Water Quality Assesment of Hashidu Reservoir Along River Gongola, Gombe State Nigeria.

ABSTRACT

AIMS: This study aim to assess the water quality in relation to fisheries of Hashidu reservoir.

STUDY DESIGN: Water samples for the physicochemical analysis were collected from Hashidu reservoir monthly over a period of six months cutting across both dry and rainy seasons.

METHODOLOGY: Water samples were collected from three locations using 250 ml sampling bottles and was taken to the laboratory for analysis. physicochemical parameters were analyzed using standard water sampling protocols. The water PH and temperature were determined using WTW PH and temperature electrodes. He turbidity meter was calibrated using potassium chloride solution. the turbidity was determined using turbidity meter by pressing the mode button until the arrow appeared as c0n in the displayer. Electrical conductivity was measured using the same Hanna measuring instrument (combo /EC model h198129). Dissolved oxygen was measured with Jenway model 1970 waterproof D.O meter at all the sites. Biochemical oxygen demand (bod) was determined as the difference in dissolved oxygen (do) before and after incubation of the water sample at 20 ^{o}c for 5 days.

RESULTS: The mean values for physicochemical parameters recorded during dry and rainy seasons are PH (7.42, 6.77), electrical conductivity (353.50 µS/CM, 545.30 µS/CM), DISSOLVED oxygen (6.77 MG/L, 6.00 MG/L), turbidity (3.94 CM, 3.48 CM), temperature (32^{O}C 29.3^{O}C), BOD (3.69 MG/L, 6.00 MG/L) and COD (6.22 MG/L, 6.00 MG/L) respectively. While the mean values the major anions are nitrate (44.00 MG/L, 50 MG/L), phosphate (11.38 MG/L, 17.70 MG/L), sulphate (15.00 MG/L, 25.50 MG/L), chloride (37.23 MG/L, 240.69 MG/L), fluoride (0.028 MG/L, 0.059 MG/L).

CONCLUSION: Most of the parameters were within the limits set by who except PH, temperature and phosphate. there is need for continuous monitoring of water quality parameters for sustainable management of natural resources.

Keywords: [Water quality, Hashidu reservoir, River Gongola, Fisheries}

1. INTRODUCTION

Water is one of the most important and abundant compounds of the ecosystem. All living organisms on the earth need water for their survival and growth. As of now only earth is the planet having about 70 % of water. Surface water bodies

such as rivers, dams, and lakes, are intrinsic to sustainable development for all living organisms. However, rapid population growth, urbanization, and industrialization have posed significant threats to water quality globally (Uba et al. 2024). Surface water is one of the vital habitats exposed to global environmental changes due to rapidly increasing anthropogenic activities. It served many functions (Soumaila et al., 2021). But due to increased human population, industrialization, use of fertilizers in the agriculture and man-made activity it is highly polluted with different harmful contaminants. Therefore, it is necessary that the quality of water should be checked at regular time interval, because due to use of contaminated water, the aquatic ecosystem suffers from varied of water pollution.
Water is a natural resource with limited and uneven distribution in time and space. All forms of life and all human activities are dependent on water. Water resources are of great importance to human life and economy and are the main source of meeting the demand for drinking water, for irrigation of lands and industries. Lack of water is considered as a limiting factor of socio-economic development of a country. Modern industrial development and urbanization have resulted in the formation of large urban areas, industrial zones and the development of intensive agriculture. This has increased the need for water, but also the growth of urban and industrial discharges into rivers without any prior treatment, thereby reducing the possibility of self-purification (auto purification) of water. The need for clean water today is considered as one of the biggest problems the global environment. This study aim at ascertaining the water quality of Hashidu Reservoir along River Gongola.

2. MATERIAL AND METHODS

2.1 Study Area

The Gongola River is in the northeastern Nigeria, the principal tributary of the Benue River (Figure 1). The upper course of the river as well as most of its tributaries are seasonal streams, but fills rapidly in August and September. The Gongola rises on the eastern slopes of the Jos Plateau and falls to the Gongola basin, running north easterly until Nafada at one time, the Gongola continue from here in the northeast's direction to lake chad. Today it turns south and then southeast until it joins the Hawal river, its main tributary. The Gongola then runs south to the Benue river, joining its opposite in the town of Numan.

