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Seasonal variations in the physico-chemical parameters of Lake Ribadu, Adamawa state Nigeria

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Abstract
The assessment of seasonal variation of the physico-chemical quality of Lake Ribadu, Adamawa State Northeastern Nigeria was investigated. The water samples were collected bi-monthly from June, 2015 to May, 2016 for the physico-chemical parameters. The water temperature, pH, conductivity and total dissolved solids, transparency were measured in-situ with the use of Mercury in glass thermometer, water testing kits and secchi disk respectively. The dissolved oxygen and biochemical oxygen demand were measured ex-situ in the laboratory using Winkler's method. The results showed variation in the water parameters within the months. The mean water temperature varied from 22^0C in January to 28^0C in April while the mean pH varied between 6.89 in July to 8.08 in January. The mean dissolved oxygen varied between 4.23mg/l in May to 6.89 mg/l in January while the biochemical oxygen demand varied between 2.17 mg/l in May and 3.91 mg/l in February. The lowest mean Conductivity was observed in August (391µmhos/cm) and the highest in April (480µmhos/cm) while the total dissolved solid was lower in August with the mean value of 343.7mg/l and highest in January (364.2mg/l). The correlation coefficient (r) showed high positive correlation between the water temperature and transparency (0.8732) and while water temperature and dissolved oxygen were negatively correlated (-0.8143). The results of all the physico-chemical parameters measured in Lake Ribadu are within the recommended limits of national and international standards; hence, support aquatic livings.

Keywords: physico-chemical parameters, seasonal variations, dissolved oxygen, conductivity

1. Introduction
The population growth and development of every community requires availability of quality ground water such as rivers, streams, lakes, wells, boreholes, spring etc. since aqua lives depend solely on it. In most sub-saharan African urban-rural communities, water is mostly used for domestic purposes [1]. The quality of ground water can best be determined by analyzing the physicochemical properties of such water. FEPA [2] and Salami and Adekola [3] had documented that the qualities of these water bodies are at risk following the release of effluent from municipal waste, agricultural activities and industrial points which will reduce the productivity of fauna and flora in the aquatic habitat. Some of these effluents may contain organic and/ or inorganic pollutants as documented by Idowu *et al*. [4].

Human activities on the river beds usually introduced inorganic substances that are non-biodegradable and have been reported to create an environmental burden of considerable magnitude [2] which effects are felt on the quantity and quality of water resources over a wide range of space and time scales. Opukri and Ibaba [5] presented a comprehensive report that the limnological features of aquatic environments in which fish live is imperative for accessing its productivity and suitability for rearing fish [6] and these are physical, chemical and biological parameters.

The fauna distribution, vertical and horizontal migration, diversities, feeding pattern and other usefulness anchored on adequate knowledge of the physico-chemical profile of a water body according to Adebisi [7].

Optimum levels of various physicochemical properties must be within the acceptable limits as reported by Boyd [8] for optimum fish yield. Blober [9] had identified fluctuations in temperature, dissolved oxygen (DO), carbondioxide (CO2), pH, conductivity, total dissolved solid (TDS), transparency and among others as determinants in riverine fish ecology. The reports of Akin-Oriola [10] on Ogunpa and Oyan Lakes; Idowu and Ugwumba [11] on Eleyele

Reservoir; Ayoade *et al.* [6] on comparative studies of Oyan and Asejire Lakes; Atobatele and Ugwumba [12] on Aiba Reservoir, Oso and Fagbuaro [13] on Ero Reservoir; Idowu *et al*., [4] on Ado-Ekiti reservoir, Ani *et al*., [14] on some selected rivers in Ebonyi state, southeast, Nigeria; Odoemelam, *et al*., [15] on cross river at afikpo north local government area of Ebonyi state Nigeria are of great value to this study.

Since water is of necessity to man, animals and plants, it is of greater importance to assess its quality so as to proffer guidelines for its sustainable usage or make corrective steps to ensure its quality. This study is therefore aimed at assessing the physico-chemical parameters of Lake Ribadu, Adamawa State, Nigeria

2. Materials and Methods

2.1 Study area: The study area is Lake Ribadu which is located in Fufore Local Government of Adamawa State with the coordinates $9^0$13′N, $12^0$39ˈE.

