



## The difficult choice - to conserve the living filters or utilizing the full potential of wetlands: Insights from the Yala swamp, Kenya

James Odhiambo Maua<sup>a,\*</sup>, Musingo Tito E. Mbuvi<sup>a</sup>, Paul Matiku<sup>b</sup>, Serah Munguti<sup>b</sup>, Emily Mateche<sup>b</sup>, Moses Owili<sup>b</sup>

<sup>a</sup> Kenya Forestry Research Institute, P.O. Box 20412-00200, Nairobi, Kenya

<sup>b</sup> Nature Kenya, Kenya



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### ABSTRACT

Wetlands are very productive ecosystems and provide a lot of goods and services to wetland-dependant communities worldwide. Despite their importance in terms of ecological, biological and socio-economic roles, they remain constantly under threat and many continue to be degraded and sometimes even lost at an alarming rate due to anthropogenic reasons. It is crucial to comprehend the utilization of wetland resources in terms of their ecological, restorative potential, biological and socio-economic roles and thereafter suggest on their wise use. The objective of the study was to determine the management and utilization of Yala swamp, the effects of the swamp utilization on livelihoods and conservation, and explore sustainable land use strategies for the swamp. Questionnaires were administered to 490 household heads from four project sites in two counties; 8 focused group discussion and 50 key interview informants were used to get information on the utilization. About 78.1% of the household heads were categorized as poor followed by the rich (15.1%) whereas the very rich and very poor had the same proportion. About 50.8% had land of 1–2.99 ac and up to 14.9% were landless. This encouraged them to encroach on the swamp. There were conflicts on land ownership which exacerbated destruction of the swamp. However, over 87% of the household heads had an interest in sustainable management of the swamp due to the benefits got from the swamp. Farming followed by use of papyrus were the main livelihood activities across all wellbeing categories. There is an urgent need to protect the swamp against encroachment and unsustainable exploitation. Further, the community should be sensitized on the importance of wetlands not only for livelihoods but also for conservation of biological diversity. Involvement of community in management of the swamp is necessary for participatory management. Several opportunities for sustainable development of the swamp should be explored by all stakeholders.

### 1. Introduction

Globally, wetlands are estimated to occupy approximately 6–10% of the earth's surface (Maltby, 1986; Schuyt and Brander, 2004) whereas in Africa; wetlands cover about 4.7% which is approximately 1.15 million km<sup>2</sup> of Africa's continental area (Lehner and Döll, 2004; MacKay et al., 2009). Kenya's wetlands are estimated to cover approximately 3–4% of the country's land area (Macharia et al., 2010; Atlas, 2012). Though these geographic areas of wetlands are small, they provide important ecosystem services to high proportion of communities in the rural areas therefore indispensable to their survival, health and welfare of human beings and biodiversity (Atlas, 2012). Wetlands are defined as “various types of habitat such as marshes, peatlands, floodplains, rivers and lakes, and coastal areas such as saltmarshes, mangroves, and seagrass beds, but also coral reefs and other marine areas no deeper than six metres

at low tide, as well as human-made wetlands such as waste-water treatment ponds and reservoirs” (Gardner and Davidson, 2011). According to Watzin (Watzin, 1992), “wetlands are transitional areas between permanently flooded deep-water environments and well drained uplands that contribute to a wide array of biological, social and economic benefits; further, wetlands support a wide array of flora and fauna and deliver many ecological, climatic and societal functions; thus scientists generally denote wetlands as the “kidneys” of the earth and forests as the “lungs” of the earth”.

Wetlands contribute to attainment of all the 17 Sustainable Development Goals (SDGs) either directly or indirectly (Seifollahi-Aghmiuni et al., 2019) and their conservation and wise use represent a cost effective investment for governments. For example, SDG 1 on No poverty – more than a billion people depend on wetlands for a living; SDG 2 on zero hunger – rice grown in wetland paddies is staple food

\* Corresponding author.

E-mail addresses: [james\\_maua@yahoo.com](mailto:james_maua@yahoo.com) (J.O. Maua), [matiku@naturekenya.org](mailto:matiku@naturekenya.org) (P. Matiku), [Serah.Munguti@fauna-flora.org](mailto:Serah.Munguti@fauna-flora.org) (S. Munguti).

of 3.5 million people (Nguyen, 2002); SDG 8 on decent work and economic growth – wetlands sustain 266 million jobs in wetland tourism and travel; and SDG 13 on climate action - peatlands cover only 3% of global land but store twice as much carbon as the entire world's forest biomass. Further, SDG 15 on life on land – 40% of all of the world's species live and breed in wetlands (Gardner and Finlayson, 2018). These actual and potential benefits continue to strain and limit the ecological services functions of the wetlands globally.

Conservation of wetlands worldwide is guided by the Ramsar Convention. It is an intergovernmental treaty with a mission as “the conservation and wise use of all wetlands through local, regional and national actions and international cooperation as a contribution towards achieving sustainable development throughout the world” (Finlayson et al., 2011). According to the annotated contracting parties list as at 4th November 2019; 171 nations had joined the Convention as Contracting Parties. More than 1900 wetlands worldwide covering over 186 million hectares had been designated for inclusion in the Ramsar list of wetlands of international importance (Gardner and Davidson, 2011). The Ramsar convention entered into force in Kenya on 5 October 1990 and the country currently has 6 sites designated as Wetlands of International Importance (Ramsar Sites), with a surface area of 265,449 hectare.

According to Ramsar classification of wetlands, there are three broad categories (inland; marine and coastal; and human-made) which are further sub-divided into 42 types (Gehrig et al., 2015). Out of these, the six types of wetlands found in Kenya are riverine, lacustrine, palustrine, estuarine, marine and constructed ones. These are well described in the Kenya wetlands atlas (Atlas, 2012). Examples of the main wetlands in Kenya are riverine that include Athi River, Ewaso Ng'iro, Nyando, Yala and Tana River; lacustrine are those wetlands occurring in and around the lakes, whether fresh water lakes or saline e.g. around Lake Victoria; palustrine wetlands occur where there are marshes, swamps, bogs and floodplains e.g. King'wal swamp in Nandi Sub-County and Nyando floodplains; estuarine wetlands occur where the fresh and salty water mix and include deltas, tidal marshes and mangrove swamps e.g. Tana River Delta; marine wetlands are those exposed to the waves and currents of the open ocean and are characterized by a high level of salinity e.g. Mombasa marine national park and the Watamu marine national reserve; and human made wetlands comprise several disparate artificial structures such as irrigation schemes e.g. Mwea, Ahero, Bunyala; major dams such as Sasumua, Kindaruma, Turkwel as well as the salt pans, sewage farms, fish and shrimp ponds. Yala swamp, the study area, is described as riverine wetland. This type usually occurs along the river and stream course, which may traverse hundreds of kilometers and forms wetlands within the river basins (Hughes, 1992; Atlas, 2012).

