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EFFECT OF SEASON ON WATER QUALITY OF LIBERTY RESERVOIR, JOS, PLATEAU STATE

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ABSTRACT

A study of the analysis of water in relation to the season was undertaken in the Liberty Reservoir for two years (April 2012 to March 2014). Water sample was collected from Liberty Reservoir. The concentration of various physicochemical characteristics was measured. Data collected were subject to analysis of variance using the SPSS software and analyzed. Seasonal variations were observed in most of the parameters measured. Increased mean values of water temperature, dissolved oxygen, free carbon dioxide, nitrate, pH. Alkalinity, conductivity, were observed in the wet season while only air temperature, phosphate, and transparency increased in the dry season. Most of the physicochemical properties of water determined were outside the range of the standard guidelines for drinking water but most were within the range of fish farming. Human activities abated by rainfall have caused significant ($P < 0.05$) changes in water quality between seasons. Therefore, these anthropogenic activities should be checked if the reservoir is to continue to supply portable water to the populace of Jos metropolis.

Key Words: Physico-chemical Parameters, Water Quality, Season, Reservoir, Liberty Reservoir

Introduction

Liberty Reservoir is a perturbed waterbody in the urban city of Jos. It is of critical importance to the surrounding inhabitants because it is a portable water supply reservoir. It is greatly impacted by effluents from anthropogenic activities such as increased irrigation and agricultural activities on the bank, fishing, block molding, tourist attraction, and introduction of domestic wastes from the growing population around the reservoir (Ajuzie, 2012, Oyedapo *et al.*, 2018). These human activities are capable of influencing water quality. This study is aimed at investigating the water quality with respect to the season.

Study Area

The Jos Plateau is a high land area in north central Nigeria that covers an area of about 8,600km² and lies between latitude 8°30' and 10°10'N and longitude 8°20' and 9°30'E (Ali, 2010). The study site is Liberty Reservoir located in Laminga village along the way to the Jos University Teaching Hospital through the main gate, Jos North Local Government Area of Plateau State.

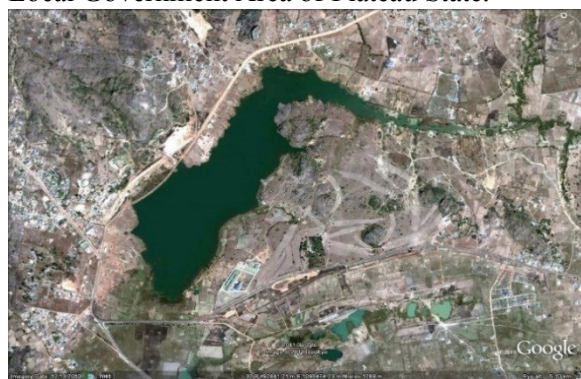


Figure 1: Map of the Liberty Reservoir in Jos North Local Government Area, Plateau State.



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Methodology of Water Quality Parameters

The water quality parameters measured were water and air temperatures, pH, free carbon dioxide, dissolved oxygen, water transparency, alkalinity, conductivity, total solids, and some dissolved nutrients

Water and air temperatures were measured on the field using a mercury-in-glass thermometer. The temperature was measured in degrees Celsius (°C). The hydrogen ion concentration (pH) of the water in the reservoirs was also measured in situ using a pocket-sized pH meter model H196107 was used to measure pH of the water

bodies. The pH of the reservoirs was determined by dipping the electrodes of the pH meter in the water sample collected in a measuring cup for five minutes. A digital conductometer, model DDS-12A was used to measure electrical conductivity. Electrical conductivity was measured in $\mu\text{S}/\text{cm}$. Water samples were collected in 250ml reagent bottles, corked underwater and fixed by adding 2ml each of manganous sulfate (MnSO_4) and alkaline iodine sodium azide solution. This was transported to the hydrobiology laboratory. These water samples were used to determine the dissolved oxygen (DO) by the Wrinklers technique. Total alkalinity was measured by titration method according to APHA (1998). Free carbon dioxide was determined by the titration method (APHA, 1995).

RESULTS

In this reservoir, water quality parameters varied between wet and dry seasons. Water temperature, dissolved oxygen, free carbon dioxide, nitrogen, pH, conductivity and alkalinity values were higher in the wet season than in the dry while air temperature, phosphate and transparency were lower in wet season than in the dry (Table 1). However, all the variations observed in the mean values of water quality parameters varied significantly ($P < 0.05$) except water temperature, pH and alkalinity (Table 1). In both wet and seasons, air temperature, water temperature, phosphate, pH and alkalinity were within range of the international standard for fish farming but dissolved oxygen, free carbon dioxide, nitrate and water transparency readings were higher than recommended for fish farming meanwhile carbon dioxide and nitrogen were lower in dry season (Table 1). Dissolved oxygen and alkalinity, were lower while free carbon dioxide, nitrogen, phosphate, pH, and transparency were higher than the recommended range for drinking water (Table 1).

