# ASSESSMENT OF FISHING GEAR YIELDS OF JEBBA LAKE, NIGER STATE, NIGERIA

**Abstract**

In a bid to update the fishing activities of Jebba Lake, North-Central Nigeria, a team of researchers set out on a survey of the area with an objective to estimating the catch per unit effort (CPUE) of the various fishing gears deployed on the Lake. Three important fishing communities (Faku, Awuru and Gbajibo) were visited, in October 2021 and March of the following year, where six fishing gears namely, gillnet, driftnet, longline, *malian* trap, castnet and *atalla* liftnet were encountered. Their number, rigging pattern, specifications, fish target and quantity of fish captured by the gear within the study period were noted and recorded. The gillnet was more common with a percentage occurrence of 49.2%, driftnet 16.9%, traps and longline 15.1% each and cast nets having the least of 3.8%. Also, a total of 41 fish species were identified during the study period, with 38, 23 and 22 species identified at Awuru, Faku and Gbajibo respectively. Total fish catch by gear within the study period was 422.4 kilogram (kg) for gillnets, 173.7 kg for longlines, 150.8 kg for traps, 64.0 kg for castnets and 61.5 kg for driftnets. Furthermore, the average CPUE (kg/manhour/day) of each gear was computed and found to be 0.3819, 0.5277, 0.4495, 0.6070 and 2.3357 for gillnets, driftnets, *Malian* traps, longlines and castnets respectively; implying cast nets to have the optimum CPUE over the other gears.

**Keywords**: Jebba Lake, Faku, Awuru, Gbajibo, CPUE, Fishing time, Man-hour

**Authors**

**Ago N. D**
Head of Fisheries Statistics Programme
Department of Artisanal Fisheries
National Institute for Freshwater Fisheries Research (NIFFR), P.M.B. 6006, New Bussa, Nigeria.

**Abiodun J. A**
Director of Research Operations
NIFFRNew Bussa
Nigeria.

**Tanko U.M**
Fisheries Statistics Programme
Department of Artisanal Fisheries
NIFFR New Bussa
Nigeria.

**Mohammed S**
Fishing Gear & Craft Programme
Department of Artisanal Fisheries
NIFFR, New Bussa
Nigeria.

**Haruna M. K**
Fish Biology & Management Programme
Department of Artisanal Fisheries
NIFFR, New Bussa
Nigeria.

**Muhammad N**
Fisheries Statistics Programme
Department of Artisanal Fisheries
NIFFR, New Bussa,
Nigeria.

## I. INTRODUCTION

Nigeria is endowed with over 14 million hectares of inland water bodies which could produce over 980,000 metric tons (Mt) of fish annually (FDF, 2007). According to FAO (2000), Nigeria is a high consumer of fish with total consumption figure put at over 1.5 million metric tons (MMt) per year, and 700,000 Mt of fish were imported. The total fish demand for Nigeria based on the 2014 population estimate of 180M was 3.32MMt. The domestic fish production from Aquaculture, Artisanal and Industrial fisheries for 2014 was 1.123MMt (NBS, 2017). Also, in 2014, fisheries contributed 0.48% to the Agriculture GDP and contribution of Agriculture to GDP (2014) was 20.24% (FCWC, 2018). Fisheries as a major sector of the economy is estimated to employ over 8.6 million people directly and a further 19.6 million indirectly, 70 percent of whom are women. Currently, Nigeria produces just over 1MMt of fish, leaving a deficit of over 800,000Mt, which is imported annually (WorldFish, 2018). The massive importation of frozen fish has ranked Nigeria the largest importer of this product in Africa. These statistics indicate that the demand for fish in Nigeria clearly exceeds what is supplied.

Jebba Lake is part of Nigeria's 14 million hectares of inland water bodies. The Lake is located in the North central zone of Nigeria and covers an area of approximately 303 $km^2$ (Abiodun, 2009). With proper management, the Lake will not only improve the livelihood of the fishers and the riparian communities but contribute to sufficiency of fish production and supply in Nigeria. Several studies had been conducted on the Lake. These includes Abiodun *et. al* (2010) on Estimation of Maximum Sustainable Yield of Jebba Lake.

