What is the socio-economic value of the wetlands fisheries? The case of Yala Wetland in Kenya

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Abstract

Wetlands in most parts of the world are under threat of over-exploitation partly because their socio-economic value is not well known. Yala Wetland, the largest fresh-water wetland in Kenya, with a large part of it bordering Lake Victoria's shoreline, faces even greater threats of extinction. This wetland measures about 17,500 ha and is host to a number of indigenous fish species, animals and plants which are exploited by the local communities for subsistence and commercial purposes.There has been pressure to reclaim portions of this wetland for agricultural activity. So far, 2,300 ha has, indeed, been drained for commercial agriculture. Furthermore, it is difficult to control effort in the exploitation of the remaining wetland resources since the economically sustainable yields are undetermined.

This study was undertaken to close down the information gaps and generate relevant data for managing the wetland. Data for the study were collected in two phases, first a rapid appraisal exercise, then a monitoring program for 6 months in 2004-2005. Several variables were monitored during the study period, including; fish catch and composition, commercial yield of macrophytes, demand and price levels of wetland resources, levels of effort for exploiting wetland resources and other relevant ecological variables.

This paper presents the results of the study including, the composition and fish catch levels, the quantities of harvested and marketed macrophytes and other resources. Using these, the annual economic values of the Yala Wetland resources is determined. In addition the paper gives determinants of exploitation effort and the characteristics of wetland exploiters. The paper proposes management options under which the wetland can be managed.

Introduction

The Yala Swamp is located in Siaya and Busia districts in Kenya, with its western end bordering Lake Victoria. The swamp, which presently measures approximately 17,500 ha, is largely as a result of outflow of the Yala River. Three lakes add to the water mass in the Yala wetland, namely; Kanyaboli (10.5 square Km), Sare (5 square Km) and Namboyo (0.01 square Km). Yala Swamp is Kenya's largest fresh water wetland; it is one of several wetlands in the Lake Victoria basin, which include the wetlands of Nyando River, Sondu-Miriu River, River Nzoia and Kuja-Migori River.

A number of studies on the Yala Swamp since the 1950s have recommended that the swamp could be reclaimed and developed so as to establish a smallholder settlement scheme on the reclaimed swamp area, that would provide increased food and cash crop production (Gibb *et al.*, 1955; ILACO, 1975). This has been an issue of great controversy, particularly between the 'pro-development', mainly government officers who regard the swamp as a potentially rich agricultural ground, and the 'environmentalists', who see the swamp as an important ecosystem for various species of plants and animals (OSIENALA, 1998; Aloo, 2003). Some of these studies have further suggested that the reclaimed land could support commercial fish production in fish ponds, and in cages in running water channels, which they estimate could produce up to 60 MT of fish per year (JICA, 1987).

Despite those controversies, the first reported reclamation actually took place in one part of the swamp, commonly known as area 1, from the mid 1960s to early 1970s, in which 2,300 ha of swamp was drained, under a project sponsored by UNDP and FAO (Government of Kenya, 1987; OSIENALA, 1998). Reports, though, indicate that swamp reclamation resulted in ecological problems, such as lower water quality in Lake Kanyaboli, decreased species diversity and increased pressure on resources of the remaining wetland (OSIENALA, 1998). Investigations by Schuijt (2002) and Abila (1998) further indicated that the local community was the net loser from the reclamation; the benefits forgone from their use of wetlands far outweighed what they obtained in the new situation. Despite this, new proposals have been developed and feasibility studies conducted for further reclamation and development of parts of the remaining wetland (Government of Kenya, 1987; OSIENALA, 1998).

Improved commercial fish production was not one of the outputs of the first reclamation project, and has not been considered in any of the proposed future projects. In spite of the low priority given to enhanced fish production in Yala Swamp's development plans, fishing has been repeatedly rated among the most important income earning activities for the swamp community. Most reports have ranked fishing behind agriculture (cereals and horticulture crops production) and livestock keeping as leading sources of cash and for subsistence, while some (such as Abila's, 1998) considered fishing as the most important economic activity, with average incomes nearly four times that attainable in agriculture. Other economic activities in the swamp include hunting, tourism, fuel wood collection, brick making, papyrus exploitation, transport, salt lick supply and water supply for domestic use (Abila, 1998). In addition, fisheries is regarded as the highest supplier of animal protein in the area (Lihanda *et al.,* 2003).