2.2 Water sampling and Duration: Water samples were collected from three different points on the lake and mean values of the three points were computed and recorded. The sampling was carried out every fortnight between June, 2015 and May, 2016. Sampling was done between 7.00 am and 9.00 am. Air temperature, water temperature, pH, turbidity, total dissolve solids and Conductivity were carried out in-situ while dissolve oxygen and biochemical oxygen demand were done in the department of fisheries laboratory. Temperature readings were taken using mercury in glass thermometer to the nearest 0.1 °C. The thermometer was place at about 10 cm below the water surface for about 5 minutes to stabilize after which the readings were taken and recorded. The pH readings were measured using a pH meter (7020 model) while the turbidity was measured using a secchi disk of 20 cm marked with black and white. Total dissolve solids and conductivity were measured using a portable TDS meter (model). Dissolve oxygen (DO) and Biochemical Oxygen Demand (BOD) was estimated using APHA [16]. All determinations were done in triplicates and the mean values were recorded.

3. Results

Table 1 shows the mean, standard error and range of physic-chemical parameters measured during the study period in Ribadu Lake. The monthly variations of physic-chemical parameters of Ribadu Lake measured between June, 2015 and May, 2016 are presented in Figure 1-7. The highest mean air and water temperature were recorded in May while the lowest mean temperature was in January. Transparency was highest in April and lowest in November. The highest dissolved oxygen value was recorded in January and lowest in July, although there was no significance difference in the value recorded in the months of September, 2015 to April, 2016. The biochemical oxygen demand had the highest value in the month of February and not significantly different to the value recorded for the month of January and December while the lowest was recorded in the month of May. The mean highest conductivity was recorded in the month of April while the mean lowest was recorded in the month of August. The mean highest total dissolved solid was recorded in January while the mean lowest was recorded in August. The correlation coefficient (r) values for the physic-chemical parameters are showed in Table 2. The air and water temperature correlated positively with transparency (r=0.7537; 0.8732) but correlated negatively with pH (r=-0.3739; -0.35655), dissolved oxygen (r= -0.9110; -0.8142), BOD (r= -0.7244; -0.38059), conductivity (r= -0.2079; 0.04471) and total dissolve solids (r= -0.5379; -0.2247) ($p<0.05$) respectively. The pH showed low negative correlation to transparency (-0.2609) while it showed low correlation to dissolved oxygen (0.2493), BOD (0.2829), and total dissolved solid (0.3258) but showed higher correlation to conductivity (0.5387). The total dissolved solid showed low correlation with the dissolved oxygen (r=0.4588) while it showed high correlation with biochemical oxygen demand (r=0.7762) and conductivity (r=0.7728).

Table 1: The mean, standard error and range of physico-chemical parameters Lake Ribadu and Set standard for Domestic Use and Aquaculture

			Present Study	Maximum permissible limits in water		
	Min	**Max**	**Mean±S.E**	**WHO**	**USEPA**	**SON**
Air Temp. (^{0}c)	21.32	29.17	25.73±0.73			
Water Temp. (^{0}c)	22.23	29.17	24.86±0.52	40		Ambient
pH	6.89	8.08	7.6±0.09	6.8	6.5-8.5	6.5-8.5
Transparency (cm)	32.73	54.37	43.40±2.13	50		50
Dissolved Oxygen (mg/l)	4.23	6.89	5.64±0.23	4-6		≥4
Biochemical Oxygen Demand (mg/l)	2.17	3.91	2.66±0.15			
Conductivity (µmhos/cm)	391	480	432.67±8.64	500		1000
Total Dissolved Solid (mg/l)	343.7	364.2	352.83±1.81	1000	500	500

***Source*:** Dimowo *et al.* [1] and Ani *et al.* [14]. Where: WHO-World Health Organisation; USEPA- United States Environmental Protection Angency; SON- Standard Organisation of Nigeria

Table 2: Correlation coefficient between the physicochemical parameters in Lake Ribadu, Adamawa state

