoring springs yield, river discharge, borehole depth and yield, abstraction and quality testing, surface water quality and effluent discharge to the lake and lake levels. The trend nowadays is to install telemetric monitoring sensors and receive the data near real time at a central place. Manual data collection introduces errors and is not always to required standard.
2. Since 79% of the residents carry out rainwater harvesting there is need to install an Automatic weather station to quantify the amount of rainfall and other parameters in the catchment. Frequent water quality of rainwater samples should be taken to determine quality as this cannot be taken for granted given the number of people who rely on RWH.
3. Water abstraction from the mapped points should be quantified and data analysed in real time to stem water resources conflicts between users like farmers, pastoralists, water supply and the ecosystem.
4. Upgrading of the water resources to telemetry requires more resources. This will guarantee quality water resources data.





**Figure 17: Water resources and proximate infrastructures**

### **Management Challenges**

Given the increasing human population in the lake basin and its catchment, the pressure on the natural resources is high and is anticipated to increase. The current trend in land use practices in the lake basin and its catchment demands for an integrated approach to the conservation of natural resources in the overall local community development needs.

The Lake catchment has been converted into farming land and horticultural farming is on the increase especially at the foot of the Muruai escarpment. The degradation of the catchment vegetation could lead to the drying up of the streams that drain into the lake if not checked. In addition, the use of water from these streams for irrigating horticultural farms combined with use of herbicides and pesticides on the farms threatens the lake biodiversity. Although the impacts of these are yet to be evaluated, it is known from other studies in other areas that catchment degradation, abstraction, fertilizer and herbicide deposition affect wetland dynamics (Thenya *et al.*, 2008).

### **Programme Objectives**

- a) To ensure adequate water flow regime that meets both environmental and socio-economic needs
- b) To ensure equitable flow of water within the river channels
- c) To ensure sustainable supply and availability of water
- d) To improve solid and effluent management along the River Tana Basin

## **7. 4 Land resources management programme**

### **Background/Introduction**

The major drive for settlement dating back to pre-colonial times was farming, which started with large scale farming after the Second World War. Post-independence period saw the development of settlement schemes with sub-division of former large-scale farming. Land-use changes around have had major ecological and socio-economic impacts on the delta landscape over the years. Poor land-use practices including overstocking and shifting cultivation have caused increased soil erosion leading to increased sediment load in the lake.

Over the years the land has been sub-divided due to demand for land as population increased. This has resulted in clearing of original indigenous species and planting of exotic trees like eucalyptus, which has significantly altered the landscape. Due to increasing demand for land resources, encroachment into the lake has occurred with fences put up close to the lake ecosystem, degradation of ecosystem, reduced production in both farming and livestock production. The purpose of this management programme is to promote interventions that will foster sustainable use and management of land as a resource.

## **Management issues and challenges**

- a) Poor land use practices mainly involving overstocking and over grazing
- b) Lack of land zonation which has led to competition for land various interest groups
- c) Poor land tenure system
- d) Pest and disease infestations

## **Operational objectives**

- a) To promote sustainable land use practices

## **7.5 Social-Economic Development programme**

### **Background**

The socio-economic activities by the local communities' dependent on the lake's natural resource that include livestock keeping; fishing and subsistence farming. Large-scale economic activities mainly entail large scale agriculture projects by the government. The conduct of these socio-economic activities has however not been without negative impact on the environment mainly through encroachment and degradation of key habitats. Social economic development such as road network is critical in management of ecosystems. Around Lake Ol' Bolossat there are about 64km of roads that serve the ecosystem in various capacities. A study is needed to establish cranes movement routes in and out of the basin. This will help in mapping critical routes so that the power lines are fitted with reflectors to alert cranes and other large birds so they can flow low or higher to avoid collisions and eventually death.

### **Management Challenges**

The following are the main challenges that are likely to be encountered in the implementation of the proposed management actions in this programme:

- a) Unsustainable livelihood practices characterised by livestock over-stocking; slash and burn agriculture and charcoal burning
- b) Poor and inadequate infrastructure and social amenities
- c) Gender inequality and inequity
- d) Poor adoption of alternative livelihoods

## **Operational Objectives**

- a) To promote sustainable economic development and local livelihoods

## **7.6 Governance improvement programme**

### **Background/Introduction**

Ineffective governance is one of the main causes of environmental degradation and unsustainable development in the lake basin. This is largely evidenced by the continued competing interest between conservation and development in and around the lake. In order to effectively manage the lake, there is need to raise awareness on its importance and enhance the capacity and coordinate the work of key agencies involved management of the area. The governance management programme seeks to promote these actions among others with a view to ensuring effective management and sustainable development in the lake basin.

### **Management issues and challenges**

- a) Inadequate institutional capacities in management of the lake
- b) Inadequate awareness amongst the public and policy makers on importance of the lake
- c) Weak enforcement and poor with environmental regulatory frameworks
- d) Inadequate community participation in environmental conservation
- e) Conflicting and competition for resources
- f) Poor knowledge base and understanding of Lake Olbolossat ecosystem
- g) Poor coordination of conservation efforts in the delta


### **Operational objectives**

- a) To enhance institutional capacity for effective management of Lake Ol' Bolossat
- b) To improve knowledge and understanding of Lake Ol' Bolossat through research and monitoring
- c) To enhance communication, education and public participation and awareness
- d) To promote effective conflict management and resolution mechanisms

## **7.7 Climate change Mitigation and Adaptation programme**

### **Background/Introduction**

Like many other parts of the country climate change is a reality in Lake Ol' Bolossat causing wide fluctuations in climatic conditions. The effects of the changing climate in the lake include droughts, reduced rainfall amounts, pronounced floods and degrading eco-systems. This management programme seeks to promote measures and interventions to mitigate climate change



rive related impacts as well as foster the communities' adaptive capacity to the changing environment.