Discussion

The effect of season on the water physico-chemistry is evident in the results obtained. The fluctuations in physicochemical parameters may be attributed majorly to pattern of anthropogenic activities, temperatures and rainfall which is in agreement with Ayoade, Fagade & Adebisi (2006); Usman (2015). Human activities around these reservoirs such as cattle grazing arable crop farming, swimming etc. also introduces organic wastes into the reservoir. The influx of these materials into the reservoir during the wet season is responsible for the increase in the values of most of the water quality parameters measured.

Table 1: Physico-chemical Parameters in relation to Season in Liberty Reservoir compared with Standard of Requirement for Drinking Water and Fish Farming.

Parameters	Drinking Water	Fish Production	Wet season	Dry season	SEM
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GLOBAL CHALLENGES**

Air temperature (°C)	-	15-35	25.25 ^b	27.95 ^a	0.64
Water temperature(°C)	-	20-30	24.75	24.10	0.41
Dissolved oxygen (mg l ⁻¹)	8.5	6.0-7.0	8.01	7.88	0.14
Free CO ₂ (mg l ⁻¹)	<5	6.0-7.0	9.16 ^a	6.10 ^b	0.69
Nitrate (mg l ⁻¹)	0.11	0-3.0	5.48 ^a	0.41 ^b	0.09
Phosphate (mg l ⁻¹)	<0.25	0.01-3.0	0.30 ^b	1.00 ^a	0.08
pH	6.5	6.5-8.5	6.83 ^a	6.73 ^b	0.09
Alkalinity (mg l ⁻¹)	500	10-400	25.89 ^a	24.15 ^b	1.11
Conductivity (µSiemens/cm)	<400	30-5,000	90.94 ^{aco}	80.22 ^b	0.19
Transparency (cm)	10-50	30-60	92.67	194.3	4.86

Rainfall encourages influx of debris, organic matter dissolved nutrient from the surrounding soil and rock surfaces which are capable of changing the water quality.

This finding is supported by *Vega et al. (1998)* who stated that seasonal variations in surface run-off, precipitation, interflow, groundwater flow and pumped inflows and outflows have a strong effect on river discharge and subsequently on the concentration of pollutants in river water. The high oxygen concentration obtained may be due to the wide surface area of the reservoir which enables diffusion of good quantity atmospheric oxygen into the reservoir. It may also be attributed to the high presence of photosynthetic algae present in the reservoir. It is worth knowing that the increased nutrient is capable of raising the population of algae particularly cyanobacteria which may cause toxins to be introduced into the reservoir's water hence making it unfit for human consumption. In the same vain, phosphate levels higher than 1mg l⁻¹ will interfere with water treatment coagulation process resulting the escape of micro-zooplankton into the already treated water that is being supplied for domestic uses as reported by *SWCSMH (2015)*. The higher levels of some of the physicochemical parameters in this reservoir in the wet season particularly the nutrients (nitrate and phosphate) make the water quality more impaired and unfit for human and livestock consumption than in the dry. This finding also agrees with that of *Gupta, Pandey, & Hussain (2017)* who discovered that the water quality along the river Narmada was found to be excellent in the season summer and winter but range from poor to unsuitable for human consumption in the season monsoon (rainy season). *Khatri & Tyagi (2015)*. Increase in the organic matter decomposition known to occur more in raining season can increase the acidity of the water in these reservoirs (*Psenner & Schmidt 1992*). Temperature is expected to cause an increase in pH (*Evans et al., 2005*). The anthropogenic activities going on around this reservoir leave organic wastes on the banks which are further washed into the reservoir during the rainy season thereby impairing the water in the Liberty reservoir.

Conclusion and Recommendation

Physicochemical attributes varied with season with most of the parameters high in the rainy season. therefore, rainfall seems to be a major driving factor of the seasonal changes. In addition to seasonal variation, this study has also revealed that the Liberty Reservoir is undergoing pollution which is more evident in the wet season. Therefore, this water body in gradually becoming unfit for domestic water supply but quite ideal for fish farming. Farming activity and other human activities going on the bank of this reservoir should be checked otherwise the reservoir should be converted for fish farming purposes.

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