	Air Temp.	**Water Temp**	**pH**	**Transparency**	**DO**	**BOD**	**Conductivity**	**TDS**
Air Temp.	1							
Water Temp.	0.895729	1						
pH	-0.37392	-0.35655	1					
Transparency	0.753687	0.87315	-0.26096	1				
DO	-0.91107	-0.81429	0.249326	-0.7204	1			
BOD	-0.72449	-0.38059	0.282995	-0.29945	0.68282	1		
Conductivity	-0.20794	0.04471	0.538765	0.207656	0.13971	0.52771	1	
TDS	-0.53799	-0.22479	0.325839	-0.00225	0.458829	0.776213	0.772838	1

($p<0.05$)

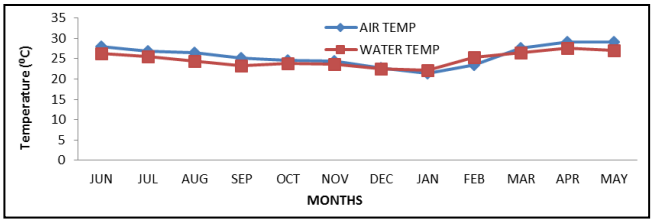

Fig 1: Monthly Variations of Air and water temperature of Lake Ribadu, Adamawa State

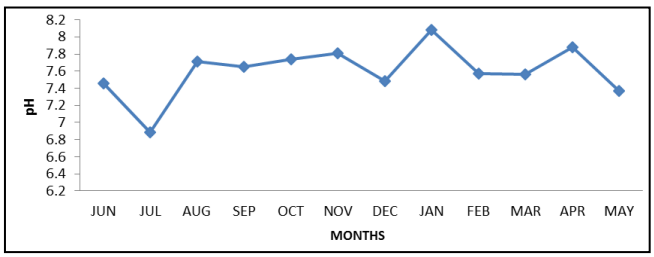

Fig 2: Monthly Variations of pH of Lake Ribadu, Adamawa State

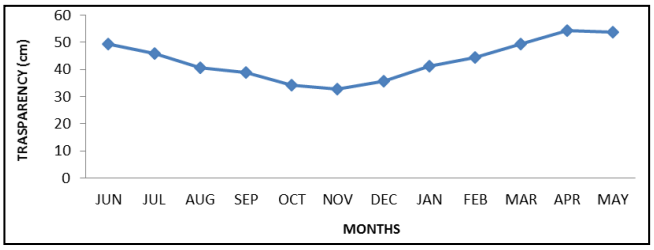

Fig 3: Monthly Variations of Transparency (cm) of Lake Ribadu, Adamawa State

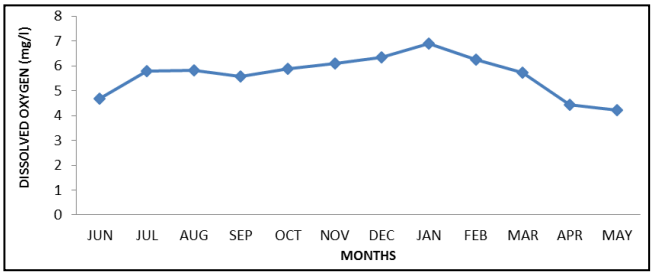

Fig 4: Monthly Variations of Dissolved Oxygen (cm) of Lake Ribadu, Adamawa State

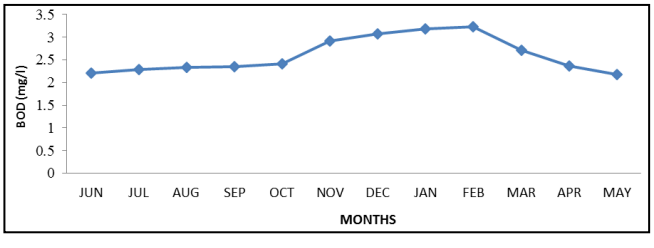

Fig 5: Monthly Variations of Biological Oxygen Demand (mg/l) of Lake Ribadu, Adamawa State