**Management issues and challenges**

- a) Droughts, floods and reduced rainfall amounts affecting agricultural productivity
- b) Degrading ecosystems due to reduced flooding

**Operational objectives**

- c) To promote climate change mitigation measures
- d) To improve community adaptive capacity and resilience to climate change

## **CHAPTER 8: PLAN IMPLEMENTATION FRAMEWORK**

### **8.1 Stakeholder involvement and partnership**

The preparation of this integrated management plan involved several stakeholders, from initial review process planning phase, stakeholders' mobilization to review phase to actual review and drafting of the plan, which has been detailed in the approach process phase. Taking this into consideration, implementation will be a collective responsibility by the stakeholders, which has been indicated in each programme covering national and county government, civil society, research, academic institution and donor community. Development of partnerships amongst these stakeholders as well as cultivation of political good will through engagement of leaders at both national and county level is important for the successful implementation of the management plan. In light of its mandate to supervise and coordinate environmental programmes in the country, NEMA will take a lead role in implementation of the management plan including stakeholder engagement and coordination. Engagement of stakeholders in the implementation process will be guided by their statutory mandate and capacity. Stakeholders will be involved at all stages of activities implementation including monitoring and evaluation. The activities are clearly outlined in each programme and monitoring and evaluation framework.

### **8.2 Coordination of the management plan implementation**

As described above, NEMA will take a lead role in coordinating implementation of the management plan. The authority will discharge this function with assistance from a technical committee to be put in place at the inception of implementation of the management plan in liaison with stakeholders. The committee shall be called 'Ol' Bolossat Integrated Management Plan Implementation Committee" (OBIMPC). Membership for the committee will be drawn from national government agencies working in the ecosystem, County government of Nyandarua and Laikipia, civil society organisations, private sector and private sector. While working and reporting to NEMA, the OBIMPC will provide a mechanism for coordination of implementation of activities, foster good partnership that support implementation of the plan. The capacity of NEMA and OBIMPC will need to be enhanced through training where necessary and allocation of adequate resources to activities related to coordination of the management plan implementation.



### **8.3 Resource mobilization**

The implementation of this IMP will be financed through mobilization of financial resources at the national as well as county government. Thus, the national government as well as Nyandarua and Laikipia County will be expected to allocate resources for implementation of the management plan through adoption of specific activities in annual development plan and associated budgets. In addition to boost resources mobilization specific projects from partners such as civil society will be prepared and submitted to potential donors. Private sector will also be mobilized to source funds or make specific investment in the ecosystem such as recreation activities.

### **8.4 Risk and sustainability**

While the ecosystem remains of local and national importance and several resources has been used to draft this plan, several potential risk may affect implementation of this management plan, these include;

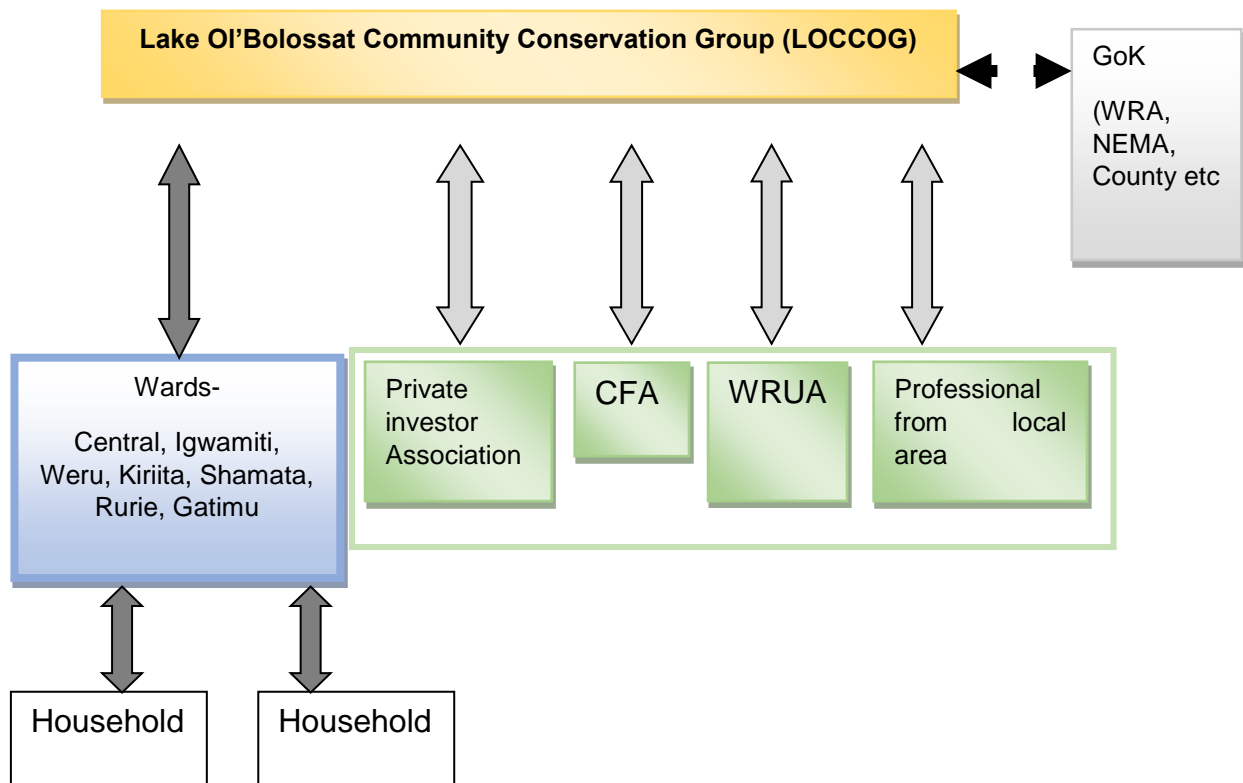
- a) Financial resources being inadequate or not provided in time to allow implementation of planned activities
- b) Deferring or conflict policies may affect implementation, such may include conservation oriented like EMCA and use and extractive one like agricultural policies.
- c) Coordination among different arms of the government with different mandates such, NEMA, KFS, KWS and County government if not well coordinate could result in conflict and low implementation of planned activities. Plans and programme funding and prioritize among government departments could present coordination challenges, which could also involve national and county governments' programmes.
- d) Politics are common in development projects and could present challenge if there are competing political fronts or certain political interests. This cuts across governments and civil society organization.
- e) Information flow among stakeholders is important since speculation due to lack of information could present conflict and mistrust among stakeholders

