The Economic Benefits of Yala Wetland Resources in the Lake Victoria Basin, Threats and Management Strategies for Sustainable Development

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Abstract

Wetlands are the most prolific ecosystems on Earth and provide many vital benefits to humans. Kenya's wetland habitats serve a range of important, interdependent human welfare, ecological, and national development objectives. Many of these are essential for improving human health and well-being and achieving a variety of MDGs and Vision 2030 objectives. The wetland ecosystems of the Lake Victoria basin encompass a vast area and provide a diverse array of economic activities that sustain a considerable proportion of East African people. The Yala wetland is one of the few vast wetland ecosystems found in Lake Victoria Basin. The Yala wetland is the largest freshwater wetland in Kenya. The Yala Wetland is an extraordinarily rich and diversified ecosystem, home to several unique, sensitive, and endangered plant and animal species. The majority of review research has concentrated on the status and challenges of Yala wetland and the wetlands in the Lake Victoria basin. Because of this narrow focus, the major role economic benefits of the Yala wetlands have been given less attention than it deserves. Given this background, the objective of this paper is to review the economic benefits of Yala wetland resources, its threats and its sustainable management. The cconomic benefits of the Yala wetland include fishing, hunting, grazing, agriculture, fuel, and building materials. The threats to the wetland include increasing human population, agricultural activities, encroachment of the wetland, over-exploitation of its natural resources, and climate change. Because of their economic importance to the livelihood of the local populations, Yala wetlands of Lake Victoria need to be conserved and managed in a sustainable manner. Yala Swamp should be restored and rehabilitated wherever possible in conformity with the Ramsar Convention. Value addition on papyrus and its products, practice conservation agriculture including smallholder wetland aquaculture, developing fish value chain with support to hatcheries, local production of fish feeds, and fish processing and marketing. The establishment of an animal sanctuary, commercial tree growing, and integrated organic farming are other initiatives plus several opportunities for sustainable development. In order to promote sustainable wetland management, the study suggests ensuring that wetland use takes into account the various factors outlined in the framework for sustainable use of wetlands; developing and enhancing an appropriate institutional framework; adopting a community-based, multi-stakeholder-based management approach; and enhancing the value of wetlands and their resources by adding value across the entire value chain.

Keywords: Wetlands, Yala, Economic benefits, Fish, agriculture, threats, sustainable development

INTRODUCTION

The Ramsar Convention defines wetlands as “areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres” (Gardner & Finlayson, 2018; Gebretsadik & Mereke, 2017; Gokce, 2019; Van de Noort, 2016; Haji, 2019; Nayak & Bhushan, 2022; Sharma et al., 2022). Wetlands make up 6% of the earth's surface (Schuyt & Brander, 2004; Berde et al., 2022; Junk et al., 2013). Wetland ecosystems cover 917–1275 million hectares worldwide (Ahmad et al., 2019; Nath et al., 2023). Marine and Freshwater Researchers revealed that global wetlands are valued approximately US$47 trillion per year (Della Bosca & Gillespie, 2020).

According to Ramsar Convention, wetlands are classified as marine/coastal, inland and man-made (Taminskas et al., 2012; Weise et al., 2020; Bassi et al., 2014). Estuaries, inter-tidal marshes, brackish, salty, and freshwater lagoons, mangrove swamps, coral reefs, and sea cliffs are marine and coastal wetlands (Fagorite et al., 2019; Ahmad et al., 2019). Lakes, rivers, streams, creeks, waterfalls, marshes, peatlands, and flooded meadows are inland wetlands (Im et al., 2020; Suthar et al., 2019; Schuyt & Brander, 2004). Finally, man-made wetlands include canals, aquaculture ponds, water storage, and wastewater treatment (Turcios & Papenbrock, 2014; Bassi et al., 2014). The genesis of wetland areas, as well as their location, water regime, dominating species, soil type, and sedimentation, all have a significant impact on the wetland's unique characteristics (Ligi et al., 2014).

