UNDER PEER REVIEW

Original Research Article

INVENTORY AND IMPACT OF DOMINANT FISHING GEAR AND METHOD IN ELEYELE LAKE, OYO STATE, NIGERIA

Abstract

Gill nets fishery are potentially selective and therefore use as a sampling gear if mesh sizes are rightly chosen in order to conserve the young and developing fishes. Precautionary approach towards Conserving and sustaining renewable aquatic resources is the best as cheapest sources of animal protein in sub Sahara region. This paper gives inventory of the existing fishing gears and methods and impacts of gill net fishery in Eleyele Lake Ibadan. A total of 539 fishing gears were encountered in six sampled areas of two strata; gill nets, traps, cast nets, dragnets and long - line (baited and un-baited). Gillnets accounted for 36% in the strata. Apparently, stratum 1 had 159 and stratum 2 had 33 units of gill net with mean weight of 203g of the total catch. The most caught species was tilapia, 57.7% by number and 33.8% by weight of the total catch and were not sizable. The numerical strength of gill nets on the lake is significant P> 0.01 in the recruitment of resources and the use of legal mesh sizes (> 51.88mm / 2") is not significant P> 0.01. Gill net fishery of Eleyele Lake comprises of legal and illegal mesh sizes of which the later accounted for 48% of 192 and its use accounted for over 58.7% by number and 20% by weight of the entire fish caught. The outlawed mesh sizes had mean weight of 75.7g, while 350.3g was recorded for legal mesh sizes. Gill net fishery of Eleyele Lake can only fetch its production cost about 12.23 times in a life span.

Keywords: sustainability, fishing gears and methods, fishing efficiency, gill nets, mesh size, Eleyele Lake.

1. Introduction

Nigeria, like most tropical regions of the world is endowed with abundant water bodies which form excellent environment for numerous fish species with other aquatic flora and fauna. These water bodies are subjected to multipurpose use and therefore prone to various degrees of environmental pollution and degradation that are hazardous to fisheries resources, (1). Ecological information is useful as a basis for planning and formulation of management policies towards the rational utilization of the resources among different end users (2). Rivers and lakes (natural and man-made) are very important for human settlement from origin of mankind. The history of river impoundment to create artificial lake can be traced to the Roman culture and later, that of Western Europe (3). Initial aim of such impoundments was to conserve water of seasonal river for dry season, primarily for domestic use. However, with modernization and technological

UNDER PEER REVIEW

advancement, other uses for impounded river such as irrigation, hydroelectricity generation emerged (Kainji Lake). There are 12 major reservoirs with an estimated surface area of 303,600 ha, in addition to numerous smaller reservoirs with an estimated area of 98,900 ha (4). Kainji Lake with a surface area of 1280km^2 is both the largest and most intensively studied in Nigeria. Oyo State is land locked with no access to territorial water and as a result has 28 man-made lakes built by different government agencies and Research Institutes. They include Water Corporation of Oyo State (WCOS), Oyo State Agricultural Development Programme, (OYSADEP), Railway Corporation, Federal Department of Fisheries (FDF), International Institute of Tropical Agriculture (IITA) and Ogun-Osun River Basin Development Authority (OORBDA). There is also a natural lake at Ibusogbooro in Oyo West Local Government. The prominent Nigeria natural and artificial lakes are Lake Chad and Kainji respectively. These major lakes in Oyo state cover a total water surface area of 10, 250.2 hectares with 1, 152 fisher folks, 962 canoes as at 1999 (5) In 2000, 2,433.02 tons of fish were landed in various landing sites (6).

Hydrological data on the lake has been provided by (7). It has a surface area of 156.27 ha and storage capacity of 1550 million gallons; a maximum depth of 12 m, and of a mean depth of 6.5 m. Its basin is long and narrow and conspicuously divided into two; main stretches, with the widest 250 m and the narrowest part 20 m. The principal source of water to the dam is from River Ona and other associated tributaries including water from run – offs. The development, exploitation, management and protection of the fisheries resources resided in the Oyo State Ministry of Agriculture, Natural Resources and Rural Development (M.A.N.R&RD) acting through its Department of Fisheries.