Catch per unit effort (CPUE) is adopted all over the world to evaluate or assess fisheries population as well as forecasting fluctuation in various water bodies. When fisher's catch is high, it means there is relatively high abundance of fish population and vice versa. CPUE is influenced by catchability and fishing efficiency. Catchability indicates the relationship between catch rate and actual population of the stock (Ghosh and Biswas, 2017). Fishing efficiency on the other hand defines changes in fishing practices. Efficiency varies based on gear type, habitat and among fish sizes of the same species. It is therefore important to note that CPUE is an index of population in relation to fishing gear (Maunder *etal*., 2006). This means that catch by a set of gear in unit time is dependent on the species and on the gear. The quantity of fish harvested or caught per trip is usually as a result of the type of fishing gear used, its design characteristics and targeted species.

The main objective of the present study is to highlight the gears in used on Jebba Lake and examine fish yield per gear type and thus the efficiency of the gear.

## II. Materials and Method

1. **Study Area:** Jebba Lake lies between latitude $9^o$ 10'N to $9^o$ 55'N and longitude 4 $^o$ 30'E to 5'E. Three fishing communities of the lake (Faku, New Awuru and Gbajibo) were selected based on their importance to fisheries activities and were visited as the study sites. Fakun at the upper region of the lake, New Awuru at the mid-region and Gbajibo at the lower region of the lake

 

respectively (Figure 1). These communities/sites are destinations for a significant number of migrant fishers involved in a variety of fishing activities.

