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64 WATER QUALITY ASSESSMENT OF THE PROPOSED KWADNA RESERVOIR WITHIN GIDAN KWANU MAIN CAMPUS, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA

[1] Ibrahim, S. U., [2] Ibrahim, A., [3] Yusuf, J., [4] Adama, S. B., and [5] Abdulmumini, A.N.

[1,3 & 5] Department of Water Resources, Aquaculture and Fisheries Technology,
School of Agriculture and Agricultural Technology,
Federal University of Technology, Minna,
Niger State, Nigeria

[2] Marine Biology, School of Life Sciences
College of Agriculture, Engineering and Science
Westville Campus
University of Kwazulu-Natal
South Africa

[4] Department of Animal Biology
*Federal University of Technology, Minna
Niger State, Nigeria

Corresponding author: [1]Ibrahim Saratu Usman suibrahim@futminna.edu.ng
Phone: +234(0)7039025846, +234(0)8055957138

Abstract

The study assessed the Water Quality parameters of the Kwadna Reservoir located at Federal University of Technology, Minna guided by the following objectives: determine the variation of the physico-chemical parameter across the months, the stations and to provide baseline data of the various physical and chemical properties of water. The Physico-chemical parameters of the river were studied for twelve weeks. Water samples was taken from five (5) stations in the reservoir, biweekly for the period of study. Samples collected was taken to the department of Water Resources, Aquaculture and Fisheries Technology (WAFT) laboratory for analysis. The results of the research depict that there was no significant variation in the mean values of physico-chemical parameters observed across the Station ($p>0.05$), pH range from 7.05±0.03 -7.36 ±0.03, Conductivity 281.5±45.5-311.7±44.9 µS/cm, Total alkalinity 115.7±22.0 -174.0±18.9, Total hardness 48.1±9.5-57.4±11.3mg/L, Calcium 17.3±5.4-24.6±4.6mg/L, Magnesium 4.0±2.4-8.6±2.9 mg/L, TDS 177.2±28.3-199.3±28.9mg/L,BOD 2.7±0.1-3.1±0.4mg/L, Dissolved oxygen 4.9±0.6-5.7±0.1mg/L, Carbon dioxide 1.7±0.9-3.4±2.3mg/L, BOD 2.7±0.1-3.1±0.4mg/L. Except Temperature and COD that has significant difference ($p<0.05$) range between 27.0±0.0-28.5±0.5^{0}C and 18.1±2.8-104.9±45.9 mg/L respectively. For monthly variations most parameters had significant difference ($p<0.05$) except Temperature and BOD that has no significant difference ($p>0.05$). Most of the physico-chemical parameters studied were within WHO range set standard for optimal fish production and survival. The mean temperature of the Reservoir (29.46°C) is in line with FAO (2006), which states that temperature requirements of 25^{0}C–30^{0}C is optimum for fish growth. This shows that temperature in the proposed Kwadna Reservoir is suitable to support the growth of fish Therefore, constant monitoring of the reservoir should be encouraged.

Keywords: Water Quality, Kwadna, Reservoir, Physico-chemical

INTRODUCTION

Water is one of the vital needs of all living beings. The quality of water usually described its physical, chemical and biological characteristics. Hence it becomes necessary to find out its the suitability for drinking, irrigation, fishing and Industrial purpose. The availability of good quality water is a necessary feature for preventing diseases and improving quality of life (Oluduro and Aderiye, 2007).

Dam reservoirs, which are an integral part of civilization development, have many features that distinguish them from natural lakes or rivers, hence they constitute a different category of surface water reservoirs. Their most important functions include water collection for municipal and agricultural purposes or flood protection. They are also used for recreational purposes, hydropower and fishing.

Water quality deterioration in reservoirs usually comes from excessive nutrient inputs, eutrophication, acidification, heavy metal contamination, organic pollution and obnoxious fishing practices. The effects of these "imports" into the reservoir do not only affect the socio-economic functions of the reservoir negatively, but also bring loss of structural biodiversity of the reservoir.

Water quality can generally be defined as chemical, physical and biological waters that are characteristic with respect to their suitability for a given use (Pawar, S.S, 2017). He further stated that the physico-chemical properties of water refer to the joint of physical characteristics and chemical composition of water body which include turbidity, colour, odour, temperature, pH, conductivity, dissolve oxygen (DO), Biological Oxygen demand (BOD), hardness, alkalinity, nitrate, chloride, CO_2, etc. Each of the designated uses has different definitions of the chemical, physical and biological standards needed to support the use.

