

Assessment of some Selected Physicochemical Parameters of Kiri Dam Reservoir, Adamawa State, Nigeria

¹Makinta, Y. H., ²Yila, M. E. & ³Wandiyahel, T.

¹Department of Biological Sciences, Faculty of Sciences, Federal University Wukari, P. M. B. 1020, Taraba State, Nigeria.

²Department of Biological Sciences Technology, Federal Polytechnic Mubi, P. M. B 35, Adamawa State, Nigeria.

*Corresponding Author: Hajaramakinta500@gmail.com

ABSTRACT

This study assessed the physicochemical parameters of Kiri Dam Reservoir in Adamawa State, Nigeria, to evaluate its water quality and potential ecological impacts over a five-month period (October 2023 – February 2024). Water samples were collected from four stations and analyzed for temperature, pH, transparency, conductivity, dissolved oxygen (DO), biological oxygen demand (BOD), phosphate, nitrate, chlorophyll-a, and depth, following standard APHA protocols. The results revealed significant temporal and spatial variations in most parameters. Temperature ranged from 2.29°C to 25.53°C, with higher values in October. DO peaked in February (7.03mg/L), coinciding with lower temperatures, while BOD was highest in January (4.88mg/L), indicating active microbial decomposition. Nutrient levels fluctuated, with phosphate ranging from 0.91 to 1.69mg/L and nitrate from 0.73 to 1.96mg/L, influenced likely by agricultural runoff and sediment release. Transparency and conductivity also varied significantly across months and stations, reflecting changes in water clarity and ionic content. Chlorophyll-a concentration indicated moderate primary productivity, with highest values in February. Statistical analysis showed significant differences ($p < 0.05$) across months and sampling stations for most parameters, suggesting dynamic ecological conditions within the reservoir. Kiri dam reservoir exhibits seasonal fluctuations in water quality, largely influenced by climatic variation and anthropogenic activities such as farming. While the dam maintains water quality within acceptable limits for most parameters, elevated BOD and nutrient levels during certain periods suggest potential risk of eutrophication. Continuous monitoring and effective water shed management are recommended to sustain the ecological health and productivity of the reservoir.

Keywords: Physicochemical, Parameters, Water quality, Kiri Dam, Reservoir,

INTRODUCTION

Physiochemical condition of water in dams depends on condition of spillway such as when spillway is closed, oxygen level in water becomes lower and when spillway is opened oxygen level in water increases comparatively. Water quality in the downstream river of a hydroelectric dam may be affected by the structural design and operation (Ling *et al.*, 2016). Besides this, physicochemical parameters of water also have

influences on domestic life, while physical and chemical parameters of soil affect many processes such as microbial activities and also in the breeding of aquatic life (Rahman *et al.*, 2015). Moreover, physical changes of damming leads to chemical changes within the reservoir, which alters the physical and chemical water quality, which in turn leads to ecological impacts on downstream rivers and associated wetlands. The physical change of damming leads to chemical changes within the reservoir, which alters the physical and chemical water quality, which in turn leads to ecological impacts on downstream rivers and associated wetlands (Winton *et al.*, 2019). Primary production refers to the amount of organic matter made from inorganic materials through the process of photosynthesis. Primary producer are organisms able to use organic nutrient through the process of photosynthesis to build matter. Thus, primary producer in order to live and grow need essential nutrients such as nitrogen, phosphorus, magnesium, calcium, iron, and zinc (Babar *et al.*, 2015). Primary producer in lakes, dams and reservoir are phytoplankton, macrophytes and periphytons. Measurement of primary production or photosynthesis potential is helpful to understand the trophic status and assess the fish production of aquatic ecosystem (Babar *et al.*, 2015).

The quality of surface water in dams is determined by the chemical, physical and biological characteristics but owing to inadequate management of wastes, freshwater for production potential has been reduced due to widespread pollution. Previous studies have shown deterioration of water quality and low faunal abundance and diversity caused by stress imposed by effluents from land based sources (Kansas Department of Health and Environment, [KDHE], 2001). This, therefore, calls for continuous investigation into the processes that occur in our water systems.

