Indigenous strategies and dynamics of resource utilization in tropical wetland. A case study of Yala swamp, Lake Victoria Basin, Kenya

Thuita Thenya[a,*] and Wilson Mwaniki Ngecu[b]

[a] Department of Geography & Environmental studies, University of Nairobi,
P. O. Box 30197-00100, Nairobi, Kenya
[b] Department of Geology, University of Nairobi, P. O. Box 30197-00100, Nairobi, Kenya

Abstract

The focus of the study is on the significance of the wetland resources utilisation in supporting local livelihood, emerging utilisation and management challenges. Wetland use includes harvesting the macrophytes for roof thatching and craft items. Other uses include grazing, forage gathering, fishing, sand and soil harvesting for brick making. 72% of the harvested macrophytes used at domestic level, balance sold to raise income. Average income in wet season is ca. USD24.94 ± s.e 2.01 and ca. USD18.29 ± s.e 1.82 in dry season per month per household respectively. Swamp farming supply 70% of domestic food and energy respectively. The process of acquiring land is significantly correlated to the nature of land tenure (r= -0.282, at p=0.01; r= -0.179, at p=0.05) and the year of settling in this area (r= -0.290, p=0.0; r=0.240 p=0.05) respectively. In the absence of resources use strategy this promotes monotypic utilisation (farming) of the swamp, leading to resource degradation.

Keywords: Farming; Income; Livelihood; Macrophytes; Harvesting

[*] Corresponding author.
Permanent (Current) address: Department of Geography & Environmental Studies, University of Nairobi
E-mail address: tthenya@yahoo.co.uk (Dr. T. Thenya)

1. Introduction

The historical association between people and wetlands dates back to the beginning of civilization. In Africa, the productivity of wetlands that support a great diversity of plants and animals provides the natural resources essential to the survival of a significant part of the African rural population (Halls, 1997). The Convention on Biological Diversity (1992) Article 15 recognises this ‘close and traditional dependence of many indigenous and local communities embodying traditional life–style on the biological resources. It further acknowledges the desirability of sharing equitably benefits arising from the use of traditional knowledge, innovations and practices relevant to the conservation of biological diversity and the sustainable use of its components. However, the people who benefit the most from these services and products provided by wetlands in Africa (and other developing regions) are generally unable to influence decision making at a political level (UNEP, 1997).

Over the years communities living next to these wetlands have developed adaptations and strategies to make best use of them (Halls, 1997; Abila, 2002, Nasongo et al 2015). The abundance of water and fertile soils within many wetlands provide them with the potential to provide considerable agricultural resources. For example, the Inner Niger Delta floodplain supports about one million sheep and goats, which belongs to over 550,000 people (Halls, 1997) while in Nagaon districts there are several wetlands that are fully dependent by the rural communities (Sarma and Kaiti, 2010). In addition, wetlands are also important in providing dry season grazing area especially in arid and semi-arid areas. The Kafue flats in Zambia provide important grazing area on highly productive *Vossia* and *Echinocloa* vegetation (Halls, 1997). In some African countries, wetlands are also important in supporting tourism industry due to the abundance of local wildlife that provides a means of income for the local communities. Some of these areas include the Kafue wetlands in Zambia, Kenya Amboseli swamps and the rich riverine vegetation of Mara River in the great Masai Mara Game Reserve.

The use of papyrus plants (Cyperus papyrus L.) for making “papyri” (papyrus paper) has been documented since 3600 BC in Egypt and it was later on adopted in Greece, Middle East countries and indeed the whole of Roman Empire. In addition, papyrus has also been used to make sandals, fences, huts, boxes, ropes, mats, cloth, medicine, cordage, formal bouquets, funeral garlands, boats and building materials (Lind and Morrison, 1974; Duke, 1983; Burnmeister, 2001, Kateyo, et al, 2014). Currently, papyrus is used by local communities in places like central and in the eastern Africa for both domestic and commercial items including building materials (Lind and Morrison 1974; Katondo, 2001). In the Okavango delta roots of palm Hyphae, Phragmites and palm hearts are used to make food and wine by the local community. In addition, the use of high calorific papyrus rhizomes as fuel has been recorded in Ewaso Narok swamp, Kenya (Thenya, 2001), Simiyu wetland in Lake Victoria Basin (LVB) (Katondo, 2001) and in the making of fuel briquettes in Rwanda among other uses. In LVB, Yala swamp is important as a source of providing building and fish traps material and collection of vegetables as well as grazing field (Ogutu, 1987; Kareri, 1992 and ICRAF 2000) and similarly for Nyando wetland (Nasongo et al, 2015) and in Katongo wetland Uganda it is an important source of products like monitor lizards (*Tragelaphus spekii*), phoenix palm stems, water according to Kateyo, (2014). This forms an important base for the local economy and livelihood support.

The Lake Victoria basin (LVB) supports an estimated 21 million people who rely primarily on subsistence agriculture and pastoralism for their livelihood (ICRAF, 2000). The basin has had sedentary communities for a long time. They have intensified exploitation of the catchments areas dating since the 1930s. In addition, there is a strong reliance on the wetland resources as a significant source of income for the local communities (Hoekstra and Corbett, 1995; ICRAF, 2000; Abila, 2002, Kateyo, Nasongo et al, 2015), but the direct values attached to the wetlands have not been documented and quantified in a consistent fashion.

2. Study area

2.1. Biophysical conditions

Yala swamp is located in Lake Victoria Basin (LVB). The swamp is a deltaic wetland dominated by different species of the genus Cyperus. They include among them *C. papyrus, C. dives, C. exaltatus* and *C. distans*. The swamp is located between Yala and Nzoia rivers, 0^0 07' N – 0^0 01' S / 33^0 58' – 34^0 15' E (Fig. 1). Its formation is as a result of backflow of water from Lake Victoria as well as flooding of the Rivers Nzoia and Yala. The swamp is mainly fed by river Yala that flows right through the swamp with a small contribution from river Nzoia in the North-eastern section of the swamp. The wetland comprises 20,000 ha; with an approximate distances of 15-25 km north-south direction for (Thenya, 2006). This ecosystem also encompasses three lakes, which include Lakes Sare, Namboyo and Kanyaboli (Fig. 1). These lakes contain some endemic haplochromine fish species, some of which are no longer found in Lake Victoria and are in acute danger of extinction (Kaufman and Ochumba, 1993). Likewise, the wetland provides vital habitats for various species of birds, mammals, reptiles and fish (Mavuti, 1989; Hughes and Hughes, 1992).

