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PHYSICO-CHEMICAL ATTRIBUTES OF KANYE DAM RESERVOIR FOR ALGAL GROWTH, IN KANO NORTH-WESTERN NIGERIA

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Abstract

Some Physico - chemical attributes of Kanye Dam water reserviour such as; Temperature, pH, Dissolved Oxygen, Biological Oxygen Demand; Nitrate, Phosphate and Electrical Conductivity were studied from five (5) sampling sites (A,B,C,D and E) monthly for a period of Six Months using standard methods of American Public Health Association (APHA). The result revealed the value of temperature ranged between 24.00 to 28.00ºC with the mean values 25.83ºC pH ranged between 6.9 to 8.6 with the mean value (7.7).DO ranged between 2.30 to 7.70Mg/L, with the mean (4.70Mg/L).BOD ranged between 1.20 to 3.70Mg/L with the mean (2.10Mg/L). Nitrate ranged between 0.40 to 7.60Mg/L with the mean (2.62Mg/L). Phosphate ranged between (0.50 to 3.50Mg/L with the mean (1.00Mg/l), while EC ranged between 510 to 728µs/cm with the mean (612µs/cm).The analysis of variance showed that there was no significant difference between the physicochemical parameters within the sampling sites. However there was significant difference between them within the months of sampling. This suggests that the reserviour water indicates significant pollution level and therefore can support the growth of some algae.

Keywords: Pollution, Physico-chemical, algae, Attributes, Sampling sites

Introduction

Water quality generally means the component of water which must be present for optimum growth of aquatic organisms.The determinant of good growth in water body includes dissolved oxygen, hardness, turbidity, alkalinity, nutrients, temperature.

Conversely, other parameters like biological oxygen demand, and chemical oxygen demand indicate pollution level of a given water body. In most water bodies, various chemical parameters occur in low concentrations. This concentration level increases due to human activities, and lack of environmental regulation (Wetzel, 2001). The productivity depends on physiochemical characteristics of the water body (Abida and Harikrishna, 2008). This variability is

related to water movements and to the quality and quantity of resources brought into the system by tributary rivers (Threlkeld and Choinsk, 1985; Dirnberg and Threlkeld, 1986; Marzolf, 1990; Betsil and Van Den Avyle, 1994). In most developing countries, point and nonpoint source pollution are major environmental problems affecting water quality. The situation is exacerbated by lack of or scarcity of treatment for domestic wastes (Dudgeon, 1992) and poor agricultural practices (Iwata *et al.,* 2003). This study was undertaken to determine if there is any build up of toxic substances which could lead to bio-accumulation and magnification leading to health implications.

Materials and Methods

Study Area

Kanye Dam is located in the Sudan savanna zone of Northern Nigeria on latitude 11°57'N and longitude 8°.1'E with two distinct seasons (wet and dry). The rainy season lasts from May to October while the dry season lasts from November to April. Kanye Dam is approximately 50 km away from Kano, along Kano-Gwarzo road in Kabo Local Government Area of Kano State, and about 11.25 km from Kabo town. It has an area of 11.31km^2. It was constructed in 1969 and commissioned in 1970. The dam was constructed for agricultural purposes (such as irrigation, fisheries, forestation), domestic uses and to control flooding. The Dam has a total storage capacity of 24.60 million cubic meters, active storage capacity of 21.53 million cubic meters and dead storage capacity of about 3.07 million cubic meters (RSMP, 1982). It has two major sources these are river Guzu-Guzu and river Kanyan maja.

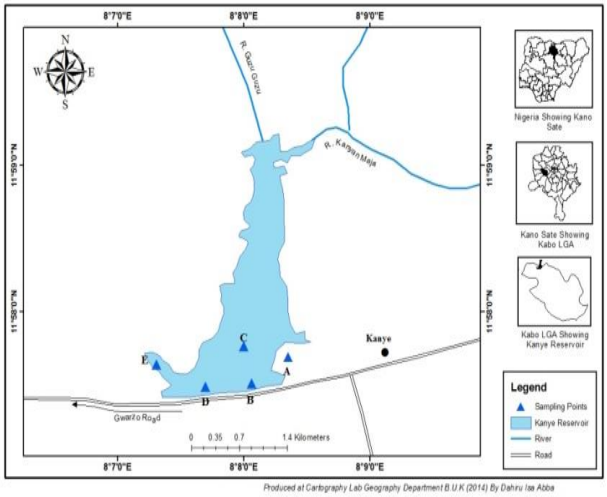

Figure 1: Map of Kano Showing the

Study Area and Sampling Sites

Sampling sites

The sampling site was divided in (5) sampling locations namely: sites A, B, C, D and E which were selected based on intensity/type of anthropogenic activities. GPS 12 model (GRAMIN, USA) was used in taking the global position of the sites as follows:

Site A: This is an enclosure that is directly linked with the dam about 30m to the inshore of the dam. At this site human activities like farming, washing ,bathing, were taking place and is located at Lat 11° 57' 32.02" N and Long 8°08' 25.13"E.

