# Seasonal Variations in Physicochemical Properties of Water, Sediment and Fish of Tiga Dam, Kano-Nigeria.

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## ABSTRACT

*The levels of some physicochemical parameters in the dam water were determined in wet and dry seasons while the concentrations of Na, K and heavy metals (Cd, Cr, Fe, Mn, Pb, Zn) were determined in sediment, Tilapia fish (Cichlid sp) and Cat fish (Synod onus sp) during the dry season when fishing activities were high. Variations in levels of pH, conductivity, alkalinity, DO, TDS and hardness in the water samples during the wet and dry seasons were observed but were all within the acceptable limits for drinking stipulated by the World Health Organization (WHO). However, the levels of turbidity (35.7±5.5NTU/wet -16.54±0.96NTU/dry), total suspended solids (2657.9±974.3mg/l/wet – 1496.0±101.4mg/l/dry) and total solids (2694±975.2mg/l/wet -1533.2±103.1 mg/l/dry) were higher than the acceptable limits of 5NTU and 500mg/l. Concentrations of heavy metals ranged from 0.01±0.00mg/l Cd - 0.84±0.17mg/l Fe in water, 0.51±0.02mg/kg Pb - 4.37±3.17mg/kg Fe in sediment and 0.045±0.005mg/kg Mn - 0.23±0.06 mg/kg Zn in fish tissues. Significant differences in heavy metal concentrations were recorded between seasons but variations within season were statistically insignificant. The order of high accumulation of heavy metals was sediments > fish >water which indicates possible long term health implications and environmental problems.*

## INTRODUCTION

Dams are constructed for different purposes, ranging from generation of electricity, direction of water courses from rivers into canals, direction of water for irrigation system and water supply systems; increasing river depths for navigational purposes; control of water flow during flood and drought, provision of artificial lakes for fisheries and recreational purposes[1]. In the process of using these dams, man has polluted the water so much that they can hardly be described as natural[2].

Environmental concern on heavy metal pollution is mainly due to their toxic effects and bioaccumulation characteristics[2]. Studies on heavy metals in rivers, lakes, dams, fish and sediments have been a major environmental focus in many parts of the world[3]. Sediments being important sinks for various pollutants also play a significant role in the remobilization of contaminants in

aquatic systems and in interactions between water and sediments. Fish samples have been used as significant indicators for the estimation of metal pollution level in fresh water systems[4].

Tiga Dam is located on Latitude 11°26′14″N and Longitude 8°24′9″E, it is known to be one of the largest dams in Nigeria constructed between 1970 and 1974[5]. The dam is the cornerstone of water resources development in the Kano River Valley in Kano State and Hadejia River Valley in Jigawa State. The dam sustains irrigated agriculture for thousands of hectares in Kano River Irrigation Project, Hadejia Irrigation Project and a major source of drinking water for Kano metropolis, towns and villages along the river course in Kano, Jigawa, Yobe and parts of Borno States[5]. Like other states in northern Nigeria, Kano state where Tiga dam is located is characterized by three to four months of rainy season (June to September) while dry and hot period is experienced throughout the rest of the year.

The aim of this study was to assess the effects of seasonal variations on water quality of Tiga dam using some physicochemical parameters and the heavy metal levels in the water, sediments and in muscles and gills of *Tilapia* and *Catfish* species.The results will form the baseline for monitoring and tracking changes in the water quality as a result of the dam's natural dynamics over time and the impacts of anthropogenic activities on the dam.