The use of the physiochemical properties of water to assess water quality gives a good impression of the status, productivity and sustainability of inland water bodies. The changes in physical characteristics like temperature, transparency and chemical elements of water such as dissolved oxygen, nitrate and phosphate provide valuable information on the quality of the water, the source of the variations and their impact on the functions and biodiversity of the reservoir (Kavindra *et al.*, 2019). Dammed reservoirs are artificial lakes created and controlled by a dam constructed across a valley and rely on the natural topography to provide most of the basin of the reservoir. These reservoirs can either be on-stream reservoirs, which are located on the original streambed of the downstream river and are filled by creeks, rivers or rainwater that runs off the surrounding forested catchments, or off-stream reservoirs, which receive diverted water from a nearby stream or aqueduct or pipeline water from other on-stream reservoirs. Construction of a dammed reservoir will usually require the river to be diverted during part of the build, often through a temporary tunnel or by-pass channel (Sahoo *et al.*, 2021).

MATERIALS AND METHODS

Description of the Study Area

Kiri Dam Reservoir is located on floodplain of lower Gongola River basin, about 25km upstream of its confluence with River Benue at Numan. It was reported to have formed as a rift phase due to lithospheric peak thinning which caused long narrow depression that developed in some places filled with variety of sedimentary environment (Whiteman 1982, reported in Mubi 2001). Specifically, Kiri dam is located in Shelleng

Local Government Area of Adamawa State and situated on latitude $09^{\circ} 42'$ North and longitude $12^{\circ} 01'$ East (Figure 1). The area has a sedimentary rock, which made up of shale and thin bands of limestone and lignite. It contains wide range of alluvial deposits, along wide channels of River Benue and Gongola which overlies the cretaceous deposit. It is generally a lowland area, between 500 – 700 meters above sea level. The landforms of the area are characterized by extensive floodplains and alluvial swamps. Most of the locations are liable to flooding, water logging or swamps along river catchments. The subsoil and shale formation allow underground flow of water, which raises water table during raining season and drops very low during dry season (Zemba and Adebayo, 2016).

Kiri is pluralistic in either composition, the main ethnic group found is Kanakuru, and there are also other tribe, like the Lunguda, Bachama, Hausa, Bura, Jukun and Jenjo. The dominant religions found include Christianity and Islam, the people are also well known for their diverse historical and cultural heritage (Adebayo and Tukur, 2020).