The Lake Victoria basin comprises one of the most populated rural areas in the world with an estimated 1,200 persons per km^2 (Hoekstra and Corbett, 1995). The population is characterised by high out migration rate to urban areas in search of jobs (GoK, 1994). This is attributed to the fact that the population is generally poor and its livelihood is mainly derived from subsistence farming and indigenous livestock. The local communities are traditionally dependent on the local wetlands for their livelihood including vegetable harvesting and grazing among others (Abila, 1998; Gichuki et al., 2001). Other uses include sourcing of macrophytes for building, fishing gears, beehives as well as a source of income (Odak, 1987; Ogutu 1987; Kareri 1992 Hoekstra and Corbett, 1995; ICRAF, 2000). Farming in the swamp in particular is an important activity (Mugo and Shikuku, 2000) but the declining soil fertility in and around the swamp coupled with high population acts partly as driving force to wetland conversion to farmland. In general, pervasive poverty in the wetland hinders sustainable use of the land resources leading to considerable land degradation, sedimentation and nutrient run-off, which contributes to its degradation.

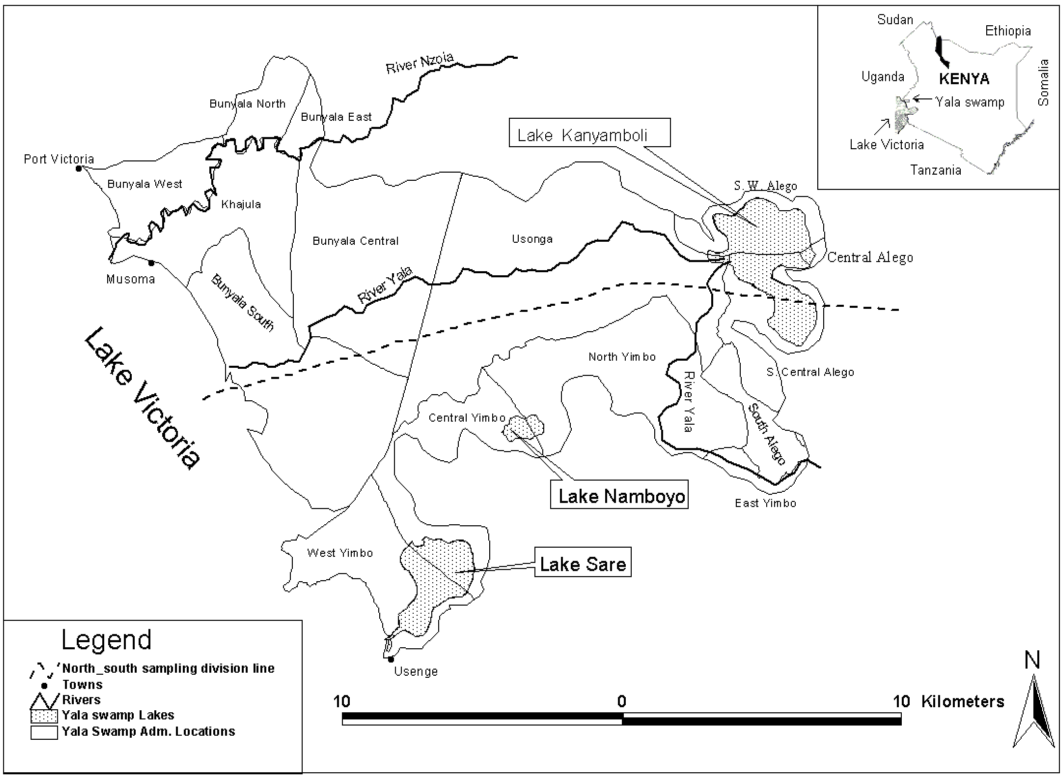

Fig.1 Yala swamp, associated lakes ecosystems and administrative Locations, Kenya

2.2. Climate and Hydrological dynamics of Lake Victoria basin

Annual rainfall in LVB comprise of a bimodal pattern with 'long rains' from March to April and 'short rains' from Oct. to Nov. (Fig. 2). The Yala/ Nzoia catchment has high precipitation in the Northern highland (1,800-2,000 mm per annum) and low in the South-Western lowlands (800-1,600 mm per annum). Conversely the average rainfall around lowland Yala swamp is approximately 760mm.

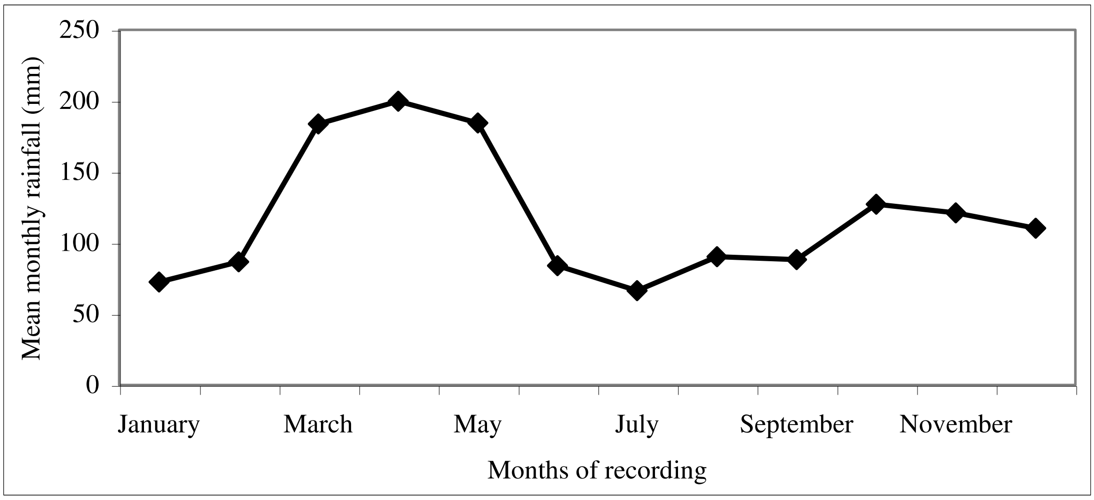

Fig. 2. Annual rainfall trends in Lake Victoria basin, Kenya
(Source: Lake Victoria Environment Management Programme)

2.3. Yala swamp ecosystem historical changes and socio-economic status

Until the mid 1960s the Yala swamp covered a total of 17,500 ha as natural swamp. However, between 1965 and 1970, 2,300 ha were reclaimed for farming by the Ministry of Agriculture (MOA) (Aloo, 2003). Later in 1990s, the then Lake Basin Development Authority (LBDA) earmarked two other Phases for reclamation, with Phase II constituting 6,000 ha and a Phase III 9,200 ha (Mavuti 1989; Mavuti 1992; Ocholla, 1997). In year 2002, some 7,000 ha, including a large section of phase 1 LBDA 2,300 ha drained section, was leased out for rice farming to a private company threatening the indigenous use (Thenya, 2006).