Wetlands are the most prolific ecosystems on Earth and provide many vital benefits to human (Barbier, 2019; Bassi et al., 2014; Menbere & Menbere, 2018). They're also eco-sensitive and adaptive (Gitay et al., 2011; Ragavan et al., 2021). Wetlands regulate climate, hydrology, ecosystem variety, and human wellbeing (Forslund et al., 2009). The wetlands provide many unrecognized benefits and services, including food and fibre production, water balance, groundwater recharge, flood mitigation, storm protection, cultural and social functions like sacred and religious significance, recreation and tourism, and soil formation and sediment retention (Ahmad et al 2019; Finlayson et al., 2005; Sherren et al., 2021; Camacho et al., 2019; Chaudhry, 2010; Kairu, 2001).

Wetlands in Kenya consist of deltas, estuaries, mangroves and mudflats, swamps, marshes, flood plains, small lakes, rivers, and the margins of deep lakes and rivers (Okeyo-Owuor et al., 2012). Wetlands make up between 3 and 4 % of Kenya's total land area, which increases to 6 % during the rainy season (Aron Keche et al., 2007). Kenya's wetland areas are primarily the result of rainfall and one distinctive landform. In Kenya, wetlands are beneficial on both an ecological and an economic level (Oduor et al., 2015; Maithya et al., 2020). Despite the fact that they are valuable, wetland habitats are quickly disappearing because to human activities such as agriculture, settlement, and industry (Van Rees & Reed, 2014; Xu et al., 2019; Bezabih & Mosissa, 2017; Masese et al., 2012). Wetlands are degraded as a result of pollution, overexploitation, and the destruction of catchment areas (Imdad et al., 2022).

Lake Victoria is Africa's largest and the world's second largest freshwater lake (Tong et al., 2016). Lake Victoria attracts approximately a third of Kenya, Uganda, and Tanzania's population to its shores (Geheb & Crean, 2003; Twesigye et al., 2011; Standley et al., 2014) (Figure 1). Lake Zone is one of the most densely populated places on Earth, with a population growth much higher than the rest of Africa (Scheren et al., 2000; Tong et al., 2016). Population growth within a 100 km buffer zone around the lake surpassed the continental average each decade, indicating increased dependency and pressure on lake supplies (Newenham-Kahindi, 2011). There are 40 million people living in the Lake Victoria basin, with 250 people living every square kilometre. The population of the basin is growing at a rate of 3.5 percent annually, making it one of the highest in the world (Mailu, 2001; Bremner et al., 2013).