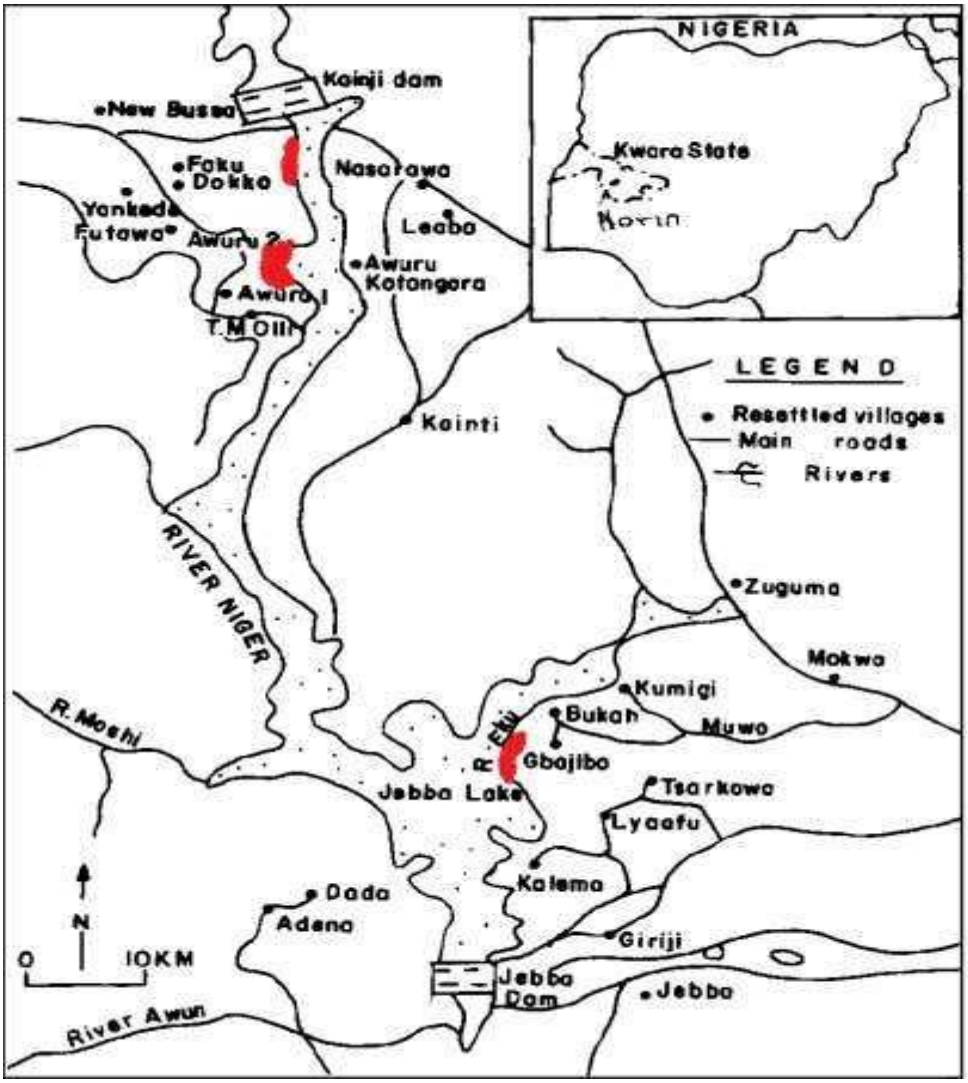


**Figure 1:** A Map of Jebba Lake Showing Study Sites (Modified After Downloading from google.com on 27-03-2023)

2. **Fish Sampling and Analysis:** Fish landings from artisan fishers that used wide range of fishing gears were assessed in October 2021 for the rainy wet season and March 2022 for dry season. The catches were sorted and identified to species levels, using taxonomic keys and guides as provided by Olaosebikan and Raji (2021) and Idodo- Umeh (2003). The identified species were also sorted according to the gear used in catching them. They were counted and their weights and numbers were noted. Data so collected were used to compute the CPUE.

3. **Computation of Catch Per Unit Effort:** In this study, gear-wise CPUE for fish caught per unit hour of operation was calculated by dividing the total sampling gear catch in biomass, which is the observed weight in kilogram of fish caught by a particular gear, by total sampling effort

 

hours (Fishing Effort). Fishing Effort is calculated as the product of average sampling effort hour of operation of a particular gear per day (Total Man-Hours) and total numbers of such gear used, i.e. sampling gear density.

Total Man-Hour = (Mean Crew per canoe per day) x (Fishing time)

Fishing Effort = Total No. of gear x Total Man-Hours/24hr [man-hours/day]

$$\text{Catch per Unit Effort} = \frac{\text{Total Weight of Fish Landed by Gear type}}{\text{Fishing Effort}} \quad \text{[Kg/man-hours/day]}$$

(Gracia 1984, Pauly 1984, Otubusin 1990 and Ago, 2019)

## III. RESULTS

1. **Fishing Gears encountered and their Description:** Six different fishing gears are mainly used by fishers to carry out their fishing operations. These are gill nets, drift nets, longlines, lift nets, traps and cast nets.

- **Gillnet:** Gillnet, locally known as *taru hako*, is classified with code number **07.1** under the Gilling and Entangling net of the International Standard Statistical Classification of Fishing Gear (ISSCFG, 2016). The use of this gear was observed both in October and March. The use of cork as floaters and lead as sinkers are a rarity on the lake. However, pieces of Styrofoam and pebbles are used by the fishermen as floaters and sinkers respectively. Both monofilament and multifilament netting materials with a mean length of 92±3.1 meters (m); mean depth of 3.4±0.6 and mean mesh size of 82.6±1.2 millimeters (mm) were recorded on the selected sites. The multifilament gillnet had a twine thickness of ply 18±9; Fishes caught by this gear include *Citharinus citharus, Synodontis sp, Hydrocynus fuskali, Alestes sp, Labeo sp, Oreochromis niloticus, Bagrus sp, Gymnarchus niloticus, Mormyrus sp* etc. The number and weight of catch varied in October and March significantly.

- **Drift Net:** Drift net is locally known as *taru duru*. It is classified with code number **07.2**, according to ISSCFG (2016). *Duru* is a gillnet but operated in an active manner by drifting or moving it across the water usually against water current. The net is operated in both shallow and deep water that is free of stumps. The net is majorly operated by two fishermen each on a boat holding the opposite ends of the gear after setting it in water and dragged at the same time to haul the fish caught. The drift nets encountered are made of polyamide multifilament netting materials with length 50±10m. The mesh size range 60.4±1.4mm with a combination of ply 3 and ply 6 twine thickness. Fishes targeted by this gear includes *Alestes sp, Hydrocynus fuskali, Citharinus citharus, Synodontis sp, Clarotis laticeps, Chrysichthys sp, Schilbeid sp, Labeo sp, Distichodus rostratus, mormyrus sp, Brycinus sp* etc.

