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STUDIES ON WATER QUALITY AND FISH ABUNDANCE IN BALANGA RESERVOIR, GOMBE STATE, NIGERIA

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ABSTRACT

Water quality and fish abundance in Balanga dam, Gombe state, Nigeria was studied over a period of three months (October, November and December). The water quality of balanga reservoir was optimum between the sites and months from October to December which is within the survival value of fish species when compared the world health organization (WHO 2021). The result of the physico - chemical parameters showed that the temperature of the reservoir, pH ,The electrical conductivity, The total dissolved solids, the turbidity , the dissolve oxygen and the total hardness shows no significant differences between the months and sites ($P > 0.05$). A total of ten (10) fish species were identified from Balanga Dam for the period of three months from October to December 2022. These fish species represent a total of seven (7) families. Relative abundance of fish species identified in Balanga Dam indicate that, *oreochromis niloticus* had the highest relative abundance with the total number of 638 individual species of fish.The fish Species *oreochromis niloticus, oreochromis aureus* and *Brycinus nurse* had the highest percentage with the percentage of 43.37%, 40.24% and 11.83% respectively. Followed by *bagrus bayad* with 2.11%, while *clarias gariepinus, labeo senegalensis , lates niloticus, mormyrus macrophthalmus, mormyrus rume, and Auchenoglanis occidentalis* had 0.68%, 0.54%, 0.41%, 0.41%, 0.20% and 0.20% respectively of the total fish catches.

Keywords: Water Quality, Fish abundance, Gombe

INTRODUCTION

Water is a natural resource and fundamental need of all organisms, plants, animals and humans; it is also the most necessary solvent for agriculture, industry, tourism and aquaculture (Aydin, 2018). Successful implementation of efficient management strategies requires the monitoring of water quality changes (UNEP, 2012). The quality of water should be checked at regular intervals to prevent deterioration of water quality and to maintain healthy aquatic biota. Balanga dam is a very large dam of economic importance, the survey of the fish species available in the dam and their interaction with physicochemical parameters will provide a good base for research especially on the pollution related issues, this is one the biomonitoring technique that will provide a healthy ecological integrity of the dam. A fish refers to a vertebrate that lives, breath and breed in water Small scale fisheries (SSF) and aquaculture provide two thirds of the catches destined for human consumption which account for 90% of employment in the sector (Welcomme, 2019). So therefore human societies face enormous challenge of having to provide food and sources of livelihoods to a population well in excess of nine (9) billion people (FAO, 2019).

Biodiversity is a concept to ecology and its measurements is essential to ecosystem health due to wide variations of ecosystems in distribution, abundance, dominance and biodiversity levels (Omayio and Mzungu, 2019). In a functional diversity context; richness is understood to increase or enhance community functionality and complexity (increases in productivity) (Nazeef, 2017).

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MATERIALS AND METHODS

Description of the Study Area

The dam is located in Balanga local government area of Gombe state. Its lies on latitude 10o16'N and longitude 11o 16'E of the greenwhich meridian. It is bordered by Reme, Tula, Dong, and Junge villages respectively. The dam was built in 1980's on river Gongola with the goal of providing water for irrigation practice and electricity. The dam is currently providing water for irrigating 1000 hectares of farmland, fishing activities is taking place in the dam throughout the year.

Methods of Data Collections

The water sample was collected twice a month from Balanga Reservoir, Balanga L.G.A, Gombe State, Nigeria using sterilized bottles. The water sample was transported to biological science department laboratory for analysis

Water quality parameters

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Temperature

The temperature was measured using a thermometer model (Mrc. Scientific Instruments –RS232.). The thermometer probe was immersed in the pond water and left for at least 30 seconds to stabilize before taking the reading.

pH

A pH meter (Model; HI 99121) with temperature compensation to 250C was used to measure pH. The meter probe was immersed into the water to10 cm depth let to stabilize, read and recorded.