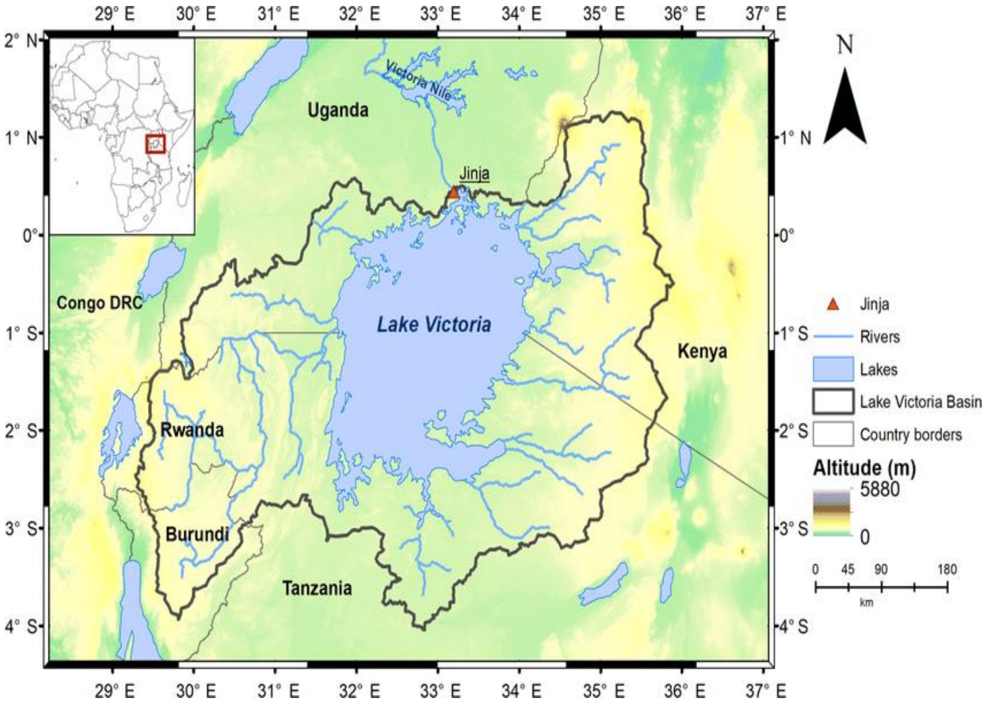

Figure 1. Map of Lake Victoria
Source: *Vanderkelen et al. (2018)*

Kenya's Lake Victoria Basin watersheds include Lake Victoria, wetlands, hill reservoirs, rivers, and wells (Ong'or, 2005). There are also watersheds formed from river floods and frequent damage to river causeways especially in the plain lands. Lake Victoria wetlands constitute a vital life support system for12 million Kenyans who depend on it for fresh water, fish, medicinal plants, and building materials (Kayombo & Jorgensen, 2003). Wetlands in Kenya have ecological diversity, gene pool research materials, cultural values, and aesthetic qualities, but their overall value is unknown (Kansiime et al., 2007). Because of their ecological significance and importance to the livelihood of the local populations, wetlands of Lake Victoria need to be conserved and managed in a sustainable manner. The majority of previous research has concentrated on the status and challenges of Lake Victoria wetland. Because of this narrow focus, the major role economic impacts of the wetlands in Lake Victoria basin have been given less attention than it deserves. Given this background, the objective of this paper is to review the economic benefits of wetland resources in Kenya's Lake Victoria Basin and their management for sustainable development.

Description of wetlands of the Lake Victoria basin

There are 422 distinct types of wetlands that surround Lake Victoria (LVBC, 2011; Okotto-Okotto et al., 2018;). Lake Victoria wetland accounts for around 37% of the total wetland surface area in Kenya and approximately 13% of the same in Uganda (Sayer et al., 2018; Kayombo & Jorgensen, 2006; Okeyo-Owuor et al., 2012; Sijali, 2007). The Lake is surrounded by a vast network of marshes and wetlands that provide habitat for a variety of animal species (Chibwana et al., 2020; Sayer et al., 2018). The wetlands of Lake Victoria in Kenya can be divided into two categories depending on their distance from the lake. The first category includes the swamps and marshes that are located in the Lake Victoria catchment basin but are further away from the lake. The second category includes the swamps that lie in the lake's coastal zone (Kairu, 2001; Okotto-Okotto et al., 2018). Riverine, inland delta, and freshwater wetlands are the three subgroups of the two groups (Okotto-Okotto et al., 2018). The wetlands regulate floods, prevent soil erosion, purify wastewater, and retain nutrients in Lake Victoria's catchments (Bakibinga-Ibembe et al., 2011; Obiero et al., 2012). The Kenyan government recognises the significance of wetland ecosystems and their contribution to the country's gross domestic product. Kenya ratified the (Ramsar Convention, 1991) and has since initiated extensive changes to address the sustainable use of wetland resources. Kenya already has 6 recognised Ramsar sites namely: Lakes Naivasha, Baringo, Elementaita, Nakuru, Bogoria; and Tana Delta. The Yala, Sio-Siteko, and Saiwa marshes are other candidates for nomination as Ramsar sites (Maithya, 2021). Wetlands such as Nyando Wetland (Okotto-Okotto et al., 2018), Yala Swamp (Owiyo et al., 2014; Abila, 2002), Bunyala Wetland (Okidi, 2006), Mosirori Wetland (Mati et al., 2008; Murunga, 2017), Osodo Swamp (Okeyo-Owuor et al., 2012), Ngegu Wetland (Okotto-Okotto et al., 2018), and Kuja Delta Wetland (Okeyo-Owuor et al., 2012) are all located in the basin of Lake Victoria in Kenya.

