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Studies of Seasonal Variation of Heavy Metals in Gubi Reservoir, Bauchi, Nigeria

Area of Research: Ecology

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ABSTRACT

Heavy metals found in water bodies are usually due to activities like domestic, industrial, mining, agriculture, weathering of rocks and leaching of soil. Heavy metals have a tendency to bio-accumulate. The study aimed to assess the seasonal concentration of heavy metals in the study site for 12 months. Four sampling sites at the Gubi reservoir were chosen: ***kwatanyashi, KwatanKifiya, KwatanKifi and KwatanSha***. Water samples was collected forth-nightly between 6am to 8am every sampling day for 12 months covering both rainy and dry seasons. Samples were taken in sample bottles and sent to laboratory for analysis. Selected heavy metals (Zn, Fe, Pb, Cr, Cu and Cd) concentrations were determined using Atomic Absorption Spectrometer Model 210 VGP.Zinc concentration during the study period was found to be low in the wet season than the dry season. Cadmium concentration varied between 0.0mg/L in January, February, March to October and 0.2mg/L in the months of November and December. Monthly mean concentration of Iron was 0.05mg/L±0.1 while lowest value of 0.0mg/L was found in station 2. Chromium concentration had highest value of 0.58mg/L while the mean annual concentration of Lead vary between 0.0mg/L and 0.67mg/L.The levels of Zinc, Cadmium, Copper and Iron in water samples were within the international acceptable limits while Lead and Chromium were found to be above the permissible limits.

Keywords: *Variation; Heavy Metals; Reservoir; Gubi; Bauchi*

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INTRODUCTION

Heavy metals found in water bodies are usually due to activities like domestic, industrial, mining, agriculture, weathering of rocks and leaching of soil. Mining, manufacturing industries and agricultural activities release heavy metals into the soil, water and air [1]. They are non-biodegradable and persist in biological amplification through food chain [2]. Heavy metals have a tendency to bio-accumulate and end up as permanent addition to the environment. Heavy metals include elements such as copper, lead, cadmium, zinc, mercury, chromium, iron, arsenic, nickel, manganese, tin, cobalt and others. High concentration of heavy metals are toxic to the environment and pose a serious threat to the ecosystem. High concentration of heavy metals in water bodies may also lead to morphological changes in tissues, poor swimming performance, and change in enzyme activity, growth, development and reproduction in aquatic animals [3]. The presence of calcium and magnesium is responsible for water hardness thereby causing wastage of soap during laundry near water bodies [4]. Lead at low concentration is detrimental to fish and humans and its toxicity can affect the nervous system, reduce intelligence and sensory disturbance such as hearing problems [5].

MATERIALS AND METHODS

Gubi Reservoir is located 8km along Bauchi Maiduguri road 12 kilometers north-east of Bauchi metropolis, in Ganjuwa local government area. The Reservoir is located at latitude 10^0 50' 0E and 9^0 '52' 0'E and longitude 10^0 '0' 24 '0' N and 10^0 '26' '0'N.The reservoir serves as a source of drinking water for domestic animals, it provides good and nutritious fish and also provides suitable sites for fadama farming for the production of some selected crops such as vegetables and crops.

Four sampling sites were chosen along the reservoir for heavy metals assessment: ***kwatanyashi, KwatanKifiya, KwatanKifi and KwatanSha*** respectively. Water samples was collected for heavy metals assessment forth-nightly

between 6am to 8am every sampling day for 12 months from November 2019 to October 2020. Samples were taken in sample bottles and sent to laboratory for analysis. Selected heavy metals (Zn, Fe, Pb, Cr, Cu and Cd) concentrations in the collected water sample were determined using Atomic Absorption Spectrometer Model 210 VGP. The collected water samples were digested by adding 5mls of concentrated Nitric acid (HNO_3) to 50 mls of thoroughly shaken water sample, then heated for few hours on a hot plate at about 100^0C till the solution was reduced to less than 20mls. The solution was then filtered in to a 100ml volumetric flask and made up to the 100ml mark with distilled water. The reagent blank was also prepared by digesting deionized water with 5mls of concentrated Nitric acid till the solution reduced to about 20mls, then filtered in a 100mls volumetric flask and made up to the mark with distilled water. The digest of each sample was read on the Atomic Absorption Spectrometer Model 210 VGP.

RESULTS

The mean annual concentrations of the assessed selected heavy metals in the waters of Gubi Reservoir during the study period is as presented in table 1.