Site B: Point B is the inshore of the Dam. Washing, bathing, Irrigation and fishing were taking place at the site and is located at Lat 11° 57' 31.79"N and Long 8° 08' 21.59"E.

Site C: This is the midshore of the Dam, it is the middle of dam, only fishing was found to be taking place at the site, it is considered to be deepest part of the dam. And is located at Lat 11° 57' 31.09"N and Long 8° 08' 07.93"E.

Site D: Site D is the outlet of the dam, where water is taken to the treatment plant through a pipe, human activities like bathing also take place at the site. It is located at Lat 11° 57' 28.33"N and Long 8° 08' 07.91"E.

Site E: This is the offshore of the Dam where fishing, huge agricultural/farming activities were taking place; this is where possibly the water and other algal communities may be influenced by the chemical substances from surface runoff. Washing and bathing are frequent at this sampling site. It is located at Lat 11° 57' 23.74"N, and Long 08° 07' 22.02"E.

Photograph of the Sampling Sites Kanye Reservoir, Kano

Figure 2: Sampling Site A

Figure 3: Sampling Site B

Figure 4: Sampling Site C

Figure 5: Sampling Site D

Figure 6: Sampling Site E

Collection of Water Samples

All surface water samples were collected between 7 – 8am from the months of March-August 2013and analysed either in the field (*in situ*) or within six hours in the laboratory.

Surface water Temperature was determined *in situ* with mercury in glass thermometer (Fisher S- 41624 model) graduated in units of ℃ as described by Offem, *et al.*, (2009). pH was determined using dip in mobile battery pH meter as described by APHA, (1999) Dissolved Oxygen was determined using Hach 7021Model Jenway Dissolved Oxygen Meter as described by APHA, (1999). Biological Oxygen Demand (BOD_5) was determined after 5 days incubation method as described by APHA, (1999) The Nitrogen-nitrate was determined using portable data logging spectrophotometer Hach DR/2010 model. Phosphorus-phosphate (PO_4^{3-}): The concentration of phosphate was also determined using portable data logging spectrophotometer Hach DR/2010 model. The Electrical conductivity was determined using conductivity meter (Hach- CO 150/2010) as described by APHA (1999).

Result and Discussion

The mean physico-chemical attributes was recorded in Table 1 below where the Surface Water Temperature during the period of study influenced the other physico-chemical and biological characteristics of water bodies. In this study the highest mean temperature value was recorded at site 'A' and 'D' (25.83°C) while the least was recorded at site 'B' (25.25°C). This could be as a result of the variation in season. In table 2 below the result also indicates that temperature has significant correlation with nitrate, phosphate and electrical conductivity at 0.01% level significance. According to work of Ezra and Abdulhameed (1997) the high values of temperature recorded could be associated with high solar radiation, high evaporation and low rainfall, while the relatively low mean values of temperature recorded at site 'B' could be due to low values of these parameters. Generally the temperatures during the period of study reflected that of tropical region. It increased from March to April and decreased gradually through May to August. The pattern of temperature changes from dry to rainy season could be attributed to low solar radiation, low evaporation and rainfall.

The pH ranges recorded in this study were 8.2 - 8.7.Lower values in water decreases algal growth. WHO standard of pH range in

fresh water is 7- 9. In this study, the highest mean pH value was recorded in site 'E" (7.9) while the least was recorded in site 'D' (7.6). The values of pH recorded in this study fall within the WHO standard and correlates significantly with electrical conductivity. The highest value of pH recorded could be attributed to run off from the neighbouring farm land as well as discharge into the water bodies. Similar observation was made in site A' which are the two sites that have direct influx from neighbouring farm land. This finding agrees with that of Antoine and Al-Sa'adi (1982) who associated the pH values recorded in their studies to run off from agricultural land.

The highest mean value for dissolved oxygen was recorded in site 'A' (4.70mg/L) while the least was recorded in site 'C' (3.35mg/L). The result indicated a negative correlation with temperature and significant correlation with conductivity.

