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Frame survey and catch assessment of the fisheries of Gurara Dam, Kaduna State, Nigeria

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Abstract
Frame survey and catch assessment of the fisheries of Gurara Dam were conducted from March to September, 2016 to provide technical information for sustainable fish production. Fish caught by each fisher randomly sampled were identified and sorted according to species and the gear type used. Data were then recorded and analysed with descriptive statistics. A total of 33 fishers, eight assistants, 85 wooden canoes, 20 motorised wooden canoes and four gourds were identified. 11 fish species belonging to seven families were also identified. The family *Cichlidae* dominated the catch contributing 91.8% to the number and 89.4% to the weight of the total fish caught while *Cyprinidae* was the least. The current fish yield estimate of Gurara dam is 42.84 tonnes. This represents 6.7kg/ha and considered very low. Majority of the fish caught were small and a large number of fishers were operating on the dam. Effective management strategies were recommended.

Keywords: Frame survey, Catch assessment, Fisheries, Fishing gear, Analysis, Fish yield.

1. Introduction
Freshwater fisheries provide benefits such as food to the people in developing countries. They provide a livelihood and income for millions of the world's poorest people, and also contribute to the overall economic wellbeing of many developing countries by means of export commodity trade, tourism and recreation (World-Fish Centre, 2002) [1]. Nigerians are high fish consumers with total consumption figures of about 1.5 million metric tonnes, out of which about 700,000 metric tonnes is imported (FAO, 2000) [2]. The total fish demand for Nigeria based on the 2014 population estimate of 180 million is 3.32 metric tonnes. The domestic fish production from Aquaculture, Artisanal and Industrial fisheries for 2014 is 1.123 metric tonnes (FDF, 2016) [3]. While the demand for fish keeps growing in Nigeria, the production of fish in the country is declining. Therefore, there is a strong need of information on the fisheries of Gurara dam. Detailed frame and catch assessment of the fisheries of dam have not been carried out since its impoundment. However, the potential for fisheries observed on the dam during the frame survey can be explored through the generation and analysis of frame and catch data from the dam to provide current information for sustainable management and development of its fisheries, and also contribute to the annual fish production in Nigeria. It is in view of this that the study seeks to determine the size and distribution of fishing localities, fishers, fishing crafts and fishing gears and also assess the catch composition, species abundance, distribution, diversity and the current fish yields.

2. Materials And Method
2.1 Study Area
Gurara dam is located in Kachia Local Government Area of Kaduna State. The dam is built on the Gurara River near Abuja, the capital of Nigeria. It is located between latitude 9˚38' and 9˚46'N and longitude 7˚42' and 7˚48'E. The dam with capacity of 880 million m^3 has a surface area of 64 square kilometres and an average depth of 53m. The dam was impounded in 2007 by Salini Company for water supply, hydropower and irrigation. However, the dam created another opportunity in fisheries that attracted fishers from Tunga mallam, Atara and Anturu that bordered the dam.

2.1.2 Data Collection
The collection of data was done over the period of six months from March to September,

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2016. Data were collected from the three fishing villages (Tunga Mallam, Anturu and Atara) using structural questionnaires and interviews with 20 randomly selected fishers including the Chief Fisherman for frame survey. Total count and listing of all the fishing villages, fishers and fishing equipment operating on the dam were made. During the catch assessment, fishers' catches at landing sites were also assessed (plates 1 and 2). Fish caught by each fisher randomly sampled were identified using Idowu-Umeh (2003) [4] method of fish identification and sorted according to species and the gear type used. They were counted and their weights taken using weighing balance and recorded on data sheet. The landing prices of all the fish species identified were also recorded.