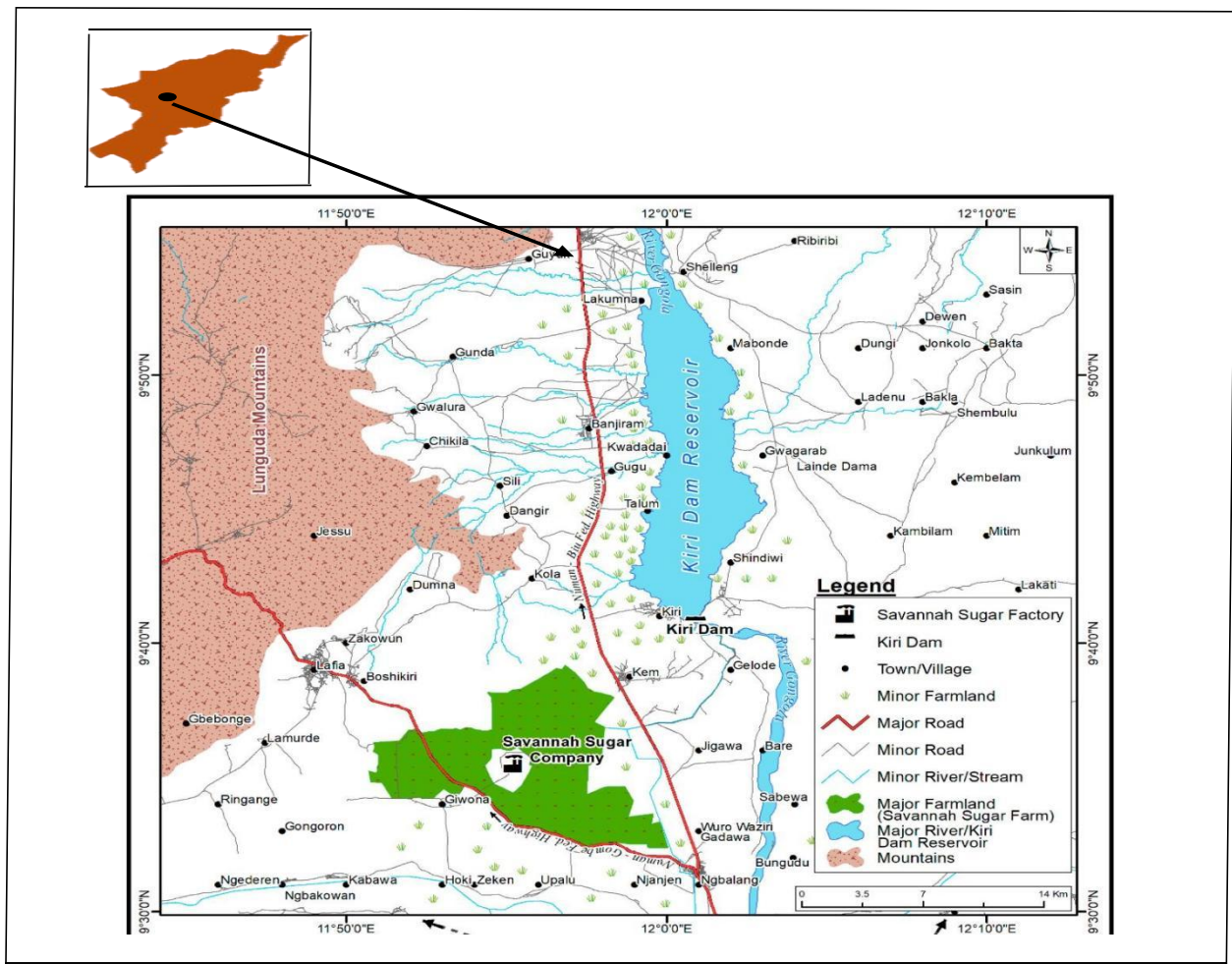


Figure 1: Map of Adamawa State, showing Kiri Dam Reservoir (Adebayo and Tukur 2020).

Sample Collection

Water samples were collected for the period of five months (October 2023, - February 2024), where by triplicate samples were taken in the morning hours (8:00–10:00 AM) from the four sampling stations as in the research design from the sampling site. Temperature and pH were measured insitu using a combined pH/temperature-meter (OAKTON®, Model: PHH-SDI pH/Mv/°C METER, Singapore). The dam's water conductivity was determined with portable digital meters. (Conductivity meter OAKTON®, Model WD35607-10, Singapore). These three parameters were measured at a depth of approximately 10 cm below the water surface for about 2 minutes. Water samples for nutrients (total nitrogen, total phosphorus) were taken immediately after sampling for the physiochemical. The samples were then fixed with 3 drops of concentrated sulphuric acid in the field and transported in a cool-box to maintain the nitrogen balance to the laboratory for further analyses.

Physiochemical Variables

A replicate water sample from the four sampling stations (A, B, C and D) was sampled in borosilicate bottles for 5 days for Biological Oxygen Demand (BOD₅) and Dissolved Oxygen (DO) using Wrinkler method (APHA, 2003).

Dissolved Oxygen

Dissolved Oxygen was measured using DO digital meter model: DAS-3™

Biological Oxygen Demand (BOD)

The water sample was collected in a 250 ml capacity glass bottle (BOD bottle) avoiding air bubbles and the stopper was tightly replaced. The bottle was then kept in an incubator for five days at 20°C after which the dissolved oxygen (DO) content of the samples was determined and the BOD was calculated as follows:

$$\text{BOD (\%)} = \frac{(\text{Initial DO level} - \text{final DO level})}{(\text{Initial DO level})}$$

Determination of Nitrogen

100ml of water sample was poured into a clean dry metallic crucible, then allow it to dry, evaporate and cooled, 2ml of phenoldisulphonic acid was added and smeared around the crucible, after 10 minutes, 10ml of distilled water was added followed by 5ml strong ammonia solution. Setting the spectrophotometer at the wave length 430nm, absorbance of nitrogen was obtained, using distilled water as blank. The concentration of nitrogen was obtained from the calibration curve in mg/L (APHA, 2017).