The inland water bodies of the state are already overfished as a result of increasing rate of fishing efforts being employed for exploitation of aquatic resources (8). Fisher folks density of 10 Canoes/km^2 is far in excess of the recommended density of approximately 2 Canoes/km^2 for African lakes (9). In 2000, the catch estimates of the lake was as high as 159.87 tonnes as against 143.88 tonnes in 1998 (7). The commonest fishing nets adopted in Elayele lake include among others: gill net (Fixed type), cast nets, Drag nets, Long lining (baited and unbaited) etc; and majorly made of multifilament. There were reported research works carried out on Eleyele lake including (10; 11) on the plankton and hydrology; (12) on stock assessment of the post impoundment fisheries amongst others. This study was conducted to provide baseline

UNDER PEER REVIEW

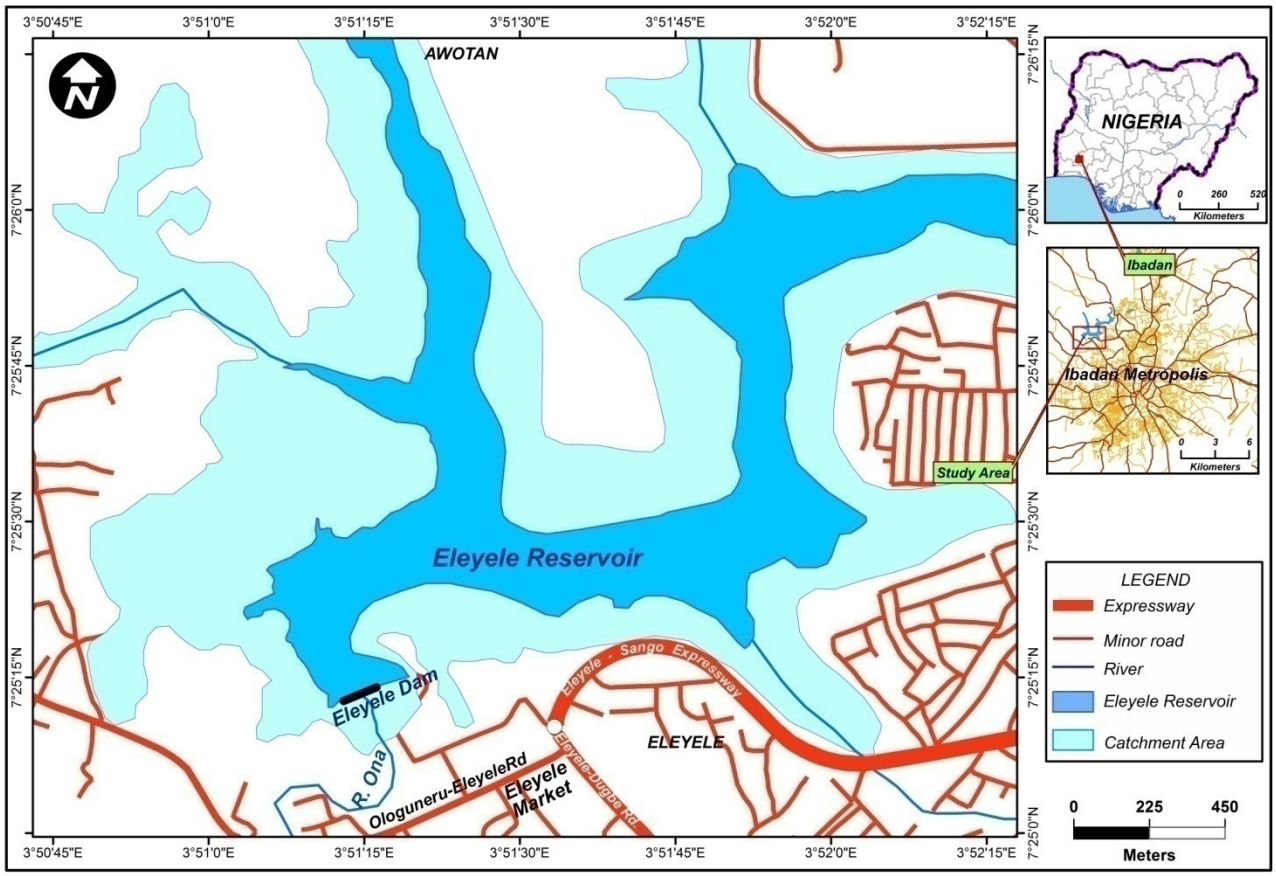
information on inventory and impacts of dominant fishing gear and method in Eleyele man-made lake for sustainable fish production.