Despite the importance of fish in nutrition, employment and as a source of income to the local communities, not much has been documented on the socio-economic aspects of the swamp fisheries. This is easily understandable considering that Lake Victoria, with its dominant commercial fisheries, is just adjacent to the Yala Swamp, which makes the swamp fisheries to be of comparatively insignificant commercial value. Thus, the main interests for managing the swamp fisheries seem to be for conservation, rather than commercial, goals. Admittedly, the swamp fisheries are important for biodiversity, but also have great socio-economic value to the local community, which need to be put in adequate perspective.

This paper investigates into the socio-economic aspects of the Yala swamp fisheries. It gives a profile of the wetland fishers and the distribution system for Yala Swamp fish. In addition, it assesses the status of the fisheries, using socio-economic approaches, to get an estimate of the yield and, using market prices, to determine value of the catches. Unlike other wetland products whose markets are underdeveloped, it is assumed that fish markets are sufficiently developed and the prices reflect the economic value. The catch and effort levels are estimated and cost of effort derived.

Sources of data for the report

This report has obtained data and information from both primary and secondary sources. The main source of primary data was a survey conducted in November 2003, in which fishermen of Lake Kanyaboli and Lake Sare were interviewed using questionnaires, key informant interviews and participatory methods. A total of 40 fishermen and other key informants, randomly selected in the two lakes, participated in that study. The primary information is complemented with data from relevant published and unpublished papers, technical reports on Yala Swamp and some historical data from KMFRI databases.

Review of literature

Yala Swamp fisheries and fishing activities

Fishing in the Yala Swamp is semi-commercial and takes place in lakes Kanyaboli and Sare, while hardly any fishing takes place in Lake Namboyo. The fish species composition in the Yala Swamp lakes is now well understood following studies by Okemwa (1981), Government of Kenya (1987), Opiyo (1991), Kaufman and Ochumba (1993), Aloo (2003), among others. These studies have revealed that the lakes' fisheries are dominated by cichlids, particularly *Oreochromis esculentus* in Lake Kanyaboli and *Oreochromis niloticus* in Lake Sare (Table 1). Okemwa's (1981) results, in particular, showed that *O. esculentus* composed about 65% of Lake Kanyaboli fisheries, while in Lake Sare, *O. niloticus* constituted nearly 60% of the catch. Kaufman and Ochumba (1993) reported that various species of haplochromines formed the second most important group of fishes in Lake Kanyaboli after the *Oreochromis* species.

Table 1: Percentage catch composition from experimental data.

	% catch composition from experimental data			
	Lake Sare		**Lake Kanyaboli**	
Species	(Okemwa, 1981)	(Government of Kenya, 1987)	(Okemwa, 1981)	(Government of Kenya, 1987)
Oreochromis esculentus	0	0	64.4	30
Oreochromis niloticus	58.6	31	24.7	30
Oreochromis variabilis	0.4	<1	0.5	6
Oreochromis leucostictus	9.6	20	0.2	<1
Tilapia zilli	0.1	<1	0.6	<1
Haplochromis spp.	16.2	30	8.6	30
Clarias mossambicus	0.4	<1	0.7	<1
Protopterus aethiopicus	7.5	18	0.2	1
Xenoclarias spp.	-	0	0.1	<1
Synodontis afrofischeri	6.3	7	0	0
Synodontis victoriae			0	0
Barbus spp.	0.2	<1	0	0
Gnathonemus spp.	0.7	<1	0	0

Adapted from Okemwa, 1981; Government of Kenya, 1987.