## MATERIALS AND METHODS

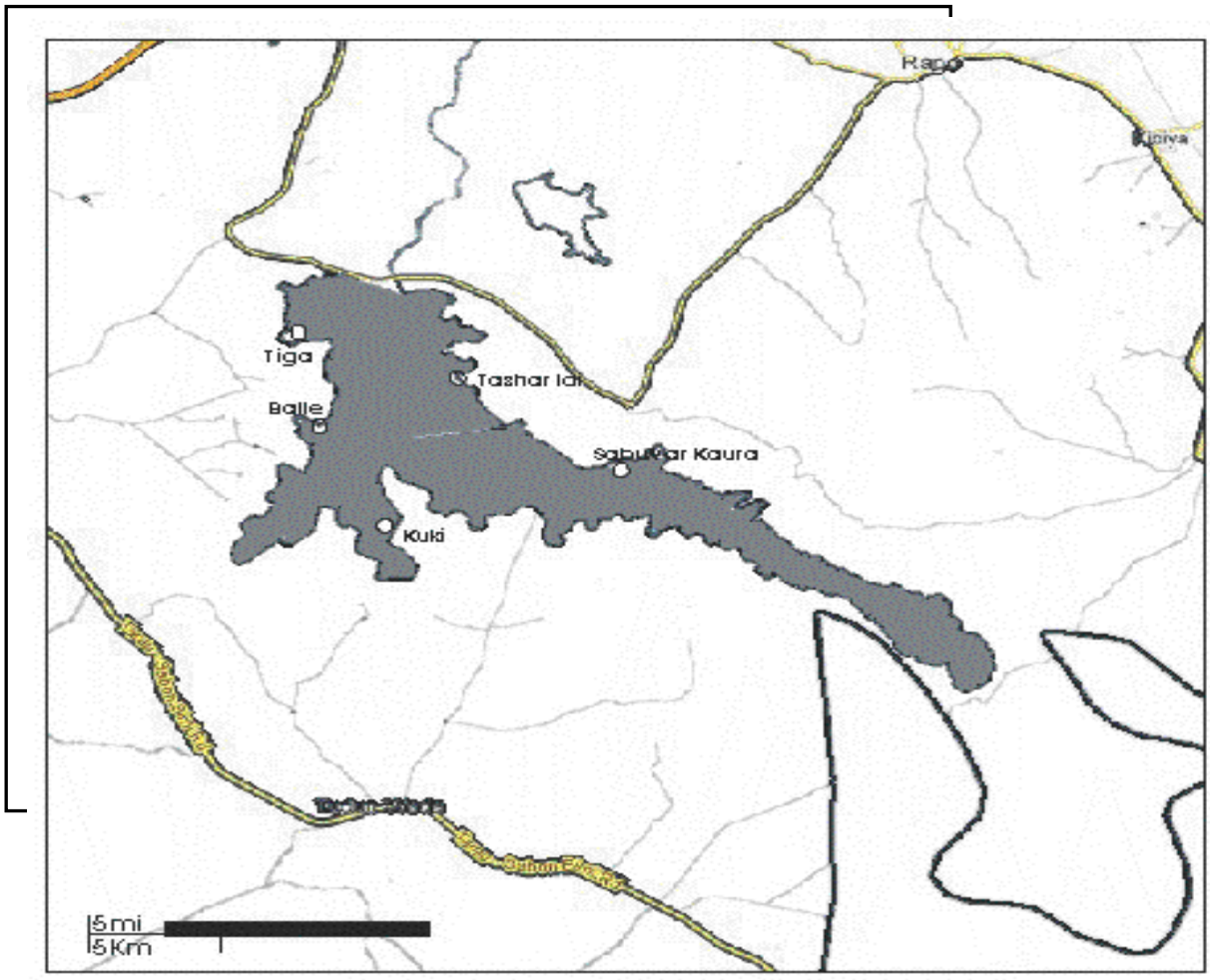
### *Sample Collection*

Water, Sediment and fish (*Tilapia* and *Catfish*) samples were collected from five different locations (Figure 1) during the wet and dry seasons. The collection, pre-treatment and digestion of all the samples were done according to standard procedures[6,7,8].

### *Sample Analysis*

The physicochemical parameters were determined using standard procedures. Heavy metal concentrations were determine using Buck scientific Model 210VGP Atomic

Absorption Spectrometer (AAS) while Na and K concentrations were determined using Flame photometer (FES).




## RESULTS AND DISCUSSION

The mean seasonal variations of the physicochemical parameters in water are shown in Figures 2 and 3 while mean concentrations of the heavy metals and minerals in water, sediment and fish samples are shown in Figures 4 and 5.