 

- **Traps:** *Malian* traps are passive fishing gears classified under code **08.9** of the ISSCFG (2016). *Malian* traps, locally called *gura*, are conical in shape and are mostly set in shallow waters to allow fishes enter voluntarily and will be hampered from escaping. The traps encountered on the lake are made with local materials which are cheap and readily available. Seventy per cent of the traps are usually baited with rice bran or corn offal, others are unbaited. The unbaited traps are usually set along water channels where fish enter freely without been lured by a bait. The baited traps are usually set at the bottom of water in all the three sampled locations to catch demersal fish species. The *Malian* traps encountered are conical in shape with average height between 0.8±0.5m; entrance valve length of 25.1±6.0cm while valve diameter is 180±20mm. Fishes targeted by the *Malian* traps of Jebba Lake include *Sarotherodon galilaeus, Oreochromis niloticus, Coptidon zillii, Bagrus spp, Mormyrus rume, Synodontis spp, Malapterurus electricus* e.t.c.

- **Long Line:** Long line, locally known as *kugiya* or *mari-mari*, *depending* on location, is a passive gear with large number of hooks which can be used as either baited or un-baited. It is classified under the ISSCFG code number **09.39**. The longlines encountered in this study are baited and are used to target fish species such as *Auchenoglanis occidentalis, Synodontis schall, Mormyrus rume, Mormyrups anguilloides, Gnathonemus tamandua, Bagrus sp, Chrysichthys sp Citharinus citharus, Synodontis sp* e.t.c. The range of hook size used was 9 – 18 with a mean of 13.2 while the type of baits used by fishermen on the water body include small live fishes, earthworm (locally called *tana*) and washing soap. The mainline length of the long line length is 80±20m and snood lines distance are 270±30mm. The number of snood lines ranges from 100 to 1000, which is equivalent to the number of hooks attached to the long line. The mainline is made of ply 18 – 30 netting twine and snood line is made of ply 9 – 12 netting twine and the twine twist of both the main and snood line is Z-twist.

- **Lift Nets:** A common type of lift net locally known as *atalla*, was observed at Faku. This is an active gear which is operated from the side of canoes, mainly by migratory Ijaw fishers. It is classified under the ISSCFG code number **05.39**. *Atalla* is made from raffia palm poles which are arranged to make a square of 5m.

The net is usually made of the smallest mesh size available, generally about 10mm or less. *Atalla* mainly targets the two-clupeid species (*Pellonula afzeliusi* and *Sierrathrissa leonensis*) usually available at thesurface of the wate. Live or freshly caught clupeid were not sighted by the researchers. However, processed clupeid was encountered at Fakun and Gbajibo indicating that clupeid fishery, usually carried out at night, is available at these locations.

2. **Fish Catch Composition:** Apart from clupeid, a total of 41 fish species belonging to 16 families were identified during the study period. These are presented in Table 1. Multiple species were encountered at all study sites.

 