The main difference between the fisheries of the two lakes could, in fact, be attributed to Nile perch. It is known that Nile perch has already penetrated Lake Sare through a natural channel linking it to Lake Victoria. As a result, certain species, such as *O. esculentus*, which are very vulnerable to predation by Nile perch, are not found in significant quantities in Lake Sare. The same species are dominant in Lake Kanyaboli, which is still free of Nile perch (Government of Kenya, 1987: Opiyo, 1991; Aloo, 2003; Lihanda *et al.,* 2003).

Aloo (2003) and Opiyo (1991) explained that some of the fish species that disappeared from Lake Victoria occur abundantly in both lakes. The fishery of Lake Kanyaboli has particularly been of interest to conservationists, who see it as a replica of the situation in Lake Victoria before the introduction of Nile perch. In fact, some reports have called Lake

Kanyaboli a 'living field museum' of Lake Victoria (Government of Kenya, 1987; Mavuti, 1989; OSIENALA, 1998). The swamp lakes, therefore, are potentially important nursery grounds for many species of fish.

Okemwa (1981) reported that fishermen in lakes Kanyaboli and Sare mainly used canoes in shallow and deep water, in which the main gears were monofilament nylon gillnets, beach seines, purse seines and long lines. Some fishermen used fishing rods and operated in deep water which they accessed using papyrus stem rafts. The fisheries of Lake Sare, though, depended largely on seasonal rains, which stimulated the ascent of migrant fish from Lake Victoria. Fishermen took advantage of this migration and used traditional traps to catch fish on their ascent.

OSIENALA (1998) and Abila (1998) reported that most fishermen in Lake Kanyaboli used gillnets of between 1 and 2 inch mesh sizes. As evidence, most tilapia fish landed were below 25 cm long.

Previous estimates of fishing effort and fish values

Okemwa (1981) estimated the average catch of tilapia per canoe per day in Lake Kanyaboli to be 20 Kg for tilapia. Using this result, the commercial yield of tilapia in Lake Kanyaboli was estimated at 100 MT, and that of all fish in the lake at 250 MT in 1981. Other results obtained by Okemwa (1981) showed that the catch per net was higher in Lake Kanyaboli for the smaller mesh sizes (less than 4 inches), while the catch per net for mesh sizes above 4 inches were higher in Lake Sare than Lake Kanyaboli. Opiyo (1991) estimated the catch per canoe of *O. esculentus* in Lake Kanyaboli to be 26 Kg per day. OSIENALA (1998) indicated that gillnet fishermen in Lake Kanyaboli had an average of 3 nets per boat, but other effort statistics were not given.

Lihanda *et al.* (2003) revealed that there were about 130 fishermen in Lake Kanyaboli operating 56 fishing vessels, mostly of "sesse" type and a few dug out canoes, the main gear being hooks, gillnets and traps. The authors estimated that fishermen in Lake Kanyaboli landed about 21,807 kg (per month), valued at about 1,033,230. These estimates could be used to derive the average price for all fish species at about Ksh 47 per Kg. Furthermore, the authors estimated that the catch represented about 60% of the lake's capacity; indicating that with due care, the lake could yield up to 36 tonnes per month, and earn as much as Ksh 1.7 million.

Abila (1998) estimated the average income per day for each fisher at Ksh 143, and there were other income generating activities associated with fishing, such as net repairing (Ksh 100 per person per day) and making traditional fishing gear.

Results of socio-economic survey

The profile of Yala Swamp fishers

The typical fisher in Lake Kanyaboli and Lake Sare is a male adult, commonly in age range 25 – 45 years, although in recent years, there has been increased entry by people below 25 years. Most new fishers enter as crew with no gear, who fish for boat owners. (In the olden days, most fishers would be boat owners fishing in their own boats). It was estimated that there are about 3 new boats in the two lakes each year, indicating additional 6 fishermen. Women have little role in fishing. It was indicated that in some seasons, women do involve in a type of fishing called 'Kitenga', in which they scare and drive fish into set basket traps. This takes place in shallow waterways in the lake wetland.