### **8.5 Institutional Arrangements for Plan Implementation**

The successful implementation of the management plan necessitates the use of appropriate and integrated institutional and organizational structures that exist in the relevant institutions. Field organization for the implementation of this plan at the ecosystem level has been discussed and agreed upon (Figure 18). The implementation of this ecosystem management plan by



stakeholders will be guided by a signed management plan. There will be need to undertake strategic assessment of the management plan before and institution involved during its implementation.



**Figure 18: Implementation organogram**

**Table 13: Implementation matrix**

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
Biodiversity Management Programme										
Objective 1: To promote rehabilitation and restoration of degraded biodiversity										
Delineate mark the lake boundary	Mapping of the lake boundary Identification, verification and relocation of those on the riparian area	Map of the lake and its riparian area List of developments/settlers on the riparian area	Map of the lake boundary No. of developments/settlers on the riparian area relocated	NEMA, KWS, KFS, WRA, NLC, Survey of Kenya, CGN, NGOs, CBOs, Communities	10,000,000	x				
Rehabilitate degraded habitats (forests etc.) and riparian area	Rehabilitation of degraded areas	Increased biodiversity cover	Number of rehabilitated sites Ha of degraded sites rehabilitated	NEMA, KWS, KFS, WRA, CGN, NGOs, CBOs, Communities	5,000,000	x	x			
Enforce relevant environmental and biodiversity conservation laws and regulations including the Gazette notice	Undertake routine compliance monitoring Prosecute non-compliant entities/parties Create Awareness on environmental laws/regulation	Improved compliance with environmental and biodiversity laws/regulations	Enforcement reports; Number of prosecution cases Number of awareness meetings	NEMA, KWS, KFS, WRA. CGN, State Department of Fisheries (DF);	5,000,000	x	x	x	x	
Raise awareness on importance of biodiversity in Lake Ol' Bolossat	Conduct awareness forums	Enhanced awareness on importance of biodiversity	Awareness meetings/forums reports Number of people attending the meetings	CGN, NEMA, KWS, KFS, NMK, NGOs,						

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
	Prepare and disseminate awareness materials Awareness using electronic media (TV & radio)		Number of TV/Radio programs aired	CGN, CBOs, Communities	5,000,000	x	x	x	x	x
Control developments in critical habitats through SEA/EIA process	Subject developments to SEA/EIA process	Critical habitats well conserved; Controlled developments	Number of SEA/EIAs reviewed	NEMA, CGN, NGOs, CBOs, Communities	3,000,000	x	x	x	x	x
Develop and implement alternative sources for products derived from critical habitats e.g. charcoal, fish etc.	Identify and implement sustainable alternative sources for products from critical habitats	Reduced pressure on critical habitats	Number and type of sustainable alternative sources of products derived from critical habitats successfully developed	CGN, NEMA, NMK, Research agencies; NGOs, CBOs, Communities	10,000,000	x	x			
Conduct strategic environmental assessments (sea) and other projects to be subjected to environmental assessments (EIA) and Environmental audits (EAS)	Conduct SEAs, EIAs and	for environmental protection and compliance	numbers of environmental assessments and audits conducted	NCG, Private Developers, Development Partners NEMA, KWS, KFS, NGOS. and.	2,000,000					
<b>Objective 2: To promote sustainable fishing practices</b>										

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
Enforce fisheries laws and regulations	Undertake routine compliance monitoring Prosecute non-compliant entities/parties Awareness on fisheries laws and regulations	Improved compliance with fisheries legal and regulatory requirements	% decrease in use of destructive gear Enforcement reports; Number of prosecution cases Number of illegal fishing gear confiscated Number of illegal fishers arrested	SDF; CGN, BMUs, KWS	2,000,000	x	x	x	x	x
Education and awareness on sustainable fishing practices	Conduct sensitization meetings Prepare and disseminate awareness materials Awareness using electronic media (TV & radio)	Adoption of best fishing practices and methods	% decrease in use of destructive fishing gear/methods Number of legal fishing gears adopted Monitoring reports Number of education & awareness meetings Number of people reached by awareness efforts	SDF, CGN, BMUs, KWS, NGOs, CBOs, NEMA, Communities	5,000,000	x	x	x	x	x
Train BMUs on sustainable fishing and processing technologies	Conduct trainings on modern/innovative fishing/processing technology Organise exchange visits for BMUs	Improved capacity of BMUs on modern fishing and processing technologies	Number of training sessions Number of exchange visits Monitoring reports Number of individuals within BMUs who have adopted the innovations	SDF, CGN, BMUs, KWS, NGOs, CBOs, Communities	3,000,000		x	x		