Plate 1: Fisher landing with his catch

Plate 2: Fisher's catch in a canoe

3. Results And Discussion
3.1 Frame Survey
There are three fishing villages around the dam, Tunga Mallam, Anturu and Atara. Table 1 shows the distribution of the fishers, their fishing crafts and gears. A total of 80 fishers with 62 assistants were counted and recorded. A total of 33 fishers and eight assistants were recorded in Tunga Mallam, 27 fishers and 49 assistants in Anturu and 20 fishers and 5 assistants in Atara. This revealed that 142 fishers and assistants from the three fishing villages were operating on dam. With surface area of 64km², only 128 fishers should have been registered to fish in the dam. Henderson and Welcomme (1974) [5] recommended a density of two fishers per square kilometre.

A few numbers of the fishers are full-time fishers. Throughout the 80's research has demonstrated that half of the fishermen's population is engaged in other jobs conforming to a well known pattern of occupational multiplicity (Valdez-Pizzini, 1990) [6]. In comparison with the rest of the fishers, all part-time fishers operating on Gurara dam are not exclusively devoted to fishing as economic activity. They also engaged in other farming activities as means of their livelihood.

There were 85 wooden canoes without engines, 20 motorised wooden canoes and four gourds counted and recorded. Those fishers who used motorised wooden canoes fished far away from the shores of the dam and their catches are higher than the fishers that mostly fished close to the shores with un-motorised wooden canoes.

The fishing gears recorded include 293 gill nets, 30 cast nets, 215 long-lines and 145 Malian traps. Gill nets were the most used fishing gear by the fishers. The gillnet method is widely used in artisanal fisheries in developing countries because they are efficient, relatively in-expensive and capable of catching higher amount of commercially valuable species than other fishing gears (Valdez-Pizzini *et al.*, 1992)[7]

3.1.2 Catch Assessment
Table 2 reveals species caught based on number and weight during the six month sampling periods. A total of 1740.3 kg was recorded from Tunga Mallam, followed by Anturu 1269.4kg and Atara 501.12 kg. In terms of number, Tunga Mallam, Anturu and Atara recorded 17863, 21837 and 5144 respectively. Tunga Mallam had the highest catch both in terms of number (17863) and weight (1269.4 kg).

Table 3 shows the species occurrence, their relative abundance and the mean weight on Gurara dam. A total of 11 species from seven families were recorded in the fishers' landings during the sampling periods. The species composition of the fishers' catch remained relatively stable throughout the period of the assessment.

The family *Cichlidae* dominated the catch contributing 91.8% to the number and 89.4% to the weight of the total fish caught during the assessment. *Cyprinidae* was the lowest in terms of number (0.04%) and weight (0.3%) overall.

Others are *Alestidae*, 2.17% in terms of number and 9.82% in terms of weight; *Clariidae*, 0.53% in terms of number and 13.5% in terms of weight; *Hepsidae,* 0.47% in terms of number and 6.1% in terms of weight.

The rest are *Momyridae*, 0.59% in terms of number and 5.41% in terms of weight and *Schilbeidae*, 4.45% in terms of number and 27.2% in terms of weight overall.

Tilapia zillii dominated other species of *Cichlidae* in terms of number and weight contributing 72.6% and 70.1% to the number and weight respectively of the total cichlidae caught. This was followed by *Oreochromis niloticus* and *Sarotherondon galilaeus.*

In terms of species diversity, *Cichlidae* had the highest diversity with 5 species, Alestidae (2), *Mormyridae* (2), *Clarridae* (1), *Cyprinidae* (1), *Hepsetidae* (1) and *Schilbeidae* (1).

The mean sizes of fish revealed that majority of the fish caught were small. This is evident in the fishers' catches earlier observed and can be attributed to the mesh sizes below 3 inches (76.2mm) used by most fishers that are against the recommended size for inland water bodies. A minimum mesh size of 3inches (76.2 mm) has been recommended for gill net fishing (Ita, E.O, 1982) [8]

Table 4 shows catches by gill nets, cast nets, long-lines and traps from Gurara dam. Majority of the catches was from mesh 63.5 mm in terms of number (40.5%) overall. This

shows that mesh sizes below 76.2 mm catch small sizes of fish which was also observed in the fishers' catches. Fish traps had the least catch in terms of number (1.8%) overall. Figure1 reveals catch by gill nets, cast nets, long-lines and traps based on weight from Gurara dam. Majority of the catches were from mesh 63.5 mm in terms of weight (46.7%) overall. Fish traps had the least catch in terms of weight and accounted for 0.7% of the total catch. There are declining catch rates in the more traditional trap fishery, and a re-direction of effort toward the use of gill net over fish traps (Matos and Sadovy, 1990) [9].