Conductivity

The conductivity was measured using a conductivity meter type (CD-4303.Q572825). The conductivity probe was then immersed in water to a depth of 10cm. It was then allowed to stabilize and the readings were read and recorded in µS/cm-

Dissolved Oxygen (DO)

Dissolved oxygen was measured with an Oxygen meter, type (MRC-RS.232). The DO probe was immersed in the water to 10cm depth, while stirring the water, the readings were let to be stable and the dissolved oxygen read in mg/l.

Turbidity

The turbidity was measured using a Secchi disc, with a diameter of 20cm with a black and white pattern on the upper surface. The Secchi disc was lowered into the water, as it is lowered, the depth at which it just disappears was recorded, and then the disc was lowered a little further, then raised and the depth at which it reappeared was noted. Average for the two depth readings were recorded as the Secchi depth in cm.

Fish sample collections

Data for the study was collected once a month for the period of three (3) months from October to December at the various landing sites and it involved detailed examination, actual counting and recording of all fishes caught by the local fishers. Fish were caught using Traps (Gura), Gillnet (Kelle-kelle), Hook and line (kugiya). The other fishing gears used in the study area included Dragnet (Taro), Cast net (Birgi), Long line (Mari-mari) and Clap net (Homa). The only craft used in the study area as at the time of study was plank canoe. All fish landed were sorted according to species and counted, According to method described by Olaosebikan and Raji (2004).

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Fish identification

Genus and species identification of all fishes caught were carried out using field guide to Nigerian Freshwater fishes by Olaosebikan and Raji (2004).

Data Analysis

The species of fish and number of individuals were recorded. Fish species relative abundance were analyzed using descriptive statistical tools to calculate frequency and simple percentage and the water quality parameters were Analysed using Statistical method, one way ANOVA.

RESULTS

Physicochemical Parameters

The result of the physicochemical parameters of Balanga Reservoir, Balanga L.G.A, Gombe State are shown in the following figures, where temperature in water sample from the balanga reservoir ranged from 29.50 to 30.30. the highest temperature was 30.30 which was at site B. and the lowest temperature was 29.50 (Figure 1). In the study period i.e. October to December, pH value ranged from 7.5 to 7.7. The maximum pH reported was at side A which was 7.5 and minimum was at site C which was7.7 (Figure 2). The total dissolved solids in the sampled water in this study ranged from the 55.19 to 69.50mg/L. The highest TDS was reported at side B which was 69.50 mg/L and lowest TDS reported at A was 55.19mg/L (Figure 3).

The electrical conductivity of the Balanga reservoir ranged from 96.46 to 129.57 Ω/cm. The highest electrical conductivity was reported at side C from October to December which was 129.57 Ω/cm and lowest at side B, which was 96.46Ω/cm (Figure 4). The turbidity of the water sample of balanga reservoir during the time of this research ranged from 3.96 to 6.80. the highest turbidity was 6.80 at site C. and the least turbidity was 3.96 at site A (Figure 5). The amount of dissolved oxygen of Balanga reservoir water samples ranged between 1.80 to 2.10mg/L. The highest amount recorded was at site A which 2.0 mg/L. The lowest dissolved recorded was at site B which was 3.13 mg/L. The total hardness from the water samples at Balanga reservoir ranged between 71.00 to 82.33 mg/L. The highest amount of total hardness in the water was recorded in site A which was 82.33 mg/L . The lowest amount of total hardness was at site C which was 71.00 (Figure 6)