The wetland ecosystems of the Lake Victoria basin encompass a vast area and provide a diverse array of economic activities that sustain a considerable proportion of East African people (Agol et al., 2021; Mamboleo & Adem, 2022; Owuor et al., 2012). The primary economic activities in Kenya's Lake Victoria wetland basin are fishing, transport, agricultural farming, and livestock exploiting wetland resources, and marketing. **(**Owuor et al, 2012; Kipkemboi et al, 2007; Odenyo & Verdonck, 2015). Despite the significance of Lake Victoria's wetland to economic development and human well-being, its functions have been deteriorated by overexploitation, which has resulted in the loss of biodiversity and an increase in poverty (Kinaro, 2008; Maithya, 2021). Therefore, sustainable utilisation and conservation of these wetland ecosystems must be enhanced (Maithya, 2021). “Our objective is to develop an evidence-based business case for the sustainable management of Yala Swamp, restore and protect wildlife habitats in and upstream of the delta, improve the livelihoods of the local communities in a sustainable way, encourage ecotourism and ensure that lessons learned here have a major influence on wetland management not only in Kenya but East Africa.”

Description of the Yala Wetland

The Yala marsh is one of the few vast wetland ecosystems found in western Kenya (Onywere et al., 2011; Nakanishi et al., 2012). The Yala wetland is the largest freshwater wetland in Kenya (Githiora-Murimi et al., 2022). The wetland is situated between the Yala and Nzoia rivers, which empty into Lake Victoria, at 0° 06' N and 0° 04' S/33° 58' and 34° 13' E (Aloo, 2003; Mfundisi, 2005; Githiora-Murimi et al., 2022) (figure 2). The wetland is 17,500 hectares in size and is home to three freshwater lakes: Kanyaboli, Sare, and Namboyo. Approximately 64% of the area of the Swamp is dominated by papyrus vegetation. Local communities farm around 11.5% of the Swamp, while Dominion cultivates an additional 9.4% of the swamp for rice cultivation. About 10% of the wetland is covered by water (Muoria, 2015).

The Yala Wetland is an extraordinarily rich and diversified ecosystem, home to several unique, sensitive, and endangered plant and animal species (Odenyo, 2021). Species with different ecological relevance and specialised habitat and microhabitat requirements inhabit this distinct ecosystem. The wetland is characterised by four types of vegetation: aquatic plants, riparian plants, grassland plants, and terrestrial weeds (Odenyo, 2021). Over thirty species of mammals have been recorded in Yala Wetland which includes Sitatunga (Tragecephalus spekeii), Hippopotamus, wild pigs, and monkeys (*Cercopithecus aethiops*) (Odero & Odenyo, 2021; Maua et al., 2022). The Wetland serves as a vital sanctuary for Lake Victoria cichlid fish, of which many have been wiped out by the introduction of Nile Perch (*Lates niloticus*), a non-native predator fish (Odero & Odenyo, 2021). The Sitatunga is threatened due to the country's unsustainable hunting practises and loss of wetlands (Thomas et al., 2016).