Most fishermen in the lake have many direct dependants (Figure 1). The survey revealed that the number of people directly supported by each swamp fisher was in the modal range of 4 - 7, followed by the range 12 - 15. The mean number of direct dependants was 9.

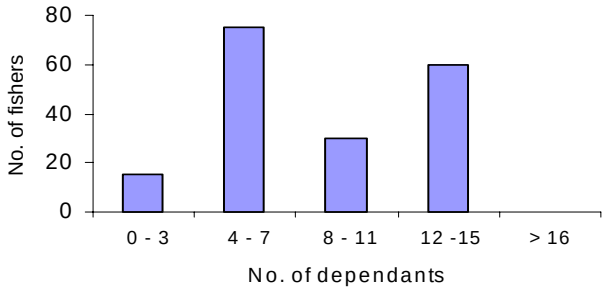

Figure 1: Dependence ratio on Yala Swamp fishers.

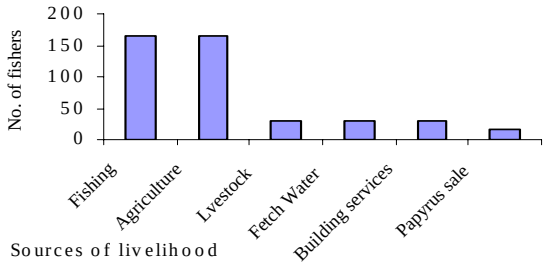

Figure 2: Fishers' main alternative sources of livelihood.

Fishing is the main source of livelihood for the swamp fishers, although agriculture has almost equal importance. The fishers also raise livestock (mainly cattle, goats and sheep) and provide various services, listed in Figure 2, for which they get additional income. To most fishers, fishing is the principle employment. However, when not fishing

they engage in a number of activities, either for extra income or for recreation (Figure 3).

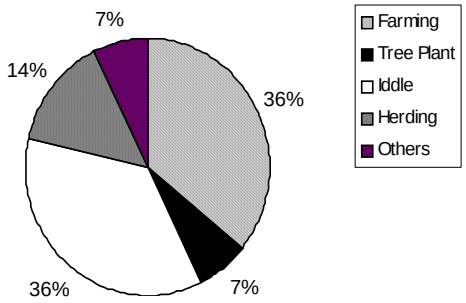

Figure 3. What fishers do in their spare time.

Main fish species targeted

\The survey revealed that fishermen of lakes Kanyaboli and Sare target mainly six groups of fish species, namely; *Protopterus aethiopicus* (mud fish, 'Kamongo'), *Clarias* spp. (Cat fish, 'Mumi') and three *Oreochromis niloticus* (*O. variabilis, O. esculentus, and O. niloticus*,) and the *Haplochromis* spp. ("Fulu"), the latter which is mainly targeted for bait. In Lake Sare, however, some fishermen also indicated that they often catch Nile perch, thought to drift into the lake from Lake Victoria. Results further indicate that the fishermen mostly prefer to target *P. aethiopicus, C. Gariepinus, O. esculentus* and *O. niloticus,* a decision that is probably based on the market value of each fish species, and their relative abundance (Figure 4).

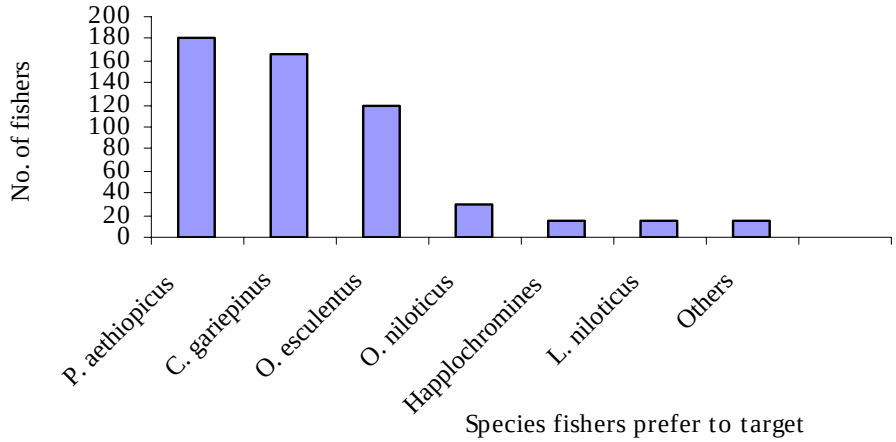

Figure 4: Fish species targeted.