Determination of Phosphorus

This was determined using the Deniges method APHA, (2017), 1ml of Dennigs reagent (Ammonium Molybdate) and 5ml stannous chloride was added to 100ml water sample. Absorbance at 690nm was measured with spectrometer, model S101 using distilled water as blank. The phosphate-phosphorous concentration of water sample was read from the calibration curve in mg/l⁻¹.

Turbidity

The turbidity was measured using a manually constructed Sechi disc attached with a

calibrated rope (in centimeter). The disc was gradually lowered into the lake until the disc disappear from sight and was recorded as D₁. It was slowly raised up until it reappears and was recorded as D₂. This was done while backing the sun and the average depth at which the disc disappeared and reappeared calculated as the turbidity in centimeter (cm) as follows:

$$\text{Turbidity} = \frac{D_1 + D_2}{2}$$

D₁= Depth at which the disc disappeared

D₂= Depth at which the disc reappeared

Water Depth

Water depth was determined using the method of Hanson, (2017). A boat was used to move round the Lake and a calibrated rope (in centimeter) attached to a weight was lowered into different areas until it gets to the bottom of the Lake. The rope was brought out at each point and measurement was taken. This was done at five different points after which the average was calculated as the depth of the Lake.

Determination of Nitrate- nitrogen

100ml of water sample was poured into a clean dry metallic crucible, it is then dried, evaporated and cooled, 2ml of phenoldisulphonic acid was added and smeared around the crucible, after 10 minutes, 10ml of distilled water was added followed by 5ml strong ammonia solution. Setting the spectrophotometer at the wave length 430nm, absorbance of nitrate-nitrogen was obtained, using distilled water as blank. The concentration of nitrate-nitrogen was obtained from the calibration curve in mg/L (APHA, 2017).

Data Analysis

Microsoft Excel Version 2010 was used to tabulate the data obtained, after the analysis, phytoplankton was analyzed using PAST Statistical Package (Version 2.10) and Anova.

RESULTS

Physiochemical Parameters

During the study period, an average temperature of 25.53±0.02 °C with a pH of 7.01±0.03, transparency of 60.45±12.005 was recorded in the month of October. The temperature reading dropped from 24.55±0.16 °C in November, to 23.53±0.15 °C in December to 22.49± °C in January and increased at 23.19±0.34 °C. The pH was ranged from 7.01±0.03 in October to 6.09±0.58 in November to 7.04±0.35 in December to 6.45±0.24 in January and 7.07± in February. Transparency was 61.74±10.19cm in November to 51.75±5.59cm to 56.16±12.19cm in January and 62.90±16.09cm in February. The water depth was 117.57±3.95cm in October to 115.25±3.81cm in November to 113.11±6.44cm in December to 112.78±5.50cm in January, but reduced to 102.93±9.32cm in February.

The same was observed for Conductivity (µS/cm), with the highest average value of 170±104.25µS/cm recorded in the month of October to 163.32±90.62µS/cm in the month of November to 91.57±12.23µS/cm in the month of January to 84.79±7.71 µS/cm