Table 1: Mean values for heavy metals Concentrations of Gubi Reservoir

STATIONS	Zn (mg/L)	Fe (mg/L)	Pb (mg/L)	Cu (mg/L)	Cr (mg/L)	Cd (mg/L)
K/ yashi	0.01	0.05	0.13	0.45	0.09	0
K / kifiya	0.01	0.05	0.10	0.49	0.09	0
K/ Kifi	0.01	0.06	0.12	0.49	0.12	0
K / Sha	0.02	0.06	0.13	0.49	0.14	0
Seasons						
Wet season	0.02	0	0.31	0.05	0.16	0.12
Dry season	0.01	0	0.66	0.04	0.06	0.11

The highest zinc concentration of 0.14mg/L was recorded in November while lowest value of 0.0mg/L was recorded in almost all the stations except in February, March, April, May and July. Zinc concentration during the study period was found to be low in the wet season than the dry season.Cadmium concentration varied between 0.0mg/L in January, February, March to October and 0.2mg/L in the months of November and December. Copper had lowest value of 0.0mg/L, which was only recorded in November at station 4. Highest value of 1.6mg/L was recorded in the month of October at station 3.Monthly mean concentration of Iron was 0.05mg/L±0.1 during the study period. Lowest value of 0.0mg/L was found in station 2 from November to January. Highest value of 0.41mg/L was found in October at station 3. Lowest value of Chromium concentration of 0.0mg/L was found in station 3 in the month of February, March and October while highest value of 0.58mg/L was found in station 4 at the month of December. There was significant difference between months for Chromium values during the study period.The mean annual concentration of Lead vary between 0.0mg/L in the month of February and March at station 2 to 0.67mg/L in December at station 1.

DISCUSSION

Heavy metals have been known to pose problems globally due to their effects on man and aquatic organisms [6]. Heavy metals content in the analyzed samples of water collected from the stations were mostly within the standard limits. High levels of metals such as Arsenic, Cadmium, Chromium, Lead and Mercury may be hazardous to our health [7].
The concentration of Zinc in surface water recorded in this study did not exceed the recommended limit of 3mg/L for Zinc levels in drinking water [8]. The low level of 0.14mg/L of Zinc concentration may be as a result of the low anthropogenic activities along the reservoir at that station. Highest concentration recorded at station 4 may be due to high domestic and agricultural activities. Lower values of 0.12mg/L to 2.0mg/L were also found in the work of Adesalu et al., [9].

The concentration of cadmium in Gubi reservoir was within the maximum permissible limit of 0.003mg/L [10]. This observation is similar with the work of Auwalu et al., [11] where they recorded lower value of cadmium concentration in river Gongola. However, this findings also disagree with the work of Suzie [12] where high concentration of cadmium were observed due to agricultural and industrial effluents in Romi River. Cadmium concentration in water samples were below detection limits. Therefore, this indicates little toxicity of cadmium concentration in Gubi reservoir. This could be as a result of low use of and disposal of items containing cadmium into the water body.

The mean copper levels obtained in this study was within the range of 0.0mg/L to 1.6mg/L. However, the highest value of 1.6mg/L in the month of October was above the WHO limits of 1.0mg/L of copper concentration in water for drinking [13]. This could be as a result of agricultural activities during the month. The mean copper levels obtained in this study were lower compared to 3.7mg/L obtained in surface water of Romi River, Kaduna [12] and higher than

0.92mg/L in DadinKowa Dam, Gombe state Nigeria [14], 0.37mg/L in Gombe Abba portion of River Gongola, Gombe State [11] and 0.23mg/L obtained in river Kaduna, Shiroro fishing settlement [15].

In all the stations, iron concentration was below the standard limit of 0.30mg/L [13]. Low concentration of iron in this study could be attributed to less anthropogenic inputs of untreated sewage contaminants, non-biodegradable waste and agricultural run-offs. This finding is in agreement with the work of Maigari et al., [14] where they recorded 0.21mg/L of iron in Dadinkowa Dam, Gombe state Nigeria.

Chromium concentration during the study period was found to be higher during the dry season. Higher value of 0.58mg/L was found in station 4 which could be due to influx of surface water runoffs from agricultural farmlands. Similar observation was also made in the work of Suzie [12] in River Romi due to agricultural runoffs and effluent from industries. The result also showed that some stations were able to fall within the [13] standard limits (0.05mg/L) while some stations were above the standard limits.

The mean Lead concentration of 0.31mg/L seen in dry season and 0.66mg/L seen in dry seasons during the study period were above the acceptable limits [16,13]. High concentration of Lead in Gubi reservoir corresponds to the report made by [12,17] on high Lead concentration, which could lead to pollution. Egbe et al., [1] reported on high Lead concentration in River Gora, Kaduna (0.82mg/L) and emphasizes on its toxic effects on living organisms. Lead is ubiquitous and is a characteristic trace constituent in rocks, soil water, plants, air and animals.

Highest Lead concentration of 0.66mg/L in station 1 indicates the presence of rocks that surround the station and sharp sand used for building, from where the station derived its name, ***KwatanYashi***. The sharp sand at the station is also used by the locals in making blocks. High concentration of Lead in the study area could pose a threat to humans that utilize the water for drinking purpose and other domestic purposes.

CONCLUSION

The levels of Zinc, Cadmium, Copper and Iron in water samples were within the international guidelines for heavy metals in water. Lead and Chromium were found to be above the permissible limits. The observed high levels of heavy metals in sites 3 and 4 indicates improper disposal of waste into the reservoir.

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