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
Identify and protect fish breeding grounds	Mapping of fish breeding grounds Implement fish breeding grounds protection measures Establish community conserved areas Develop BMU by-laws for management of fish breeding grounds and CCAs Develop fisheries specific management plans	Fish breeding areas mapped and protected	Maps of fish breeding grounds Number of fish breeding grounds protected/gazetted Habitat monitoring reports Number of CCAs established Number of BMUs who have developed by-laws Number of management plan developed	<b>SDF, CGN, BMUs, KEFRI KWS, NGOs, CBOs, Communities</b>	5,000,000	x	x			
Restock overexploited fisheries ecosystems	Survey and identify reservoirs that have depleted fish stocks; Awareness on the depleted fisheries Restock overexploited fisheries in ox-bow lake ecosystems	Increased fisheries stock within degraded ox-bow lakes	Number of fingerling restocked Number of reservoirs/lakes restocked Catch assessment survey reports	<b>SDF, CGN, BMUs, KEFRI, KWS, NGOs, CBOs, Communities</b>	2,000,000	x	x			
Promote sustainable aquaculture	Identify sites with potential for aquaculture Research on appropriate fish species for aquaculture	Diversified sources of fish Adoption of aquaculture	Number of farmers/farms successfully practicing aquaculture	<b>SDF, CGN, BMUs, KEFRI, KMFRI KWS, NGOs, CBOs, Communities;</b>	15,000,000	x	x			

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
	Undertake pilot aquaculture projects			BMU/fish farmers						
Promote value addition to fisheries products	Identify and develop potential technologies for value addition Identification of areas with scope for value addition Implement value addition measures Upscale/replicate relevant technologies	Increased income to fishermen Quality of new products	% increase in income per fisherman Number of technologies Number/types of products developed	SDF, KMFRI, CGN, BMUs, KMFRI KWS, NGOs, CBOs, Private sector	20,000,000		x	x		
<b>Objective 3: To promote wildlife conservation measures in the lake</b>										
Establish community conservation/conservation area	Stakeholder mobilization and sensitization Establish conservancies Develop management plans for the conservancies	Improved conservation status of wildlife	Number of conservancies established % population increase in wildlife Number of management plans developed	KWS, CGN, NEMA, KFS, SDF, NGOs, private sector, CBOs, Communities	30,000,000	x	x	x		
Gazettement of lake Ol' Bolossat as a national reserve	conduct stakeholder forum, collaborate with the national government on modalities of gazettement and establishment of the national reserve	reduce human wildlife conflict and create more space for wildlife	area gazetted and conserved as a national reserve	KWS, CGN, KFS, SDF, NGOs, private sector, CBOs, Communities	3,000,000					

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
Develop and update biodiversity species inventory	Prepare inventory for all biodiversity in the area Update the inventory regularly	Enhanced understanding of biodiversity species in lake Ol' Bolossat	Inventory for biodiversity species in Lake Olbolossat	NMK, KWS, NEMA, KFS, SDF, NGOs, Communities	3,000,000		x	x		
Identify and protect habitats for endangered wildlife species	Mapping, law enforcement and monitoring of habitats for endangered species	Improved health of species and their habitats	Increased populations of endangered species  Monitoring reports	KWS, CGN, NEMA, KFS, SDF, NMK, NKM, NGOs, Communities	4,000,000	x				
Develop and implement human-wildlife conflict resolution mechanisms	Develop conflict resolution mechanisms Implement conflict resolution mechanisms	Reduced cases of Human-wildlife conflict	Human-wildlife conflict resolution mechanisms % decrease in HWC cases	KWS, CGN, SDF, BMUs, NEMA, KFS, NGOs, Communities	10,000,000	x	x			
Establish community wildlife conservation groups	-Mobilize wildlife conservation groups -Train the conservation groups and empower them.	Reduced cases of Human-wildlife conflict	Number of community wildlife conservation groups formed and trained.	KWS, CGN, SDF, BMUs, NEMA, KFS, NGOs, Communities						
<b>Operational objective 4: To promote measures to prevent and control introduction of invasive species</b>										



Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
Carry out survey on prevalence of invasive species	Undertake survey on invasive species	Enhanced understanding of invasive species in the delta	Number and extent of invasive species documented	KEFRI, KWS, KFS, NEMA, Communities	2,000,000	x				
<b>Total</b>					<b>141,000,000</b>					
<b>Eco-tourism development programme</b>										
<b>Objective 1: Develop and enhance eco-tourism around the Lake</b>										
Map and document potential tourist attraction sites	Identify and document potential attraction sites and suitable activities for each site	Tourist sites mapped and documented	No. of potential sites identified and mapped. Reports, photos and attendance list	KTB, Eco-tourism Society of Kenya, KWS, CBOs, KATO, NGOs, tourism experts, community	10,000,000	x				
Promote eco-tourism around the lake	Publicize the tourism potential of the area through brochures, web maps, posters, local media (printed, radio and television)	Increased number of tourists in the area	Posters, Brochures, website and social-media	KTB, KWS, CBOs, KATO, NGOs, marketing companies	1,000,000	x	x			
	Support development of tourist facilities/ infrastructure including water, electricity, access road	Increased number of tourism activities in the area	No of tourism facilities developed,	KTB, CGN, NEMA, NGOs, CBOs, Ministry of Tourism,	85,000,000		x	x		