These physiochemical compositions of water bodies need to be evaluated and compared with standards as a basis for the identification of the causes of the change in the water quality, high mortality or low population of aquatic animals in the dam reservoir.

Water quality parameters examined were pH, alkalinity, calcium, conductivity, magnesium, total hardness, Dissolved carbon dioxide, Chemical Oxygen Demand (COD) Total dissolved Solids (TDS), dissolved oxygen (DO), biochemical oxygen demand (BOD).

MATERIALS AND METHODS

Study area: The study was carried out at proposed Kwadna reservoir located within Federal University of Technology Minna, Bosso Local Government Area of Niger State, Nigeria which lies in between the latitude of 9^0 30' 40" N and longitude of 6^0 24' 50" E in the northern guinea savannah vegetation zone of Nigeria.

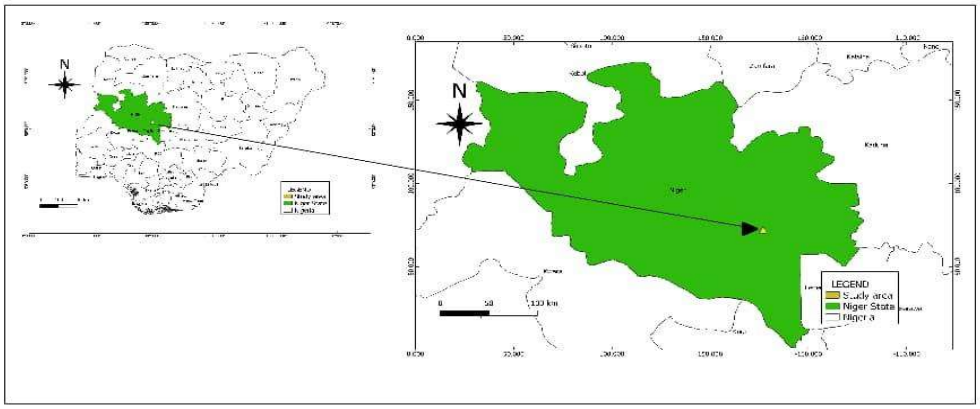

Figure 1: Nigeria indicating Niger State and the study area

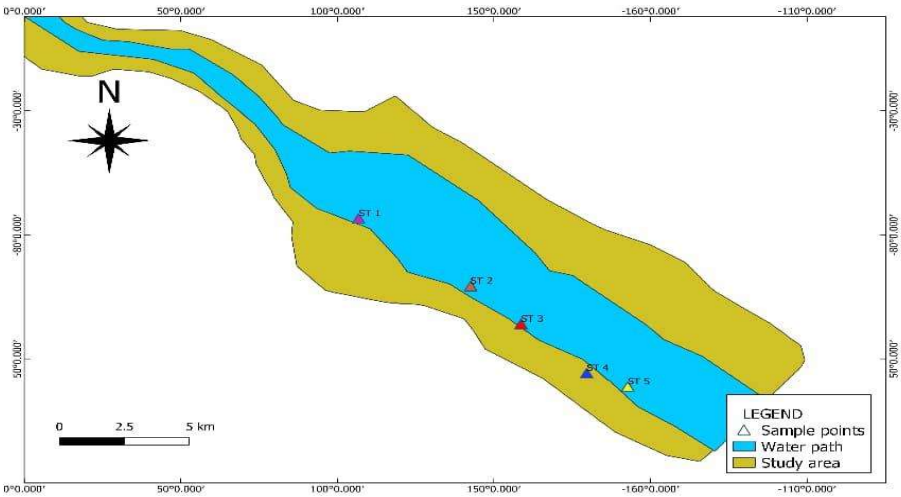

Figure 2: The study area indicating Sampling Stations

Sample collection and preparation: The samples were collected bi-weekly for three (3) months March, April, May from five different stations (Figure 2). Inlet of the Reservoir, open water of the reservoir bank of the reservoir were anthropogenic activities and opposite sides of the bank. The samples collected were analyzed for pH, Temperature, Alkalinity, Calcium, Conductivity, Magnesium, Total Hardness, Dissolved Carbon Dioxide, Chemical Oxygen Demand (COD) Total dissolved Solids (TDS), dissolved oxygen (DO), Biochemical Oxygen Demand (BOD).