Despite the important roles played by the wetlands in terms of ecological, biological and socio-economic roles, they remain constantly under threat and many continue to be degraded and sometimes even lost at an alarming rate (Mengesha, 2017; Owuor et al., 2012). For example, between 1970 and 2015, inland and coastal wetlands have reduced by 35% across the globe; resulting in loss in provision of potential ecosystem services worldwide (Dodds et al., 2013; Xu et al., 2019). Globally, the main causes of wetland loss and degradation include conversion of wetlands to agriculture, urban housing development, invasive species, pollution, sand harvesting and climate change (Finlayson et al., 2013; Xu, 2019). In Africa, the decline of wetlands is mostly attributed to growing populations, economic development and climate change (Schuyt, 2005). In Kenya, severe degradation has taken place due to a number of factors including overexploitation of papyrus, farming and grazing (Oduor et al., 2015) insecure tenure, poverty and inability to enforce management decisions. For example, Yala swamp contains many plants and animals whose values are not known but they make the lives of the surrounding community better every day (Aloo, 2003). Therefore, clearing/draining wetlands have adverse effects on the ecosystem; especially the fish fauna as breeding sites are destroyed (Riedmiller, 1994). Conversion of wetlands to agricultural land threatens ecological systems including hydrology, geomorphology and vegetation (Nyamadzawo et al.,

2015), thus haphazard conversion of wetland to cropland should be regulated. Some efforts to sustainably utilize and conserve Yala swamp include use of participatory approach in preparation ecotourism business plan in Got Ramogi (Odede et al., 2013); resolve issues in sharing of natural capital between the community and Dominion Farms that had affected livelihoods of community and conservation (Kemunto, 2018). Further, future conservation and management efforts for wetlands and related watersheds are likely to achieve more with well-informed stakeholders. Therefore public education and awareness of the benefits of biodiversity conservation, adoption of wetland user-friendly alternatives and income generating activities would offer opportunity to sustainably manage and conserve wetlands amidst increasing populations, poverty and limited resources (Macharia et al., 2010). It is necessary to comprehend the utilization of wetland resources in terms of their ecological, restorative potential, biological and socio-economic roles and thereafter suggest on their wise use. Therefore, the objective of the study was to determine the utilization of Yala swamp, the effects of utilization on livelihoods and conservation, and explore sustainable land use strategies for the swamp and community livelihoods.

## 2. Methods

### 2.1. Study site description

#### 2.1.1. Study area

The study was done in four Sub-counties in Alego-Usonga, Bondo and Gem in Siaya County and Bunyala Sub-County in Busia County. The counties were purposively selected because they were Nature Kenya project sites. The study targeted about 50% of the 635 households made up of 3055 people in the areas adjacent to the river and the swamp in the four Sub-Counties. The Swamp is estimated to cover 17,500 ha (Abila, 2002). It is a complex freshwater wetland in the delta of the Yala river, on the North-East shore of Lake Victoria located in both Siaya and Busia counties with coordinates Latitude: 0°02'10.80"N and Longitude: 34° 04'0.60" E (Fig. 1). The altitude ranges from 1130 to 1160 m above sea level. The climate of study site is bimodal with long rains occurring between March and May and short rains from the months of October and December. The annual rainfall in the lowlands of Yala Swamp is approximately 760 mm (Hughes, 1992), which is not sufficient for rain-fed agriculture, a motivation for households to farm in the swamp and river banks. The annual mean temperature varies from 27.7 °C to 28.6 °C with a range of between 20.3 °C and 36.8 °C (Abura et al., 2017). The soils of Yala Swamp have been described as eutric fluvisols, dystric histosols and humic gleysols (Sombroek et al., 1980). Fluvisols indicate fluvic properties with no diagnostic horizons apart from ochric, mollic or umbric A-horizons, or histic H-horizon, or sulphuric horizon, or sulfidic material within 125 cm of the surface (Nachtergaele et al., 1–6 August 2010). A study in Yala Swamp showed that wetland soils had more total N than adjacent agricultural-land soils, however, organic matter in wetlands do not mineralize as readily as soils drained for longer periods (Mfundisi, 2008). This results to high productivity which attract to the community to engage in farming at the swamp which results in degradation of the swamp.

#### 2.1.2. Resource base in study site

The human resource in the two counties according to the Kenya Population and Housing Census 2019 is outlined as; Busia County had a total of 893,681 people, of which 426,252; 467,401 and 28 were male, female and intersex respectively. On the side of Siaya County, the total population was 993,183. The proportion of male, female and intersex were 471,669; 521,496 and 18 respectively (Kithiia et al., 2020). The land tenure system is a combination of trust land and private land.

The natural resource base at the swamp includes the water-body, papyrus vegetation and the riverine area. The water body comprise of three lakes; Lake Kanyaboli, L. Namboyo and L.Sare. Lake Kanyaboli as part of the Yala swamp and forms at the mouth of both Rivers Nzoia and

### LOCATION MAP OF THE STUDY AREA

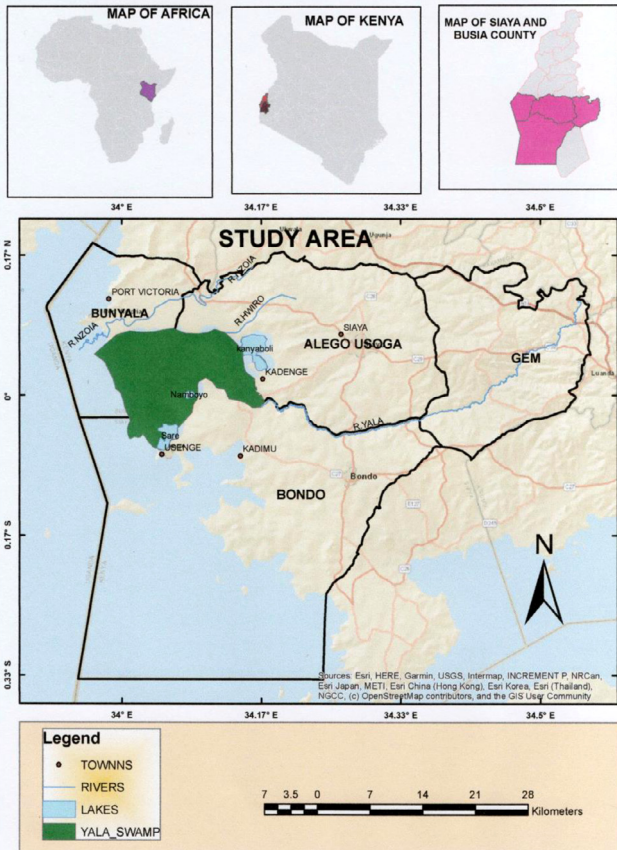


Fig. 1. Map of the Yala Swamp in Kenya showing both River Yala and River Nzoia and some surrounding towns (Source: KEFRI GIS LAB).