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
	networks, hippo point watch towers, boat jetties, boating, zip lines, floating restaurants, raised walkways activities and other facilities that would support tourism growth.			National and County Governments,						
	Link the facilities with existing regional and National tourism circuits	Increased number of tourists in the area	Reports	<b>KTB</b> , NGOs, KWS, Magical Kenya, and private sector	1,000,000			x	x	
	Capacity build stakeholders on eco-tourism, promote tour guiding, bird watching	Increased revenue collection	Number of interest groups trained and capacity built.	<b>CGN</b> , CSOs, KTB, private sector, CBOs, KWS	1,000,000	x	x			
Conduct of lake Ol' Bolossat half marathon	In conjunction with Athletic Kenya establish avenues and modalities of conducting lake Ol' Bolossat half marathon as an annual event to create awareness, promote sports tourism and enhance conservation.	Increased number of visitors and enhanced sports tourism.	Number of successful Lake Ol' Bolossat half marathons held.	<b>NCG</b> , Athletic Kenya, NGOs, KTB, NMK, Magical Kenya, and private sector and other development partners.	50,000,000					

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
The blue economy aspect.	Explore on ways of developing the lake Ol' Bolossat water front and incorporate and implement the blue economy aspect to promote social and economic prosperity	Increase revenues and employment opportunities.	area covered under the blue economy aspect	NCG, KeFS, KFS, NGOs, KWS, KTB, NMK, Magical Kenya, and private sector, blue economy fund, other National government agencies and other development partners.	20,000,000					
<b>Total</b>					<b>168,000,000</b>					
<b>Water Management Programme</b>										
<b>Objective 1: To ensure adequate water flow regime to meet both environmental and socio-economic needs</b>										
Develop and implement water allocation plans for lake Ol' Bolossat	Develop water allocation plans Implement water allocation plans	Equitably allocation of for both economic and environmental needs	Water allocation plans, Reports on implementation of water allocation plans	<b>WRA</b> , Ministry of water and Sanitation CGN, NEMA, NGO, private sector, WRUAs, communities	15,000,000	x	x			

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
Promote use of efficient irrigation technology around the lake	Identify and promote efficient irrigation technologies Promote use of efficient irrigation technologies	Use of efficient irrigation technology adopted	Number of entities/ individuals using efficient irrigation technologies  Monitoring reports	WRA, CGN, NEMA, NGOs, WRUAs	20,000,000	x	x			
Awareness creation on sustainable water abstraction from the Lake	Conduct sensitization meetings Prepare and disseminate awareness materials Awareness using electronic media (TV & radio)	Sustainable water abstraction from the Lake	Meeting reports; Number of awareness meetings conducted; awareness materials; number of TV and Radio programmes	WRA, Ministry of water, CGN, NEMA, NGO, private sector, WRUAs, communities	10,000,000	x	x	x	x	x
<b>Objective 3: To ensure sustainable supply and availability of water</b>										
Provide alternative water sources to villages affected by restrictions in accessing the Lake	Identify and implement alternative water sources	Alternative water sources provided to the villages	Report on number of households, livestock, industries using alternative sources of water; Number of alternative sources of water provided	MoWSI, Water companies, CGN, private sector, NGOs	30,000,000	x		x		
Promote rain water harvesting	-Awareness creation on rainwater harvesting Implement rain water harvesting projects	Increased water availability and accessibility	Number of awareness meetings on rain water harvesting Reports from awareness meetings	MoWSI, Water companies, CGN, private sector, NGOs, CBOs	20,000,000	x	x	x		

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
			Number of households using rain water harvesting technology							
Promote good agricultural practices around the Lake and catchment areas	Promote good agricultural practices around the Lake and catchment areas	Reduced soil erosion and siltation in Lake Ol' Bolossat	Monitoring reports (increased agricultural produce, improved soil fertility)	MoALF, CGN communities, NGOs, private sector	50,000,000	x	x			
Establish and strengthen Water Resource Users Associations (WRUAs)	Establish and strengthen Water Resource Users Associations (WRUAs)	WRUAs actively involved in water conservation activities	Number of WRUAs established and strengthened through capacity building; Monitoring reports	WRA, CGN, WRUAs, NGOs, Water companies	10,000,000		x	x		
Undertake water quality and hydrological monitoring in the Lake basin	Undertake water quality and hydrological monitoring in the Lake basin	Improved knowledge and understanding of water quality trends in Lake Ol' Bolossat basin	Water quality monitoring reports	WRA, Ministry of water, CGN, NEMA, NGOs	10,000,000	x	x			
<b>Total</b>					<b>165.000,000</b>					
<b>Land Resources Management Programme</b>										
<b>Objective 1: To promote sustainable land use practices</b>										
Building the capacity of local farmers in best agricultural practices (soil	Undertake capacity needs assessment on sustainable farming practices	Best agriculture practices adopted widely	Training needs assessment report; Number of farmers trained on sustainable	MoALF, CGN, NGO, private sectors,	20,000,000	x		x		x