The use of physicochemical parameters to assess water quality gives a good assessment of the status, productivity and sustainability of such water body. Changes in these parameters will provide information on the quality of the water, the sources of the variations and their impacts on the functions and biodiversity of the reservoir[9].

The following parameters showed seasonal variations; temperature ($31.9\pm0.9^0$C/dry, $26.9\pm1.3^0$C/wet), pH (8.29± 0.19/dry, 8.07± 0.11/wet), alkalinity (36.2±4.2mg/l/dry – 44.5±2.8mg/l/wet), conductivity (57.8± 6.2µscm$^{-1}$/dry, 59.4± 2.2µscm$^{-1}$/wet), hardness (16.4±1.4mg/l/dry, 13.0±1.8mg/l/wet) and dissolved oxygen (6.66±0.37/dry 10.12±1.02mg/l/wet) (Fig.2). None of these parameters showed any significant variations between the wet and dry seasons. Alkalinity above 40mg/L is indicative of high productivity, thus the dam

will support good fish production, especially during the wet season[10]. The higher level of electrical conductivity of the dam during the wet season is a good measure of dissolved solids and is used in determining the suitability of water for irrigation purposes[10]. The DO values of greater than 4 in all seasons are within the recommended levels for fishing[11].

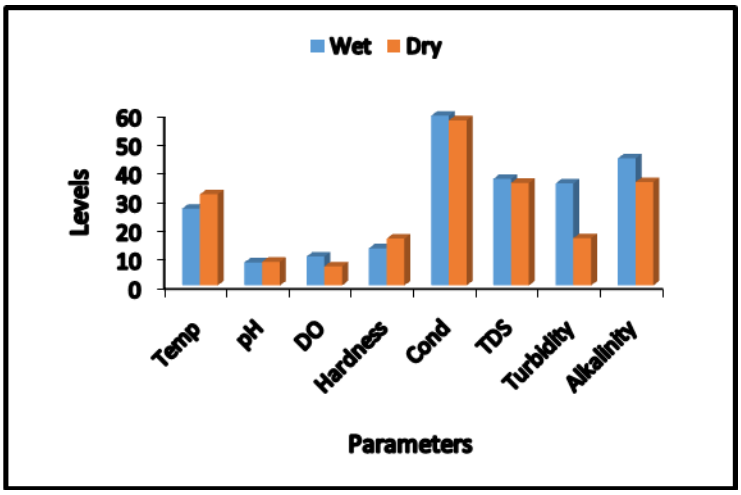



Figure 2: Mean Seasonal Variations of the Physicochemical Parameters

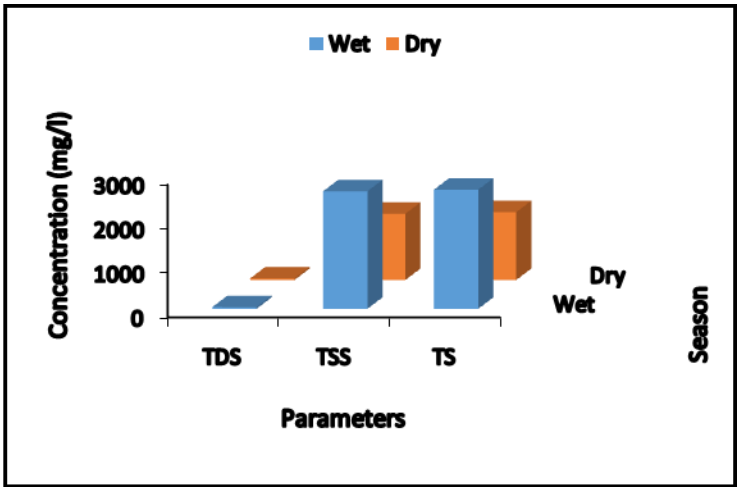



Figure 3: Mean Seasonal Variations (mg/l) of TDS, TSS and TS of Tiga Dam Water

The variations in turbidity in the wet (35.7±5.5NTU) and dry (16.54±0.96NTU) seasons were very significant (Fig. 2) and much higher than the recommended value of 5 NTU. The total suspended solids (2657.9±974.3mg/l/wet– 1496.0±101.4mg/l/dry) and total solids (2694±975.2mg/l/wet – 1533.2±103.1mg/l/dry) were the major causes of turbidity in the dam water (Fig. 3). The high TSS and TS values during the rainy season may be due to siltation, deterioration, heavy precipitation and contribution from run offs from the surrounding farmlands which carries mud, sand and other materials. Higher turbidity can cause temperature and DO stratification in water bodies while suspended clay particles can cause clogging of gills or direct injury to tissues of aquatic organisms.

