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Heavy Metals Concentration of River Chanchaga and Effects on Fisheries Resources

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ABSTRACT

The concentration of heavy metals at four locations in River Chanchaga, Minna in Niger state and effects on fisheries resources were investigated. Water samples were collected biweekly from June to December, 2015 in triplicates from each sample location. These were Kosobo, Tunga-waya, Numukpan and Chanchaga village. The Atomic Absorption Spectrometric technique was used in determining the concentration of the metals: Pb, Fe, Zn, Cu and Cd. Mean concentrations (mg/L) of the metals varied along sampling stations with marked reduction in fisheries resources. Agricultural activities such as fertilizer application and domestic activities like bathing, washing and defecation along the river course were considered to be responsible for the high concentration of heavy metals in the river.

Keywords: Heavy metals, River Chanchaga, Water, Fisheries resources and Concentrations.

INTRODUCTION

The contamination of freshwaters with a wide range of pollutants has been a matter of great concern. Heavy metals are natural trace components of the aquatic environment, whose levels have increased due to domestic, industrial, mining and agricultural activities (Oyekunle *et al.*, 2012). Many industrial wastes are acidic and thus affect many aquatic organisms causing several abnormalities including slow growth and consequently reduces the abundance and diversity of species in the ecosystem (Ayotunde *et al.*, 2011). Heavy metals, when at high concentration have been found to be very toxic to all aquatic organisms. Aquatic organisms, including invertebrates and vertebrates such as fish bio accumulate metals to concentrations

many times higher than present in water or sediment through bio magnification (Qu *et al.*, 2015).

Odu (1977) reported a decline in the number of fish being caught by fishermen, following the cases of oil blowout at Bomu and Obagi in 1970 and 1972 respectively. Kolo (1982) reported total absence of fish in Ogupa River in areas that were heavily polluted with heavy metals. Adeniyi *et al.* (1983) in their studies on the effects of oil on the fishing activities of the Ibeno and Oyakama communities in Cross River State showed that considerable damage was done to the fishing sites.

Fish stock assessment evaluates the effort of fishing on fishery as a basis for fishery management decision (Cadima, 2003). Amadi *et al.* (2012) found that the River Chanchaga was adversely affected by heavy metal pollution and attributed the sources to gold mineralization, mining, fertilizer application and waste disposal near the river course. Therefore, this study aims at investigating the effects of the heavy metals concentration on the fisheries resources of River Chanchaga.

MATERIALS AND METHODS

Study Area

River Chanchaga lies between latitude 9°30′N and longitude 6°32′E and flows from Shiroro through Bosso Local government areas of Niger state (Figure 1). Some village communities situated around the river course include: Kasobo, Numukpan, Tunga-waya, Isatiwambai Gurusu and a village Chanchaga, after which the River was named.
The people in these areas are predominantly farmers with lots of farming activities carried out on daily basis. Dumping of wastes in the river have been reported and domestic activities such as bathing, washing and defecation are done along the banks of the river (Edegbene et al., 2015).

Four sampling stations: Kasobo, Tunga-waya, Numukpan and Chanchaga village were selected for the study based on their perceived exposure to effluents.

Figure 1: Map of Niger state showing the study location

Field Sampling Procedures

Triplicate water samples were randomly taken from each sampling location biweekly from June to December, 2015. The samples were collected using acid-washed polythene bottles which were rinsed with distilled water. Prior to storage, the water samples were acidified to PH 1.5 with nitric acid after collection (APHA, 1990). Samples of three West Africa Cichlids namely: *Tilapia mariae, Tilapia zilli* and *Chromidotilapia guantheri* were highest among the total fish caught on each sampling day by means of cast and gill nets. The catch per unit effort (number of Tilapia species/boat-hour) at each sampling location was estimated.

Presence of Heavy Metals

Each sample was analysed for the concentration of lead (pb), iron (Fe), Zinc (Zn), Copper (Cu) and Cadmium (Cd) using Pye Unicam Atomic Absorption Spectrophotometer (AAS) model SP 190.

Statistical Analysis

Data collected were analysed with the one-way analysis of variance (ANOVA) using Statistical Product for Service Solution (SPSS

version 16.0) for windows. Statistical significance of difference among means was compared using Tukey (HSD) test.