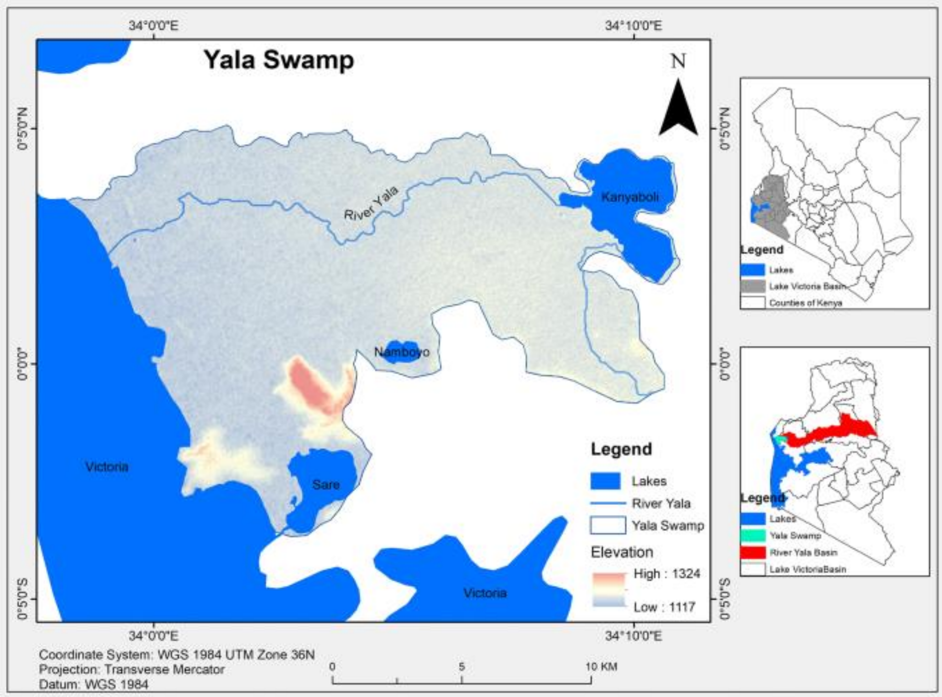

Figure 2. Location of Yala swamp within Kenya
Source: *Wanjala et al. (2020)*

Yala Swamp has a bimodal equatorial climate with heavy rains in March–May and brief rainfall in October–December (David et al., 2014). Yala swamp has solids with intermediate to low fertile soils (primarily ferrasols with plinthite "murram") and poor water retention, which can sustain agricultural cultivation with nutritional support (Ondere, 2016). The key economic activities include crop production, fishing, and animal rearing (Maua et al., 2022; Abila, 2002; Owiyo et al., 2014; Kinaro, 2008). The swamp environment provides water, medicine, firewood, and food to about a quarter-million people. There are three lakes within the Yala wetland system: Kanyaboli, Namboyo, and Sare. Lake Sare occupies 5 km2 and has a maximum depth of 5 metres; Lake Kanyaboli occupies 10.5 km2 and has a mean (highest) depth of 3 metres and a catchment area of 175 km2; and Lake Namboyo occupies 1 km2 and has a maximum depth of 10 to 11 metres (Ikiara et al. (2010). The local government leased 6,900 hectares of the Yala wetland to Dominion Farms Limited for 25 years in 2003/2004. Dominion sought to drain the wetland for commercial agriculture and aquaculture (Omambia, 2008; Tronarp, 2011; Owiyo, 2015).

Economic benefit of the Yala Wetland

Abila (2002) found that local communities gain from fishing, hunting, grazing, agriculture, fuel, and building materials around the Yala Swamp Wetland in Kenya. According to a survey, fish is the most significant wetland product, and 98-100% of respondents depend on it economically or subsistence. Fishermen earn roughly Ksh 143 per day (1$=Ksh 60 at the time of research; 1$=Ksh 75 in September 1999). Fishing indirectly affects other businesses like net repair. Net repairers receive Ksh 100 daily. Sitatunga, duiker, hare, duck, Guinea fowl, and harlequin quail are some of the hunting animals with average prices (Ksh 20-50). Grass and papyrus roofs are a common sight. An average-sized dwelling requires 30 bundles of Ksh 70 papyrus (Ksh 2,100 for the roof of a 13x20-foot house). Iron sheets cost Ksh 11,500 to roof a comparable house. This is papyrus' construction material replacement value. The majority of the persons who become fishers do so due to lack of alternative job opportunitiess. In a study, Mwakubo et al. (2007) found that the value of fish harvest in Yala wetland per household per month ranges from zero to 44,800 Ksh (600 $US) with a mean of

2,435 (33 $US). The average monthly household income is Ksh 4434 (59 $US), ranging from Ksh 2000 (27 $US) to Ksh 46800 (624 $US).