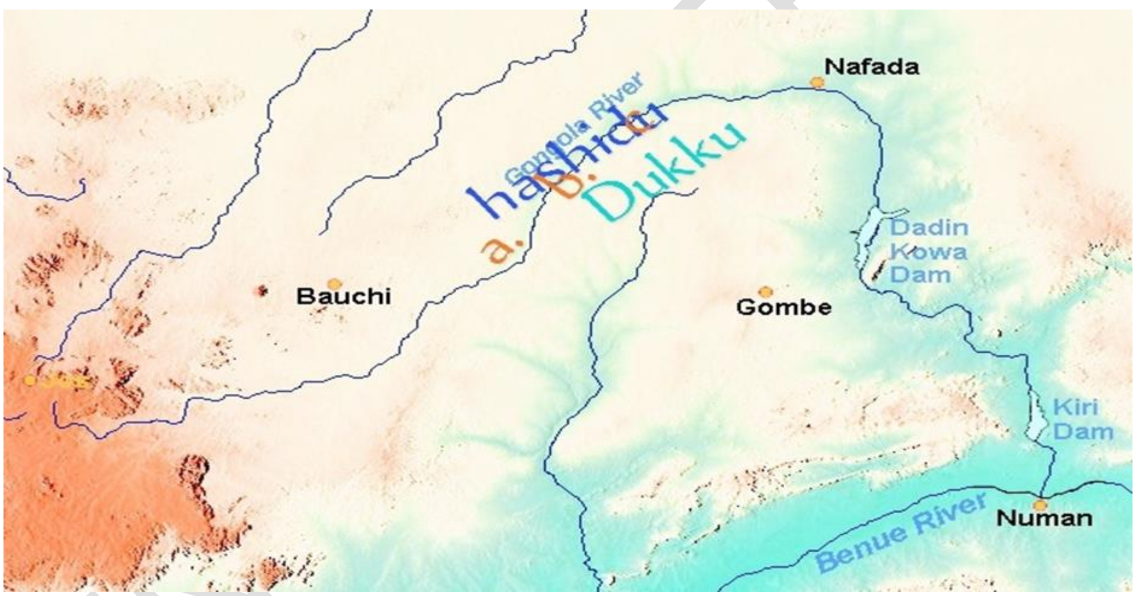

Figure 1: Map of the study area showing the sampling points along River Gongola

2.2 Collection of Water Samples

Water samples for the physicochemical analysis was collected on monthly basis from each station at sub-surface level, using 250 mL sampling bottles and was taken to the laboratory for analysis. Samples were taken at three stations on the same day and at the same sampling points for ease of reference. (Zahraddeen,. 2011).

2.2.1 Determination of Physicochemical Parameters

The water pH was determined using WTW pH Electrode. The pH meter was calibrated using buffers of pH 4.0, 7.0, and 10.0; the pH electrode membrane was immersed into the water sample, the pH measurement was selected by pressing the button pH, it was confirmed by pressing RUN button. (Akhtar et al., 2021). Temperature was determined using WTW Temperature meter. The meter was calibrated and the membrane was immersed into the water sample, the Temperature measurement was selected by pressing the button. Turbidity was determined using a CO150 meter. The turbidity meter was calibrated using potassium chloride solution. The turbidity was determined using turbidity meter by pressing the mode button until the arrow appeared as C0N in the displayer. Electrical Conductivity was measured using the same Hanna Measuring Instrument (Combo /EC Model H198129). Dissolved oxygen was measured with Jenway Model 1970 waterproof D.O meter at all the sites. Dissolved oxygen meter was calibrated prior to measurement with appropriate traceable calibration solution of 5% HCl. The probe was immersed into the water sample; the switch was turned on. Biochemical oxygen demand (BOD) was determined as the difference in dissolved oxygen (DO) before and after incubation of the water sample at 20 ^{o}C for 5 days. The water sample was pour into stopper bottle and the DO concentration was measured at beginning and was measured after incubation for five days at 20 ^{o}C. Anions were determined using titration methods.

3. RESULTS AND DISCUSSION

3.1 Physicochemical parameters

The results of physicochemical parameters of Hashidu Reservoir along River Gongola is prsented in Table 1. Water pH fluctuated between 7.41 to 7.53 with mean value of 7.42 during the dry season. In rainy season, the pH values ranged between 6.63 to 6.94 with mean value of 6.77 (Table 1). All values recorded in both seasons fall within the recommended pH values (6.5-8.5) set by WHO. Values of pH above 9.0 or below 6.5 may pose adverse to aquatic life. Accordingly, pH has an indirect effect on the forms of chemicals present. The productivity of fish is believed to be higher in freshwater bodies with a pH of 6.5-9.0 (Abubakar et al, 2017; Fausey *et al.*, 1995). It have been reported that the main effect of pH seems to be on the inhibition of 0_2 uptakes at the gills of fishes (Abubakar et al. 2017). Previous research findings (Chapman, 1992) showed that, a change in water pH indicates the presence of certain agricultural and domestic effluents. Similarly, Abubakar et al. (2017) Indicated that decay and decomposition of aquatic weeds can cause accumulation of acidic gases in a lake; these may consequently affect the water pH.