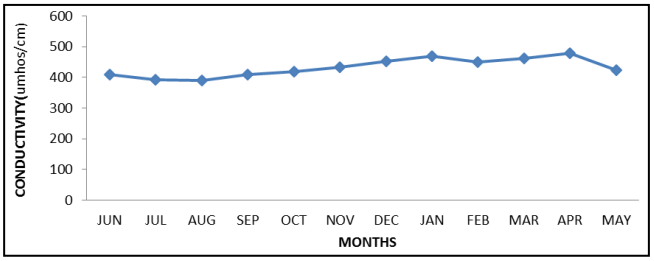

Fig 6: Monthly Variations of Conductivity (umhos/cm) of Lake Ribadu, Adamawa State

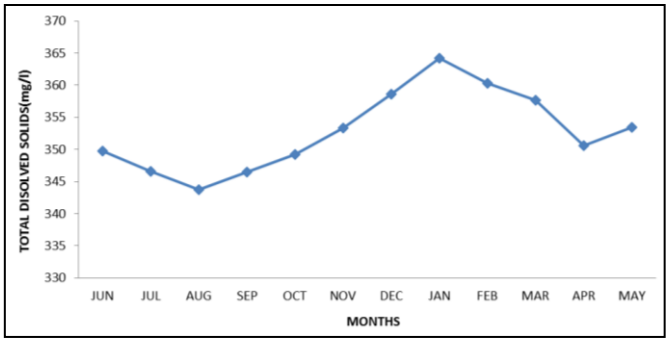

Fig 7: Monthly Variations of Total Dissolve Solids (umhos/cm) of Lake Ribadu, Adamawa State

4. Discussion

The physico-chemical parameters of Lake Ribadu showed variations which may be associated with patterns of water use and rainfall [6, 17]. The water temperature fluctuated between 21 ^{0}C and 29 ^{0}C during the study which falls within the adopted range for tropical water bodies [18]. The decrease in transparency in the month of May from the highest in the month of April marked the onset of rainy season and reached the lowest in the month of September which followed the month that had the highest rainfall. This could be attributed to the increase in debris that enters the lake at the peak of the rainy season. The mean variation in pH values was generally alkaline during the sampling period and fluctuated between 6.89 and 8.08. Similar mean pH value was also reported by Oso and Fagbuaro [13] in Ero reservoir, Ekiti State. The mean pH value from this study falls within the recommended values (6.5-7.5) [8] for most tropical natural waters which suggest that the lake is good for aquatic life production. The mean variation of the dissolved oxygen ranged from 4.23-6.89mg/l falls within the recommended value. The same dissolved oxygen value was also reported by Abubakar *et al*., [19] who worked on Dadin-kowa reservoir and Oso and Fagbuaro [13] on Ero reservoir but higher that the value reported by Anago *et al*. [17] from Awba Reservoir, University of Ibadan.

In this present study, the highest values of dissolved oxygen were recorded when the temperature value was lowest. This condition is similar to the report of Idowu *et al*. [4] from Ado-Ekiti reservoir. Lewis [20] reported that tropical water with higher temperature poses poor ability to hold oxygen compared to water with lower temperature as well as high rates of microbial metabolism at higher temperature.

The mean value of conductivity (432+8.64µmhos/cm) suggests that the conductivity level is intermediate. Conductivity levels below 50µmhos/cm are regarded as low; those between 50-600 µmhos/cm are medium while those above 600µmhos/cm are high conductivity [21]. The mean value for total dissolve solid (352.83+1.81) was relatively high in this study which is higher than that of Dadin-kowa [19], Awba reservoir [17] and Ero reservoir [13]. There was negative correlation between the total dissolved solids and air temperature which is different to the report of Anago *et al*., [17] that reported positive correlation between the total dissolved solids and air temperature.

In conclusion, it is found that all measured parameters are within the permissible limits of national and international standards; hence, the lake can be regarded as stable and healthy environment which promotes primary productivity as at the time of this study.