Yala. Lake Kanyaboli was gazetted on September 2010 as a national reserve and covers an area of 10.5km<sup>2</sup> with an average depth of 2.5 m (Aloo, 2003). Lake Sare was created through back-flooding after a cut off from gulf of Lake Victoria; it covers about 5km<sup>2</sup> and up to 5 m depth at the centre. The lake is bordered by papyrus swamps which merge into Yala swamp. It is reported that there has been significant degradation of the lake's ecology in the last 30 years; it's invaded by noxious macrophytes which may lead to this lake drying up and the threat to the whole swamp complex is scored as high. The community use the water bodies for fishing, drawing water for domestic use and water for livestock whereas farming takes place in the reclaimed parts of the swamp. There are also sites for tourist attraction in the swamp. The tourists who visit the area can participate in a number of activities including sightseeing, bird watching endemic papyrus species, waterfowls and migratory bird species; water sports such as swimming, boat races and sport fishing. Lake Namboyo is a small lake of 0.01km<sup>2</sup> and 17 m at the deepest point (Angienda et al., 2011).

The vegetation is mainly comprised of papyrus (*Cyperus papyrus*); *Phragmites mauritianus* is common in the shallower areas and swamp grasses around the periphery (Aloo, 2003). The papyrus acts as a natural filter for a variety of biocides and other agricultural pollutants from the surrounding catchment, and also effectively removes silt before the water enters Lake Victoria (Mavuti, 1992). The swamp is rich in both flora and fauna: these include 172 bird species (Odino, 2021) and has been classified as Important Bird Area (Donald et al., 2019). The endemic fish include Lake Victoria cichlid fish - *Oreochromis esculentus* and *O. variabilis* which classified as vulnerable (Angienda et al., 2011). The mammals found within the swamp include wild pigs (*Sus scrofa*), vervet monkeys (*Cercopithecus aethiops*) and a rare semi-aquatic

antelope, Sitatunga (*Tragecephalus spekeii*) which is now critically endangered (Njoroge, 2016).

### 2.2. Data collection and sampling techniques

The survey was done in communities living adjacent to the Yala Swamp and Yala River spread across four Sub-counties; Alego-Usonga, Gem and Bondo within Siaya County and Bunyala in Busia County. Secondary data from was collected from literature review on social and historical conditions in the area; government documents including policies and laws, journal papers and project reports to provide information on social, economic, environmental, and developmental features in Yala swamp.

Questionnaires were administered to households after pretesting of questionnaires in three villages to ascertain instrument effectiveness and necessary edits were done where ambiguity was noted (Reynolds et al., 1993). Semi-structured questionnaires with both closed and open-ended questions were administered by enumerators in the collection of data from household heads. The questionnaires were structured to capture data on the household characteristics of the communities living in or adjacent to Yala swamp; baseline surveys on awareness on land use plan and Strategic Environment Assessment (SEA) for Yala Swamp. The household's selection was based on wellbeing characterization done during Participatory Learning and Appraisal (PLA) exercise. Well-being characterization done during PLA exercise i.e. wellbeing-index developed by the community into four categories; category A (very rich), category B (rich), category C (poor) and category D (very poor) household heads. A total of 490 household heads in four clusters that were divided into project beneficiaries and non-project beneficiaries distributed across the clusters in Busia and Siaya counties. The households were distributed in villages in each cluster as follows: 23 villages (Alego-Usonga), 28 villages (Gem), 27 villages (Bondo) and 24 villages in Bunyala sub-county. The selection of the household heads for the survey was based on the following criteria: Beneficiaries of climate smart agriculture, conservation farming, chicken farming, beekeeping, fish farming, ecotourism and papyrus product weavers. About 50% of the 635 households made up of 3055 people in the project area involved in the survey.

Participatory Rural Appraisal (PRA) tools were used to identify and document the availability and use of natural resources based on the methodology of Chambers (Chambers, 1994). Focused group discussion (FGD) based on the procedure by Krueger and Casey (Brunger, 2009) was done to document activities in the four project clusters at Yala swamp. Eight focused group discussions were done in the four sub-counties to capture information such as community developed wellbeing index, community views on Income Generating Activities (IGAs), and views on conservation and awareness of the land-use plan for Yala swamp. The FGD were held in the project area; in Bondo, two were held in Wambasa (Wambasa Youth Group) and Yimbo Ber CBO (Community Based Organization). In Alego-Usonga, one meeting was held in Nyiego while in Upper Yala three FGD were held in Nango C village, Olalo women group and Yala community market place in Yala Town. In Bunyala, two FGDs were held at Kholohongo village weavers group and Victor's home. Social mapping was done to show trends on resource use, community based management and location in the study areas

Key informant interviews (KII) were held with members of the community, civil society, NGOs and government officers. Over 50 Key informants were interviewed based on purposive selection. They represented the following groups with an interest in the Yala swamp: Nature Kenya (2), Alego-Usonga CBOs (4), Bondo Youth Group (6), Yimbo Site Support Group (SSG) 6, Bunyala SSG (10), Yala SSG (7), Friends of Yala Swamp (1), Busia County Government officers (5) from Tourism, Sports, Environment, Trade, Agriculture, Siaya County Government officers (7) from KWS, Fisheries, Agriculture (crops), Agriculture(livestock), Tourism, NEMA, Cooperatives. The information provided by the groups covered a wide range issues such as policy, community challenges and opportunities in utilization of the swamp, for example for fishing,

**Table 1**  
Well-being ranking as perceived by the community in Bunyala, Busia County .

Category	Major characteristics	Overall (%)
Very Rich -A (Omwinda)	Permanent house, own vehicles, employed, business person, owns land in the swamp (6 acres) and 3 acres outside the swamp, mainly attends private hospital when sick, children 3 to 4, own livestock	10
Rich -B (Owenyala)	Brick/Semi-permanent house, motor cycle, owns land (4 acres in the swamp and 3 acres outside), attends private and public hospital when sick, children 5 to 6, own few livestock	18
Poor -C (Mumanani)	semi-permanent house, owns bicycle, owns land, has access up to 8 acres in the swamp and 1 acre outside, attends public hospital when sick, has 8 to 10 children	31
Very poor -D (Mumanani muno)	Grass thatched house, owns land, owns bicycle, owns up to 8 acres in the swamp and 0.5 outside, hardly goes to hospital/uses herbal medicine when sick, many children up to 10	41

NB. In parenthesis are the local names of the well-being ranking in Luhya dialect.

papyrus reeds harvesting and papyrus crafts, trade and environmental conservation as well as grazing, watering livestock and farming in the swamp. The selected community leaders were involved in project activities and for key government officers from departments that were involved in activities related to the project activities in Busia and Siaya Counties.

### 2.3. Data analysis

The views of household heads in the four sub-counties were analysed using both qualitative and quantitative research methods. Statistical Programme for the Social Sciences (SPSS) and Microsoft Excel was used to create contingency tables, draw displays and charts and generate the descriptive statistics. The descriptive statistics were compiled to give a general summary of the survey data. The contingency tables were used to test whether the independent and dependant variables were related to each other or not, and are shown in percentages (Johnson et al., 2000).

## 3. Results and discussion

The survey interviewed 490 household heads out of the 635 households made up of 3055 people in the project area. The targeted household heads were distributed as follows: 118 household heads in 23 villages represented Alego-Usonga; 126 household heads in 28 villages in Gem Sub-County, 125 household heads in 27 villages in Bondo and whereas 121 household heads in 24 villages represented Bunyala Sub-County. The wide coverage in these villages indicates a very representative sample therefore a high likelihood of getting reliable information from the household heads.