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
conservation, reforestation, regular soil analysis, etc)	Train farmers on best farming practices		farming practices; monitoring reports	Pastoralists, Farmers						
Develop and implement spatial plans for urban areas to ensure controlled development	Develop spatial plans for urban areas Implement spatial plans for urban areas	Spatial plans for urban areas developed and implemented	Number of urban areas with spatial plans; implementation reports	CGN, Ministry of Lands; NLC	50,000,000	x	x	x	x	x
<b>Total</b>					<b>70,000,000</b>					
<b>Socio-Economic and Eco-tourism Development Programme</b>										
<b>Objective 1: To promote sustainable economic development and local livelihoods</b>										
Diversify livelihood activities (e.g aquaculture, bee keeping, ecotourism, mining etc.	Undertake study on alternative livelihoods Implement survey findings	Diverse livelihood activities adopted by local communities	Documentation of alternative livelihoods; Diversified options of livelihoods; Increased income	CGN, Communities, Line ministries; NGOs; CBOs	50,000,000	x	x	x	x	x
Promote eco-tourism around the lake as an income generating activity	Identify and document potential attraction sites Publicize the potential sites through brochures, posters, media Improve infrastructure such as roads and communication networks	Sites identified and documented Awareness created on the existing tourist sites around lake Ol' Bolossat Road and communication networks created and repaired	Comprehensive documentation of tourist attraction sites  Number of people depending on ecotourism as a source of livelihood Number of access roads repaired	KTB, KWS, CBOs, KATO, CGN,	5,000,000	x	x			

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
			Number of communication networks installed							
Lake exploration and exploitation	Undertake exploration of bio-deposit organic fertilizer from lake bottom Set up of a processing factory	Increase in the Lake depth  Job opportunities created	Amount of bio-deposit fertilizer extracted, processed and sold  Number of job opportunities created	<b>MoALF, NEMA, State Dep. Of Mining, WRA, CGN.</b>	10,000,000					
Promotion of Small and Medium scale entrepreneurship activities	Survey on potential micro-enterprise activities Implementation of potential micro-enterprises Linking micro-enterprises with financial institutions Establishment of a micro-enterprises fund	Economically empowered communities	Documentation of potential micro-enterprises; Number of communities trained in micro-enterprises; Number of enterprises implemented; Number of SACCOs; monitoring reports	<b>Chamber of Commerce, Ministry of co-operatives, MOD, CGN, NGOs, private sector, Financial institutions, communities</b>	20,000,000	x	x	x	x	x
<b>Total</b>					<b>85,000,000</b>					
<b>Governance Improvement Programme</b>										
<b>Objective 1: To enhance institutional capacity for effective management of Lake Ol' Bolossat</b>										
Capacity building for relevant institutions to effectively manage the Lake	Conduct trainings for relevant county and national government departments	Effective management of the lake	Training reports; No of officers trained	<b>NEMA, CGN Resource user groups, NGOs. CBOs</b>	3,000,000	x	x			



Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
Strengthen enforcement of regulatory frameworks for management of the lake	Staff deployment Recruit voluntary community scouts for monitoring/surveillance	Improved compliance with legal requirements; Enhanced enforcement of regulations	No of staff deployed; number of voluntary community scouts engaged;	<b>NEMA, CGN, WRA NGOs, Co-management groups (CFAs, BMUs etc.), WRUAS</b>	6,000,000		x	x		
Conduct civic education on the existing NRM regulatory frameworks	Conduct civic education on the existing NRM regulatory frameworks Establishment of a Ramsar site	Improved compliance with legal requirements; Increased social accountability Lake designated as a Ramsar site	Number of awareness meetings; workshops reports; reduced cases of wildlife/NMR crimes	<b>NEMA, CGN, KWS Ramsar site Committee, NGOs, CBOs</b>	15,000,000	x	x	x	x	x
Improve resource allocation for Lake Ol'Bolossat management	Increase resource allocation for Lake Ol'Bolossat management	Improved allocation of financial resources for Lake Ol'Bolossat management	Resource allocation plans and budgets; amount of funds allocated for Lake Ol'Bolossat initiatives	<b>CGN, Line Ministries, NEMA, NGOs, private sector, Development partners, CBOs</b>	3,000,000	x	x	x	x	x

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
Develop and implement a strategy for resource mobilization	Develop and implement a strategy for resource mobilization	Availability of financial resources to support conservation and management of the Lake	-Resource mobilization strategy document; List of potential donors; - Financial and non-financial resources mobilized; number of initiatives supported by organizations	CGN, NEMA, KWS, County Environ Committee, Committee, NGOs	10,000,000	x	x			
Establish and build capacity of County Environment Committees and lead agencies for effective coordination of environ activities	Establish and train County Environment committee and lead agencies for effective coordination and management of the Lake	Functional County Environment Committee Improved coordination of the Lake management and conservation activities	County Environment Committee Training reports; Number of committee members trained	NEMA, KWS CGN Lead agencies, NGOs	5,000,000	x	x			
<b>Objective 2: To improve knowledge and understanding of Lake Ol' Bolossat through research and monitoring</b>										
Establish and operationalize scientific committee for Lake Ol' Bolossat	Establish and operationalize scientific committee for Lake Ol' Bolossat	A functional scientific committee in place	scientific committee; Reports by committee	KWS, NEMA, NMK, NGOs, Academia, among others	2,000,000	x	x			
Undertake participatory research and monitoring activities for adaptive management	Undertake participatory research and monitoring activities for adaptive management	Lake Ol' Bolossat	Research reports; Monitoring reports	KWS, KMFRI, scientific committee for Lake Ol' Bolossat NGOs, NMK, CGN	5,000,000	x	x	x	x	x