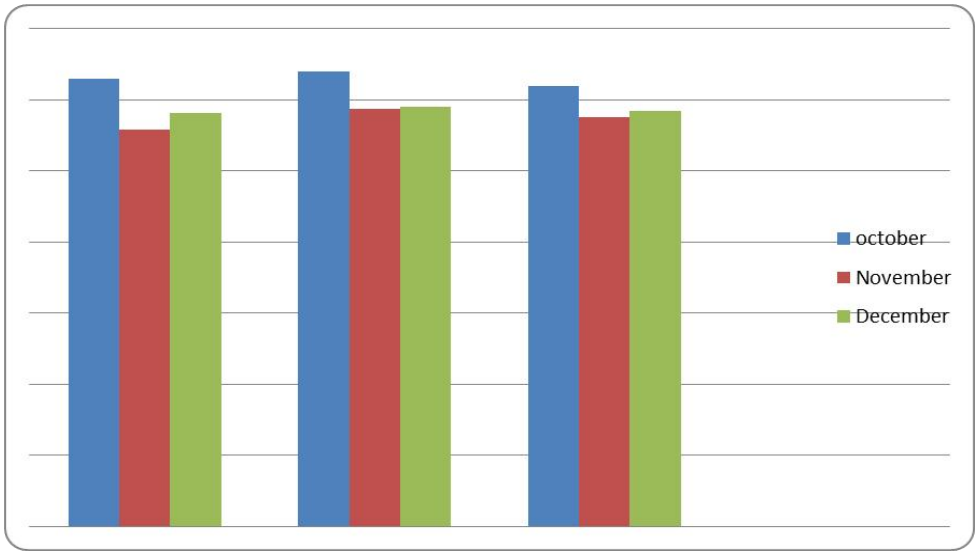

Figure 1: A bar chart Showing monthly and site variations for temperature

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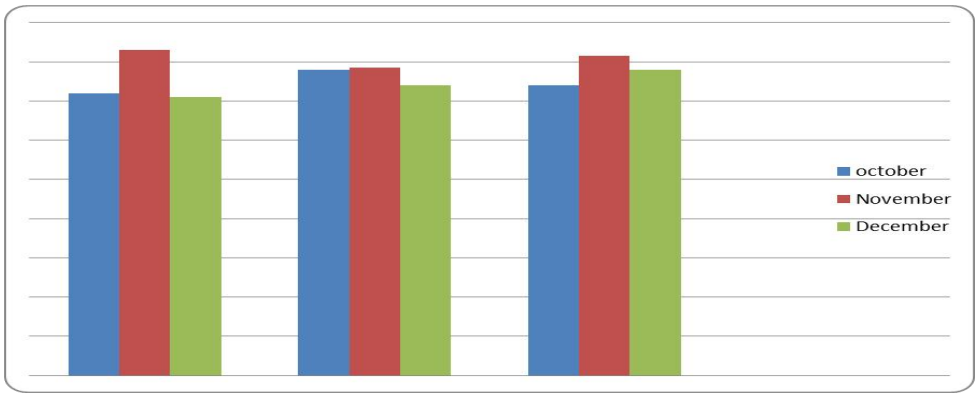