5. References

1. Dimowo BO. Assessment of Some Physico-chemical Parameters of River Ogun (Abeokuta, Ogun State, Southwestern Nigeria) in Comparison With National and International Standards, International Journal of Aquaculture. 2013; 3(15):79-84. DOI: 10.5376/ija.2013. 03.0015)
2. Federal Environmental Protection Agency (FEPA). Nigeria. Achieving sustainable development in Nigeria. National. Report for the United Nation conference on environment and development, 1992.
3. Salami N, Adekola FA. A study of sorption of cadmium by goethite in aqueous solution. Bulletin of the Chemical Society of Ethiopia. 2002; 16(1):1-7.
4. Idowu EO, Ugwumba AAA, Edward JB, Oso JA. Study of the Seasonal Variation in the Physico-chemical Parameters of a Tropical Reservoir. Greener Journal of Physical Sciences. 2013; 3(4):142-148.
5. Opukri OC, Ibaba IS. Oil Induced Environmental Degradation and Internal Population Displacement in the Nigeria's Niger Delta. Journal of Sustainable Development in Africa. 2008; 10(1):173-193.
6. Ayoade AA, Fagade SO, Adebisi AA. Dynamics of Limnological features of two man-made lakes in relation to fish production. African Journal Biotechnology. 2006; 5(10):1013-1021.
7. Adebisi AA. The physico-chemical hydrology of tropical seasonal river – Upper Ogun River. Hydrobiologia. 1981; 79:157-165.
8. Boyd CE. Water Quality Management for Pond Fish Culture. Elsevier Scruneh Publishers, 1979, 249.
9. Blober SJM. Tropical Estuarine Fishes. Ecology, Exploitation and Conservation. *Fisheries and Aquaculture Resources* Series 7, Blackwell Science, 2000.
10. Akin-Oriola GA. Zooplankton associations and Environmental factors in Ogunpa and Ona rivers, Nigeria. Revista de Biologia Tropical. 2003; 51(2):391-398.
11. Idowu EO, Ugwumba AAA. Physical, Chemical and Benthic faunal characteristics of a Southern Nigerian Reservoir. The Zoologist. 2005; 3:15-25.
12. Atobatele OE, Ugwumba OA. Seasonal Variation in the physicochemistry of a small tropical reservoir (Aiba Reservoir, Iwo, Osun, Nigeria). African Journal of Biotechnology. 2008; 7(12):1962-1971.
13. Oso JA, Fagbuaro O. An Assessment of the Physico-Chemical Properties of a Tropical Reservoir, Southwestern, Nigeria. Journal of Fisheries International. 2008; 3(2):42-45.
14. Ani C, Okogwu OI, Nwonumara GN, Nwani CD, Nwinyimagu AJ. Evaluation of Physicochemical Parameters of Selected Rivers in Ebonyi State, Southeast, Nigeria. Greener Journal of Biological Sciences. 2016; 6(2):34-41. http://doi.org/10.15580/GJBS.2016.2.0202 16030.
15. Odoemelam SA, Okorie DO, Oko IO. Physicochemical parameters and heavy metal content of water, fish and sediments from cross river at afikpo north local Government area of Ebonyi state, Nigeria. Bioresearch Bulletin, 2013, 10-15.
16. American Public Health Association (APHA). Standard methods for the examination of water and wastewater. 20th edn. Washington DC, 2005.
17. Anago IJ, Esenowo IK, Ugwumba AAA. The Physico-chemistry and Plankton Diversity of Awba Reservoir University of Ibadan, Ibadan Nigeria. Research Journal of Environmental and Earth Sciences. 2013; 5(11):638-644.
18. Alabaster JS, Lioyd R. Water Quality for freshwater fish. FAO and Butter Worths, London, 1980, 29.
19. Abubakar UM, Umar DM, Zainab MZ. Effects of Some Physicochemical Parameters on *Oreochromis Niloticus* in Dadin Kowa Reservoir Gombe State Nigeria. International Journal of Advances in Chemical Engineering and Biological Sciences. 2015; 2(2):110-112.
20. Lewis WM. Basis for the protection and Management of tropical Lakes. Lakes and Reservoirs. 2002; 5(1):35-48.
21. Adeleke CA. Studies on the ecology and feeding habits of Lymnea natalensis (Krauss), intermediate host of cattle liverfluke in Ibadan area. Ph.D. Thesis, University of Ibadan, 1982.
22. Standards Organisation of Nigeria (SON). Nigerian Standard for Drinking Water Quality Abuja, Nigeria, 2007.
23. World Health Organization (WHO) Guideline for Drinking Water Quality. Geneva, 2009, 39.