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
				Research scientists; Academia						
Develop a baseline map for critical habitats for use in monitoring habitat change	Prepare a baseline map for critical habitats for use in monitoring habitat change	Improved monitoring of habitat changes	Baseline map for critical habitats developed	KWS, DRSRs, NEMAKFS, CGN CGL, NGOs, CBOs	5,000,000	x	x			
Conduct inventories and economic valuation of critical habitats	Prepare inventories and economic valuation of critical habitats	Improved knowledge on economic value of critical habitats	Critical habitats Valuation reports	KWS, NEMA, KFS, NMK, KEFRI Academia, NGOs, CBOs	25,000,000	x	x			
Develop an information management system for Lake Ol' Bolossat	Develop an information management system for Lake Ol' Bolossat	A functional information Management System for Lake Ol' Bolossat established	Information Management System for Lake Ol' Bolossat	NEMA, KFS, KWS, NMK, KEFRI Academia, NGOs, CBOs CGN	5,000,000	x	x			
Organize information and lesson sharing forums/scientific conferences on Lake Ol' Bolossat	Organize information and lesson sharing forums/scientific conferences	Improved knowledge base on Lake Ol' Bolossat	Workshop/conference reports; monitoring reports	CGN, Research Institutions, NGOs, private sector, CBO, Academia	15,000,000	x	x	x	x	x
<b>Objective 3: To enhance communication, education and public participation and awareness</b>										
Conduct education and awareness campaigns on	Conduct sensitization forums	Improved level of awareness and social	Number of outreach forums; number of people that have	NEMA, KWS, CGN, NGOs,	25,000,000	x	x	x	x	x

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
importance of the Lake at all levels	Prepare and disseminate awareness materials Awareness using electronic media Implement an environmental award scheme to recognize best practices	accountability in conserving the Lake	received awareness; Awareness reports; awareness materials; TV & Radio programmes organized; policy briefs; environmental award schemes organized	private sector, CBOs						
<b>Objective 4: To promote effective conflict management and resolution mechanisms</b>										
Develop early warning systems and conflict resolution mechanisms	Develop and implement early warning systems and conflict resolution mechanisms	Peaceful co-existence by communities and resource users	Early warning systems in place; conflict resolution mechanisms in place; monitoring reports	CGN, Ministry of Interior, Local leaders, Law enforcement agencies, NGOs, CBOs	10,000,000	x	x			
<b>Total</b>					<b>134,000,000</b>					
<b>Climate Change Mitigation and Adaptation Programme</b>										
<b>Objective 1: To promote climate change mitigation measures</b>										
Rehabilitate degraded forests/ catchment ecosystems	Identify degraded forest sites Rehabilitate degraded forests and riverine ecosystems	Improved forest and riverine cover	Rehabilitated degraded sites; monitoring reports	KFS, CGN, KWTa, NEMA, KWS, NGOs, private sectors, CBOs	10,000,000	x		x		x
Implement the National Climate	Awareness on climate change	Reduced impacts of climate change;	Awareness reports; CC awareness materials;	MEF, CGN, NGOs, CBOs						

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
Change (CC) Action Plan and Climate Change strategy at the local level	Capacity building on CC adaptation Initiate adaptation projects (water harvesting, use of green energy, etc)	enhanced adaptation and resilience to climate change	training reports; initiative on CC adaptation; Monitoring reports		5,000,000		x		x	
Enforce laws on riverbank, seashore protection (Wetlands Regulations 2009)	Undertake routine compliance monitoring Prosecute non-compliant entities	Improved compliance with wetlands regulations	Inspection/compliance monitoring reports; prosecution cases	NEMA, KFS, WRA, Ministries of Interior and Lands, CGN, NLC	3,000,000	x	x	x	x	x
Promote reforestation through farm forestry among others	Undertake farm forestry initiatives	Improved vegetation cover around the lake catchment	Improved vegetation cover; monitoring reports	KFS, KEFRI, KWT, CGN, NGOs, CBOs, private sector	10,000,000	x	x	x	x	x
Promote adoption of sustainable agricultural practices (e.g. improved animal breeds and drought resistant crops)	Awareness on climate smart agriculture Training on climate smart agriculture Undertake climate smart agricultural initiatives (e.g. drought resistant crops, etc)	Sustainable agricultural practices adopted widely	Awareness reports; training reports; climate smart agriculture initiatives; Monitoring reports	MoALF,; CGN, NGOs, CBOs, private sector	20,000,000	x	x	x		
<b>Objective 2: To improve the adaptive capacity and resilience to climate change</b>										
Raise community awareness on climate change	Raise community awareness on climate change	Improved community awareness on climate change	Awareness reports; awareness materials	MEF, CGN, NEMA, NDMA, KFS, KWS, CBOs	3,000,000	x	x			