2. Materials and methods

2.1. Study area

Eleyele Lake was constructed by damming the Ona River which is part of the dense network of inland water course that flows towards lagoon. The water source of the lake, river Ona covers a distance of 62 kilometers across thickly forested zones. The lake lies northwest of the city of Ibadan at an altitude of 125m above the sea level. It has an area of 5.4659 km that is capable of storing 77.5 x $10^3 m^3$ of water at full capacity. The surface temperature and pH are within the range of 20^0 C - 28^0 C and 6.5- 8.5 respectively. The total dissolved solid is 174.7 mg/l. The basin is long and narrow, at its widest it covers 250 m and at its narrowest just 20 m. The bottom of the lake is not uniform, with gravel in some parts as well as soft (mud and decaying organic matter) in character.

UNDER PEER REVIEW



2.2. Sampled areas

Eleyele is a man-made lake with 15 fishing localities (villages and sites) that scattered all over the shore line and islands of the lake. The sampled areas were randomly selected out of these fishing localities using (13) method. The entire lake was divided into two strata each representing a distinct ecological zone with 6 fishing localities for a period of 12 months (January- December).

Stratum 1 (Widest part 250m) has the bottom profile that is rather regular and uniform in character. The basin is characterized by step banks (East and West banks). The deepest part of the lake has a maximum depth of 12m near the dam wall and an average depth of 6.5m with maximum width of 0.25km. The settler in stratum A comprises of Ibadan, Ilajes and Ijaws designated as 01, 02, and 03 respectively.

Stratum 2 (Narrowest part 20m) is the upper most portions of the lake, where the river Ona enters the lake through Apete characterized by a narrow channel, irregular and non-uniform

UNDER PEER REVIEW

bottom profile. It has average depth of 3 m with Gaddda, Apete, and Corner designated as 04, 05 and 06 respectively.

Encountered fishing gears in the sampled areas of each stratum were enumerated and their percentages of occurrence and distributions were calculated. The classifications of observed fishing gears and methods in each stratum of the lake followed International Statistical Standard Classification of Fishing Gear of (14) classifications.

The mesh sizes of encountered gillnets were measured as a distance between the middle of two opposite knots of stretched mesh in mm.

2.3. Determination of catch per unit effort (CPUE)

(15) stated that estimation of gear catch and the effort exerted toward such varied from one worker to another due to the difference in the definition of efforts. In artisanal fisheries like the case of Eleyele Lake, CPUE was computed by taking effort to mean the size of the fishing gear (gill net). This implies that, the fishing efforts for gill net is the size of the net based on the total head length and depth (m) of the mounted net used for the fishing operation.

Catch per Unit Effort is equal to Total fish weight (kg) divided by Total efforts (areas) m^2

$$\text{CPUE} = \frac{\text{Total fish weight (kg)}}{\text{Total efforts (areas) } m^2}$$

One bundle is equal to 30 m long multiply by 3 m deep
1bundle = 30 m by 3 m

2.4. Determination of fishing profitability index **(FPI)**

The FPI of gill net is obtained by considering construction cost and total catch values in a life span using (16) formula.

$$\text{FPI} = \frac{C^1 - C^0}{C^1}$$

where, C^1 = predicted catch in a life span

C^0 = construction cost + 10% repair cost

UNDER PEER REVIEW

3. Results

3.1. Fishing gears & methods encountered

A total number of five hundred and thirty nine (539) fishing gears including netting and non-netting gears were encountered within the six sampled areas of the two strata (Table 1). There exist six different groups that can easily be classified into five ISSCFG numbers. Gillnets and traps in classes ISSCFG 0.7.1.0 and 0.8.1.0 had the highest percentages of occurrence respectively, followed by cast nets 22.6% (ISSCFG 0.6.1.0), drag net 0.6% (ISSCFG 0.2.1.0) and long- line (ISSCFG 0.9.0.0), baited 1.6% (ISSCFG 0.9.3.1) and un-baited 0.4% (ISSCFG 0.9.3.2) . Some characteristics of these gears were highlighted in Table 2. It was recorded that gill nets and traps were used widely with clear different in use during the seasons of the year in both strata .Each stratum accounted for 410 and 99 of fishing gears encountered during the period of study. Gill nets dominated and used widely amongst fishing gears in both strata, Stratum 1 with three sampled areas had 159 and Stratum 2 had 33; followed by traps in that order with 135 and 55 respectively. Cast nets were used only in stratum 1, while drag nets and long- line (baited and un-baited) were limitedly used in stratum 1 and 2 respectively .The total number of 192 gill nets were in all the sampled areas with a mean distribution of 64 in the study area. Gill nets of different mesh sizes and twine were regularly in use on the lake .The mesh sizes ranged from 1(25.4mm) to 10 (254mm) and catch distributions for each mesh size are showed in Table 3