### 3.1. Household socio-economic characterization

#### 3.1.1. Well-being category of household heads

The household heads were ranked in four well-being categories using community based criteria developed through social mapping done during the Focused Group Discussion held in each cluster. The major characteristics of the well-being categories for Bunyala and Gem are shown in Tables 1 and 2 respectively. Overall, about 78.1% of all household heads were categorized as poor followed by the rich (15.1%) whereas the very rich and very poor had the same proportion, 3.4% each. Figs. 2(a-d) shows the photographs of the main house types in the four wellbeing categories. The house types give a more objective way of categorizing the household heads especially when combined with the other characteristics shown in Tables 1 and 2. Wellbeing category poor were the majority in the society in all the clusters but the percentage was higher in Yala cluster because the community relied mainly on agriculture while in the other clusters fishing was contributing to better livelihoods.

#### 3.1.2. Age

The number of household heads in age group (15–25 years) was significantly different from other age groups apart from those in age group

(over 66 years). It may be due to the fact that few individuals marry at that age whereas those over 66 years may be fewer than the other age groups due to natural attrition. The age group with the highest number of household heads was 36–45 years comprising 32.7% of all the households across the sub-counties (Figs. 3a & b). This suggests that most household heads are physically healthy and likely to participate in utilization of the Yala swamp and also its conservation with adequate awareness to arouse their interest. It has been described that middle-aged people are generally economically active, enthusiastic, innovative, and can do challenging work with more significant physical strength, energy, zeal, and ability (Sinha et al., 2010; Islam et al., 2015).

#### 3.1.3. Ethnic group

About 97.2% of all the respondents in Siaya County were Luo whereas in Busia County, 92.2% were Luhya. Bondo and Bunyala clusters had a few households from Turkana community, that is, 0.8% and 0.9% respectively. There is need to devise mechanisms to ensure the minority, the poor and the other disadvantaged members of the society are also involved, access development and project support or any other support is inclusive.

#### 3.1.4. Marital status, household size and religion

Table 3 indicates that the majority of the respondents were married (73.5%) and followed by the widows (18.4%), the least category were the divorced respondents (1.0%). The mean household sizes in the sub-counties were Alego-Usonga (4.9), Gem (5.9), Bondo (5.4) and Bunyala (6.0) which is above the national mean of 3.9 (Kithiia et al., 2020). The range of household size was 1–22 persons whereas the overall mean for all the sub-counties was  $5.5 \pm 2.8$  (s.d.). The households in Siaya and Busia County were predominantly Christians: Alego-Usonga (99%) Christians and Muslim (1%); Gem 98% Christians, Muslim (1%) and Hindu (1%); Bondo 97% Christians and Muslims (3%); and Bunyala 96% Christians and Muslims (2%) and others (2%). Project implementation should ensure fairness in distribution of project benefits.

#### 3.1.5. Land size

Majority (50.8%) of all households had land (1.00–2.99 ac) and the proportion of the landless ranged 7.6–14.9% with Bunyala having the highest proportion of households who were landless (Fig. 4a). About 23.2% of the households in Bondo sub-county had bigger land parcels of between 3.00–5.00 ac. compared to households in other sub-counties. The households with bigger than 5.00 ac were almost the same in all sub-counties except Alego-Usonga (Fig. 4a). There was a significant difference between household heads with land (1.0–2.99 ac) the rest of the land size categories. The household heads with land size over 5 ac were also significantly different with the rest of the land size categories at 0.05 levels (Fig. 4b). Less land available to the households were pushing people to encroach on the swamp which is viewed as public land available for sub-division while other borrowed land for farming and also leasing from neighbours.

Key informants indicated that some of the challenges in the swamp are; some parcels of land allocated to individuals within the wetland ar-

**Table 2**  
General well-being ranking as perceived by the community in Yala cluster, Gem, Siaya County.

Category	Major characteristics	Overall (%)
Very Rich -A (Won mwandu)	Land (2 acres), land has title deed, Educates children to higher level, Attends high cost hospitals when sick, Married to one wife, Stone house made of tiles, Has very good homes with workers, Uses electricity, solar, gas cooker and sometimes charcoal for cooking, Has borehole and tap water for domestic use, Family wears very expensive clothing, Have a lot of property e.g. Cars, commercial buildings and others property in towns	7
Rich -B (Jamoko)	Land (3 acres), Land has title deed, Educates children to high level, Goes to private hospital/ Dispensary when sick, Married to 2 wives, Brick house with coloured roof sheets/ permanent/semi-permanent houses, Has solar power sometimes electricity. Cooks with gas cooker and charcoal sometimes firewood, Tank water and borehole for domestic use, Family wears expensive clothing, Have some property e.g. car, land in town	13
Poor -C (Jadhier )	Land (2–7acres), Ancestral land with no title, Educates children to primary or college level, Goes to dispensary or use herbs/traditional medicine, Married to 1–3 wives with many children, Has semi-permanent house home with iron sheet roof/ mud wall, Uses solar light, firewood and charcoal, Uses river water, lake water or borehole for domestic use, Clothing poor, May have motorcycle, radio, bicycles, animals and poultry	63
Very poor -D (Hach-hach)	Land (0.5 acres with no title), Educates children to lower primary (Standard 1–4), Hardly goes to hospital/uses traditional medicine, Married to 1 wife with many children, House with flat roof/ mud wall or mud floor /grass thatched , Kerosene for lighting and firewood for cooking; Borehole, lake water for domestic use, Family has poor clothing, Has very few assets	17

NB. In parenthesis are the local names of the well-being ranking in Luo dialect.

**Table 3**  
Marital status of the household head.

Sub-County	Marital status (%)				
	Single	Married	Widower	Widow	Divorced
Alego-Usonga	2.5	71.2	4.2	20.3	1.7
Gem	1.6	70.6	0.8	24.6	1.6
Bondo	3.2	76.0	2.4	18.4	0.0
Bunyala	9.1	76.0	4.1	9.9	0.8
<b>Mean (%)</b>	<b>4.1</b>	<b>73.5</b>	<b>2.9</b>	<b>18.4</b>	<b>1.0</b>
N	20	360	14	90	5