The species type, their quantities, and average size caught depend on gear used, the season and location. For example, long lines with *Haplochromis* spp. baits are used to target *Clarias* spp. and *Protopterus* spp., while the various *Oreochromis* spp. are mainly caught using gillnets, most commonly of about 2 inches. As the lake water recedes during he drier months (for example, December – February), fishermen tend to get higher catches of *Protopterus* spp. and *Clarias* spp. These species usually tend to hide in the papyrus vegetation that surround the lakes, and are thought to come out in the open water when water level recedes, making them easier targets.

Up to very recently, a number of fishermen in Lake Kanyaboli used a kind of seine net, but the Fisheries Department confiscated most of these in August 2003. These seine nets indiscriminately scooped a lot of small size *Oreochromis* spp. ('dwela') and *Haplochromis spp*, and were regarded by the Fisheries Department, as well as the lake community, as an unsustainable and destructive fishing practice.

Markets for swamp fish

Fishing in the swamp has become largely commercialised. At least 93% of fishers sell a portion of their catch; the quantity taken home depends on the catch level, availability of buyers and the fisher's domestic need for fish.

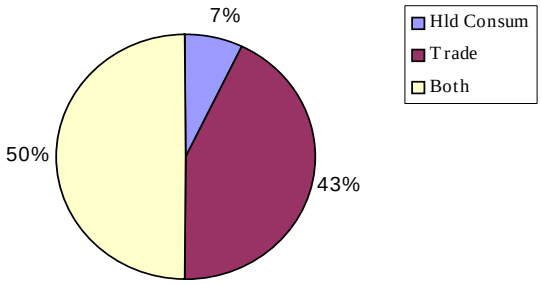

Figure 5: Use for fish.

On some days, like when a fisher has visitors in the household, more of the catch may be consumed at home. About 43% of fishers principally fish for trade and would ordinarily sell all the catch, while only 7%, mainly found in one beach in Lake Sare, admitted to completely fishing for subsistence (Figure 5). In overall, over 85% of respondents took home less than half of what they caught.

The first point of trade was at the immediate landing, where fishermen sold fish to consumers or buyers from outside markets (Table 2).

Table 2: Fish distribution pattern.

Market level	Location Fish seller	Fish seller	Fish buyer
1st level markets	Beach site	Fishermen	Local consumers, women traders, bicycle trader
2nd level markets	Nearby market centres e.g. Nyatworo and Harambee	Women traders	Consumers in neighbouring villlages
3rd level markets	Farther market centres e.g. Siaya, Boro, Ugunja, Hawinga, Mwer	Bicycle traders, women traders	Consumers in those centres

Source: Survey results.

There is a gathering place in the main landing centres, where traders and fishermen bargain until they reach an agreeable price. There is no weighing of fish in any of the landings, so prices are based on sizes and quality of fish as perceived by buyers and sellers, and the demand versus supply on a given day. Consumers from the neighbouring villages buy some of the fish, especially the very small sizes. Women traders also buy fish from the beaches and take to small market centres that they can reach on foot, for example, Nyatworo and Harambee. However, there are approximately 12 bicycle traders who come to the beaches and buy much of the fish, which they take to markets outside the swamp, for example, Siaya, Boro, Ugunja, Hawinga, and Mwer. Gang Beach on Lake Kanyaboli is particularly popular with the bicycle traders.