Figure 2: A bar chart showing monthly and site variation for p.H

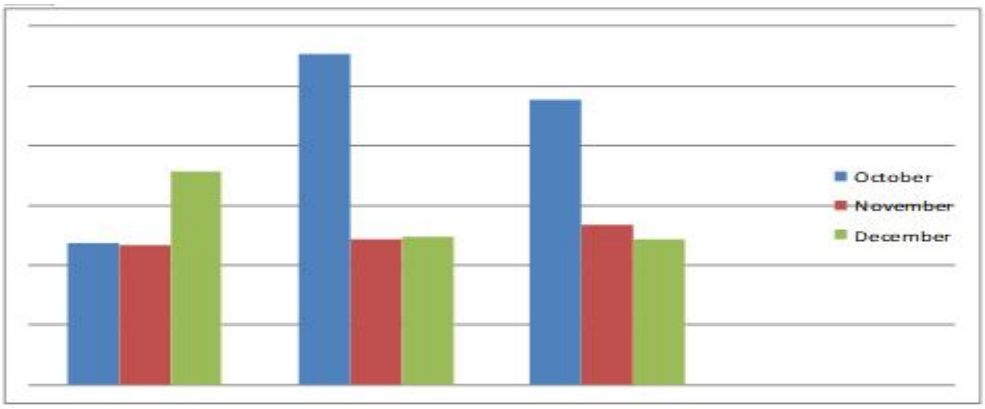


Figure 3: A bar chart showing the monthly and site variation for T.D.S

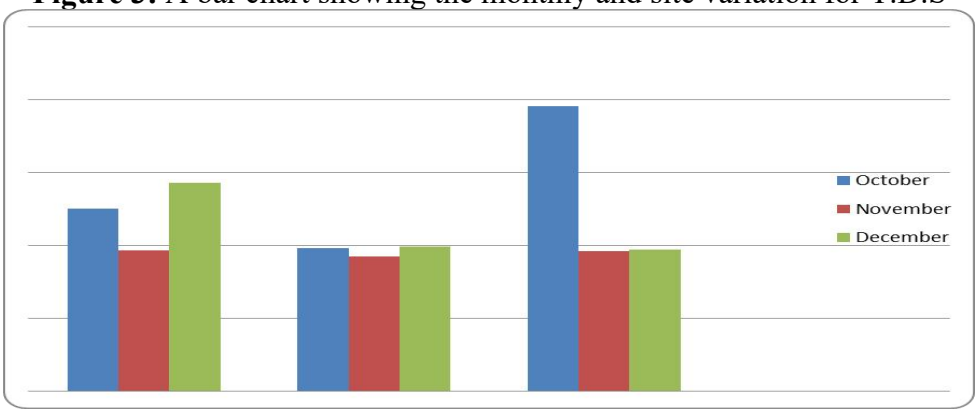
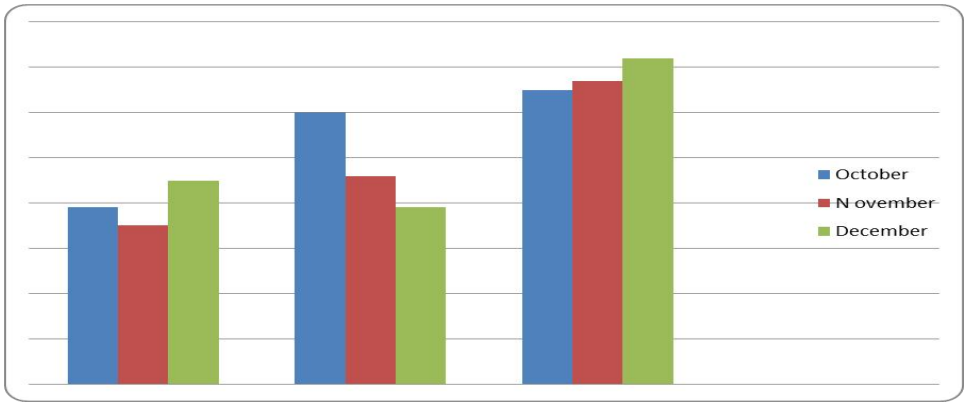