in month of February and reduced to $81.02 \pm 25.99 \mu\text{S}/\text{cm}$ in the month of December. The highest Dissolve oxygen (mg/L^{-1}) was recorded in the month of February with an average of $7.03.13 \pm 0.28 \text{ mg}/\text{L}^{-1}$ to $6.45 \pm 0.45 \text{ mg}/\text{L}^{-1}$ in the month of October to $5.13 \pm 0.28 \text{ mg}/\text{L}^{-1}$ in the month of January to $5.02 \pm 0.33 \text{ mg}/\text{L}^{-1}$ in the month of November and the lowest was recorded in the month of December with an average of $4.36 \pm 0.46 \text{ mg}/\text{L}^{-1}$. The same was observed for Biochemical Oxygen Demand (mg/L^{-1}) where the highest average value of $4.88 \pm 0.42 \text{ mg}/\text{L}^{-1}$ was recorded in the of month January to $3.99 \pm 0.90 \text{ mg}/\text{L}^{-1}$ in the month of February to $3.97 \pm 0.95 \text{ mg}/\text{L}^{-1}$ in the month of December to $3.87 \pm 0.52 \text{ mg}/\text{L}^{-1}$ in the month of October and the lowest was recorded in the month of November with an average value of $2.02 \pm 0.52 \text{ mg}/\text{L}^{-1}$. Phosphate (mg/L^{-1}) had the highest in the month of January with an average of $1.69 \pm 0.44 \text{ mg}/\text{L}^{-1}$ to $1.25 \pm 0.72 \text{ mg}/\text{L}^{-1}$ in the month of November to $1.18 \pm 0.55 \text{ mg}/\text{L}^{-1}$ in the month of October to $1.03 \pm 0.18 \text{ mg}/\text{L}^{-1}$ in the month of December and the lowest was recorded in the month of February with an average value of $0.91 \pm 0.19 \text{ mg}/\text{L}^{-1}$. The highest reading value of Nitrate was in the month of December with an average value of $1.96 \pm 0.44 \text{ mg}/\text{L}^{-1}$ to $1.83 \pm 0.46 \text{ mg}/\text{L}^{-1}$ in the month of November to $1.30 \pm 0.32 \text{ mg}/\text{L}^{-1}$ in the month of February to $1.22 \pm 0.59 \text{ mg}/\text{L}^{-1}$ in the month of October and reduced to $0.73 \pm 0.19 \text{ mg}/\text{L}^{-1}$ in the month of January. The highest reading chlorophyll-a ($\mu\text{g}/\text{L}$) was in the month of February with an average value of $2.33 \pm 0.68 \mu\text{g}/\text{L}$ to $2.29 \pm 0.72 \mu\text{g}/\text{L}$ in the month of December to $2.28 \pm 0.80 \mu\text{g}/\text{L}$ in the month of January to $1.73 \pm 0.84 \mu\text{g}/\text{L}$ in the month of October and finally reduced to $1.15 \pm 0.6 \mu\text{g}/\text{L}$ in the month of November as shown in Table 1.

Table 2 shows the mean values and p values of physio chemical parameters of the study stations. Temperature recorded a slight significant difference throughout the study period at both station. The highest water temperature was recorded at station D with a mean value of $24.01 \text{ }^\circ\text{C}$ while the lowest at station C with mean value of $23.65 \text{ }^\circ\text{C}$. The highest PH was recorded at station C with mean a value of 6.99 while lowest the at station B with mean a value of 7.22, the highest Transparency was recorded at station D with a mean value of 72.52cm while the lowest at station A with a mean value of 43.06 cm. The highest water depth was recorded at station at D with a mean value of 119.95cm while the lowest at station A with a mean value of 102.03cm the same with electrical conductivity, the highest electrical conductivity was recorded at station D with a mean value of $112.93 \mu\text{S}/\text{cm}$ while the lowest at station B with a mean value of $90.09 \mu\text{S}/\text{cm}$. The highest Dissolved Oxygen was recorded at station A with a mean of $6.67 \text{ mg}/\text{L}^{-1}$ while the lowest at station D with a mean value of $4.75 \text{ mg}/\text{L}^{-1}$.

The highest Biochemical Oxygen Demand was recorded at station A with a mean of value of $3.22 \text{ mg}/\text{L}^{-1}$ while the lowest at station D with a mean value of $1.66 \text{ mg}/\text{L}^{-1}$. The highest Phosphate was recorded at station A with a mean value of $1.81 \text{ mg}/\text{L}^{-1}$ while the lowest at station D with a mean value of $0.7 \text{ mg}/\text{L}^{-1}$. The highest Nitrate was recorded at station B with a mean value of $2.09 \text{ mg}/\text{L}^{-1}$ while the lowest at station D with a mean value of $1.17 \text{ mg}/\text{L}^{-1}$. The highest Chlorophyll-a was recorded at station A with a mean value of $2.86 \mu\text{g}/\text{L}$ and the lowest was recorded at station C with a mean value of $1.24 \mu\text{g}/\text{L}$ as shown in table 2.

