



Research Paper

Effects of Seasons on Some Physical Water Quality Parameters in Bakolori Reservoir

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Abstract

The study was conducted in Bakolori reservoir. In this study, some physical water quality parameters of Bakolori reservoir in Zamfara State in north western Nigeria were assessed through standard methods. Air and water temperatures were determined at the site using mercury in glass-thermometer. Transparency was measured at the field (Bakolori reservoir) with Secchi disk. For total dissolved solids, water samples were collected once every month and concentrations were determined in the agriculture chemical laboratory of Usmanu Danfodiyo University, Sokoto Nigeria. Data generated were analyzed seasonally and sub-seasonally using analysis of variance (ANOVA). The effects of the season on some physical parameters recognised in this study were determined. The air temperature was higher than water temperature. The annual means for air and water temperatures were $29.10 \pm 2.960^\circ\text{C}$ and $23.37 \pm 2.520^\circ\text{C}$ respectively. Transparency was maximum in dry season (9.75 ± 0.43) and late dry sub-season (10.00 ± 0.00 cm). Total dissolved solid recorded maximum concentration of 7.88 ± 1.66 mg/l in dry season and annual mean of 7.26 ± 1.61 mg/l. sub-seasonally, mid dry sub-season has the highest value (8.87 ± 1.19) followed by late dry sub-season (7.86 ± 1.35). There was no significant difference between concentration recorded by early rainy and flood sub-seasons. The results obtained indicated that seasons have no effect on the studied physical parameters.

1. Introduction

Nigeria is the most populous country in Africa with a population of over 200 million (Ekiye & Luo, 2010). It is endowed with water bodies (USAID, 2010). The source of these waters is the natural hydrological cycle which encompasses earth surface and the atmosphere (Ojekunle et al., 2014; Ibrahim et al., 2019). Fresh water bodies such as rivers and reservoirs are for water supply, irrigation and fresh water fish production (Adekole, et al, 2003). The resources in these water bodies are of various kinds. They include fish and some planktons as well as macrophytes. Water bodies show variations in their composition especially between seasons. It increases from lower levels in rainy season to high levels in dry season (Luoto, 2009; Anita & Poojo, 2013). One of the most important qualities of water that affect it is the temperature. It determines the solubility and concentration of dissolved gases in the

water as reported by Mason (2002). To the aquatic organisms, it regulates their behaviors, (activities, feeding, growth) and reproduction. Maushal & Sharma (2001) observed that pH, dissolved oxygen, sewage, anthropogenic, agricultural and industrial activities in addition to dissolved mineral substances in the water bodies adversely affect the biodiversity in the water.

Water quality is the physical, chemical and biological factors that influence the beneficial uses of water (Moses, 2018). The quality of water for human and livestock consumption as well as for fish performance depends on three major factors namely physical, chemical and biological factors which interrelate to make the water to have good or bad qualities (Nakashima et al., 2007). They regulate the suitability of water for living organisms (Ita, 1994). The aim of this present investigation to analysis of season wise physical water quality parameter in Bakolori Reservoir.

2. Materials and Methods

2.1 Study Area

The study was conducted in Bakalori reservoir which is on the elevation of 333m above sea level (Google earth, 2019) on coordinates 12° 26' 50" N to 12° 43' 00" N and 06° 10' 00" E to 6° 17' 00" E in Zamfara State in North-Western Nigeria (Ibrahim & Ogueji, 2017). It was built on Sokoto River, a tributary of Rima River. The construction began in 1974 and ended in 1978 and became impounded with water in 1981. It has a capacity of 450 million cubic metres (Ibrahim & Ogueji, 2017) and 8,000 hectares (Mohammed, 2002; Ibrahim & Ogueji, 2017; Aminu et al 2018). This reservoir was initially designed to supply 30,000 hectares with water. However, due to some technical problems, the scope was reduced to 23,000 hectares. Bakalori reservoir is found within Sokoto River basin area known to have a temperature, rainfall and humidity ranging from 25°C to 32°C, 550mm to 1000mm per annum and 20% to 40% respectively (Gusau et al., 2015; Aminu et al, 2018). Extreme heat is experienced before the rainfall (Gusau et al., 2015; Aminu et al, 2018;). It is fed by River Sokoto and many other tributaries such as Rivers Nkaba and Tarka from Niger republic (Oiganga et al., 2015). Its catchment areas are scarcely populated with the grasses, shrubs and trees. Irrigation, illegal mining and fishing are the major occupations of the people living around the reservoir (Oiganga et al., 2015).

2.2 Sampling Points and Water Sampling

Four sampling points denoted as A, B, C and D were used. Sampling points A and D were located up and down streams of the reservoir respectively. B and C were at the centre. Air and water temperatures were determined using mercury in glass thermometer and transparency was measured with Secchi disk at the site. For total dissolved solids (TDS) three samples from each sampling point were collected and transported to Agriculture Chemical laboratory of Usmanu Danfodiyo University, Sokoto on the same day.