Figure 4: A bar chart showing the monthly and site variation for conductivity



DOI: 10.56892/bima.v7i2.439

Figure 5: A bar chart showing monthly and site variation for turbidity

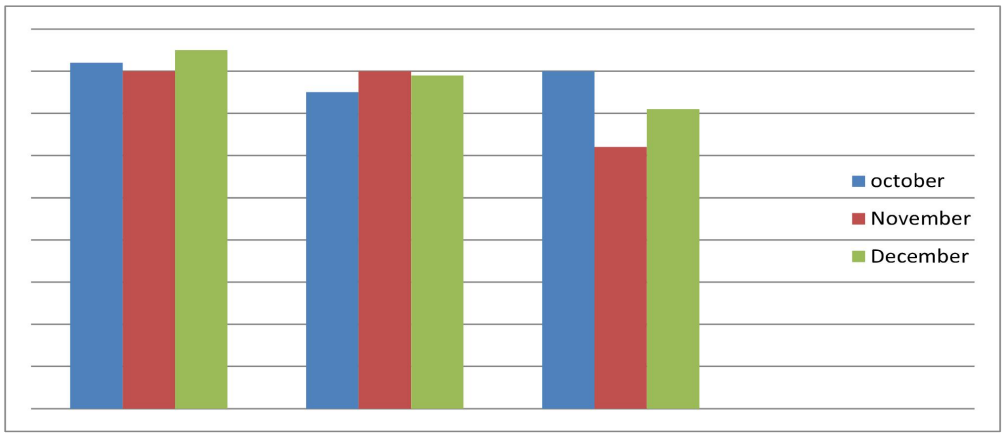


Figure 6: A bar chart showing monthly and site variation for total hardness

Fish Species Identified

The result of fish species identified in Balanga Reservoir, Balanga L.G.A, Gombe State are shown in Figure 7. A total of ten (10) fish species were identified from Balanga Dam for the period of three months from October to December 2022. These fish species represent a total of seven (7) families(table 1). The families bagridae, cichlidae and mormyridae had two fish species identified each. The family Bagridae had two species(*Auchenoglanis occidentalis and Bagrus bayad),* the family cichlidae has two species(oreochromis niloticus and oreochromis aureus), the family mormyridae also had two species *(mormyrus macrophthalmus and mormyrus),* while the family Alestidae had one species (Brycinus nurse), the family claridae had one species(clarias gariepinus), the family cyprinidae also had one species(Labeo senegalensis) and the family latidae also had only one species(Lates niloticus).

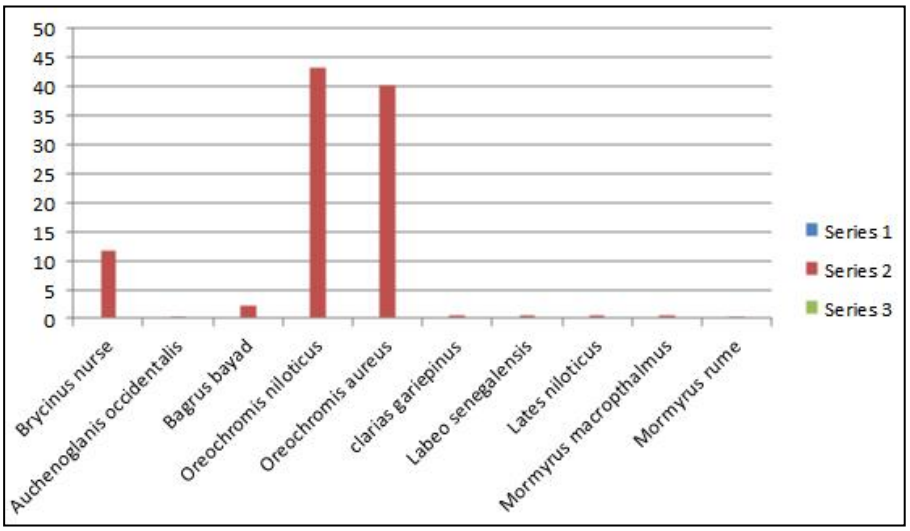


Figure 7: The ten (10) fish species were identified from Balanga Dam from October to December 2022.

The percentage composition of various fish families identified in Balanga reservoir include the Family Bagridae, Cichlidae and Mormyridae which constitute of 20% of fish families identified each, followed by the the families Alestidae, claridae, cyprinidae

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and latidae had 10% of the fish species identified respectively.

Relative abundance of fish species identified in Balanga Dam indicate that, *oreochromis niloticus* had the highest relative abundance in the month of November with the total number of 251 individual species of fish captured, followed by 205 in the month of October and the least in the month of December with the number of 182 individuals fish species identified.

The fish Species *oreochromis niloticus, oreochromis aureus* and *Brycinus nurse* had the highest percentage with the percentage of 43.37%, 40.24% and 11.83% respectively. Followed by bagrus bayad with 2.11%, while *clarias gariepinus, labeo senegalensis , lates niloticus, mormyrus macrophthalmus, mormyrus rume,* and *Auchenoglanis occidentalis* had 0.68%, 0.54%, 0.41%, 0.41%, 0.20% and 0.20% respectively of the total fish catches.