**Table 4**  
Effects of various legislations/regulations/policy actions on management of Yala swamp.

Legislation and or policy action	Resultant action	Source
Ramsar Convention	Protection and wise use of wetlands natural resources	(Farrier and Tucker, 2000)
Convention of Biological Diversity	To ensure conservation and sustainable utilization of biological diversity	(ZEDAN, 2005)
The Convention on the Protection of the World Cultural and Natural Heritage	To protect the world’s cultural or natural heritage of outstanding value for the benefit of humankind	(Forrest, 2007)
Wildlife Conservation and Management Act, 2013 (GOK 2013)	Declaration of Lake Kanyaboli as a national reserve	Wildlife Conservation and Management Act, 2013 (GOK 2013)
Political good will	Lack of political support from local politicians has impacted negatively on implementation of Wildlife Conservation and Management Act, 2013 (GOK 2013)	
The Kenyan Constitution 2010	Supports the management and conservation of wetlands, for instance, Article 42 on clean and healthy environment; Article 69 on sustainable utilization, exploitation, management of the environment and natural resources, ensure equitable sharing of benefits acquired from these ecosystems; encourage public participation in the conservation and management of the environment; ensure protection of biological resources and genetic resources; and eliminate any activities likely to destroy the environment. Further, to establish a system to monitor and conserve the environment.	The Kenyan Constitution 2010
Lack of wetland policy is still in draft form	Making wetlands vulnerable to degradation	
Environmental Management and Coordination Act Wetland Regulations 2009	To ensure conservation and sustainable utilization of wetlands and their resources	(Kemunto, 2018)
lack of appropriate institutional framework,	Different aspects of wetland conservation and management are currently handled by different government agencies and departments such as Kenya Wildlife Service, Ministry of Fisheries, Water Resources Management Authority; Ministry of Agriculture, National Environment Management Authority (NEMA), County and communities without a clear legal framework. The Environment Management and Coordination Act (EMCA, 1999) provides for the conservation and management of wetlands while NEMA only coordinates as the principal custodian of the environment.	
Approval of the Land use plan of Yala Swamp by the County Government of Siaya and Busia	Lack of approval has impacted negatively on Yala Swamp management as the plan is expected to integrate environmental concerns into development planning while at the same time enhancing sustainable use of the swamp.	



Fig. 2. (a-d): House-types observed in various well-being categories in Busia and Siaya counties.

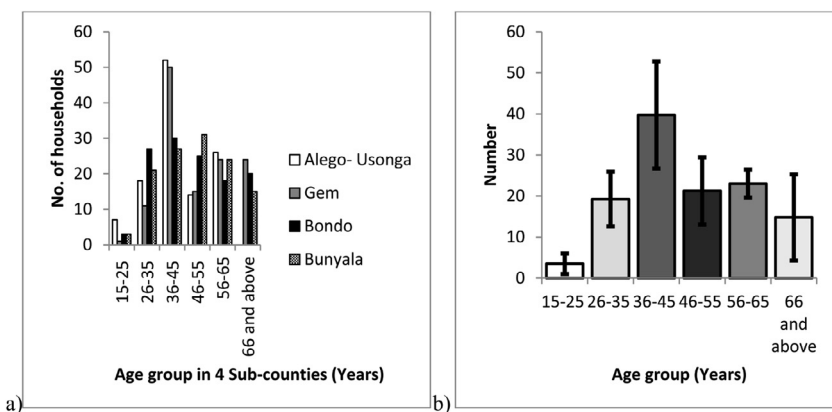


Fig. 3. a) Age group of respondents in four Sub-counties in Siaya and Busia Counties b) Age group variation across the Sub-Counties.

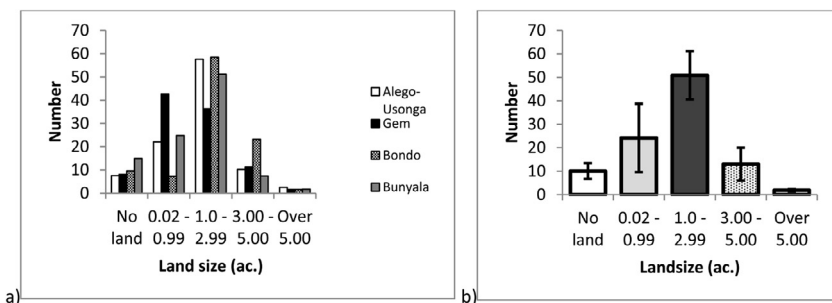


Fig. 4. a) Land size in four Sub-Counties in Siaya and Busia Counties b) Overall land size categories in Siaya and Busia Counties.

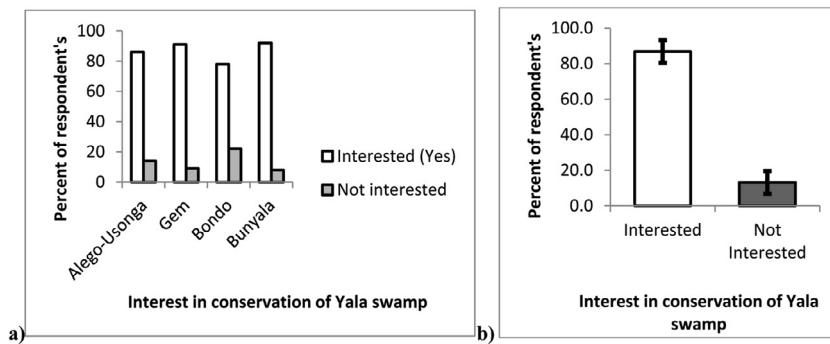


Fig. 5. a) Household head's interest in sustainable management of Yala swamp or Yala river in the 4 Sub-Counties b) Household head's interest in sustainable management of Yala swamp across the Sub-Counties.

by the Ministry of Lands despite the areas being legally protected and individual ownership not allowed, ancestral inheritance ownership claims on certain portions of the swamp, leasing of areas of the swamp forcing communities to demand fair access to what they perceive as their resource, inequitable access to swamp resources especially for farming mainly by the well-off in the community and the elite, un-defined boundaries between individual and swamp area and proposals to create conservation areas as was done with gazettement of Lake Kanyaboli. These factors have been a source of continuous conflicts between communities and also community with government and private sector. Communities living within the Yala and other wetlands in the country have a problem with regard to land tenure coupled with a historical belief that wetlands are common resource to be used by any member of the community. These uncertainties exacerbate destruction of wetland ecosystems. This is particularly so whenever the lake water level recedes, leaving fertile land suitable for cultivation against community land that perpetually yields low thus exposing it to degradation forces. A decision to conserve the resource requires schematic engagement supported by continuous awareness to change perception and guide decision making with all stakeholders consent.

### 3.1.6. Distance to swamp

Most households (95%) live less than 2000 m from the swamp or river and took an average of  $38.4 \pm 17.4$  min to reach the swamp or river. Their location favors them to effectively utilize the swamp and also provide an opportunity for them participate in the conservation of the resources. Other studies have reported that households who live closer to the natural resource draw more benefits than those living farther (Maua et al., 2019). If this access is not regulated it will be a basis for swamp and its resources degradation. This scenario would be mitigated through engagement of the communities in conservation.

### 3.2. Household interest in sustainable management of Yala swamp or Yala river

Over 87% of the households in the sub-counties had an interest in sustainable management of Yala swamp or Yala River (Figs. 5a and 5b). For them to participate effectively in conservation activities, capacities building in various aspects are necessary. Some of the ways of enhancing capacity of community in natural resource management as noted by (Shackleton et al., 2002; Paton et al., 2004) include awareness in proper crop and animal husbandry; enlightening the community on ecotourism activities; control wildlife in agriculture zones; zoning of the swamp and gazettement of buffer zones and leaving the other parts to the community. The main reasons for interest in sustainable management of Yala swamp or Yala river are due to the benefits that the households derive from the swamp including source of water, food and income to the households (Fig. 5). The household heads would have liked to be involved in the management of Yala swamp or River Yala through involvement in conservation and awareness creation as outlined in Fig. 6. The need for support of community involved in natural resources is cor-

roborated by findings of (del Mar Delgado-Serrano et al., 2016) who reported that "local communities collectively managing common pool resources can play an important role in sustainable management, but they often lack the skills and context-specific tools required for such management".