In 2010, the Kenya Institute of Public Policy, Research, and Analysis (KIPPRA) commissioned research that estimated the annual economic worth of Yala Swamp to be Sh8.31 billion or Ksh 475 million per hectare per year (US$ 120.4 million) with a present value of US$1.20 billion (1US$=Ksh 69). About 64.7 percent of Yala wetland value comes from agriculture and fishing, which are the main economic activities of the surrounding communities. Fisheries contribute 37.0% of economic value, followed by agriculture at 27.7%. TEV is high; hence the wetland should be protected rather than converted. Dominion Farm's projected worth is Ksh 3.8 billion (Ksh 330 million per hectare per year-US$ 55.1 million) (Ikiara et al. (2010).

As Muoria (2015) reported, subsistence farmers from Yala wetland earn over Ksh 110 million ($1.25 million) and commercial rice farmers over Ksh 510 million ($5.5 million) annually. Firewood, thatch grass, fish, papyrus, bush meat, wild fruits, and fodder are worth additional Ksh 450 million ($5 million) annually. Fish is the most valued wetland product. Wild fish from the wetland were worth Ksh 314,192,139, papyrus 80,865,635, firewood 57,627,056, and thatch grass 8,572,344. According to the findings of another study carried out by Kemunto (2018), Yala swamp played a significant part in the provision of fertile land for agricultural purposes, as well as in the provision of greenery and pasture for their cattle.

According to Thenya and Ngecu (2017), Yala wetland use includes harvesting macrophytes for roof thatching and craft items. Other applications include grazing, forage collection, fishing, and sand and soil harvesting for brick production. About 72% of collected macrophytes are consumed domestically, with the remainder sold to generate cash. The average monthly income per household during the wet season is around USD24.94 and USD18.29 during the dry season. Swamp farming provides 70% of domestic food and energy. According to Mwaura et al. (2003) crops produced along Yala wetland provide food security and income for residents. Local farmers earned KShs. 521732 from their entire irrigated land, averaging KShs. 2596 per respondent each year on a 504 m2 plot. The wetland grazed sheep and goats. Approximately 545 goats were reared by 98 households (43%) and sold for KShs. 730950.

Threats to the Yala Wetlands

Wetlands worldwide are under pressure from constantly increasing human population and food demand (O'Connell, 2003). Human activity is the biggest threat to wetlands worldwide, causing their loss or degradation (Bjerstedt, 2011). The loss of wetland area due to human activities is called wetland loss. Human activities affect wetland functions, causing deterioration (Moser et al, 1996). Mass waste, sea level rise, drought, hurricanes, and species overgrazing also threaten wetlands. All these natural processes and activities are directly linked to human activity on Earth. Threats have reduced wetlands' ecological and social values and services. Wetlands' importance to national economies and indigenous peoples' lives remains the principal danger (Oucho, 1993).