3. Material and methods

3.1. Sampling

The swamp was divided into two major sections based on the vegetation formation, topography, eco-types, accessibility and socio-economic status (Fig. 1). The first section covered the southern section, between the Yala bridge near LBDA farm on the eastern side and extending to Usenge beach to the western side of the swamp. The second section, which was on the northern side, covered the area from the LBDA farm extending to Musoma beach along the River Nzoia. This stratification reflected similarity of socio-economic structure and ethnicity within each section as depicted in the results. Addition survey was also done in the nearby markets to establish the outlets of the wetland products.

Socio-economic data were collected at household level in all the administrative Locations surrounding the swamp using a structured questionnaire, which was administered through personal interviews. A total of 350 questionnaires were randomly distributed within these two sections and restricted to 5km from the border of the swamp. Data collection focused on products obtained from the wetland, farming area, seasonal variations and preferred future development. Local enumerators, familiar with the local dialect were trained and used as interviewers to avoid possible misunderstandings or loss of information. The enumerators were hired to work within their own locality so as to maximise on time and enhance the quality of the data. Secondary information was gathered from various sources to provide background information for the study as well as supplement the primary data.

A specific survey was conducted in the market places, targeting different market days for the urban centres near the swamp on both the northern and the southern side of the swamp. This survey was aimed at capturing the variety of goods arriving at the market especially those allied to the wetland. Questionnaires were randomly distributed in the market depending on the presence of wetland goods. This strategy was based on prior field information that traders specialise with particular goods like fish, macrophytes or baskets. The data collected was analysed contrasting the northern and southern side of the swamp, due to the varying ecological and socio-economic status, and it involved a combination of descriptive and chi-square statistics. The variations between the two sides were quite significant. The southern side is relatively hilly, which restrict the extent of flooding to the valley bottom. The community inhabiting this side are mainly composed of Luo ethnic group. In contrast, the swamp slopes towards the northern side, experiences extensive flooding thereby displacing a high number of household in the wet season. The northern side has in addition a combination of both the Luo and the Luhyas ethnic tribes. The later are Bantus who are more inclined towards farming.

4. Results

4.1. Household land tenure around the swamp

The inherited family land holdings with or without title deeds dominate the system of land tenure both inside and area surrounding the swamp. Access and ownership of the land is mainly through membership of a kin group through inheritance with few locals or foreigners buying land locally. Due to the high population density and the small land parcels, the proportion of land, which exchanges hands through selling, is relatively low. For example, in the south inherited land constitute 70%, purchased land coming second with 23% and only a partly 5% of the land being rented. Other form of land holding includes communal land, which make up only 2% (Fig. 3). In the north, a similar trend are also observed with 82%

of the land being held as family land, a lower 11% as purchased land and about 1% as rented land. In addition, there is a slightly higher percentage of 6% communal land. The average land holding sizes outside the swamp is relatively small ranging between 1 and 4 acres but with a mean of 4.33 ± 0.375 s.e acres in the south and 3.05 ± 0.162 s.e in the north.

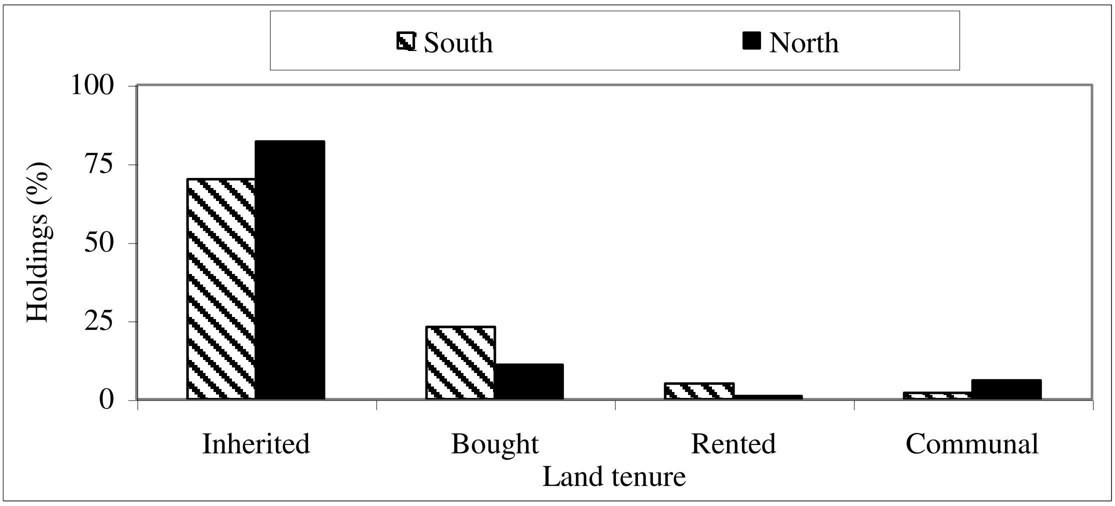

Fig. 3. Nature of household land tenure around Yala swamp

4.2. Wetland utilisation

Yala swamp provides numerous products to the local indigenous communities. These include thatch and craft material from the macrophytes, brick making soil, sand and domestic fuel. Others products include water for the animals and domestic use, vegetables, fish, forage and grazing grounds. In general wetland utilisation is mainly for subsistence sustenance with minimal commercialisation, which is mainly geared towards domestic food supply, shelter and limited income.

4.2.1. Macrophytes utilisation

Although Yala swamp has several species of macrophytes, the local community have a strong preferential use to some species based on their use. The mostly common used species include, C. papyrus L., *P mauritianus* Kunth, *C. dives* syn. *Immensus* Del, *C. distans* L.f., *E. haploclada* (Stapf) Stapf, *T. domingensis* Forst, *Phoenix reclinata* (Schum.&Thonn. syn; *Phoenix spinosa Phoenix leonensis*) and *S. sesban* L. The preferential use of these species is based on their biomass availability, sourcing distances, ecological occurrence, intended final use and the ability to purchase from the harvesters. Although there are no monetary fees levied for use of the swamp, not all the households are able to harvest their macrophytes, with the main limitation being the households with old persons and young families.