3.1.3 Approximate Estimate Of Current Fish Yields

Catches by gillnets, long-lines, cast nets and traps from the dam were examined during the six month sampling periods. The catch per unit effort (CPUE) was 11.9 kg per fishing day and average of 12 boats were operated per day. In an interview with fishers, the fishing activities take place about 25 days in a month. According to Abiodun *et al.* (2003) [10],

an approximate yield was therefore calculated.

Total catch = Total fishing effort * Catch per unit effort......1

But Fishing effort = Fcap * BAC * A....................................2

Where Fcap = Fishing capacity (the total number of fishing boats that are potentially operating at all fishing sites)

BAC = Boat Activity Coefficient (the probability that any boat will be active on any day during the month)

A = A raising time factor expressing total number of days that fishing activities take place during the month.

From equation (2) above, Fishing effort = 105 *12/105 *25 = 300 boat days. Hence, the total catch = 300 *11.9kg = 3570 kg/month

Total catches for the period of six months= 3570*6=21420 kg

Current Annual fish yield of Gurara Dam = 3570 *12 =42840 kg = 42.84 tonnes. This figure represents 6.7kg/ha and considered very low in comparison with other similar Nigerian water bodies like Bakolori Reservoir in Sokoto State with 32 kg/ha (Ita, E.O., 1993) [11]

Table 1: Frame data showing the village names, distribution of fishers, fishing craft sand gears on Gurara dam.

Village Name	Fishers	Assist	MC	CE	Gourd	GN	CN	LL	TR
Tunga Mallam	33	8	33	4		122	1	27	50
Anturu	27	49	36	15		115	14	103	55
Atara	20	5	16	1	4	56	15	85	40
Total	80	62	85	20	4	293	30	215	145

Note: Assist=*Assistant*, Motorised canoe, CE=*Canoe without engine,* GN =*Gill net*, CN =*Cast net*, LL =*Long-lines* and TR =*Fish traps*

Table 2: Species caught based on number and weight during the sampling periods

Species	Tunga Mallam		Anturu		Atara	
	No	Wt(kg)	No	Wt(kg)	No	Wt(kg)
Alestidae baremose	570	48.6	203	1.96	68	5.9
Micralestes elongatus	126	2.4	0	0.059	0	0.0
Oreochromis niloticus	2329	248.0	2895	166	710	60.9
Sarotherondon galilaeus	1036	107.0	1235	67	303	25.2
Tilapia Zillii	11933	1180.6	16600	928.7	3693	353.4
Clarias gariapinus	45	21.0	110	34.5	78	25.5
Barbus occidentalis	18	1.8	0	0	0	0.0
Hepsetus odoe	26	9.0	131	21.8	53	5.8
Mormyrus rume	66	21.0	12	4.84	0	0.0
Marcusenius isidori	180	6.7	0	0	0	0.0
Schibe mystus	1534	94.3	201	44.5	239	24.4
Total	17863	1740.3	21387	1269.4	5144	501.12