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
Promote farming of drought resistance crops	Awareness on drought resistance crops Promote on-farm use of drought resistance crops	Improved adoption of drought resistant crops	Awareness reports; Number of farmers using drought resistant crops; monitoring reports	<b>MoALF</b> ,; CGN, NGOs, CBOs, private sector	7,000,000	x	x	x	x	x
Promote water efficient irrigation and conservation agriculture	Promote water efficient irrigation and conservation agriculture	Adoption of water efficient irrigation and conservation agriculture	water efficient irrigation technologies in use; number of farmers using the technologies, monitoring reports	<b>MoALF</b> , WRMA; NIB, CGN, NGOs, CBOs, private sector	10,000,000	x	x	x	x	x
Promote breeding of animals tolerant to local climatic conditions	Awareness on animals tolerant to local climatic conditions Promote keeping of animals tolerant to local climatic conditions	Adoption of animal breeds tolerant to local climatic conditions	Awareness reports; Number of farmers keeping animals tolerant to local climatic conditions; monitoring reports	<b>MoAFL</b> , CGN, NDMA, NGOs, CBOs, private sector	5,000,000	x	x	x	x	x
Promote rain water harvesting (roof catchment, etc)	Awareness on rain water harvesting Undertake projects on rain water harvesting (water pans, roof catchment,	Water harvesting adopted widely	Rain water harvesting initiatives; Number of households doing rain water harvesting	<b>MoWSI</b> , CGN, NGOs, CBOs, private sector	20,000,000	x	x	x	x	
Rehabilitate degraded water sources e.g. de-silting of dams	Rehabilitate degraded water sources e.g. de-silting of dams	Degraded water source rehabilitated	Rehabilitated water sources; monitoring reports	<b>WRA</b> , MoWSI; water companies; CGN, CDF,	10,000,000	x	x			

Activity	Sub-activity	Expected Output/outcome	Performance Indicators	Actors	Budget (KSh)	Timeframe (years)				
						1	2	3	4	5
				NEMA, NGOs, CBOs, private sector						
Implement early warning systems for droughts and floods	Implement early warning systems for droughts and floods	Early warning system serving communities in the delta	Early warning systems for droughts and floods	NDMA, KMD, CGN Private sector	5,000,000	x	x			
Diversify livelihood activities e.g. aquaculture, bee keeping, ecotourism, etc	Awareness on livelihood activities diversification Undertake livelihood diversification activities	Diverse livelihood activities adopted by local communities	Diverse livelihood activities practiced by communities; monitoring reports	CGN, Line ministries; Lead agencies, NGOs, private sector, CBOs	30,000,000	x	x	x	x	
Promote use of alternative/clean energy e.g. wind, solar, etc	Awareness on <i>use of alternative/clean energy</i> Undertake initiatives on use of clean energy	Use of alternative/clean energy widely adopted in the delta	Clean energy initiatives; Number of households using clean energy; monitoring reports	MEF, Min. of Energy, CGN Lead agencies, NEMA, NGOs, CBOs	15,000,000	x		x		x
<b>Total</b>					<b>153,000,000</b>					
<b>Grand total</b>					<b>916,000,000</b>					



## **CHAPTER 9: MONITORING AND EVALUATION**

### **Background**

Monitoring the implementation of the Lake Ol' Bolossat Integrated Management Plan will be necessary in order to assess whether or not program objectives are being achieved and what adjustments are needed to ensure that objectives are achieved. Monitoring will be crucial in providing information on whether the involvement of communities is contributing to improved wetland management and wellbeing of local communities surrounding ecosystem.


Monitoring of the ecosystem dynamics related to this integrated management plan programme, will be useful for sound decision making. Annual environment audits where applicable like in infrastructure development like road construction as proposed in this management plan will be undertaken as per the requirements of EMCA. Monitoring and evaluation of the implementation of the management plan will be undertaken jointly various stakeholders proposed under each programme. This will involve two levels, one plan implementation monitoring and evaluation on annual basis, while the programme activities under implementation will have monthly report generated to monitor progress followed by an annual report. The monitoring and evaluation report (M&E) will be jointly evaluated by NEMA, CBOs, KFS, WRUA, and CFA for implementation and adjustments of programme activities where necessary.

### **Management Challenges**

The capacity to undertake monitoring within the key institutions and limited financial resources are the two main challenges in implementation of the programmes. The most critical is that there are no formalised system that captures information in way it can be retrieved most of it being verbal between NEMA, KFS, KWS, CFA and CBOs like WRUA and CFA, which need to be adjusted. Thus, it is hard and challenging to review progress or improvement in implementation.

### **Methods**

Data for monitoring will be collected continuously by NEMA, KFS, CSOs, CBOs like WRUA and KWS. While Monitoring during the implementation period will be maintained through preparation and submission to NEMA of monthly, quarterly, half year and annual progress reports by led by NEMA County office with contribution from CBOs, CFA, WRUA and KWS. Both data collection and monitoring will be undertaken in a participatory and consultative manner among the



stakeholders preferably using modern information technology like mobile telephony applications. While evaluation will be done mid period and after the five years by an independent body, a framework to be used is provided in appendix 3, which should be adopted for respective ecosystem activities.

### **Responsibilities**

The Monitoring and Evaluation Teams lead by NEMA with support from other relevant stakeholders will conduct periodical monitoring and evaluation using the monitoring schedule provided in appendix 6. It is noted that for each action in the management plan, responsibilities have been assigned to particular institutions or stakeholders to assess the progress made by the implementing department/stakeholder.

### **Success indicators**

Success indicators provide a measure of assessing whether set targets are being achieved. Success indicators have been set for different categories of management activities to assess the achievement of the set targets for each activity in the integrated management plan. A framework to be used is provided in appendix 6, which should be adopted for each wetland programme and activity.

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