Determination of pH: The pH of the water samples was determined using the pH meter. It was standardized with a buffer solution of pH range between 4, 7 and 9.

Measurement of temperature: This was carried out in-situ at the site of sample collection using a mobile thermometer. This was done by dipping the thermometer into the sample and recording

the stable reading

Determination of conductivity: This was done using conductivity meter. The probe was dipped into the samples until a stable reading was obtained and recorded.

Determination of Alkalinity: 50mL of the sample was pipetted into a clean 250mL conical flask. Two drops of methyl red indicator were then added and the solution titrated against a standard 0.01M NaOH solution to a pink end-point. (American society for testing and Materials, 1982). Total alkalinity (mg/L) = V x M x 50,000 / mL of sample used Where V = volume of acid used M = Molarity of acid used

Determination of total dissolved solids (TDS): by Gravimetric Method: A portion of water was filtered out and 10mL of the filtrate measured into a pre-weighed evaporating dish. Following the procedure for the determination of total solids above, the total dissolved solids content of the water was calculated. Total dissolved solids (mg/L) = (W2-W1) mg x 1000 mL of filtrate used. Where W1 = initial weight of evaporating dish W2 = Final weight of the dish (evaporating dish + residue). Determination of Dissolved Oxygen: This was done using Winkler's method. Do bottle were used to collect the water sample at the sample site, 0.5ml of reagent 1(Magnose sulphate),and 0.5ml of reagent 2 (Potassium Hydroxide +Potassium Iodide) were added immediately into the collected sample,before it was transported to the laboratory.10ml of the sample was measured from the Do bottle into a conical flask,5drops of concentrated H_2SO_4 was added,5 drops of starch indicator was also added and was titrated with Sodiumthiosulphate until color changes from blue black colorations to colorless.
DO (mg/l) = TV×0.025×8×1000 20mls
Calculation DO (mg/L) = 16000 x M xV V2/V1 (V1-2) Where = Molarity of thiosulpahte used. V = volume of thiosulphate used for titration V1 =Volume of bottle with stopper V2 = Volume of aliquot taken for titration.

Determination of Biochemical Oxygen Demand (BOD): The method involves filling the samples to overflowing, in an airtight bottle of the specified size.

Determination of total Hardness: 25mL of the samples was placed in different clean 250mL conical flask. To this were added 3mL of ammonium chloride in concentrated ammonia buffer (NH4CL/conc.NH3) and 2 drops of Eriochrome Black T indicator. This was titrated against 0.01M

EDTA solution until there was a color change from violet to blue.

Calculation: Hardness in mg/L $CaCO_3$= V x M x 1000 mL of sample used Were M = Molarity of EDTA Used V =Volume of EDTA used

RESULTS AND DISCUSSIONS

Physico-chemical parameters Variation across the stations and months

The findings of the station variations deduce that some parameters had significant variation from each other while some had no significant variation. The mean temperature of the Reservoir recorded (29.46°C) is in line with FAO (2006), which states temperature requirements at the range of 25^0C – 30^0C is optimum for fish growth, Conductivity was higher during the month of March 385µS/m and lowest during the month of May this is as a result of increased water evaporation and emergence from wind while mean value of Dissolved oxygen of 5.19 mg/l obtained agree with Cline (2012) value of 3-10mg/L.

The mean BOD values of 2.91mg/l is in line with the work of Boyd (2003), which states that the optimal BOD values ranges between 3– 20 mg/l. Mean value of hardness was 53.91mg/l. indicate that the Reservoir water is a soft water which is within the desirable limit (WHO, 1984) that states hardness values below 300mg/l is potable water. For total Alkalinity the range value was 147.43mg/l this fell within the permissible range reported by Cline (2012), to be between 50-250mg/L suitable for fish growth.

The mean value for Calcium during the course of the research was 20.11mg/l and it fell within the permissible range as posited by WHO (1984), the maximum permissible limits for calcium in drinking water is 75mg/l. Thus the calcium level in this research is within the permissible limits. Though some parameters of the stations fall within the required range that support fish in the said period of March to May, some others are out of range which calls for greater attention to correct the causes to safeguard the future of fish survival in the Reservoir.