A large proportion of the macrophytes are meant for domestic use on both sides of the swamp mainly for craft items, thatching and domestic fuel (Table 1). The macrophytes used for domestic fuel included *C. papyrus, S. sesban* and *P. mauritianus*. However, due to the low density of the above ground biomass of Cyperus species as a result of the presence of "aerynchyma", use of the rhizomes provides a much better source of fuel. All the dominant macrophytes provided some form of biomass fuel with Cyperus species providing the largest proportion. However, thatching and housing in general take the bulky of the utilisation. Some of the mats that are derived from *C. papyrus* are however used in building as ceiling material, window covers and door enclosure.

Table 1
Various forms of macrophytes utilisation and preferential allocation

	Allocation of macrophytes-type of use %				Allocation -where used %			
Species	Firewood	Ropes and Mats	Thatching Material	Not indicated	Home	Sold	Both	Not indicated
S. sesban	76	22	0	2	64	1	14	21
Latifolia +	21	12	17	50	64		22	24
C. papyrus	29	5	40	26	53	4	31	22
P. mauritianus	3	55	23	19	34		12	54
E. haploclada	0	33	21	46	53		29	18
Average	43	42	34	48	89	3	36	46

Latifolia+ includes C. dives, C. distans and C. exaltatus

Various forms of macrophyte utilisation and preferential allocation

4.2.2. Households construction material

Macrophytes provide an important source of thatch material for the local indigenous communities where most of the houses are semi-permanent on both sides of the swamp. For example, in the southern side 42% of the houses have thatched roof with 55% in the northern side. Although the remaining percentages of the houses are roofed with iron sheet over, 70% of the houses have earth walls and only about 19% of the houses on both sides are permanent (stone) (Fig. 4). There are a low numbers of houses constructed with bricks despite of the brick making activities in the north. This is attributed to the cost of purchasing the raw material since not all household are engaged in brick making activities, as it is a labour intensive procedure.

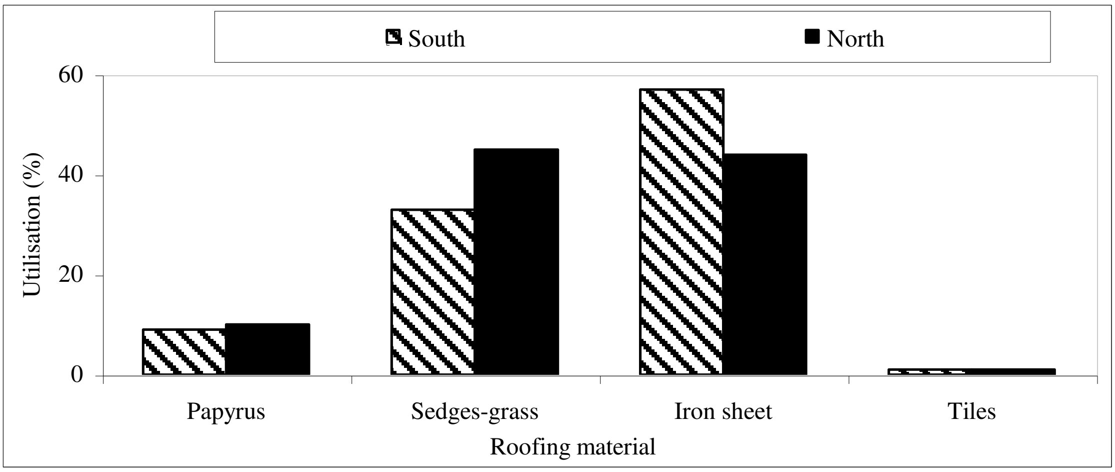

Fig. 4. Types of roofing material in the study area

Various combinations of macrophytes species are used for thatching they include *C. papyrus* sedges like latifolia (*C.distans* and *C. exltatus*), hippo grass (*Phragmites* spp.) and *Haploclada* spp. This is in contrast to the traditional use of papyrus alone as dominant thatching material relative to the other macrophytes such as latifolia (*C.distans* and *C. exltatus*). For example, both in the south and in the north of Yala swamp, *C. papyrus* make only 10% of the thatch material with 33% in the south and 45% in the north being constituted of other macrophytes species (Fig. 4). It is common to see houses thatched purely with sedges like *C.*

distans and *C. exltatus*. However, although Phragmites species offer much more durable roofing material than the other macrophytes it utilisation is limited by the availability of adequate biomass. Furthermore, it is too expensive to purchase from the harvesters relative to the other macrophytes. Its occurrence along water bodies and canals make it harder to harvest, compared to the widely distributed Cyperus species.

It is however observed that most houses are thatched with a combination of macrophytes in different layers from bottom phragmites, papyrus, latifolia and haploclada. The sequence of roofing a grass or sedge-roofed house is normally as follows: (1) bundles of senescent *C. papyrus* culms are tied together and then laid all round the roof to form a waterproof circuit as base material. Where Phragmites is available it is used since this forms a much tougher foundation that is followed by papyrus. On top of this foundation layer, leafy material from either the *C. distans* or *C. exaltatus* are laid followed by bundles of grasses such as *E. haploclada* as top dressing to produce a heavy and compact roof. All the bundles are laid in sequence from the lower side of the roof towards the apex thereby making it completely water proof. A house constructed this way lasts for approximately 10 years before any repair need to be done and it is cool during the hot months. However, only those families that could be able to provide labour for the macrophytes harvesting and transportation or those able to buy managed to construct such houses. Otherwise cheap and temporary houses are thatched with latifolia species like *C. distans* and *C. exaltatus* in combination with grasses like *E. haploclada*.

Analysis of some determinant of roofing material on both sides of the swamp indicate a strong relationship between the type of roofing and the education level of both the husband $x^2_{(20)}$ 118.84 > 37.57 at p= 0.01 and the wife $x^2_{(20)}$ 118.84 > 37.57 at p= 0.01 (Table 2). This implies that the prevalence of low education level in the area has a link to the presence of high percentage of semi-permanent houses. In general, low education level means minimal alternative sources of income, hence, the community members are unlikely to devote the small income gained to shelter improvement relative to other consideration such as education and clothing of their children among others.