**Table 1: Checklist of fish species on Jebba Lake in October 2021 (Oct) and March 2022 (Mar)**

| Family /Species | English/Common Name | Study site/Season | | | | | |
|---|---|---|---|---|---|---|---|
| | | Faku | | Gbajibo | | New Awuru | |
| | | Oct | Mar | Oct | Mar | Oct | Mar |
| Alestidae | | | | | | | |
| *Alestes baremose* | Silversides | x | x | | x | x | x |
| ***A.** Dentex* | Characin | | | | | x | |
| *Brycinus macrolepidotus* | True big-scale | | | | | x | |
| ***B.** Nurse* | Nurse tetra | | | | x | x | x |
| *Hydrocynus forskalii* | Tiger fish | x | x | x | | x | x |
| Bagridae | | | | | | | |
| *Auchenoglanis occidentalis* | Bubu | | x | x | x | x | x |
| *Bagrus bayad* | Bayad | x | x | x | | x | x |
| *B. Docmac* | Silver catfish | | x | | x | x | |
| Cichlidae | | | | | | | |
| *Oreochromis niloticus* | Nile tilapia | | x | x | x | x | x |
| *Sarotherodon galilaeus* | Mango tilapia | x | x | | x | x | x |
| *Coptidon zillii* | Redbelly tilapia | | x | x | x | x | x |
| Citharinidae | | | | | | | |
| *Citharinus citharus* | Moon fish | x | | x | | x | |
| Channidae | | | | | | | |
| *Parachanna obscura* | Snakehead | | x | | x | x | x |
| Clariidae | | | | | | | |
| *Clarias anguillaris* | African catfish | | | x | x | | x |
| *C. Gariepinus* | A. Catfish | | | | | x | |
| *Heterobranchus bidorsalis* | A. Catfish | x | | | | x | |
| Clarotidae | | | | | | | |
| *Chrycsichthys auratus* | Wide-head catfish | x | | x | x | | |
| *C. Nigrodigitatus* | Wide-head catfish | x | x | x | x | x | x |
| *Clarotes laticeps* | Wide-head catfish | | x | x | | x | |
| Cyprinidae | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Labeo senegalensis* | African carp | x | | x | x | x | x |
| *L. Coubie* | African carp | x | | | | x | |
| Distichodontidae | | | | | | | |
| *Distichodus rostratus* | Grass-eater | x | | | x | x | x |
| Latidae | | | | | | | |
| *Lates niloticus* | Nile/Niger perch | x | x | x | x | x | x |
| Malapteruridae | | | | | | | |
| *Malapterurus electricus* | Electric catfish | | | x | | x | |
| Mochokidae | | | | | | | |
| *Synodontis euptera* | Squeaker | | | | | x | |
| *S. Gambiensis* | Squeaker | | | x | | x | |
| *S. Membranacea* | - | x | | x | | x | |
| *S. Ocellifer* | Squeaker | | | | | x | |
| *S. Shall* | Squeaker | x | x | x | x | x | x |
| *S. Sorex* | - | x | | | | x | |
| Mormyridae | | | | | | | |
| *Gnathonemus abadii* | - | | | x | | x | |
| *Hyperopisus bebe* | - | x | | x | | x | |
| *Mormyrops angulloides* | Cornish jack | x | x | x | x | x | x |
| *Mormyrus rume* | Trunk fish | x | x | x | x | x | x |
| *Gnathonemus* | Elephant nose | | | | x | x | |
| *senegalensis* | | | | | | | |
| *Campylomormyrus tamandua* | Worm jawed mormyrid | | | | | x | |
| Osteoglossidae | | | | | | | |
| *Heterotis niloticus* | African bony tongue | x | | x | | | |
| Schilbeidae | | | | | | | |
| *Parailia pellucida* | Glass catfish | x | x | | | x | |
| *Shilbe intermedius* | Silver catfish | x | x | | x | x | |
| *S. Mystus* | Butter catfish | x | | | | x | |
| Tetraodontidae | | | | | | | |
| *Tetraodon lineatus* | Poffer fish | x | | x | | x | |
| Total number of species caught by season at each study site | | **23** | **17** | **22** | **19** | **38** | **17** |
| Total number of fish species caught = 41 | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Species Diversity Index (SDI) at each location | **0.56** | **0.71** | **0.54** | **0.79** | **0.93** | **0.71** |

Note: x ≈ indicates occurrence of species

3. **Fish Catch by Gear:** Table 2 shows the number of gear type and weight in kilogram (kg) of fish caught by the gear both in the wet and dry seasons. A total of 1,774 gill nets gave a catch of 422.4 Kg which is 48.4% of the total catch by weight. The catch is followed by longlines 19.9% and traps, 17.3%. Cast nets and Drift nets are 7.3% and 7.0% respectively.

**Table 2: Fish Yields [Number and Weight in Kilograms] by Gear Type from Fishers of Jebba Lake**

| Location | Season | Gill Net | | Drift Net | | Traps | | Long Line | | Cast Net | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No | Wt | No | Wt | No | Wt | No | Wt | No | Wt | No | Wt |
| Fakun | | 133 | 54.1 | 75 | 6.9 | 5 | 0.9 | 33 | 9.4 | - | - | 246 | 71.3 |
| Awuru | Wet | 228 | 63.7 | 222 | 23.2 | 111 | 66.2 | 212 | 74.2 | 33 | 16.4 | 806 | 243.7 |
| Gbajibo | | 562 | 101.8 | - | - | 83 | 5.3 | 60 | 25.1 | - | - | 705 | 132.2 |
| Fakun | | 123 | 50.0 | 79 | 7.2 | 5 | 0.9 | 13 | 9.6 | 43 | 17.6 | 263 | 85.3 |
| Awuru | Dry | 210 | 58.8 | 232 | 24.2 | 251 | 71.8 | 184 | 33.0 | 23 | 13.6 | 900 | 201.4 |
| Gbajibo | | 518 | 94.0 | - | - | 89 | 5.7 | 43 | 22.4 | 38 | 16.4 | 688 | 138.5 |
| Total | | 1774 | 422.4 | 608 | 61.5 | 544 | 150.8 | 545 | 173.7 | 137 | 64.0 | 3608 | 872.4 |
| %age | | 49.2 | 48.4 | 16.9 | 7.0 | 15.1 | 17.3 | 15.1 | 19.9 | 3.8 | 7.3 | | |