DISCUSSION

Physicochemical Parameters

In this study temperature was almost similar between site A and site B, which was 29.50 and 29.66 respectively, but different in site C which was 30.30, which was higher than the two other sites. The observation can be largely attributed to change in atmospheric temperature. According to Dauda *et al.,* (2015), A similar trend was reported by Appollos *et al.* (2016) in Zobe reservoir. The highest turbidity in this study was recorded in site C which is 6.80. The least turbidity in the water body during the period of this research which was below the recommended value of 5 could be associated with run-off from the banks to the water bodies, and this get settled and the water bodies become clearer through into dry season.s Olanrewaju *et al.* (2017) also reported higher transparency in wet season in Eleyele reservoir in Ibadan, Nigeria. The observed higher transparency in Balanga reservoir between October and December may be due to volume of activities as against the volume of the water body and probably the nature of the sediment in the water body. In this study, the dissolved oxygen ranged between 1.80 to 2.10mg/ L. The Dissolved oxygen was below the recommended minimum of 5 mg/L as optimum DO for surface waters. The result was similar with what was previously reported for reservoirs in the State (Lawal and Ahmed 2014; Suleiman and Audu 2014; Apollos *et al*., 2016). A lower DO was reported from Eleyele reservoir, Ibadan, that was classified to be under pollution stress (Olanrewaju *et al*., 2017). A slightly alkaline pH (6.5 -8.5) is recommended for optimum performance of aquatic organisms (Dauda and Akinwole, 2014), and the results in this experiment were within the range. The high highest pH was observed at site C which was 7.7 and least pH observed was in site A and site B which was 7.5 and 7.6 respectively. This might be associated with decomposition of acidic chemical run-off from agricultural farmlands around the water bodies. The highest hardness was 82.3 in site A, usually hardness is influenced by the geology of the area and the dissolution of carbon dioxide at the water surface. And The least hardness obtained was 71.00 at site C. results obtained in the study are comparable with that of Dirican (2015) in Camligoze Lake in Turkey and Bera et al. (2014) in Kangsabati reservoir in India.

Fish Species Diversity and Abundance

In this study; ten (10) fish species originating from seven (7) families were identified from the Balanga Dam. The families Bagridae, cichlidae and mormyridae were the dorminant families having two (2) fish species each. The fish species composition of this study agreed with the findings of 28 fish species in New Calabar. Twenty-seven (27) fish species were documented from Kalgwai river (Jigawa State, Nigeria) and Gilo river (Ethiopia). However; despite this greatconformities, the

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outcomes of this study yielded lesser fish species biodiversity as compared to other studies such as eighty-three species documented from Jebba (Hydro – Electric Plant) in Nigeria. In line with this category; fifty (50) fish species were also reported from Taraba river. Thirty-five (35) fish species enumerated from Agenebode, Edo State. In non-African countries; 69 fish species were reported emanating from Buenaventura Bay (Columbia), whereas 39 fish species were encountered from Palordi river (Bangladesh). Following the trend, one hundred and twenty-five (125) fish species were encountered from Cambodia's Mekong river but only eighty-four fish species were documented from the China giant Ganjiang river. The Balanga Dam fish species complex is however considered to exceed the outcomes of other study areas such as the Tiga dam which produced nine (9) fish species. The differences in fish species representation of Balanga reservoir as compared to other study areas may be attributed to the differences in lake-basin morphometry, moderate exploitation, food sources, photo-period, reservoir size, riverine tributaries, seasonal migration. While river abstraction, dynamics of hydrological regimes, fish species adaptation to lotic environment, geographical position, environmental, habitat quality, species number vary depending upon differences in sampling methods and sampling effort, as well as fish abundance.