Table 2
Chi-square table of local socio-economic status and wetland utilisation

Status and wetland use	Cal. Value	d. f.	Sig. (2-tailed)	0.05	0.01	sign	Determinant
Roofing material	50.12	20	0.000	31.41	37.57	Y*	Husband education level
Roofing material	118.84	20	0.000	31.41	37.57	Y*	Wife education level
Roofing material	8.27	12	0.763	21.03		N	Nature of land tenure
Roofing material	28.37	24	0.245	36.41		N	Household type
Income long rains	53.77	35	0.022	49.8	57.34	Y	Husband education level
Income long rains	78.45	35	0.000	49.8	57.34	Y*	Wife education level
Income long rains	70.60	21	0.000	32.67	38.93	Y*	Nature of land tenure
Income long rains	102.62	42	0.000	55.76	63.69	Y*	Household type
income dry seasons	44.75	40	0.279	55.76	63.69	N	Husband education level
income dry seasons	95.77	45	0.000	61.65	69.95	Y*	Wife education level
income dry seasons	48.09	27	0.008	40.11	46.96	Y*	Nature of land tenure
income dry seasons	97.79	50	0.000	67.5	76.42	Y*	Household type
wetland income Vs other sources	25.49	10	0.004	18.3	23.2	Y*	Husband education level
wetland income Vs other sources	7.73	8	0.460	15.51		N	Wife education level

wetland income Vs other sources	10.41	6	0.108	12.59	N	Nature of land tenure
wetland income Vs other sources	15.15	12	0.233	21.02	N	Household type
ownership of wetland	4.84	5	0.436	11.07	N	Husband education level
ownership of wetland	10.01	5	0.075	11.07	N	Wife education level
ownership of wetland	1.72	3	0.632	7.81	N	Nature of land tenure
ownership of wetland	13.40	6	0.037	12.59	Y	Household type
Wetland contribution to domestic food	26.99	20	0.136	31.41	N	Husband education level
Wetland contribution to domestic food	25.07	20	0.199	31.41	N	Wife education level
Wetland contribution to domestic food	13.15	12	0.358	21.02	N	Nature of land tenure
Wetland contribution to domestic food	28.02	20	0.109	31.41	N	Household type

N-not significant, Y-significant at both 0.05 and 0.01*

Chi-square table of local socio-economic status and wetland utilisation

4.2.3. Wetland products and marketing

Various products from the wetland are available on sale at the local markets but on small quantities. These include various sizes of mats, fish, food crops like maize, sweet potatoes and beans among others and thatching materials. The thatching materials are only sold in the markets, which are located near the swamp such as Ratuoro near the LBDA farm offices in the south due to its bulkiness. Generally, most of the households harvest their own thatch material. However, some are limited by aging workforce and therefore they have to buy from harvesters. This acts as a source of income for others households (Table 3). In general, income derived from macrophyte varies according to different species (Table 4). The purchasing of the macrophytes is necessitated by its labour intensive sourcing procedure and the mode of transportation, which is mainly by bicycles (49%) and backloads (35%). The low usage of motorised transport is attributed to the poor infrastructures, small quantities or low prices. The transportation of wetland products by middlemen to distant markets like Busia and Kisumu make use of public service vehicles.

Table 3
Average household income (USD) per month from the various swamp products

Product	Vegetables	Soil for brick making	Fishing (swamp)	Thatch	Craft items material	Fuel wood	Sand	Harvesting forage	Poles
South	20.84	0.07	27.86	8.88	15.57	10.28	17.04	rare	4.63
North	25.99	19.47	16.53	23.08	22.53	12.14	10.12	7.89	5.26

Average household income (USD) per month from the various swamp products

Table 4
Average household income (USD) per month from macrophytes

species	C. papyrus	P. phragmites	E. haploclada	Latifolia+	S. sesban	P. reclinata
South	8.68	4.21	9.74	9.57	7.79	0.00
North	5.74	8.11	0.00	7.21	0.00	11.14

(Latifolia includes *C. dives, C. distans and C. exaltatus*)

Average household income (USD) per month from macrophytes

Products on sale in the local markets are mainly fish, mats, papyrus ropes and baskets. This is attributed to the combined effect of low products demand and lack of market information. Some products are also sold at the household level but are scattered and hard to quantify. Hence, the figures presented here may not reflect the real value of income, which is likely to be higher due to the income that is not captured at the household level. Sale of fish both at the local markets and at the household level included a combination of both fish from the swamp and Lake Victoria. Fish from the swamp are mudfish *Protopterus aethiopicus* while those from Lake Victoria and the satellite lakes included a combination of omena -*Rastrineobola argentea*, Nile perch –*Lates niloticus* (L) and tilapia. Tilapia is the most commonly traded fish in the local markets followed by omena and then mudfish. The Nile perch is only sold in the markets centres close to the Busia highway like Siaya and Ngyia but not at the local markets near the swamp, since it is mainly geared towards the larger urban centres such as Busia due to better prices. Therefore, the swamp direct contribution to the availability of fish is low, although it provided crucial ecosystem functions related to the lakes like macrophytes water filter functions.

Comparatively, commercialisation of the macrophytes products is relatively higher in the northern side of the swamp (Table 3) due to the presence of relatively more developed social infrastructures compared to the southern side. These include good commuter routes connection to bigger towns like Busia and Kisumu, although prices do not change significantly compared to smaller markets. Some of the products are also traded across Lake Victoria to Uganda from Musoma beach and Port Victoria urban centres, increasing income levels. These trading outlets have great potential that can be tapped through improved marketing and flow of market information. However, in order to exploit this potential there is need to have organised groups and products diversification to meet both market challenges and demands.

In more than 60% of the businesses the capital to start the business is mobilised from personal savings (40%), followed by merry go round or from other businesses like sale of charcoal, bananas and sugarcane. There is only one organised business group trading in macrophytes near Nyandorera market in the northern side, which was initiated by Lake Victoria Environment Management Programme (LVEMP). The group had relatively good income even by local standards ca. 389.61USD per month. Indeed, the income could have been higher than this but members are exploited by middlemen who buy the products at low prices from the group and sell them to other markets, which offer better prices such as Busia, Kisumu and Nairobi. This happens because of the limited market information reaching the local people that would enable them to penetrate lucrative markets.

4.2.4. Dynamics of income sources

The levels and sources of income from the wetland vary widely on both sides of the swamp across the seasons. This is determined by several factors, among them education, household construction material and land tenure (Table 2). The later, land tenure is important with regard to farming since ownership of the land in the swamp increases chances of income during the dry season. The four most important sources of income in the southern side of the swamp include farming (70%), business (10%), fishing (6%) and local employment (4%) in that order. However, while farming and local employment drop from the wet to the dry season, business and fishing increases (Fig. 5a). Some minor sources of income (4%) include hunting and remittances from relatives, which are shown under auxiliary. The drop in farming which contributes about 80% of the income is due to the reduction of flooding in the dry season. The increase in business during the dry season as well as fishing caters for the shortfall in farming and low local employment.