Table 1: Monthly Mean Variation of Physiochemical Parameter of Kiri Dam Reservoir, Adamawa State (October, 2023 - February, 2024)

Parameter	October	November	December	January	February
Temperature (°c)	25.53±0.02	24.55±0.16	23.53±0.15	22.49±0.29	23.19±0.49
PH	7.01±0.03	6.09±0.58	7.04±0.35	6.45±0.24	7.07±0.34
Transparency(cm)	60.45±12.05	61.74±10.19	51.75±5.59	56.16±12.9	62.90±1.9
Water Depth(cm)	117.57±3.95	115.25±3.81	113.11±6.4	112.78±5.0	102.93±92
Conductivity(µS/c)	170.88±1045	163.32±90.62	81.02±25.99	91.57±12.23	84.79±7.1
Dissolved Oxygen (mg/L ⁻¹)	6.45±0.45	5.02±0.33	4.36±0.46	5.13±0.28	7.03±0.05
Biochemical Oxygen Demand(mg/L ⁻¹)	3.87±0.52	2.02±0.42	3.97±0.95	4.88±0.53	3.99±0.90
Phosphate (mg/L ¹)	1.18±0.55	1.25±0.72	1.03±0.18	1.69±0.44	0.91±0.19
Nitrate(mg/L ⁻¹)	1.22±0.59	1.83±0.46	1.96±0.44	0.73±0.19	1.30±0.32
Chlorophyll-a(µg/L)	1.73±0.84	1.15±0.67	2.29±0.72	2.28±0.80	2.33±0.68

F=52.76, df=9.40, P=0.00

Table 2: Monthly Variation of Physiochemical Parameter based on Sampling stations at Kiri Dam Reservoir, Adamawa State (October, 2023 - February, 2024).

Parameter	A	B	C	D	P value
Temperature (°c)	23.89	23.83	23.65	24.01	0.000
PH	6.77	7.22	6.99	6.79	0.420
Transparency(cm)	43.06	56.24	63.36	72.52	0.406
Water Depth(cm)	102.03	112.42	116.94	119.95	0.401
Conductivity(µS/cm)	182.58	90.09	93.98	112.93	0.001

Dissolved Oxygen (mg/L ⁻¹)	6.67	5.59	5.18	4.75	0.356
Biochemical Oxygen Demand(mg/L ⁻¹)	3.22	4.73	2.37	1.66	0.374
Phosphate (mg/L ⁻¹)	1.81	1.29	1.02	0.7 0.004	
Nitrate(mg/L ⁻¹)	1.77	2.09	1.09	1.17	0.006
Chlorophyll-a(µg/L)	2.86	2.22	1.24	1.69 0.003	

F=41.07, df=9,30, P=0.00

DISCUSSION

Physiochemical Parameters

The use of the physiochemical properties of water to assess water quality gives a good impression of the status, productivity and sustainability of inland water bodies. The changes in physical characteristics like temperature, transparency and chemical elements of water such as dissolved oxygen, and nitrate provide valuable information on the quality of the water, the source of the variations and their impact on the functions and biodiversity of the reservoir. The physiochemical parameters and phytoplankton communities together form comprehensive ecosystem and as in any ecosystem, there are interaction between the phytoplankton and the water quality. These interactions are directly or indirectly subjected to the complex influences, some of which results in quantitative and seasonal changes there was an episodic family change throughout the study period, which was attributable to the interaction of physicochemical parameters. There was statistically significant difference between the months where high temperature was recorded in October (25.53°C), whereas lower temperature was recorded in November (22.29°C). This revealed that higher significant variation existed between the months. Temperature plays a vital role in determining the occurrence and specie composition of fresh water organisms. our result showed low water temperature was recorded between the months of January to February in response to changes in temperature. This affects the occurrence and distribution of phytoplankton species as reported by Dimowo (2013). The relatively low temperature recorded during this period might be due to the cool, dry harmattan winds effect at time of the year. A similar effect was observed by Kolo and Oladimeji (2014), in their study of some water bodies in Nigeria. This supports our findings as shown by the result of the analysis of variance which showed significant difference between the months. Temperature affects the distribution of plankton. This corresponds with the findings of Abdullahi and Indabawa (2017) in their study of the ecology of fresh water phytoplankton of River Hadejia, Jigawa State.