The electrical conductivity (EC) of the water ranged from 291.23 to 623 µS/cm during the dry and rainy seasons with mean values of 353.5 and 545.3 µS/cm respectively (Table 1). The seasonal variation could be due to dilutions of the water body during the rainy seasons by different components through the action of rain that washed away chemicals from fertilizers and other components by human activities. It has been established that the mineral content of the water expressed as total dissolved salts can be used as a rough indicator of the edaphic condition which play a fundamental role in determining the biological productivity of water bodies (Fausey et al., 1995). Thus, the wide variation in the total dissolved salts for the three stations could be due to the autochthonous contribution to the water body (Abubakar et al. 2017).

Dissolved oxygen fluctuated between 5.65 mg/L and 7.09 mg/L with mean values of 6.77 mg/L and 6.0 mg/L in both dry and rainy seasons and all values fall within the recommended values of dissolved oxygen of surface water (Table 1). It has been documented that dissolved oxygen below level of 5.0 mg/L impairs the growth and reproduction of fishes and other aquatic life as well as made them to become more susceptible to diseases and parasitic attack (Umar et al, 2018). Consequently, Boyd, reported that dissolved oxygen (DO) value of <2 mg/L is deleterious (Boyd, 1981). Thus, it have been reported that oxygen saturation percentage is influenced by phytoplankton densities and organic matter decay (Mustapha et al., 2017). The high DO concentration obtained in this research especially in the rainy season could be attributed to the effect of mixing of upper and lower layers of the water body by the action of rain thereby increasing the dissolved oxygen. Moreover, it was observed that water current causes mixing of the upper and lower layers in a river column thereby increasing dissolved oxygen (Yuwei et al., 2019). The value of DO concentration in this research is in agreement with the finding of similar studies, recorded 4.3 mg/L - 8.88 mg/L in Lake Alau (Bankole, 2002), 3.9 mg/L - 8.0 mg/L in Water in Lake (Abubakar et al. 2017) and 7.0mg (Umar et al*.,* 2018) in a study conducted in Balanga Dam, Gombe, Nigeria.

Turbidity of water ranged between 3.16 cm to 4.96 cm with mean values of 3.94 cm and 3.48 cm during dry and rainy seasons. The increased values during the rainy season could be attributed to surface run off and erosion carrying soil/silt and partially dissolved/un-dissolved organic matters (Morokov, 1987; Sulaiman and Maigari, 2016).

The highest and lowest water temperature values of 32℃ and 28.5 ℃ with mean values of 32 ℃and 29.3℃ respectively (Table 1). The surface water of the study site is slightly above the favorable temperature range of 16^{o}C - 30^{o}C during dry season as reported by (Chapman, 1992) and also (Alabaster and Lloyd, 1981) who reported that the normal range of temperature in the tropics to which fish is between 8^{o}C and 30^{o}C and these make the critical thermal minimum and maximum respectively.

The lowest BOD value of 3.18 mg/L was recorded in site A during the dry season, while the highest recorded value of 6.55 mg/L was recorded during the rainy season with mean values of 3.69 mg/L and 6.00 mg/L respectively (Table 1). The higher BOD which was lower than the obtained DO during the same period could be due to the presence of rains which brought in biogenous materials into the river. These findings agreed with those of (Oni et al., 1983; Maigari et al 2021), who noted that higher BOD in water system was due to biogenous materials that were brought in by rainfall. The

high concentrations may be attributed to the nature of the catchment area, municipal or domestic wastes, run-offs, agricultural wastes (fertilizers) and solid waste dump.
Chemical oxygen demand (COD) fluctuated between 5.57 mg/L in site A during the dry season to 6.55 mg/L in sites B and C during same dry season with mean values of 6.22 mg/L and 6.00 mg/L respectively (Table 1). The recorded values of COD reported in this study fall within the recommended value of COD of surface water (Alabaster and Lloyd, 1981).

Table 1: Physicochemical parameters of Hashidu Reservoir along River Gongola

Seasons	Stations	Physicochemical parameters pH	EC (µS/cm)	DO (mg/L)	Turbidity (cm)	Temperature (℃)	BOD (mg/L)	COD (mg/L)
Dry season								
	A	7.41±0.06	409.76±16.22	6.91±0.01	4.96±0.01	32.70±1.44	3.18±0.00	5.57±0.02
	B	7.34±0.00	291.25±32.01	7.09±0.01	3.16±0.00	30.43±2.90	4.24±0.31	6.55±0.01
	C	7.53±0.00	359.51±17.42	6.31±0.01	3.72±0.00	32.87±1.42	3.65±0.02	6.55±0.03
	Mean	7.42	353.50	6.77	3.94	32.00	3.69	6.22
Rainy Season								
	A	6.94±0.02	623.89±32.08	6.16±0.01	3.30±0.09	29.76±1.12	5.57±0.02	6.16±0.01
	B	6.63±0.14	483.11±27.20	6.19±0.03	3.77±0.02	29.60±0.56	6.55±0.01	6.19±0.04
	C	6.73±0.01	528.90±24.21	5.65±0.02	3.39±0.03	28.50±0.74	5.78±0.06	5.65±0.02
	Mean	6.77	545.30	6.00	3.48	29.30	6.00	6.00
	MPL (WHO)	**6.5-8.5**	**2500**	**5.00**	**5**	**15-25**	**6.00**	**125**