### Fig. 7.

It was noted during FGDs that apart from capacity building of communities, it is important to embrace participatory approaches in wetland management. For this reason, Community-based management (CBM) of wetlands in many countries in Africa is recognized as most appropriate approach for sustainable natural resource management compared to strict control of wetlands by government agencies (Fisher and Maginnis, 2005). For example, Uganda reported success in implementing sustainable management of wetlands through a project whose overall objective was "to establish and strengthen community based systems and regulations that promote the sustainable use of wetlands with important biodiversity" (Wood et al., 2013). That project was successful because the community was made to understand the link between wetland biodiversity and livelihoods. Also, that wise-use practice was necessary for sustainable wetland management. Integrating community-based conservation models into policy and planning is worth considering so that the community appreciate that they are included in wetland management (Wood et al., 2013). This is the implementation approach that the project was developing to ensure sustainable management and improved community livelihoods.

### 3.3. Household involvement in Yala swamp

Farming was the main activity the household heads were involved in followed by collection of papyrus reeds (Fig. 8). Distance from the swamp could be one of the reasons for non-involvement in Yala swamp especially for respondents in Bondo (44%) Sub-Counties; the proportion of household heads not involved in any activities at the swamp in Alego-Usonga and Bunyala Sub-Counties were 32% and 14% respectively (Fig. 9).

Figs. 9 (a-d) shows the activities household heads were involved in when segregated by sub-counties and well-being categories. amongst the very rich, farming and sale of papyrus products were the main activities, however, the very rich household heads in Bondo Sub-County were not involved in farming (Fig. 9a) though key informants and FGD indicated that they hold the largest portions in the lake but used hired labour and proxies as the owners of the farming enterprises. This has affected interventions to conserve the lake like encroachment and stopping farming in the lake as those being engaged are not the major users, decision makers and opinion leaders who can influence community actions. Farming was the main activity amongst the household heads in the rich category in the sub-counties, with firewood collection recorded only in Bunyala sub-county whereas papyrus reeds and products encountered only in Alego-Usonga and Bunyala Sub-counties (Fig. 9b). For the poor category, farming was first followed by an almost equal proportion of respondents who were not involved in any activity at the swamp. This

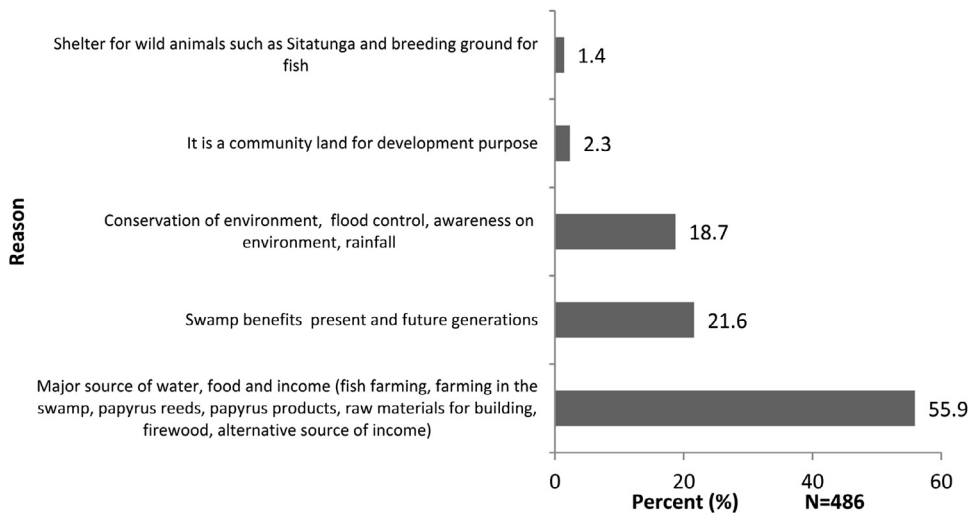


Fig. 6. Reasons for community interest in the sustainable management of Yala swamp and river .

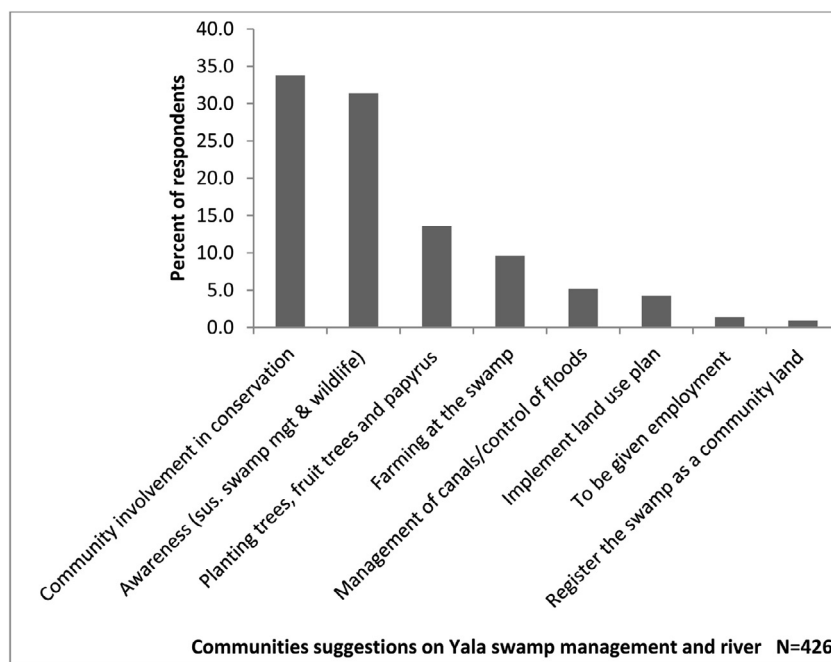


Fig. 7. Communities views on the management of Yala swamp and Yala river.

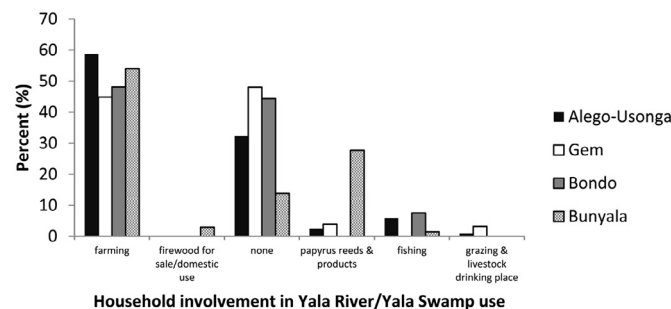


Fig. 8. Utilization of Yala River/Yala swamp by the household heads .

was followed by sale of papyrus products in Bunyala, and fishing mainly in Alego-Usonga and Bondo sub-counties. Grazing was only recorded in Gem Sub-County (Fig. 9c). amongst the very poor only farming was the predominant activity (Fig. 9d). Apart from farming in the swamp; the other products derived from the swamp are papyrus reeds, water,

fish, firewood, sand harvesting and brick making, grass cutting, and bee keeping. Some of the Income generating activities are shown in Fig. 10.