Table 1. Mean ± SE in Physico-chemical Variations at Sampling Sites (A -E) of Kanye Dam Reserviour, Kano State

Sites	Temperature (ºC)	pH	DO (mgL^{-1})	BOD (mgL^{-1})	N-NO_3 (mgL^{-1})	P-PO_4 (mgL^{-1})	EC (µS/cm)
A	25.8 ± 0.6	7.7 ± 0.2	4.7 ± 0.9	2.1 ± 0.4	2.6 ± 1.2	1.0 ± 0.5	612 ± 39.1
B	25.5 ± 0.6	7.7 ± 0.3	3.4 ± 0.4	2.2 ± 0.4	1.4 ± 0.7	1.0 ± 0.5	625 ± 42.4
C	25.3 ± 0.6	7.8 ± 0.3	3.4 ± 0.4	1.8 ± 0.4	1.6 ± 0.9	0.9 ± 0.5	606 ± 47.3
D	25.8 ± 0.6	7.6 ± 0.3	3.3 ± 0.4	2.1 ± 0.4	1.8 ± 1.2	1.1 ± 0.6	623 ± 51.5
E	25.7±0.8	7.9±0.3	3.7±0.6	2.2±0.6	2.0±1.1	1.0±0.6	626±45.7

Do = Dissolved Oxygen, BOD = Biochemical Oxygen Demand, P-PO_4 = Phosphorus Phosphate, N-NO_3 = Nitrogen Nitrate, EC = Electrical Conductivity

Table 2: Correlation Analysis between physico-chemical attributes of Kanye Dam

	Temp(ºC)	pH	DO (mgL^{-1})	N-NO_3 (mgL^{-1})	P-PO_4 (mgL^{-1})	BOD (mgL^{-1})	EC (µS/cm)
pH	-0.115	1					
DO (mgL^{-1})	-0.207	-0.063	1				
N-NO_3 mgL^{-1})	-.488**	-0.202	0.08	1			
P-PO_4 (mgL^{-1})	-.517**	-0.13	0.289	.807**	1		
BOD (mgL^{-1})	-0.176	0.125	.719**	0.264	.495**	1	
EC (µS/cm)	.467**	-.754**	0.064	-0.047	-0.131	-0.135	1

*. Correlation is significant at the 0.05 Level

**. Correlation is significant at the 0.01 level

This is not unconnected with the nature of anthropogenic activities taking place around sites 'A' and 'E' such as farming, washing and bathing. This agrees with the findings of Indabawa and Abdullahi (2004) who reported a DO of 0.51-9.25mg/L. Lind (1968) also reported seasonality of DO in two highland reservoirs that are influenced by runoff in the rainy season.

Nitrate and phosphates are the two most important factors contributing to eutrophication in water. The highest mean nitrate value was recorded at site 'A' (2.62mg/L) while the least was recorded at site 'B' (1.35mg/L). The nitrate values recorded in this study fall within WHO (1998) limit. Nitrate values recorded positively correlate with temperature and phosphate at 0.01% level significance. However, the values of Nitrate fluctuated with variations in seasons. This could be attributed to the runoff from neighbouring farm land fed with inorganic fertilizers by farmers, discharged in to the water bodies. Similar observation was made by Olaniyan (1969) and Watanabe *et al*., (1995), who reported that nutrients are potential determinant of ultimate productivity, as evidenced by many limnological studies correlating high nitrate and phosphate values to luxuriant phytoplankton flora.

The Biochemical Oxygen Demand was within the WHO standard limits for BOD of unpolluted water is less than 5mg/L. The highest mean BOD value was recorded at site 'E' (2.23mgL^{-1}) while the least was recorded in site 'C' (1.77mgL^{-1}).The result indicated a significant negative correlation with DO and phosphate. The highest mean electrical conductivity value was recorded in site 'E' (626µS/cm) while the least was (606µS/cm) in site 'C'.The values recorded in this study correlate significantly with temperature, and pH. The EC values recorded also fluctuates with season due to different some human activities taking place in the Dam and discharge from surface run off. Similar observation was made by Adeniji (1993) and Sunda *et al.,* (2006) in Shiroro Lake who reported a dry season mean conductivity attributed to higher concentration effect due to reduced water volume; however the higher conductivity of the water may be a pointer of eutrophication of the Dam.

Conclusion

The results obtained indicate that the physicochemical parameters vary with some degree of pollution and can support luxuriant phytoplankton flora.

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