Table 1: Monthly variations of physico-chemical parameters of Proposed Kwadna reservoir

Parameters	March	April	May
pH	7.34±0.02[a]	7.05±0.03[b]	7.36±0.03[a]
Temperature (°C)	28.5±0.5 [a]	27.0±0.0 [a]	28.0±0.0 [a]
EC (µS/cm)	346.5± 10.84 [a]	336.80±10.63[a]	206.60±6.40[b]
TDS (mg/l)	216.00±9.67[a]	215.30±6.83[a]	132.00±3.98[b]
Alkalinity(mg/l)	162.50±12.49 [b]	156.60±8.72 [a]	118.20±18.35 [a]
Hardness (mg/l)	67.69±4.43 [a]	61.24±1.11 [a]	32.77±1.62[b]
Calcium (mg/l)	20.75±2.58[a]	26.32±2.01[a]	13.66±0.72[b]
Magnesium(mg/l)	12.85±1.17[a]	2.87±0.95[b]	4.03±0.57[b]
DO (mg/l)	4.70±0.29[b]	5.12±0.17[b]	5.19±0.09[a]
DCO2 (mg/l)	5.28±0.83[a]	1.59±0.14[b]	1.08±0.20[b]
BOD (mg/l)	2.71±0.13[a]	2.96±0.13[a]	3.08±0.21[a]
COD (mg/l)	58.24±27.27[a]	23.73±6.84 [b]	59.20±11.87[a]

Mean in the same row followed by the same superscript are not significantly different (P>0.05)
Mean not followed by the same superscript are not significantly different (P<0.05)

Table 2: Stations variation of physico-chemical parameters of Proposed Kwadna reservoir

Parameters	Station 1	Station 2	Station 3	Station 4	Station 5
Ph	7.26±0.0[a]	7.31±0.09 [a]	7.25±0.12 [a]	7.23±0.12 [a]	7.20±0.11 [a]
Temperature (°C)	28.5±0.5 [b]	27.0±0.0 [a]	28.0±0.0 [a]	28.2±0.0 [b]	27.5±0.5 [a]
EC (µS/cm)	297.3±51.1 [a]	311.7±44.9[a]	291.8±49.7[a]	299.8±41.0 [a]	281.5±45.5 [a]
TDS (mg/l)	189.8±32.8 [a]	199.3±28.9[a]	177.2±28.3[a]	191.8±26.3 [a]	180.7±29.1 [a]
Alkalinity(mg/l)	174.0±18.9 [a]	123.5±22.5[a]	162.3±17.9[a]	161.7±6.4 [a]	115.7±22.0 [a]
Hardness (mg/l)	57.4±11.3 [a]	53.8±13.5 [a]	54.9±20.6 [a]	55.4±10.8 [a]	48.1±9.5 [a]
Calcium (mg/l)	18.9±3.0 [a]	19.3±4.2 [a]	20.5±4.1 [a]	24.6±4.6 [a]	17.3±5.4 [a]
Magnesium(mg/l)	8.6±2.9 [a]	6.5±4.3 [a]	6.9±2.5 [a]	4.0±2.4 [a]	6.9±3.8 [a]
DO (mg/l)	5.1±0.4 [a]	4.9±0.6 [a]	5.1±0.2 [a]	5.1±0.3 [a]	5.7±0.1 [a]
DCO2 (mg/l)	1.7±0.9 [a]	3.4±2.3 [a]	2.3±0.8 [a]	2.7±1.2 [a]	3.0±1.5 [a]
BOD (mg/l)	3.1±0.4 [a]	2.9±0.1 [a]	2.7±0.1 [a]	3.0±0.3 [a]	2.9±0.2 [a]
COD (mg/l)	50.9±11.0 [ab]	18.1±2.8[b]	35.2±17.6 [ab]	26.1±2.3 [b]	104.9±45.9 [a]

Mean in the same row followed by the same superscript are not significantly different (P>0.05)
Mean not followed by the same superscript are not significantly different (P<0.05)

Conclusion

The study on the assessment of physic-chemical parameters of Proposed Kwadna dam reservoir, Minna, Gidan Kwano Niger State was carried out bi-weekly for the period of three months in order to provide baseline information on the ecological status of the Reservoir. The physico-chemical parameters of the Reservoir varied with months and stations. The variations may be due to change in weather cycle during the study period.

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