### 3.4. Sustainable management of Yala swamp

Commercial agriculture was under the former Dominion Farms (K) Limited up to 2017; ownership transfer to Lake Agro Limited took place when there was a business transfer through a legal notice published in the Kenya gazette, January 2020. The community adjacent to Yala swamp practice conservation and local smallholder farming. However, controversy had arisen in the past over the boundaries of the commercial agriculture section and community land. Other major stakeholders in Yala swamp include Nature Kenya, Fisheries Department, the County Governments of Siaya and Busia, Community Based Organizations (CBOs).

Lake Kanyaboli and its riparian areas was gazetted in 2010 in line with The Wildlife Conservation and Management Act, 2013 (Gitari, 2014) that provides for declaration of a national reserve for conservation of biodiversity, migratory routes or catchment protection. However, the management of Lake Kanyaboli as a national reserve has



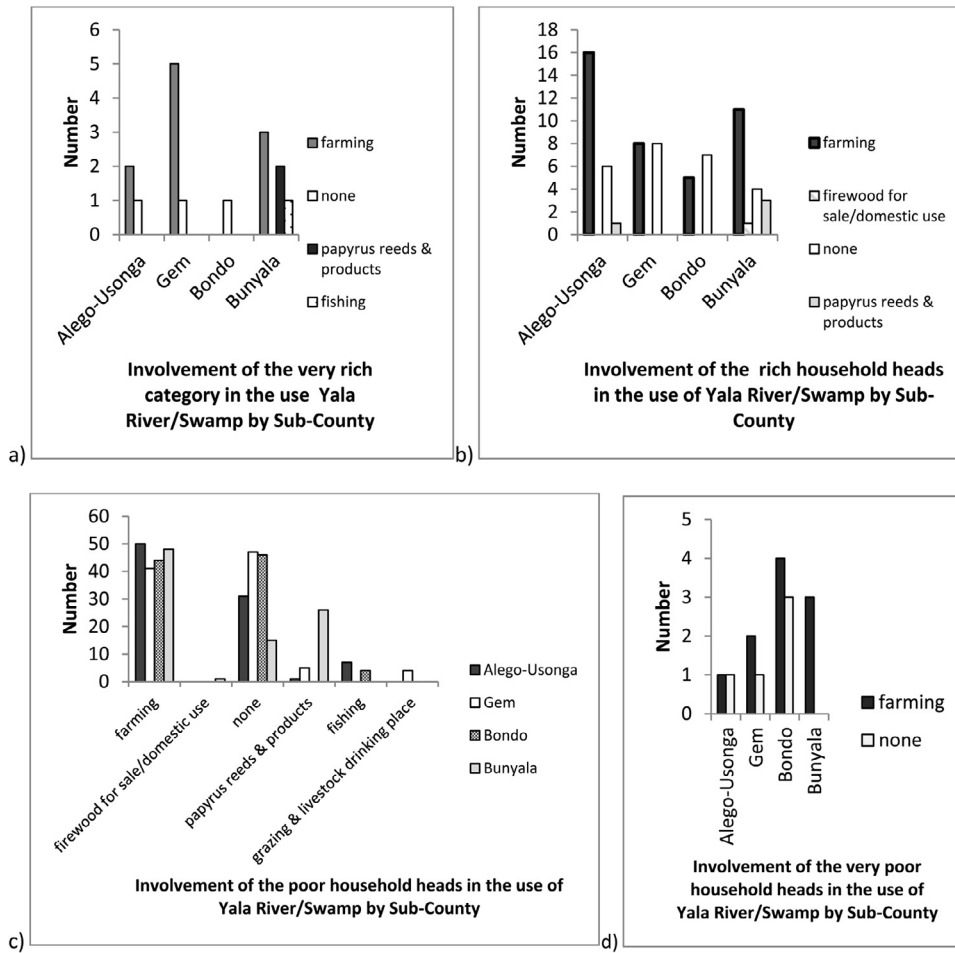


Fig. 9. (a-d): Involvement of different wellbeing categories in the use of Yala River/swamp



Fig. 10. Various income generating activities for communities to enable them promote conservation of Yala swamp.

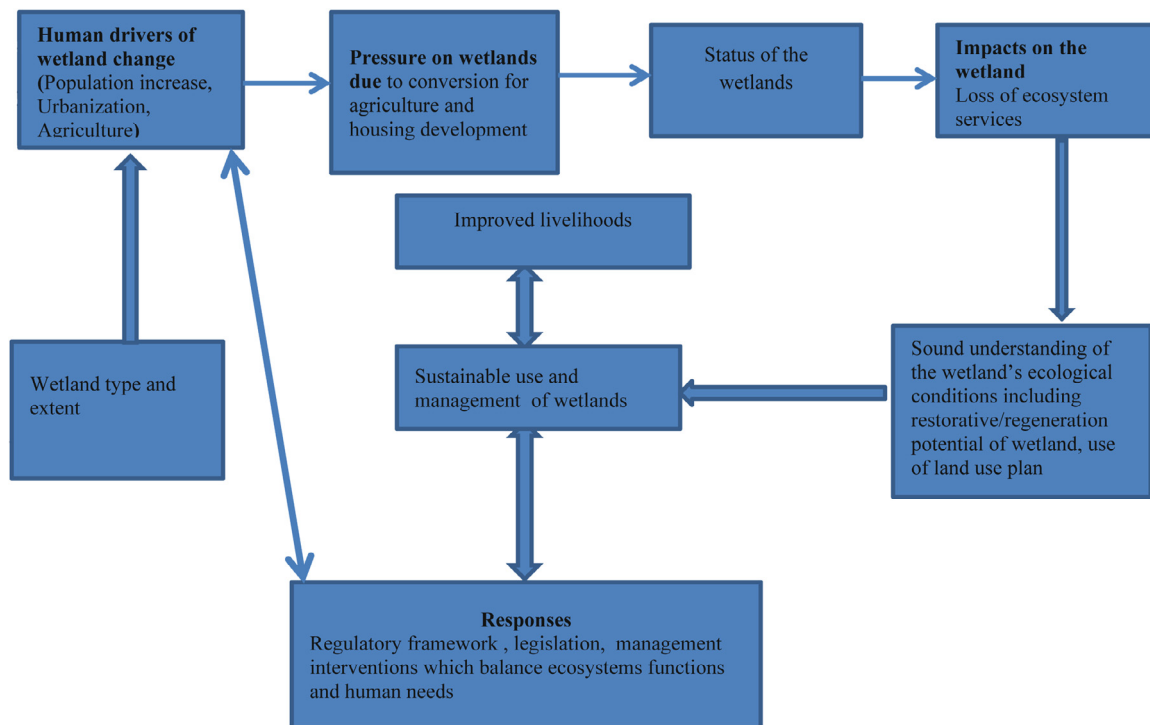


Fig. 11. Framework for sustainable wetland use. (Adopted from (Musasa and Marambanyika, 2020)).

not been operationalized due to political interference leading to KWS being unable to: control encroachment and hunting in the swamp especially of Sitatunga antelope; regulate the use of papyrus as more people continue to take up and engage in papyrus based business and ensure there is no over-harvesting in future. Further, they cannot create awareness on conservation of the lake and its associated riparian area due to a dispute in the swamp boundaries; and minimize inequity in access and utilization of the Yala swamp resources.