The present study indicated that Balanga reservoir harbors a total of seven (7) fish families; this family composition is in line with the findings of other researchers such as Zira et al. (2017) who reported 15 fish families from Kiri reservoir. Whereas fifteen (15) families were recorded from Donga river Taraba State. This is similar to the sixteen (16) families enumerated from Upper Benue (Nigeria). Olopade et al. (2020) reported 15 fish families from New Calabar. Going across African lakes and water confinements, Hu et al. (2019) recorded 15 families from China's Ganjiang lake. Besides these outstanding accords, the fish family composition of Balanga reservoir illustrated contrary accordance to the outcomes of other lakes and water confinements such as Otammiri river where 10 families were recorded, with the documentation of 28 expected fish families from Pendjari river, Lake Volta. Going by this family variations; Pius et al. (2020) identified 20 fish families in Taraba river. Tiga dam (Kano State) also hosted seven fish families. Whereas 29 families emerging from Buenaventura Bay were encountered. This differences were also strengthened by the eleven (11) and twelve (12) fish families enumerated from New Calabar and Asejire reservoir accordingly.

The susceptibility of a fish species to a fishing gear is likely linked with the habitat of fish species; unlike non-riverine system, riverine aquatic ecosystems are characterized with fluctuations of increasing species abundance, diversity and richness. Habitats differences in species abundance can be as result of differences of sediments accumulation which serves as a precursor to food generation and liberation. Additionally; environmental factors such as salinity and suspended particles, natural or anthropogenic causes can definitely bring differences in the composition of fish species and families.

CONCLUSION

The water quality of balanga reservoir was optimum between the sites and months from October to December. therefore the water quality is within the survival value of fish species when comparedto the world health organization (WHO 2021). A total of ten (10) species belonging to seven families were identified in Balanga reservoir. The most numerically abundant fish in descending order include; *Oreochromis niloticus , Oreochromis aureus, Brycinus nurse, Bagrus bayad, Clarias gariepinus, Labeo senegalensis, Lates niloticus, Mormyrus*

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macrophthalmus, Auchenoglanis occidentalis and *Mormyrus rume.* Inhabitants of the reservoir area should be enlightened on the effects of agricultural and domestic activities around the water body. Authorities should create means of protecting the reservoir by enforcing laws to reduce over exploitation of the reservoir.

REFERENCES

Apollos TG, Raji A, Modibbo U: Seasonal variation of water qualityparameters of Zobe reservoir Dutsinma Katsina State, *Nigeria. Hydrol Curr Res, 7: 261. 2016.*

Aydin, U. A. (2018), Statistical assessment of water quality parameters for pollution source identification in Bektaş Pond (Sinop, Turkey), Global NEST Journal,20(1):151 160.

Berkes, F., Coldings, J. and Folke, C., 2010. Rediscovery of Traditional Ecological Knowledge as Adaptive Management. Ecological Applications,10, 1251-

Dauda AB, Dasuki A, Bichi AH: Analysis of constraint to aquaculture development in Sudano-Sahelian region of Nigeria. Trop Subtrop Agroecosystem 18:189-193. 2015.135-140.

FAO. FAO publications catalogue. 2019

Olaesobekan, D. O. and Raji, A. (2004): Field guide to Nigeria freshwater fishes. Federal college of freshwater fisheries technology New Bussa Nigeria. 104pp.

Olanrewaju AN, Ajani EK, Kareem OK: Physico-chemical status of Eleyele reservoir, Ibadan, Nigeria. J Aquac Res Dev 8: 512. 2017. doi: 10.4172/2155-9546.1000512.

Welcomme R.L. (2019). An overview of global catch statistics for inland fish. ICES J Mar Sci. 2011; 68(8):1751-1756.

Omayio G.U and Mzoiyi Y.I. (2019). Statistical assessment of water quality parameters for pollution source identification in Bektaş Pond (Sinop, Turkey), Global NEST Journal

Lawan U.O. and Ahmad Y.I. (2014). Analysis of constraint to aquaculture development in Sudano-Sahelian region of Nigeria. Trop Subtrop

WHO (2021). World Health Organisation Report

Nazeef, S. (2017). Physico-chemical status of Eleyele reservoir, Ibadan, Nigeria. J Aquac Res Dev 8: 512.