Increasing human population and agricultural activities are one of the major threats now facing Yala Wetland (Aloo, 2003; Okeyo-Owuor et al., 2012; Ondere, 2016; Abila, 2005; Siegenbeek van Heukelom, 2013; Kemunto, 2018; Githiora-Murimi et al., 2022; Maua et al., 2022). Large-scale agriculture has made Yala Wetland more vulnerable. Lake Agro Limited took over commercial agriculture from Dominion Farms (K) Limited in January 2020. Thus, large-scale agricultural, particularly rice production, has put wetlands under severe strain (Githiora-Murimi et al., 2022) and (Githiora-Murimi et al., 2022). The degradation of the Yala wetland has resulted from agricultural encroachment. In addition, agricultural activities have resulted in the extinction of several fish species, including mbiru, fulu, kamongo, okoko, nyamami, ningu, fwani, and adel, as a result of the chemical discharge into lakes caused by aerial spraying and other activities (Ondere, 2016). Moreover, , the draining of the swamp has resulted in the migration of a variety of various bird species (Kemunto, 2018). Other authors cited those agricultural activities in the surroundings of the Yala wetlands contributed to water contamination (Owiyo et al., 2014; Orodo, 2020 Nthenge & Romulus, 2015). Yala Wetland further threatened by over-exploitation of its natural resources by competing local communities such us cutting of papyrus and overfishing has led to loss of biodiversity (Ondere, 2016; Abila, 2005; Siegenbeek van Heukelom, 2013; Kemunto, 2018; Githiora-Murimi et al., 2022; Maua et al., 2022). Authors have also noted that climate change has affected Yala Weland (Maua et al., 2022; Odenyo, 2021). Wetlands are susceptible to the direct and indirect effects of climate change, which include a rise in temperature, shifts in the intensity and frequency of rainfall, and the occurrence of extreme weather events such as droughts, floods, and increased storm activity. Because of changes in hydrology and rising temperatures, the biogeochemistry and function of the wetland may undergo significant shifts. As a result, some of the wetland's most critical services may be rendered obsolete (Salimi et al., 2021).

Sustainable Management of the Yala Wetlands

From a review of the relevant literature, it is undeniable that Yala wetland plays a vital part in economic development of Yala's inhabitants. Therefore, sustainable utilization and management of the Yala wetland are required. According to Kemunto (2018) the national and local governments have failed to properly maintain and manage the swamp and its natural resources. The local community has resisted KWS's limited policies during implementation and enforcement. Community understanding of wetland conservation is low. According to interviews, local inhabitants value the swamp because of its benefits, but they have not taken any environmental conservation measures. As continuous encroachment may result in wetland loss and severe environmental degradation, the Yala Swamp should be restored and rehabilitated wherever possible in conformity with the Ramsar Convention. Value addition on papyrus and its products, conservation agriculture including smallholder wetland aquaculture, 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 are several opportunities for sustainable development. The establishment of an animal sanctuary, commercial tree growing, and integrated organic farming are other initiatives. Many stakeholders influence Yala wetlands management. Local fishermen and farmers, private firms, government agencies, and domestic and foreign development groups work in fisheries, agriculture, tourism, the environment, rural development, and public works. However, such a diverse group rarely sees itself as related, let alone as custodians of a critical national resource. Wetlands resist boundaries; thus, they must be managed holistically. They are privately and publically owned and vary seasonally. Resource consumption decisions in one component of the system affect other portions in complex ways.

CONCLUSION AND RECOMMENDATION

Kenya's wetland habitats serve a range of important, interdependent human welfare, ecological and national development objectives. Many of these are essential for improving human health and well-being and achieving a variety of MDGs and Vision 2030 objectives. The important roles of these ecosystems contrast starkly with their deteriorating biophysical quality, since Kenya's wetlands are disappearing and degrading at an alarming rate. These concurrently undermine these essential activities and initiate a self-perpetuating circle of destruction. This alarming situation must be remedied immediately by implementing a number of comprehensive and coordinated policy, legal, and institutional initiatives.

The economic befits of Yala swamp include Farming, fishing, papyrus harvesting, and handcrafts, food, feed, construction materials and water. However, increasing human population, agricultural activities, agricultural encroachment of the wetland, over-exploitation of its natural resources, climate change are some of the major threats now facing the Yala Wetland. It is important to consider that wetlands provide a vast array 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 management, and flood regulation.

In order to promote sustainable wetland management, the study suggests ensuring that wetland use takes into account the various factors outlined in the framework for sustainable use of wetlands; developing and enhancing an appropriate institutional framework; adopting a community-based, multi-stakeholder-based management approach; and enhancing the value of wetlands and their resources through value addition across the entire value chain.

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