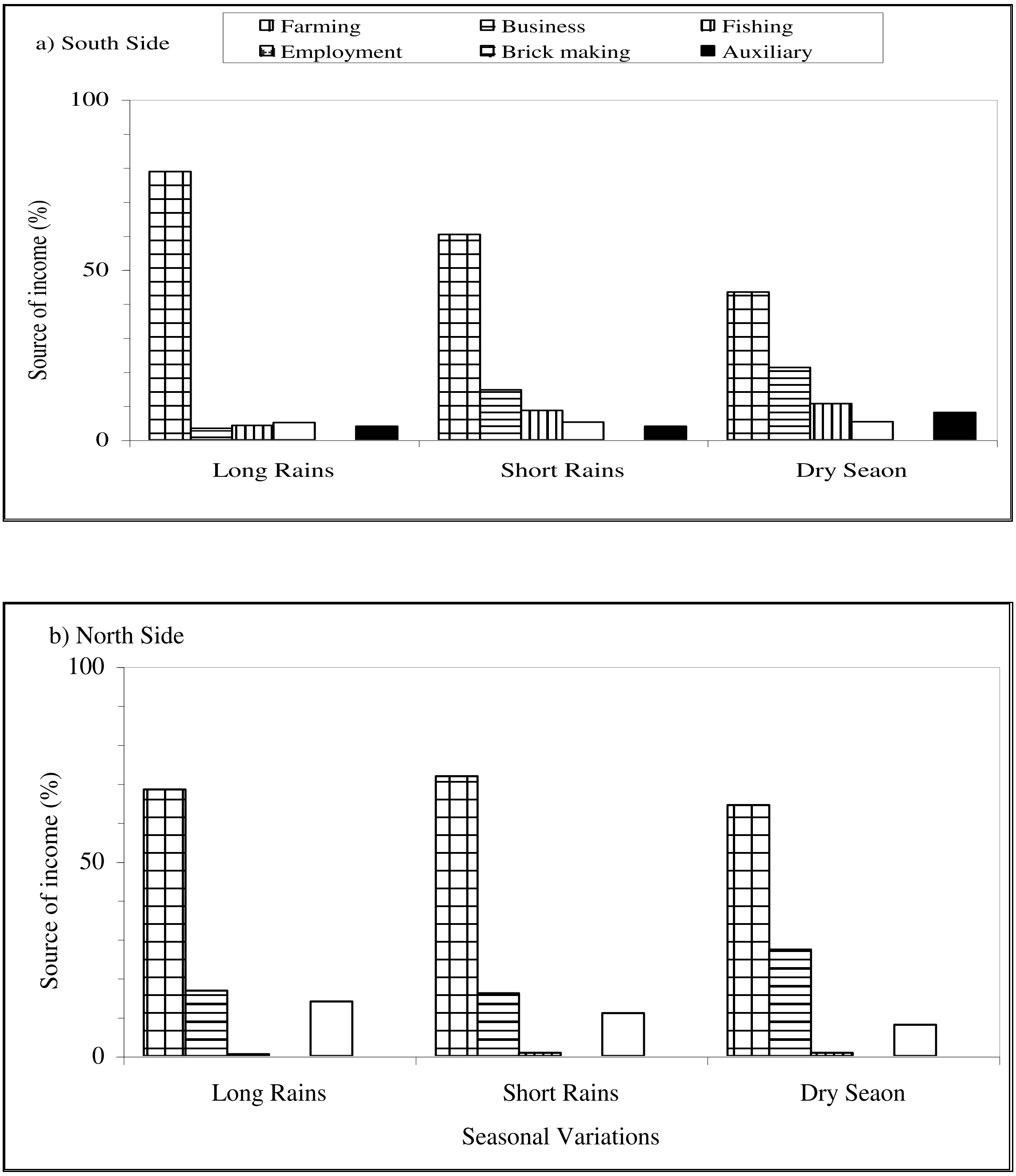

Fig. 5. Major sources of income in the (a) south (b) north

In contrast, a slightly different scenario emerges in the north with only three major sources of income, which includes farming (70%), business (17%) and brick making (15%) (Fig. 5b). Fishing remained at a low 1% since all the satellite Lakes are located in the southern side (Fig. 1). The low percentage drop in farming in the north is due to availability of large wetland converted into farming area that is convenient for dry season farming. This also allows access to macrophytes as the water recedes with dry season, hence business rise. The rise in business, cater for the likely shortfall in farming during the dry season. Brick making activities are restricted to the northern side of the swamp and dropped as the water level recedes in the swamp. In total, the overall average income in the wet season is ca. USD24.94 ± s.e 2.01 with the dry season having ca. USD18.29 ± s.e 1.82 on both sides.

Various types of crops are grown in the wetland across the seasons on both sides of the swamps. These include bananas, maize, millet, yams, oil crops (groundnuts, simsim), sugarcane, kales, cowpeas, onions and cassava, which are common in the LVB. There does not seem to be a clear distinction of crops grown in specific season either during the dry or wet season as the swamp caters for rain shortfall in dry season. The annual cycle encompasses three distinct seasons, namely 'long rains' (March to May), 'short rains' (Oct to Nov) and the dry season (Dec to Feb). Cultivation can take place throughout the year because the wetland has a constant supply of water from high rainfall catchments in the upper reaches of Mount Elgon and Chelengani hills. However, due to the topographical limitations in the wetland and reduced rivers discharge, the distribution of the dry season water is not uniform, which limit farming. Hence, several business undertakings are used to supplement local income especially in the dry season. These include mainly sale of crops including those cultivated in the swamp {e.g. oil crops (groundnuts, simsim), sugarcane, kales}, trade in thatch material and game meat and boat making. Other items traded included fish, water vending, sale of local brews locally known as chang'a, sale of building poles, pots, vegetables, milk, millet and running of kiosks. Their incomes are supplemented by casual jobs like security guards and working in other people's farm for a pay.

Comparing wetland income to other sources outside the swamp, more than 52% of the respondents on both sides of the swamp acknowledged that the swamp provides more economic opportunities. This fact is reinforced by the fact that 82% of the households interviewed had farming land in the Yala swamp, thus emphasising the importance of wetland opportunities. The education level of the husband is also important in determining the contribution of income from the wetland $X^2_{(10)}$) 25.49 > 23.2 at p = 0.01 (Table 2). Wetland activities are labour intensive and therefore require a large input from men relative to women.

4.2.5. Wetland land ownership and farming trends

The process of acquiring land in the swamp varies slightly on both sides of the swamp. In the south, about 56% of the land has been acquired through self-allocation; with 25% having been acquired through purchasing. In addition, 16% had been acquired through inheritance with a moderate 3% having been allocated by undisclosed authority. In northern side (82%) was acquired through self-allocation, 9% was acquired through purchasing, 8% through inheritance with 25% having been allocated by undisclosed authority again. It is noteworthy, that since there is no clear management authority in the Yala swamp all the land is initially acquired through self-allocation. Later the same land may have changed hand through either selling or inheritance. Farming activities take a large portion (95%) of the swampland utilisation, while the other land uses such as grazing, furrow and sand harvesting have an equal distribution on small proportions on both sides of the swamp.