**Note:**

Percentage = $\frac{\text{Total (No. or Wt.) of fish catch from the Gear}}{\text{Total (No. or Wt.) of fish catch by all the gears}} \times 100$ (Ago, 2019)

Table 3 shows computed data for fishing effort and catch per unit effort of fishing gears in the artisanal/commercial fishery of Jebba Lake. Parameters monitored include the mean crew per canoe (boat) and average fishing time for each gear.

**Table 3: Total Fish Catch, Fishing Time, Fishing Effort and Catch per Unit of Effort of Jebba Lake**

| | Total No. of gear sampled | Total Weight(kg) of fish Landed | Mean Crew per canoe per day | Fishing Time (hr/day) | Total Man-Hours | Fishing Effort (man-hr/day) | Catch per Unit Effort (kg/man-hr/day) |
|---|---|---|---|---|---|---|---|
| **Gill net** | 1774 | 422.4 | 1.1 | 13.6 | 14.96 | 1,105.79 | 0.3819 |
| **Drift net** | 608 | 61.5 | 2.0 | 2.3 | 4.60 | 116.53 | 0.5277 |
| **Trap** | 544 | 150.8 | 1.0 | 14.8 | 14.80 | 335.46 | 0.4495 |
| **Longline** | 545 | 173.7 | 1.0 | 12.6 | 12.60 | 286.13 | 0.6070 |
| **Cast net** | 137 | 64.0 | 1.0 | 4.8 | 4.80 | 27.4 | 2.3357 |

## IV. DISCUSSION

Catch per Unit Effort (CPUE), has been described as the quantity of fish harvested or captured per day in respect to time taken and the number of fishers involved using a particular type of gear (Abiodun and John, 2017). As a tool used in measuring capacity in fisheries, it has long been recognized that CPUE may not accurately reflect changes in abundance. This has long been investigated by simulation (Swain and Sinclair, 1994) and through examination of empirical data (Rose and Leggett, 2011). Despite its well documented shortcomings, it is used in the assessment of fish populations (Harley *et al.,* 2001). Fishing effort is dependent on the type of fishing gear, fishing time, number of fishers involved and the type of craft used. CPUE therefore, provides a standardized measure of the relative catch rates with changes in CPUE assumed to correspond to proportional changes in abundance of fish population.

In view of the foregoing therefore, cast nets seemed to be the most important gear with a CPUE of 2.34kg/Man-hour/day. Cast nets happened to be more of a seasonal gear as it is not usually observed at Faku and Gbajibo in the dry season when the Lake's water level is likely to be low. Though the number of cast net recorded in the course of this study was lowest among all the gears observed, its ability to generate such a high value of CPUE can be attributed to being an active gear that directs its action to the capture of its target. Fishers involved in cast-netting don't return empty. This is a fact that the fishers of the Lake are yet to uncover hence, their high patronage of gill nets which CPUE is least among others. The CPUE continued to reduce from longlines to traps to drift and to gill nets, a trend that is similarly observed by Ghosh and Biwas, 2017.

 

For decades, fishing has been going on in the Jebba Lake area of River Niger which happen to be a major drainage system of Nigeria. Several kinds of fishing gears have been employed without recourse to their impact to the environment and the resource they are exploiting. Studies like this are aimed at bringing to light the effect of such gears and how better to employ them without causing much damage to the system. The cast net, having been found to yield so much, should be constructed to meet local and international standards mainly to make it environmentally friendly.

## V. ACKNOWLEDGEMENT

Authors acknowledge the research facilities and cooperation extended to the Department of Artisanal Fisheries, National Institute for Freshwater Fisheries Research, New Bussa, Nigeria and the Fishermen Cooperative Societies at Faku, Awuru and Gbajibo. We also acknowledge other staff of the Department who gave their support one way or another.