Fishing was observed in the lake during the wet and dry season months of January to December. The family cihlidae was most abundant and dominated by *Oreochromis niloticus*, *Tilapia zilli* e.t.c. Table 4 shows the catch selection of the various fishing gears used on the lake. About 10 different species were recorded which fell into five (5) commercially important genera. Tilapia was the most widely selected by all the mesh sizes of gill net both in number and weight stratum by stratum**.**

UNDER PEER REVIEW

3.2. Mesh size selectivity

The catch in each number decreased as the mesh size increased from 2.5 -10 with the exception of mesh size 3.5''. The mesh size 3.5 (89mm) caught the highest number in fish (26.2%) this was followed by the mesh size 2'', 1'', 2''.5'', 3'', 1.5'', 4'', 6'', 5'', 8'', 9'' mesh sizes 7'' and 10'' caught the least number in fish (0.02%) each. The catch in weight also increased with increased in mesh sizes. The 3.5'' mesh size had the highest catch in weight 551.8kg (44.8%) while mesh 7'' had the least catch 9.3g (0.76%) in weight.

3.3. Catch per unit efforts (CPUE)

As mesh sizes increased, average weight of fish caught increased but the number of fish caught decreased. CPUE of the resident water body was 12.93, while stratum 1 and 2 had 3.81 and 22.02 CPUE respectively. Stratum 2 had the highest number of illegal mesh sizes which resulted into low weight value and percentage of 1''- 2'' (Table 5).

3.4. Fishing profitability index (FPI)

The Fishing Profitability index adopted here was based on the cost of producing a unit gear, fishable days in a month, estimated life span of gear and projected revenue expected in a life time. The production cost included total materials cost plus 10% repair cost in a life span. Since the study area is basically artisanal in nature, other ancillary costs such as Vessels, Motorization, and fueling e.t.c were excluded. Gill nets in all sampled areas had FPI ranged from 12.03-12.28, while the highest mean FPI of 12.27 was observed in stratum 2 and mean FPI of 12.23 for the entire gill net fishery in Eleyele Lake (Table 6).

4. Discussion

A detailed analysis of the fishing gears and occurrence stratum by stratum shows that gill net, cast net, Traps and drag net dominated the gear used in stratum 1. In stratum 2 it was Traps, followed by gill net and cast net. The result showed that fishing gear in class ISSCFG 0.7.1.0 comprising of gill net was the commonest gear used. It must be emphasized that the fisher folks of Eleyele Lake are not restricted to the use of just one particular fishing gear alone. They rather tend to combine the use of two or more different types of gear at different fishing periods of the clay.

UNDER PEER REVIEW

In the gill net fishery, the highest catch was in 3 ½'' (89mm) where 1587 fishes caught weighed 551.8kg (44.89%) of the total weight of fish caught (1230kg) (Table 3). However, further analysis showed that the catch of 1" (25.4mm) to 2" (51.8mm) which were the banned mesh sizes in the fisheries edicts of Kebbi and Niger states total 3258 in number and weighing 246.5kg (58.72%) by number and 20% by weight . Mean weight of total fish caught by these illegal mesh sizes being 75.7g. Also, the catch data of $2^{1/2''}$ (64mm) and above was 2807 by number and 983.4kg by weight representing 46.22 and 78 percent of the total number and weight caught respectively. Mean weight of fish caught being 350.3g.

This study had vividly shown that small mesh size in gill net fishery is not only detrimental to the rejuvenation of fish stocked of the resident water body, but it also yield low mean weight of fish caught. Economically, low revenue is fetched in the market since large fish command better/higher price than the smaller ones. However, apart from the resource management consideration for sustainable livelihood, the fisher folks tend to gain immediate advantage for using large mesh size netting by selling their product at a higher price.

The mesh size, which caught the highest catch in weight, was the 3.5'' with fish quantity 551.8kg (44.8%), while mesh 7'' had the least catch 9.3kg (0.76%). The catch weight increased with increased in mesh sizes; an indication of overfishing. The fish catch decreased in number as the mesh size increased from 2.5'' – 10'' with the exception of illegal mesh sizes 1'', 1.5'' and 2''. In this study, the observed inverse relationship between mesh size and fish catch (in number) was in agreement with the earlier works by (17) on Lake Oyan, (18) on Al-Kalakla and Jabel Awlia Dams and (19) in Khartoum State Fisheries. CPUE (weight) increased in value and percentage in 3.5'' but showed a fluctuation between 1'' – 2'', the result that is contrary to the earlier work of (17) on Oyan Lake. As mesh sizes increased, average weight of fish caught decreased. This was in accordance with the observation reported on Kainji Lake by (20).