Swampland ownership is bequeathed through the process of initially, clearing the land for farming, which involves slashing and burning. On both sides of the swamp, the process of acquiring land is significantly correlated to the nature of land tenure (r= -0.282, at p=0.01; r= -0.179, at p=0.05) and the year of settling in this area (r= -0.290, p=0.01; r= 0.240 p=0.05) respectively. The ownership of the swampland unit have also a significant relationship with the nature of land tenure, $X^2_{(6)}$ 13.40 > 12.59 at p = 0.05 in chi-square. Since the swamp is utilised mainly by the local people, it is also likely that those with land near the swamp and live there throughout the year have also land in the swamp. Most of the land around Yala swamp is acquired through inheritance, which emphasis the relationship between swamp utilisation and local land ownership. The negative relationship means that those without land are unlikely to have acquired swampland as well as the recent settlers. These relationships are weak meaning that other factors are also important in determining ownership of land in the swamp. In chi-square analysis, only the household type have a significant relationship with the ownership of land in the wetland $X^2_{(6)}$ 13.40 >12.59 p=0.037 (Table 3). The process of acquiring land is based at the household rather than at individual level, hence the importance of household factor in determining the acquisition of the swamp land.

There has been a gradual rise in the wetland farming as population increase over time, wetland farming dates back to the 1920s on both sides of the swamp. The reasons for starting to farm in the wetland are quite varied but almost the same on both sides of the swamp. The most important reason is to supply subsistence food. Other important reasons attracting people to the wetlands included water availability, high crop yield, favourable farming climate condition according to 70% in the south and 90% in the north. However, the need to raise subsistence income through cultivating the wetland is low, constituting only 30% in the south and 10% in the north. This shows that farming is mainly geared towards supply of domestic food, while the need to raise income being a secondary activity. Farming activities in the swamp starts along the edge of the swamp where water level is low and gradually edged inwards in dry season, again retreating as water increases with rain.

In spite of the numerous products that are obtained from the swamp, the community inclination towards farming is quite high. According to the survey, the most prioritised future development is draining the swamp for farming with fishing and conservation taking a low priority. Fishing in the area around Yala swamp is more associated with the open waters of the Lake Victoria and the satellite Lakes such as Sare, Kanyaboli and Namboyo.

4.2.6. Grazing and forage

The area around Yala swamp is semi-arid and the wetland offers an important dry season grazing area. Grazing normally takes places along the edges of the swamp since deep inside the wetland the ground is both unstable and has low concentration of grass biomass and other palatable species. In particular, the southern side and eastern part of the swamp including the section that is currently leased out to large scale farming company (Dominion) are important grazing area. Apart from the presence of ideal ecological grazing environment, the Luo community in the southern and the eastern side are agro-pastoralist while the Luhya community in the north is more agrarians. In addition, the relatively lower flooding levels in the southern side relative to the northern side of the swamp make grazing in the southern side more convenient. Occasionally forage is harvested for livestock from the swamp, but this is often reserved for shoats and young calves. Cyperus species like papyrus are only edible when very young (first few weeks) and such shoots are at times harvested as forage.

5. Discussion

The socio-economic survey of Yala swamp indicates that the swamp provides numerous products and support to the local indigenous community. This is mainly at the subsistence level though there is increasing commercialisation. The need to supply domestic food and to raise income for cash economy forms an important part of the swamp activities. Income is generated mainly from the sale of food crops grown in the swamp, macrophytes products, fishing, sand harvesting and brick making. The indirect of income include, sale of the livestock that are dependent partly on the swamp.

Increased exploitation of the wetland resources for commercial purposes outside the traditional domain have been on the increase in developing countries. For example, Kiwazi et al., (2001) and Maclean et al., (2003), note that in Uganda, increased harvesting of the papyrus is geared towards meeting education related expenses. Similarly, the shift from tradition fishing in Tana delta wetland in Kenya to farming is due to the need to meet cash economy transactions requirements (Terer et al., 2004). Likewise, the increased wetlands conversion to farming land in Uganda from the 1970s has also, been attributed to combined population increase, plus socio-economic changes like the need to pay school, buy commodities under cash economy. According to Kateyo et al (2014) wetland provides as important source of income with an average of USD 22 per month in Katongo wetland. Similar observations have been made elsewhere in Uasin Gishu District wetlands, (Kareri, 1992 and Odongo, 1996), Yala swamp (Abila, 2002) and Nyando (Nasongo et al, 2015). Yala swamp falls within a high population density area where the living standards are low with limited means of livelihood; hence, the swamp provides an ideal source of income.

However, since business is normally not the primary reason for harvesting the macrophytes or farming only a small proportion is sold with most being used at the domestic level. This phenomenon is not restricted to the Yala swamp, where only a modest 30% of the macrophytes and food is used to raise income. In Nyando swamp within Lake Victoria only 4% of the macrophytes harvested are used for commercial purposes according to Nasongo et al (2015). Similarly, according to Katondo (2001), only about 40% of all the mats that are made from macrophytes. In India Nagaon district, the wetlands are mainly exploited to support local livelihood with minimal commercialisation (Sarma and Saikia, 2010). Simiyu wetland in Tanzania, are sold to the outside markets through intermediaries. In any case, income levels remain extremely low to promote sustainable use. The sale of other swamp products like fish and crops attract equally low prices, which are not adequate to raise the living standard. The frustration with marketing of the wetland products in the Yala swamp can be attributed to poor transportation infrastructures mainly. These structures work to keep the prices at low levels, which encourages more farming and suppress diversification of the swamp utilisation.

Although, wetland cultivation has been documented as an old tradition of the communities living next to these wet ecosystems and posed no threat to them; Thenya (2001), in Uganda Kiwazi, et al., (2001), Ethiopia (Wood et al., 2002), and in Uganda Maclean et al., (2003;), and Terer et al., (2004) in Kenya . Studies in LVB indicate that land is an important asset and a significant source of income and food (Kiwazi et al., 2001 and Mugo et al., 2001). There is heavy and rising reliance on the Yala swamp as a source of subsistence food for the local communities, which threatens other diverse and sustainable uses. This is due to several factors including; high population density (ICRAF, 2000) and small land holdings size averaging 4 ha around the swamp. In addition, the low rainfall around Yala swamp averaging 750 mm per annum put a limit to rainfed farming forcing the community to seek alternative farming land in the swamp. However, the need to feed the rising population and raise income to meet other cash transactions increases the need for more farming land from the swamp. This takes places in form of large wetland conversions to farm lands or several small-scale conversions, which deviates from indigenous wetlands sustainable utilisation and threatens the ecosystem functions.