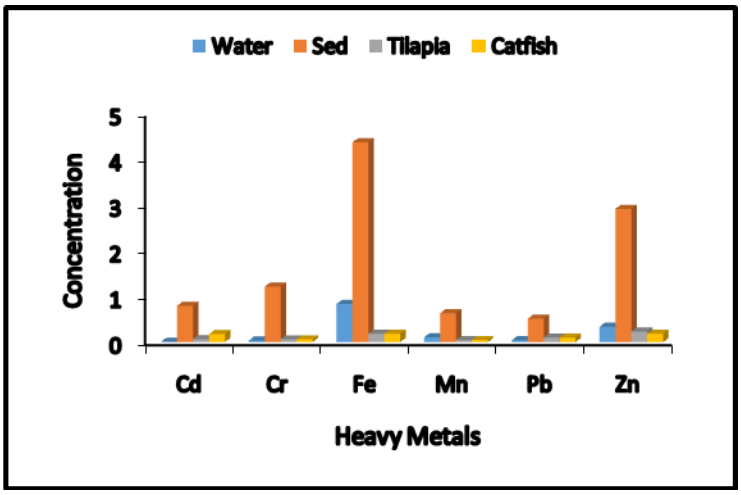



Figure 4:Mean Concentrations of Heavy Metals in Water (mg/l), Sediment (mg/kg) and Fish (mg/kg) samples

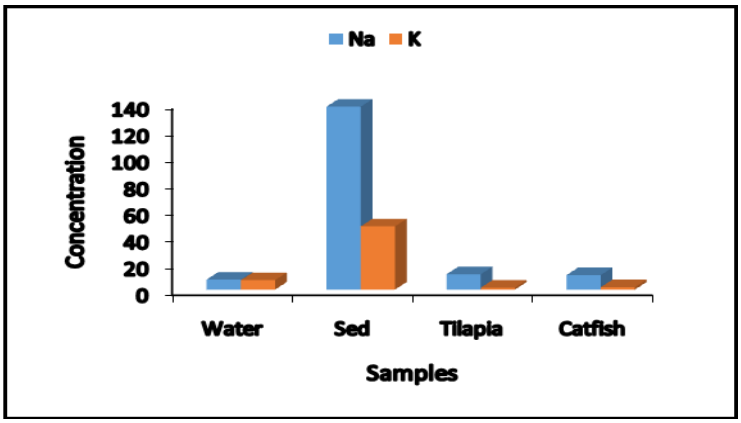



Figure 5: Mean Concentrations of Na and K in Water (mg/l), Sediment (mg/kg) and Fish (mg/kg) samples

Highest levels of the heavy metalsand Na were observed in the sediment samples followed by the fish samples and least concentrations were found in the water samples. (Figs. 4 and 5) but the levels of K in water were higher than that of the fish samples (Fig. 5). The levels of all the tested heavy metals and minerals in the water, sediment and fish samples were within the permissible limits for drinking, sediment quality and tolerable values of heavy metals in fish[12,13,14].

## CONCLUSION

This study investigated the levels and seasonal variations of some physicochemical properties, heavy metals and minerals in water, sediment and fish samples of Tiga dam. Significant differences in heavy metal concentrations were recorded between seasons but variations within season were statistically insignificant. The decreasing order of accumulation of heavy metals was sediments > fish >water which indicates possible long term health implications and environmental problems. This suggests that the Tiga dam water and its aquatic lives are currently safe for human consumption, irrigation system, domestic and industrial uses. However, constant monitoring of the dam is necessary to safeguard the water quality, prevent fish contamination and human lives.

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