The monthly variation of water pH of Kiri Dam was ranged between 6.09 to 7.09, the dam water was acidic during the month of January while slightly alkaline in the month of October throughout the study period, thus revealing a significant ($p < 0.05$) variation

between the months. The pH was found to have increased in month the of February and slightly decreased in the month of January. Low pH indicates acidity possibly due to the presence of nitrate and sulphate ions in water. The level of pH could support many fish and other benthic organism like mollusc. Similar report was observed by Alam *et al* (2014). This distribution of pH could be explained by photosynthetic activity of surface algae and mineralization of bottom waters by bacteria. The increase in pH results solely from the photosynthetic activity of green algae. The high algal activity allows high CO₂ uptake by the waters, which leads to the imbalance of the carbonate buffer system and increases the pH level of the dam (Labrecque and Milne 2012; Ihnken *et al.*, 2014).

The mean monthly variation of transparency between months and the result reveal that highest transparency of water was recorded in month of February, whereas lowest was recorded in January, and the range across month lies between 51.75 to 62.90cm, Decrease in transparency from December to January. Transparency was between the ranges of 51.75cm to 62.90cm. This corresponds with algal bloom that leads to decreased oxygen concentration of water (Babatunde and Raji, 2017).

The electrical conductivity showed highly significance variation between months, where relatively higher conductivity was recorded in the month of October respectively. The gradual decreased in electrical conductivity from December to February could be attributed to the decreased in water volume. This was in line with the work of Akpan (2018) who reported similar result in their Limnological study whose observation revealed high level of evaporation leading to reduction in water volume and increase in salt concentration. The high average of electrical conductivity values in ponds would be justified by leaching from agricultural land and the input of domestic wastewater into the ponds. On this subject, Zébazé Togouet (2017), confirm that the supply of wastewater to the aquatic environment increases its content of cognizable salts and consequently its electrical conductivity. The percentage of dissolved oxygen saturation was high in the pond, characteristic of a strong photosynthetic activity of algae and aquatic plants that release oxygen into the environment (Ramade, 2005).

Increases in total dissolved organic matter result to increase in conductivity and turbidity but a decrease of the benthic fauna, thus agreeing with observation made Adakole (2015) in his limnological study of river Kubanni, Zaria. Kolo and Oladimeji (2014) observed a similar trend in Shiroro Lake that there was high mean conductivity in the month, this was attributed to higher concentration effect due to reduced water volume from their main tributaries. High electrical conductivity of the water surface indicated trophic status and productivity (Akphan 2018).

Higher mean value of DO was obtained in the month of February. The monthly variation of dissolved oxygen for the study period showed that dissolve oxygen concentration was higher in the month of February than in January. The values for dissolved oxygen concentration of the water samples in all the month fall within an average, there was significant difference in dissolved oxygen between the months and this could be attributed to the peak time of biochemical oxygen demand due to bacteria and other decomposers uptake. Highest concentration of dissolved oxygen coincided with the minimum water temperature in February and January, due to harmattan wind that cause cooling effect. The higher the temperature, the lower the dissolved oxygen and the

lower the temperature the higher the dissolved oxygen. High dissolved oxygen concentration in January conformed to increase in phytoplankton productivity during this period. This result conforms to the findings of Mageed *et al*, (2015). In freshwater bodies, oxygen fluctuations could be due to close relationship between the free water and the bottom where organic matter accumulates. Biological Oxygen Demand (BOD) fall within an average across month, highest value was obtained in December during the study period, this agrees with the findings of (Mustapha, 2014). The value of phosphate ranged from (0.91 to 1.67mg/l⁻¹) the maximum phosphate Iron concentration was observed in the month of January (1.67mg/l⁻¹) and lowest is the month of February (0.67mg/l⁻¹). The higher Phosphate phosphorus values obtained during the study period might be due to run-off from nearby farmlands, since phosphate fertilizer application is common in the farmland around the catchment area.

Nitrate-nitrogen ions obtained throughout the period of this research was higher in December to January. This could be due to run-off from the farmlands into the reservoir, and also application of fertilizer by the farmers from the catchment area as observed. Other reasons for this variation could also be as a result of nitrates released from sediments during decomposition of organic matter. Observed that the peak nitrate seems to be related to input from agricultural lands, preceding the first upsurge of phytoplankton growth (Lymer *et al.*, 2014) observed that concentration of nitrate could be reduced by plankton and macrophytes uptake during the period.

CONCLUSION

The findings indicate that Kiri Dam Reservoir exhibits seasonal fluctuations in water quality, largely influenced by climatic variations and anthropogenic activities such as farming. While the dam maintains water quality within acceptable limits for most parameters, elevated BOD and nutrient levels during certain periods suggest potential risks of eutrophication. Continuous monitoring and effective water shed management are recommended to sustain the ecological health and productivity of the dam.