Apart from the pressure that is generated by the increasing cash economy needs and food demand, there is also heavy reliance on the macrophytes biomass as a source of domestic fuel. This observation has been recorded by several researchers in the tropics among them (Odak, 1987; Gichuki et al., 2001; Katondo, 2001; Kiwazi et al., 2001; Thenya, 2001 Abila, 2002, Kateyo et al, 2014, and Nasongo et al, 2015). Although, this could be attributed to their high biomass availability and spatial extent, poverty and the low income levels at household level especially in Yala swamp area limit other possible alternatives like electricity or gas. This means that reliance on the macrophytes will continue to be an important source of domestic fuel in the Yala swamp. The amount of biomass used was not quantified, but based on the regenerative ability of the macrophytes (Thenya, 2006), extraction at the domestic level does not pose a major threat to the ecosystem. There is however, need to do more research on possibility of making briquettes from the macrophytes to enhance domestic energy supply from the macrophytes.

In order to facilitate sustainable use of the Yala swamp under the current scenario of increasing population pressure, the use of organised marketing system is essential. This would enable the local communities to realise tangible benefits, encourage conservation and sustainable use of the wetland resources. The sustainable use of the swamp is complicated further by the question of property ownership and management, which is not clear. Although, most wetlands are reserved as government land under either the local authority or the central government, free access and utilisation over time lead to over exploitation or degradation. According to Nasongo et al (2015), there is no wetland management systems in Lake Victoria with tradition systems having collapsed coupled with increased exploitation. In Uganda, Kiwazi et al., (2001) and Maclean et al., (2003) highlights the considerable ambiguity that surrounds the concept of the government or the local authority holding wetland “in trust for the people”. The researchers further note the confusion over rights and obligations of ownership on one hand and management on the other. This situation is replicated in Yala swamp, where land is wholly self-allocated or derived from quasi-family inheritance.

This scenario revolves around Hardin's 1968 "free-rider" assertion where degradation and over use is linked to common property regime (CPR) (Hardin, 1968). Communities are unlikely to invest resources and time in a land that have no security of tenure, or is surrounded by ambiguity of ownership. Indeed, Yala swamp is seen as a resource with free access for farming, grazing, fishing and macrophytes harvesting. This means that with free access notion, there is low drive to develop swamp management institutions locally since ownership could be denied or change anytime. The allocation of swamp land to private companies such as Dominion for large scale farming company on the eastern side, could led to increased exploitation pressure in a scenario of poor resource governance.

In order to develop a secure wetland management system then a clear institution arrangement has to be put in place that fits within the current local situation. A local management plan that takes into consideration the current community diverse reliance on the ecosystem as well as ecosystem services would be necessary. A participatory management approach would deliver numerous benefits to the local communities (Terer et al., 2004, Nasongo et al, 2015), although precautionary measures are necessary to limits draw backs by limiting utilisation options (Allison and Badjeck, 2004; Stoll-Kleemann, 2004). This is important because a set of rules crafted to fit one socio-ecological condition like leasing land for large-scale farming in Yala swamp can erode social good will leading to increased human damage to the ecosystem. Under the current utilisation arrangement, the need to engage in long time management structure development for sustainable natural resources management by the local community is discouraging. Consequently, the drive to engage in immediate benefits activities like farming has a high priority. Unfortunately, the increasing monopolistic use of land like farming, lead to the loss of the ecosystem diverse utilisation including fishing, water, macrophytes harvesting and species habitat provision. The failure to maintain ecosystem diversity will lead to several detrimental effects including, water systems siltation, loss of habitat and weak macrophytes products base. Some of these impacts of the swamp degradation are clearly visible for instance water siltation from 2001 satellite image analysis (Thenya, 2006).

In general, there are limited regional experiences to draw from of a successful active wetland management under the current cash economy much having been under traditional use since this is a recent phenomenon, (Kiwazi et al., 2001, Kateyo et al, 2014). Allison and Badjeck, (2004), Terer et al., (2004); Stoll-Kleemann (2004) and Kateyo et al, (2014) provides valuable lessons on the emerging neo-management issues. One of the highlights is the need to trend carefully on participatory management due to some inherent drawbacks of communal management, like time-consuming decision-making but acknowledges the benefit of more inclusive management. However, data on traditional management uses like grazing, fishing, farming and macrophytes harvesting could provide valuable lessons on the management under cash economy (Wood et al., 2002 and Dietz et al., 2003, Zebedee and Manzano, 2008, Wiegleb and Viviana, 2016). There is therefore need to integrate the traditional roles with the modern management in order to address the question of emerging needs like income sources and increased food demand. Further research in the emerging institutions arrangement and changing dynamics on livelihood support from the wetland is necessary. This would help to formulate a balanced management plan "wise use" that takes into consideration ecosystem services, habitat protection and support to the local livelihood.

6. Conclusions

Yala swamp ecosystem is very important to the local communities livelihood. In spite of the ecological and social differences between the northern and the southern sides, the swamp provides numerous beneficial products. These include water, thatch material and raw material for craft items. The other uses include farming, grazing and fishing. Farming is identified as the most important wetland utilisation, which can be attributed to the, high population density, low precipitation and declining soil fertility outside the swamp. Like the other wetland utilisation, farming is mainly geared towards supplying domestic food, as well as to raise modest income for local community. The swamp land holdings are often self-allocated or inherited along kinship line.

The uses of macrophytes are diverse and including thatching, domestic energy supply and making of craft items. Although *C. papyrus* is the main thatching material, other species are equally important since it involves a combination of several species including *C. dives* and *C distans*. The returns from the sale of wetland products are often low mainly due to the marketing constrains such as lack of market information, poor transport network and exploitation by intermediaries. This acts as a major hindrance to the sustainable wetland utilisation due limited income in the process promoting mono-use of wetland that is farming.

Therefore, to promote sustainable use, there is need to increase the direct benefit to the local communities including cash benefits. In addition, a clear ecosystem management, which clarifies ownership, would help to promote sustainable use. This maybe achieved through participatory wetland planning and management. However, research on the emerging challenges like the rising wetland farming and cash economy transactions, which present a strong deviation from the tradition uses, would help to boost the ecosystem sustainable management.

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