## REFERENCES

[1] Abiodun, J.A. (2009). Estimation of Fish Yield Using Three-Stage Stratified Sampling and Artisanal Fisheries Statistics of Jebba Lake, Nigeria. *PhD. Thesis submitted to the University of Ilorin*, Ilorin, Nigeria. 139pp.
[2] Abiodun, J.A., Apeloko, F.O. and Musa, F.A. (2010). Estimation of Maximum Sustainable Yield of Jebba Lake using Asymptotic Exponential Model. *National Institute for Freshwater Fisheries Research Annual Report*, p.7
[3] Abiodun, J.A., Apeloko, F.O. and Musa, F.A. (2014). A Catch Assessment of Kontagora Reservoir, Niger State, Nigeria. *National Institute for Freshwater Fisheries Research Annual Report*, pp. 53-56.
[4] Abiodun, J.A. and John, P. (2017). Biodiversity and abundance of fish and some processing methods in Lower Niger River, Idah, Kogi State, Nigeria. *Nigeria Journal of Fisheries and Aquaculture.* Vol.5 Issue 2. 20 – 25pp
[5] Ago, N.D. (2019). Assessment of the fisheries of Gurara Reservoir, Kaduna State, Nigeria. *A PhD Thesis submitted to Ahmadu Bello University, ABU*, Zaria. 188pp.
[6] FAO (2000). Fishery Statistics: Capture Production, FAO Fish series 54 and FAO Statistics series 152.
[7] Food and Agricultural Organization of Fisheries Publication, Abuja, 2000, P.713. 11.
[8] FDF (2016). Nigeria Fishery Statistics. Federal Department of Fisheries Summary Report. 2016.
[9] www.https://fcwc-fish.org/uncategorized/nigeria-fishery-statistics-2016-summary-report
[10] FDF (2007). Federal Department of Fisheries. Fisheries statistics of Nigeria, 4th Ed.: 1995-2007. 49pp. Garcia, S. (1984). The Problems of Unstable Resources Management. FAO Rome. CECAF/ECAF Series 82/28 (En). 31p.
[11] Ghosh, D. and Biswas, J.K. (2017). Catch per unit efforts and impacts of gears on fish abundance in an oxbow lake ecosystem in Eastern India. *Environmental Health Engineering and Management Journal* 2017; 4(3): 169–175. doi: 10.15171/EHEM.2017.24
[12] Harley, J.S., A.R. Myers and A. Dunn (2001). Is catch-per-unit-effort proportional to abundance? [13] *Canadian Journal of Fisheries and Aquatic Sciences* 58:1760 – 1772.
[14] Maunder, M.N., Sibert, J.R., Fonteneau, A., Hampton, J., Kleiber, P. and Harley, S. J. (2006). Interpreting catch per unit effort data to assess the status of individual stocks and communities. *ICES Journal of Marine Science*, Volume 63, Issue 8, 2006, Pages 1373– 1385, https://doi.org/10.1016/j.icesjms.2006.05.008
[15] NBS (2017). Nigeria's Fish Production: 2011 – 2015. *A Report by the National Bureau of Statistics, Nigeria.* 22p.
[16] Olaosebikan, B.D. and Raji, A. (2021). Field Guide to Nigerian Freshwater Fishes. 4th Edition.
[17] University of Ilorin Press.

 

[18] Otubusin, S. O. (1990). Effects of lunar periods and some other parameters on fish catch in Lake Kainji, Nigeria. *Fisheries Research*. 8: 233 – 245.
[19] Pauly, D. (1984). Fish population dynamics in tropical waters: A manual with programmable calculators. *ICLARM Studies and Reviews 8*; 305p.
[20] Rose, G.A. and W.C. Leggett, (1991). Effects of biomass-range interactions on catchability of migratory demersal fish by mobile fisheries: An example of Atlantic cod (*Gadus morhua*). *Canadian Journal of Fisheries and Aquatic Sciences.* 48: 843-848.
[21] Swain, D.P. and A.F. Sinclair (1994). Fish distribution and catchability: What is the appropriate measure of distribution? *Canadian Journal of Fisheries and Aquatic Sciences*, 51:1046-1054.

 

 