Estimation of fishing effort

This survey established that there were about 65 fishing boats in Lake Kanyaboli and 25 in Lake Sare, giving a total of about 90 boats in the two lakes. Each boat had an average of about 2 fishers; the estimated total number of fishermen was actually 195 for the two lakes. About 54% of all fishers fished for each day of the week, although the mean number of days fished per week was about 5.5. On average, fishermen would be expected to fish for about 70% of the possible number days in the year, which allows for any planned or unexpected disruptions. This gives a total fishing crew-days of 38,766 days in a year (Table 3).

Table 3. Estimated number of fishing crew-days.

Fishing days per week	Projected no. of fishers	Effort (Crew days)
1	0	0
2	0	0
3	60	180
4	0	0
5	30	150
6	0	0
7	105	735
Total no. of fishers	**195**	
Total fishing crew-days per week		**1065**
Total fishing crew-days per year (at 70% of total possible time)		**38,766**

Source: survey results.

The time spent on fishing by each fisherman was also obtained and projected for the entire lake (Table 4). According to the time ranges provided, most fishermen in the two lakes carried out each fishing operation for 4-7 hours. This included the entire period spent by fishermen in the water, for setting the gear, in case of passive gears, inspecting gear, for removing trapped fish and eventually, landing it.

Table 4. Fishing time (source: survey results).

Hours mostly spent per day	Projected no. of fishers	Fishing hours per day
0-3	0	0
4-7	107	589
8-11	0	0
12 –15	88	1188
≥16	0	0
Total no. of fishers	195	
Total no. of fishing hours per day		**1,777**
Total no. of fishing hours per day at 70% probability of fishing		**1,244**

In Lake Kanyaboli, some fishermen occasionally stayed for 12-15 hours in the water, especially as a result of blockages by floating 'islands'. The result of the number of fishing hours could, though, have large daily variations depending on the local situation and the fisherman's intentions. Fishermen spent a total of about 1,244 crew hours fishing in the two lakes each day.

There was a variation in the amount of fish caught by different boats. The least was an average of 2 Kg per day, while the highest reported a mean of 40 Kg per day. Table 5 gives the estimated mean catches per boat. The Figure s show that the modal catch rate was about 5-9 Kg per boat per day, while the mean was about 15.2 Kg per boat per day.

Based on these Figure s, the total catch of the two lakes per day was estimated as;

Mean catch per boat per day x No. of boats in both lakes x 70% probability that a boat goes fishing.

= 15.24 x 90 x 70% = 960 Kg

Based on above estimates, the annual catch for the two lakes is;

= 960 x 5.5/7 x 365 =275,314 Kg

Table 5. Estimated catch levels (source: survey results).

Kgs per boat per day	**No. of boats**	**Catch (Kg)**
0-4	14	28
5-9	21	147
10-14	14	168
15-19	7	119
20-24	14	308
25-29	14	378
≥30	7	224
Total no. of boats	90	
Total catch		**1,372**
Total catch in the two lakes per day (at 70% probability of boat fishing)		**960**
Mean catch per boat per day		**15.2**
Total annual catch (at 70% probability)		275,314

Valuation of swamp fisheries

To obtain unit fish prices, actual weights of the units which fishermen usually use for selling fish, and the related prices, were determined. This involved taking samples of each unit of fish and weighing it, then recording the actual price of fish in that unit on the day of survey, and adjusting it to take account of the 'usual price range' as perceived by fishers.

This Survey estimated an average price of all fish species in the two lakes at about Ksh 40 per Kg. There was, though variation in prices between landing sites and species (and obviously, on different days and seasons). The highly priced species such as *Protopterus aethiopicus* and *Clarias* spp. fetched an average of about Ksh 50 per Kg, while the small sized *Oreochromis* spp. was sold at about Ksh 35 per Kg. Using the mean price above, a swamp fishing boat, on average, could receive;

= 15.2 x 40 = Ksh 608.