The focused group discussions revealed that the threats to Yala swamp were: increasing human population coupled with the growing need for increased food production has put tremendous pressure on wetlands. Others are droughts, flooding, overexploitation of wetland resources, loss of biodiversity, wetland reclamation and encroachment, climate change, burning of vegetation in wetlands. The burning of papyrus reeds in the swamp to allow cultivation causes degradation of wetland vegetation (van Dam and Kipkemboi, 2016), resulting in the loss of biodiversity, fish breeding grounds, birds and Sitatunga habitats and livelihoods.

Pollution from agrochemicals, use of fertilizers in wetland and arable cropland, sand harvesting and brick making along road reserves lead to land and wetlands degradation (Mugambagye, 2018). For instance, use of agricultural inputs such as fertilizers and other chemicals/pesticides may end up in the lake resulting in eutrophication with its known effects on aquatic systems such as serious deterioration of the water quality and pronounced threat to the biotic components of aquatic ecosystem (Dorgham, 2014). This implies that there is an urgent need to protect Yala swamp biodiversity as it is threatened by agricultural inputs, mostly from the upland catchment area where large scale agriculture is practiced. Also, awareness creation is necessary to conserve and protect the swamp against practices such as dumping of wastes, burning papyrus and unsustainable exploitation of the wetland resources. This may lead to loss of some ecological functions of wetlands such as storm prevention, flood control and groundwater recharge which offer greater benefits through protection (Barbier, 1993) or supporting economic activities and properties of the community. Therefore, the community should be sensitized on the importance of the swamp, not only for livelihood but

also for conservation of biological diversity. However, the conservation approaches should take into account the socio-economic account of the community adjacent to the swamp and involve them in the conservation process. This strategy has been used with success in Peruvian Amazon where the local communities were effectively linked to broader conservation and development processes (Wali et al., 2017).

Wetlands, for example, the Yala Swamp should be restored and rehabilitated whenever possible in accordance with the Ramsar Convention as gradual encroachment may result in wetlands loss and irreparable environmental damage. It is estimated from satellite image analysis that between 1973 and 2001, there was a decrease of macrophyte community (papyrus-phragmites-typha community sedges-papyrus), from 7180 ha to 4999 ha, which is 30.4% loss of wetland (Thenya et al., 2006); which may have negative implications on the biodiversity conservation.

### 3.5. Interventions or opportunities to conserve Yala swamp

Table 4 shows how conservation of Yala swamp is supported by various international, national and local regulatory actions. The main international treaty on wise use of wetlands is the Ramsar Convention which Kenya signed as one of the nations in 1990. The other important treaties which complement Ramsar include Convention of Biological Diversity which addresses issues of conservation and sustainable utilization of biological diversity including wetland ecosystems; Convention of Migratory Species of Wild Animals – wetlands are commonly used by migratory birds as feeding points and shelters from harsh weather (Kemunto, 2018); Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES); Convention concerning the Protection of the World Cultural and Natural Heritage; United Nations Framework Convention on Climate Change (UNFCCC); United Nations Convention to Combat Desertification (UNCCD); and Kyoto Protocol to the United Nations Framework Convention on Climate Change (Atlas, 2012). Locally, there is a need to hasten the approval of land use plan for Yala swamp. Lack of this plan has impacted negatively on Yala Swamp management as the plan is expected to integrate environmental

concerns into development planning while at the same time enhancing sustainable use of the swamp.

Several opportunities for sustainable development has been suggested e.g. value addition on papyrus and its products, conservation agriculture including smallholder wetland aquaculture (Kipkemboi et al., 2007) developing fish value chain with support to hatcheries local production of fish feeds and fish processing and marketing, chicken farming value chain and fruit processing supported by a reformed cooperative movement. Others include irrigated agriculture to support all year round production, initiation of IGAs supported by training and incubation programme, Greenhouse crop production, Agroforestry and tree planting, alternative energy sources, eco-tourism resources and cottage industry, setting up an animal sanctuary, commercial tree farming and integrated organic farming.

Sustainable use and management of wetlands together with improved livelihood of community can be achieved if factors in the framework developed by (Musasa and Marambanyika, 2020) are considered (Fig. 11) and these include:

- 1) Need to understand changes in wetland in terms of land cover and use –spatial and temporal
- 2) Need to understand the drivers that cause the above change and how they impact on local livelihoods
- 3) Need to balance conservation and utilization of wetland resources guided by the principles on wise use of wetlands
- 4) Balanced human need, social and ecological processes that contributes to sustainable use of wetland resources and improved livelihoods
- 5) Consider plans and strategies for sustainable use of wetland and associated landscape
- 6) Improve institutional framework to clearly support agencies to enforce regulations in the wetland and promote conservation

#### 4. Conclusions and recommendations

The main livelihood sources in Yala swamp included farming, fishing, papyrus harvesting and products making like handcrafts. The local communities depend on plant and animal species from the swamp for food, income, medicines and raw materials. Farming was the most popular land use across the respondents in all well-being categories. It is important to recognize that wetlands carry out a wide range of ecosystem services, economic values and recreational values that contribute to human well-being such as food and feed, construction materials, water supply, water purification, climate regulation, flood regulation and recreational values. Despite the importance of the Yala swamp, this study showed that effects of its utilization resulted in a number of negative impacts on livelihoods and conservation. These included burning papyrus and unsustainable exploitation of the wetland resources which may lead to loss of some ecological functions of wetlands; for instance, storm prevention, flood control and groundwater recharge which offer greater benefits through protection or supporting economic activities and properties of the community. There is much to be gained from conserving the biodiversity of the Yala Swamp.

In order to reverse the negative impacts on the swamp, the following measures are recommended: 1) hasten the approval of the Land use plan of Yala Swamp by the key stakeholders so as to integrate environmental concerns into development planning while at the same time enhancing sustainable use of the swamp; 2) ensure wetland use takes cognizant various factors enumerated in the framework for sustainable use of wetlands in order to promote sustainable wetland management; 3) develop and enhance development of appropriate institutional framework, for management of wetland ecosystems at all levels from the community to the national level and ensure participation and inclusion of civil society and development partners to embrace the multi-stakeholder, transnational and global value of wetlands; 4) enhance the value of wetlands and their resources through value addition across

the entire value chain; 5) Adopt community based multi-stakeholder based management approach. This will be enhanced through formation of trans-county swamp management framework supported by a national and trans-country facilitative organization to ensure decisions to conserve the wetland are developed through consultation and consensus achieved to ensure ownership and implementation.

#### Credit authorship contribution statement

JOM: Conceptualization, Survey, Data analysis, Writing original draft; MTM: Review original draft, Funding acquisition, conceptualization, survey; PM: Conceptualization, Funding; EM &MO: Survey and logistics in the study area, review and validation of the findings.

#### Declaration of Competing Interest

No competing interests

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