Gill net fishery of Eleyele Lake had catch per unit effort (CPUE) and fishing profitability index (FPI) of 12.93 and 12.23 respectively. This implies that, gill net with a CPUE of 12.93 can only fetch its production cost about 12.23 times in a life span. This result followed the same trend pattern with earlier work of (20); who reported 9.85 CPUE and 9.39 FPI for gill net fisheries in Kainji Lake. However, Stratum B was more than Stratum A, possibly, because of its ecological

UNDER PEER REVIEW

function as a breeding ground with agglomeration of members of food chain, low fishing intensity in terms of number of fishermen and fishing efforts and complete absence of drag net fishery; the observations that confirmed the findings of (20).

There is no gear that does not have negative impact on the water body. But the level of destruction is a function of the fishing technique and fabrication method that is adopted. (20) identified these to include:

i. Use of legal mesh size for the main panel
ii. Non- regulation of operation frequency, that restricts excessive exploitation of a specific fishing ground

5. Conclusion

The fisheries of Eleyele Lake are mainly artisanal with commercial orientation. There are five types of fishing gear that are currently being used for the artisanal fishery and gill net fishery dominated fishing activities in Eleyele lake. Results from this study showed that outlawed mesh sizes are still prominently used. As a result, an estimated number of 3,258 juvenile fishes may be under intensive exploitation on a daily basis. The use of illegal mesh sizes dominated gill net fishery in Eleyele Lake with highest number in operation, stratum A had low value in terms of weight and economic gain.

The incessant uses of illegal mesh sizes are biologically and economically detrimental to renewable resources and fisher folks. This serious management problem that affects the rate of resource recruitment therefore deserves quick attention of the stakeholders.

Table 1- Distribution of Fishing Gears encountered in Sampled Areas of Eleyele Lake, Ibadan Nigeria

Gear names	Stratum 1 sampled Areas			Sub. Tot.	Sub. Av.	% Av.	Str 2 sampled areas			Sub. Tot.	Sub. Av.	% Av.	Grant Tot.	Av. No.	% Av. No.
	01	02	03				04	05	06						
Gill nets	80	64	15	159	53	38.78	10	09	14	33	11	31.14	192	64	37.9
Cast nets	03	75	35	113	37.7	26.56	-	01	-	01	01	2.83	144	38.7	28.4
Traps	45	80	10	135	45	32.73	31	15	09	55	18.33	51.90	190	63.3	37.5
Drag nets	-	02	01	03	1.0	0.73	-	-	-	-	-	-	03	1.0	0.6
Long – line															
Baited	-	-	-	-	-	-	4	2	2	08	2.66	7.53	08	2.9	1.6
Unbaited	-	-	-	-	-	-	-	01	01	2	1.0	2.83	2	1.0	0.4

UNDER PEER REVIEW

258 **Table 2 – Characteristics of fishing gears used in Eleyele Lake Fishery, Ibadan Nigeria**

Type of Fishing gears (nets).	Local name	Twine	Mesh size (mm)/ Hook number	Operation period	Area of practice
Gill net		Multifilament/	64 up to 254	Day & Night	Deep water
	Simini	Monofilament	25.4 up to 51.8	Day & Night	Deep water
Cast net	Obiliki/ Ahe	Multifilament	38.1 to 64	Day	Deep water & Dam's barrier
Drag net	-	Multifilament	51.8 up to 76	Day	Near shore
Traps	Asabilli	Multifilament	51.8 up to 76	Night	Flooded area/ near shore
Long line					
Baited	Ayanfi	Multifilament	5-8	Day & Night	Deep water
Unbaited	Atada	Multifilament	10-15	Day & Night	Deep water

259
260
261
262
263
264
265
266
267
268
269
270
271

UNDER PEER REVIEW

UNDER PEER REVIEW

Table 3- Distribution of catches (number and weight) for Gill net at varying mesh sizes