In line with the existing remuneration system, 50% of this amount would go to the boat owner, while the crew would share out the other half. (In a few of the beaches, there was a different remuneration system where boat expenses were subtracted and the balance shared out between boat owner, taking 40%, and crew, 60%). Thus, a boat and gear owner expected to receive about Ksh 300 daily, and crew, Ksh 150 each, if all fish were sold out. This gives an average income per person (one boat owner and 2 crew for each boat) of Ksh 200. Since some fish went for subsistence, the actual amount received in hand by boat owners and crew would be less than these Figure s.

To countercheck the validity of this Figure , fishermen were directly asked to state, in confidence, how much they normally expected to receive in a day. The stated Figure s had a mean of 187 (usually fishermen are more likely to state a lower income if asked directly). Hence the average income level of Ksh 200 per person as derived above may be within acceptable range.

With the above Figure s, it is possible to derive an overall annual value for the fisheries of the two swamp lakes. The fish market price at landing is taken to represent the value of the traded fish as well as the economic value of the fish for subsistence. Hence, value of annual fish yield is derived as;

$\sum$ (traded fish + subsistence fish) x mean price of traded fish

= 275,314 x 40

= 11,012,560

Thus, the total annual fish yield from Lake Kanyaboli and Lake Sare is about Ksh 11 million.

The average returns per boat, therefore;

= 11,012,560 / 90 = Ksh 122,362

Cost of fishing effort

The main effort components are the fishing boat, its components and gear, as well the fishing labour, all represented in Table 5. The wage rates have been used to represent the cost of labour, while the depreciation cost of boats, estimated using the straight-line method, represents the annual cost. A new canoe costs about Ksh 15,000, and has a life span of about 5 years, giving an annual cost of Ksh 5,000.

Most boats had 3 nets, each costing Ksh 700, giving a total cost of Ksh 2,100 per boat at a time. A net had a lifetime of 3 months (a possible distortion is that fishers would go on using an old torn net for several more months, when its efficiency had greatly reduced). Assuming fishers would replace nets about 4 times a year, then the annual cost of gillnets per boat per year would be about Ksh 8,400. The other components such as oars (each Ksh 200, for three oars two times a year), plastic basin (each Ksh 50, for four per year) and plastic rainproof sheeting ("capera") costing Ksh 170 two times a year.

The long line fishing boat had all the above components, except gillnet, but instead had lines and hooks. On average long line fishermen had 200 hooks, each costing approximately Ksh 3, replaceable four times a year, thus an overall annual cost of Ksh 2,400. The line thread capable of supporting 200 hooks costs Ksh 250 and would be replaced about thrice a year, giving a total annual cost of 750. Labour constitutes the greatest cost in fishing. The wage rate per boat per year, calculated at about Ksh 300 (for 2 crew per day), is about 60,225 (at 70% boat operation days a year and 5.5 days a week). The costs of fishing effort are estimated in Table 6 for both gillnet and long line fisheries.

Table 6. Estimated cost of effort (source: survey results).

Effort item	Total cost per year per gillnet boat	Total cost per year for per long line boat
Boat	5,000	5,000
Nets	8,400	
Long line thread		750
Hooks		2,400
Other components (e.g. oars, 'capera')	1,740	1,740
Fishing labour (wages)	60,225	60,225
Estimated total cost of effort per boat per year	**75,365**	**70,115**

Conclusion and recommendation

Besides giving a socio-economic assessment of the fisheries of the Yala swamp fisheries, this report has attempted to estimate the catch effort level, effort costs and value of the fisheries of Lake Kanyaboli and Lake Sare, using mainly socio-economic valuation approaches. In the situation of complete lack of statistics, other established methods of estimating catch could be attempted, and probably may provide varying results. The results presented here should, therefore, not be seen in the context of providing absolute Figure s, but as a basis for comparing and validating results obtained from other biological estimation methods.

Results show that the two fisheries are of immense economic value, as demonstrated by the actual and potential incomes established in this report for annual yields. There are additional socio-economic values obtained from the fisheries. It is, therefore, important that management of the swamp lakes be given priority in the plans to develop the Yala Swamp. There is also need for long time monitoring of swamp fisheries, and to determine the stocks sizes of the important fish species in the two lakes.

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