REFERENCES

- Abdullahi, B. A. and Indabawa, I. I. (2017). Ecology of Freshwater Phytoplankton of River Hadejia, Jigawa state. *Biological and Environmental Sciences Journal for the Tropics*, **1**(2) :141-145.
- Adebayo, A. A. and Tukur, L. B. (2020). Adamawa State in Maps.Yola: Paraclete Publishers, Adamawa State, Nigeria, p.19-28.
- Akphan, E. R. (2018). Nutrient – Relationships in Cross River Estuary. *Nigeria Journal of Chemical Society of Nigeria*, **31**(1-2):102-108.
- Alam, M. M., Rahman, M. T. and Parween, S. (2014). Morphometric characters and condition factors of five fresh water fishes from Pagla river of Bangladesh. *International Journal of Aquatic Biology*, **2**(1):14-19.
- APHA (2017). Standard methods for the examination of water and waste water. 26st edition, Washington, D. C. p.126.

- Babar, H. T. and Raje, G. B. (2015). Primary productivity of Morawane dam in Ratnagiri, India. *Journal of Global of Biosciences*, **4**(2):1430-1438.
- Babatunde, D. O. and Raji, A. (2017): Field guide to Nigeria freshwater fishes. Federal College of Freshwater Fisheries Technology. New Bussa Nigeria. p104.
- Dimowo, B. O. (2013). Assessment of some physic-chemical parameters of river ogun Abeokuta, Ogun State, southwestern Nigeria in comparison with *National and International standard*. *International Journal of Aquaculture*, **3**(15):79-82.
- Ihnken, S., Beardall, J. and Kromkamp, J. C. (2014). Light acclimation and pH perturbations affect photosynthetic performance. *Chlorella* mass culture. *Aquatic Biology*, **22**(10):95-110.
- Kavindra, J., Sharma, B. K., Sharma, S. K. and Ojiha, M. (2019). Properties and primary productivity of Jawai dam. *Journal of Entomology and Zoology Studies*, **7**(4):865-868.
- Kolo, R. J. and Oladimeji, A. A. (2014). Water Quality and some nutrient levels in Shiroro Lake, Niger State. *Nigerian Journal of Aquatic Sciences*, **19**(2):99.
- Labrecque, L. I. and Milne, G. R. (2012). Exciting red and competent blue: the importance of color in marketing. *Journal of the Academy of Marketing Science*, **40**(5):711-727.
- Ling, T. Y., Nyanti, L., Muan, T., Grinang, J., Sim, S.F. Mujahid, A. *et al---* (2016). Physicochemical parameters of Bakun Reservoir in Belaga, Sarawak, Malaysia, 13 months after reaching full supply level. *Sains Malaysiana*, **45**(2):157–166.
- Rahman, H. U., Akbar, N. U., Gul, I., Gul, N., Akhwan, S. Sajed, M. *et al---* (2015). Impacts of some physicochemical parameters of water and soil collected from Panjkora River, Pakistan. *Journal of Global Veterinaria*, **15**(10):57-61.
- Ramade, F. (2005). Ecology elements. Applied ecology. 4th edition, Dunod, Paris, France, p.864.
- Sahoo, D., Nayeb, Y. M., Owen, J., James, S., and White, S. A. (2021). The Basics of Irrigation Reservoirs for Agriculture. *Land-Grant Press*. **20**(4):124-126.
- Winton, R. S, Calamita, E. and Wehrli, B. (2019). Reviews and syntheses: Dams, water quality and tropical reservoir stratification. *Biogeosciences*, **16**(8):1657-71.
- Zemba, A. Adabayo,A. (2016). Effects of Kiri Dam Construction on the Economy of Lower Gongola Basin of Shelleng Local Government, Adamawa State, Nigeria. *International Journal of Economic Development*, **5**(1): 48–54.
- Zébazé, Togouet, S. H. (2017). Eutrophication and Structure of the Zooplankton Populations of the Yaounde Municipal Lake. 3rd cycle Doctorate, Faculty of Science, University of Yaoundé I, Cameroon, p. 200.