2.3 Concentration Determination

TDS concentrations were determined in the Agriculture Chemical laboratory of Usmanu Danfodiyo University, Sokoto Nigeria following the procedure below:

$$TDS (mg / L) = \frac{W_2 - W_1}{V} \times 1000$$

Where

W₁ = initial weight of Petri- dish
W₂ = final weight of Petri- dish
V = volume of water sample

2.4 Statistical analysis

Data was analyzed monthly (January to December), seasonally (rainy and dry seasons) and sub-seasonally (early rainy sub season-June and July, flood sub-season-August and September, Early dry sub-season-October, November and December, mid dry sub-season-January and February and late dry sub-season-March, April and May) (NIMA, 2015; Onaji et al., 2005) following analysis of variance (ANOVA) (Steel & Torrie, 1980). The analysis was carried out using Statistical Package for Social Science (SPSS) software. Mean separation was done following Duncan Multiple Range Test (Gomez & Gomez, 1984).

3. Results

Rainy season recorded air temperatures of 31.14 ± 2.59°C (Table 1) while flood sub-season Obtained 32.39 ± 2.93°C as the highest (Table 2). The annual mean was 29.10 ± 2.96°C. The highest air temperature in the wet seasons may be due to higher temperature associated with wet season. Air temperature increased gradually and significantly ($p < 0.05$) from mid dry sub-season to flood sub-season. Dry season obtained the highest water temperature (24.03 ± 2.48°C) (Table 1). Sub-seasonally, early dry sub-season obtained the highest value of 24.96 ± 1.63°C (Table 2). The highest temperature in dry season and early dry sub-season may be due to intense solar radiation during these seasons. This agrees with work of Okayi (2003) who recorded highest water temperature (31°C) in River Benue during dry seasons. Water temperature increased significantly from early rainy sub-season to its peak (24.96 ± 1.63°C) in early dry sub-season.

Water temperature was generally lower than air temperature during the study period. The mean values (23.37 ± 2.52°C) obtained in this study were in line with the water quality standard favorable for aquatic organisms. Transparency recorded 6.93 ± 1.36 cm rainy and 9.75 ± 0.43 cm for dry seasons. With the annual mean of 7.87 ± 1.76 cm. The mean value was 7.87 ± 1.76 cm (Table 1). Late dry sub- season recorded highest transparency (low turbidity) of 10.00 ± 0.00 cm while flood sub- season has the lowest (high turbidity) value of 6.00 ± 1.02 cm (Table 2). The values for rainy and dry seasons were 6.02 ± 0.73 mg/l and 7.88 ± 1.66 mg/l, respectively. The annual mean was 7.26 ± 1.61 mg/l (Table 1).

4. Discussions

The low transparency (higher turbidity) in rainy season and flood sub- sub-season were due to increase in the concentration of inorganic and organic inputs from allochthonous sources and the agricultural practices around the reservoir which loosen the soil particles which drained into the reservoir. However, higher transparency (low turbidity) during dry season and dry sub-seasons may be due to coagulation and sedimentation of suspended particles which resulted to

the clarity of water (Delince, 1992). Transparency increased gradually from early rainy sub-season to late dry sub-season.

Sub-seasonally, TDS has minimum of 5.68 ± 0.83 mg/l in flood sub-season and maximum of 8.87 ± 1.19 mg/l in mid dry sub-season (Table 2).

Table 1: Seasonal mean of some physical water quality parameters in Bakolori reservoir

Parameters	Rainy season	Dry season	Annual mean
Water temperature ($^{\circ}\text{C}$)	22.06 ± 2.09^a	24.03 ± 2.48^a	23.37 ± 2.52
Air temperature ($^{\circ}\text{C}$)	31.14 ± 2.59^a	28.08 ± 2.75^a	29.10 ± 2.96
Transpaency (cm)	6.93 ± 1.36^b	9.75 ± 0.43^a	7.87 ± 1.76
T.D.S. (mg/l)	6.02 ± 0.73^a	7.88 ± 1.66^a	7.26 ± 1.61

Table 2: Sub-seasonal means of some physical water quality parameters in Bakolori reservoir

Parameters	Sub-season				
	Early rainy	Flood	Early dry	Mid dry	Late dry
Water temperature ($^{\circ}\text{C}$)	20.12 ± 0.33^a	24.00 ± 1.02^c	24.96 ± 1.63^c	24.58 ± 3.24^c	22.75 ± 2.07^b
Air temperature ($^{\circ}\text{C}$)	29.91 ± 1.40^b	32.37 ± 2.93^c	28.65 ± 2.67^{ab}	27.62 ± 3.85^a	27.83 ± 1.74^a
Transparency/(cm)	6.00 ± 1.02^a	7.16 ± 0.87^b	7.33 ± 1.67^b	9.50 ± 0.51^a	10.00 ± 0.00^a
T.D.S. (mg/l)	6.36 ± 0.40^a	5.68 ± 0.83^a	7.25 ± 1.91^b	8.87 ± 1.19^c	7.86 ± 1.35^b

5. Conclusions

Base on the findings it was concluded that physical water quality parameters were not affected by seasons. They were in line with the water quality standard limits (WQSL) favourable for aquatic organisms.

6. Statements and Declarations

Ethical Approval: Not applicable.

Conflict of Interest: The authors in this article declare that they have no known competing financial interests or personal relationship that could have appeared to influence the work reported in this article.

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