Table 3: Fish composition, abundance and mean weight on Gurara dam

Family/Species	No	% No	Wt(kg)	% Wt	Mean weight
Alestidae					
Alestidae baremose	840	1.89	56.46	1.61	0.07
Micralestes elongatus	126	0.28	2.46	0.07	0.02
Cichlidae					
Oreochromis niloticus	5934	13.37	474.6	13.52	0.08
Sarotherondon galilaeus	2574	5.80	199.8	5.69	0.08
Tilapia Zillii	3226	72.59	2462.4	70.14	0.08
Clariidae					
Clarias gariapinus	234	0.53	81	2.31	0.35
Cyprinidae					
Barbus occidentalis	18	0.04	1.8	0.05	0.10
Hepsetidae					
Hepsetus odoe	210	0.47	36.6	1.04	0.17
Mormyridae					
Mormyrus rume	78	0.18	25.8	0.73	0.33
Marcusenius isidori	180	0.41	6.66	0.19	0.04
Schilbeidae					
Schibe mystus	1974	4.45	163.2	4.65	0.08
Total	44394		3510.78		

Table 4: Fish abundance in gill net, cast net, and longline catches from Gurara dam

Gear	GN	GN	GN	GN	GN	GN	GN	GN	CN	CN	CN	LL	TP
Mesh/Hook Size(mm/no)	31.75	38.1	50.8	57.15	63.5	76.2	88.9	101.6	19.06	25.4	38.1	No.6	63.5
No of fish caught	1890	1128	4260	2454	17958	3258	546	912	2778	1518	6700	192	800
Percentage	4.3	2.5	9.6	5.5	40.5	7.3	1.2	2.1	6.3	3.4	15.1	0.4	1.8

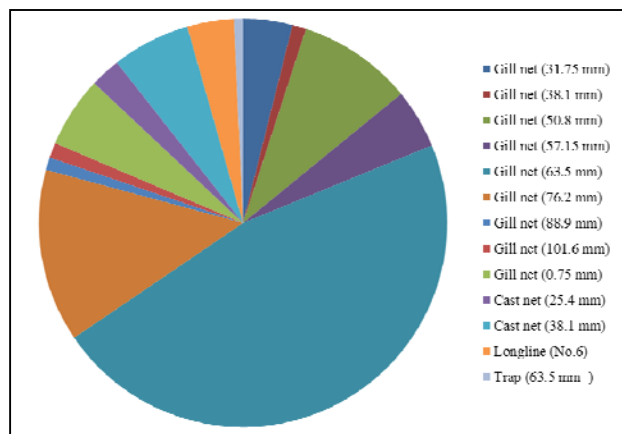**Note**: GN=Gill net, CN=Cast net, LL=Long-line, TP= Fish trap, mm=millimetre, no.=number

Fig 1: Percentage of fish caught by gill net, cast net long line and fish trap based on weight from Gurara dam

4. Conclusion And Recommendation

The current fish yield estimate of Gurara dam is 42.84 tonnes. This figure represents 6.7kg/ha and considered very low in comparison with other similar Nigerian water bodies like Bakolori Reservoir in Sokoto State with 32 kg/ha (Ita, E.O., 1993) [11]. It is important to restock the dam with fingerlings of indigenous species to enhance its productivity because of the low production per hectare observed.

The mean sizes of fish revealed that majority of the fish caught were small which is evident in the fishers' catches. This is attributed to the mesh sizes below 3 inches (76.2 mm) used by most fishers that are against the recommended size for inland water bodies. A minimum mesh size of 3 inches (76.2 mm) has been recommended for gill net fishing (Ita, E.O., 1992)[8].This should therefore be enforced to allow effective growth of all the fish species before exploitation.

The study revealed that 142 fishers and assistants from the three fishing villages were operating on dam. This can be attributed to the dam's low fish production. With surface area of 64km2, only 128 fishers should have been registered to fish in the dam. Henderson and Welcomme (1974) [5] recommended a density of two (2) fishers per square kilometre.

It is also important to restock the dam with the following fish species: *Bagrus docmark*, *Clarias gariapinus*, and *Distichodus rostratus* to increase the species diversity and reduce the fishing pressure on the few available species.

Effective management strategies including the ban on the use of mesh sizes below 76.2 mm and the registration and licensing of fishers should be enforced for sustainable management and development of its fisheries.

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