MPL= Minimum Permissible Limit

3.2 Major Anions

The results of the major anions of Hashidu reservoir is presented in Table 2. Nitrate recorded its highest value of 59.44 mg/L in station A during the rainy season, while its lowest value of 38.50 mg/L was obtained in station B during the dry season with mean values of 44.00 mg/L and 50.80 mg/L during dry and rainy season respectively (Table 2). In rainy season, nitrate levels were high indicating potential eutrophication risks. During the dry season, nitrate levels further decreased, this might be due less farming activities during the dry season as compared to the rainy season. Nitrate is found naturally in the environment, thus, giving it the potential to migrate to ground water since they are very soluble and do not bind to soil thereby making it an important plant nutrient (Punmia and Jain, 1998).
Highest values (15.26 mg/L to 19.70 mg/L) of phosphate were recorded during rainy season, while lower values of 9.18 mg/L to 10.82 mg/L recorded during the dry season (Table 2). Phosphate enters water ways from human, animal waste and other sources like phosphorus rich bedrock, industrial effluents, fertilizer run-off, laundry and cleaning (Ubwa, et al., 2013). High phosphate values obtained in some locations could be attributed to the release of salts from anthropogenic activities into the waters.
The highest value (32.13 mg/L) of sulphate was obtained in station C during the rainy season, while the lowest value of 11.90 mg/L was recorded in same station C during the dry season. The mean values of sulphate recorded in dry and rainy seasons were 15.00 mg/L and 25.53 mg/L respectively (Table 2). The relatively lower values of sulphate obtained in this study is an indicator that the waters are fairly soft which further explains the absence or low amounts of carbonates and bicarbonates which may cause poor lather formation and scales in boilers. In addition, elevated amounts of sulphate above the recommended levels are associated with catharsis, dehydration and gastro-intestinal irritation (Jidauna, et al., 2014).
Chloride recorded its highest value of 30.53 mg/L during dry season with its highest value of 249.13 mg/L was recorded during the rainy season with mean values of 37.23 mg/L and 240.69 mg/L recorded in the two seasons (Table 2). Chlorides originate from the leaching of rocks and soils containing chloride, which the water encounters. Moreover, chlorides are highly stable in water and remain largely unaffected by natural physicochemical and biochemical processes (Kangpe et al, 2014).
The highest value (0.078 mg/L) of flouride was recorded in the rainy season, while the lowest value of 0.017 mg/L was recorded in the dry season. The mean values recorded in both seasons were 0.028 mg/L and 0.059 mg/L respectively (Table 2). Fluoride concentrations are attributed to several factors such as hydrological conditions – rainfall patterns and groundwater recharge rates, which fluctuates seasonally, affects the transport and dilution of fluoride. Seasonal variations in temperature and pH can also influence the solubility and mobility of fluoride-bearing minerals, hence impacting fluoride concentrations in water samples. Low concentrations of fluoride in water have been considered beneficial to prevent dental carries but excessive exposure to fluoride in drinking water can give rise to a number of adverse effects (Barghouthi & Amereih, 2012).

Table 2: Major Anions of Hashidu Reservoir along River Gongola

Seasons	**Stations**	**Major Anions**				
		NO_3^-	$P0_4^{3-}$	SO_4^{2-}	Cl^-	F^-
Dry season						
	A	52.38±0.01	10.82±0.01	14.17±0.03	42.70±0.02	0.035±0.02
	B	38.50±0.00	9.18±0.01	17.42±0.00	30.53±0.00	0.017±0.00
	C	41.07±0.02	14.15±0	11.9±0.00	38.47±0.02	0.033±0.01
	Mean	44.00	11.38	15.00	37.23	0.028
Rainy Season						
	A	59.44±0.01	18.15±0.01	17.66±0.02	226.97±0.02	0.078±0.01
	B	47.55±0.01	15.26±0.02	26.80±0.00	245.97±0.02	0.055±0.01
	C	45.43±0.01	19.70±0.01	32.13±0.00	249.13±0.01	0.044±0.01
	Mean	50.80	17.70	25.53	240.69	0.059
	MPL (WHO)	**50**	**10**	**150**	**250**	**1.5**

4. CONCLUSION

The major water quality parameters of Hashidu reservoir along River Gongola was evaluated. Most of the parameters were within the limits set by WHO except pH, temperature and phosphate. There is need for continuous monitoring of water quality parameters for sustainable management of aquatic environment and the general well being of aquatic biota.

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