Mesh size	Number & weight of Fish	Stratum 1			Stratum 2			Number	% Number	Weight (kg)	% Weight	mean weight (g)
		01	02	03	04	05	06					
1"(25mm)	Number	631	108	-	583	85	-	1407	23.20	85.7	6.92	60.9
	Weight (kg)	51.7	8	-	21.0	5	-					
1.5" (38.1mm)	Number	81	-	235	-	-	45	361	5.95	20.9	1.70	57.9
	Weight (kg)	3.8	-	15	-	-	2.1					
2" (51.8mm)	Number	49	310	-	224	558	349	1490	29.57	139.9	11.38	93.9
	Weight (kg)	9	37.2	-	28.4	34	31.3					
2.5" (64 mm)	Number	159	46	105	-	255	-	565	9.32	54.2	4.41	95.9
	Weight (kg)	18.1	2.0	20.3	-	13.8	-					
3" (76 mm)	Number	150	110	-	90	35	26	411	6.78	117.3	9.54	2854
	Weight (kg)	39.8	24.5	-	35.0	10.0	8.0					
3.5" (89mm)	Number	-	146	-	18	89	1334	1587	26.17	551.8	44.89	347.7
	Weight (kg)	-	23.8	-	3.0	45.0	480					
4" (102.1mm)	Number	91	42	12	30	-	-	175	2.89	64.2	5.22	367
	Weight (kg)	32.8	14.1	4.3	13	-	-					
5"(127mm)	Number	-	5	4	-	2	-	11	0.18	44.7	3.64	4064
	Weight (kg)	-	30.6	9.9	-	4.2	-					
6" (152.4mm)	Number	22	-	18	-	-	9	49	0.81	67.1	5.46	1369.4
	Weight (kg)	33	-	19.1	-	-	15					
7" (178mm)	Number	1	-	-	-	-	-	1	0.02	9.3	0.76	9300
	Weight (kg)	9.3	-	-	-	-	-					
8" (203mm)	Number	-	-	-	4	-	-	4	0.07	17.2	1.39	4300
	Weight (kg)	-	-	-	17.2	-	-					
9" (229.1mm)	Number	-	-	3	-	-	-	3	0.05	27.6	2.25	9200
	Weight (kg)	-	-	27.6	-	-	-					
10" (254mm)	Number	1	-	-	-	-	-	1	0.02	30	2.44	30000
	Weight (kg)	30	-	-	-	-	-					
TOTAL								**6065**	**100**	**1229.9**	**100**	**59541.2**

Table 4- Percentage weight and number of each species caught by Gillnets in all sampled areas

Genera	Yields (kg)	% number	% weight	Differential weight (gm)
Tilapines	415.3	57.7	33.8	118.7
Characins	188.2	29.9	15.3	103.8
Lates spp	305.8	5.4	24.9	929.5
Catfishes	104.7	1.7	8.5	1016.5
Gymnarchus spp	2163	5.3	17.5	675.8
Total	1230	100	100	2844.3

Source: Field Survey, 2016

UNDER PEER REVIEW

Table 5 – Catch per unit effort (CPUE) for Eleyele Lake Gillnet fishery

Stratum	Sampled areas	Fish weight (kg)	Total efforts	Mean effort	CPUE	
	01	227.5	20, 000	250	2.84	
1	02	140.2	11, 200	175	2.19	3.81
	03	96.2	3, 000	200	6.41	
2	O4	117.6	1000	100	11.76	
	05	112.0	735	105	16.00	22.02
	06	536.4	1050	75	38.31	

Source: Field Survey, 2016

Gill net Mean CPUE for the two strata = 12.93

UNDER PEER REVIEW

UNDER PEER REVIEW

Table 6: Fishing Profitability Index (FPI) for Eleyele Lake Gill net Fishery

Stratum	Sampled Areas	Fishable days /month	Catch value #	Total effort (m)	mean effort (m)	Est. life span in months	Catch value/ unit gear #	Pr. Cost/ unit gear	Proj. Earning in life span	Est. FPI	
1	01	22	36, 000	20, 000	250	18	450	13,430.50	178, 200	12.28	
	02	22	20, 160	11, 200	175	18	315	9, 401.35	124, 740	12.27	**12.19**
	03	22	5, 400	3000	200	18	360	10, 744.40	142, 560	12.03	
2	04	22	1800	1000	100	18	180	5, 375.20	71, 280	12.26	
	05	22	1323	735	105	18	189	5, 640.81	74, 844	12.27	**12.27**
	06	22	1890	1050	75	18	135	4, 029.15	53, 460	12.27	

Source: Field Survey, 2016

Est. life span = Estimated life span **Mean FPI for the two strata = 12.23**

Pr. Cost/ unit gear = Projected cost/ unit gear

Proj. Earning in life span = Projected Earning in life span

Est. FPI = Estimated fishing profitability index

UNDER PEER REVIEW

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