RESULTS

Heavy Metals Concentration

The concentration of heavy metals determined from the water samples of River Chanchaga were lead (Pb), iron (Fe), Zinc (Zn), Copper (Cu) and Cadmium (Cd).

Table 1: Shows the mean concentration values (mg/L) of heavy metals in the four sampling stations of River Chanchaga

Heavy metals	Stations			
	Kasobo	Tunga-waya	Numukpan	Chanchaga village
Iron (Fe)	29.3 ± 0.12a	33.79 ± 1.11b	30.23 ± 0.25a	33.79 ± 1.16b
Copper (Cu)	0.13 ± 0.00a	0.94 ± 0.03a	1.83 ± 0.15b	0.88 ± 0.26a
Cadmium (Cd)	0.25 ± 0.21a	1.44 ± 0.03b	1.26 ± 0.14b	0.27 ± 0.33a
Lead (pb)	0.07 ± 0.11a	0.46 ± 0.17a	0.53 ± 0.00a	0.04 ± 0.01a
Zinc (Zn)	0.23 ± 0.22a	0.51 ± 0.07a	2.02 ± 0.20b	0.82 ± 0.22a

Mean of parameters with the same super script along the rows are not significantly different at $p > 0.05$

The results in table 1 showed that the mean concentration of iron (Fe) were at highest at Tunga-waya (33.79mg/L) and Chanchaga village (33.79mg/L). The mean concentrations for Numukpan and Kasobo were slightly low with similar trend as the former. The mean concentrations of copper (Cu) were very low in all the four sampling stations, with the highest concentration at Numukpan (1.83mg/L). The next highest concentration of Cu (0.94mg/L) was at Tunga-waya, followed by Chanchaga village and Kasobo respectively. Cadmium (Cd) concentration at Kasobo was lowest with a mean value of 0.25mg/L and highest at Tunga waya with a mean concentration of 1.44mg/L. At Numukpan, Pb concentration was highest with a mean value of 0.53mg/L, followed by Tunga-waya (0.46mg/L), Kasobo (0.07mg/L) and least concentration of 0.04mg/L at Chanchaga village. The concentration of Zinc found at Kasobo was lowest with a mean value of 0.23mg/L. The values recorded

increased to 0.51mg/L, 0.82mg/L and 2.02mg/L for Tunga-waya, Chanchaga village Numukpan respectively.

Fisheries Resources

Three tilapia species (*Tilapia mariae, Tilapia zilli* and *Chromidotilapia guantheri*) were identified and represented the highest percentage (65%) of total fish species caught throughout the 14-days sampling (June – December, 2015) from the four sampled stations. Kasobo had the highest number of the tilapia species with a population of 640 fish samples/ boat-hour. This may be attributed to the less human activities like farming and dumping of household wastes.

The reduction in the number of tilapia species at Tunga-waya, Chanchaga village and especially at Numukpan (Table 2) might be due to the gross pollution by human excreta as well as the soil excavation which occurred at Tunga-waya within the study period.

Table 2: Mean values of Tilapia species caught per boat-hour at the four sampling stations

Sampling stations	Kasobo	Tunga-waya	Numukpan	Chanchaga village
Number of Tilapia species caught	640± 0.17a	418 ± 0.03b	122 ± 0.13c	145 ± 0.22d

Mean of parameters with the same super script along the rows are not significantly different at p> 0.05

DISCUSSIONS

The heavy metals concentration recorded in River Chanchaga water included the essential ones to life such as Cu, Zn and the non-essential ones like Cd and Pb. Metals could be absorbed by fish as free ions across the gills or may be sorped on to food particulates and subsequently ingested (Iwegbue *et al.* 2009).

The non-essential metals bio accumulates over time and could constitute health hazard because their excretion is usually met with

less success (Oguzie and Igwegbe, 2007). The highest concentrations of Fe were recorded at both Tunga-waya and Chanchaga village respectively. This finding may not be unconnected with effluents from dungs/dead animal bones which are transported to the river through flood run-off (Oguzie and Igwegbe, 2007).

The highest concentrations of Cu (1.83mg/L) at Numukpan and Cd (1.44mg/L) at Tunga-waya may be associated with household wastes from washing and bathing. Similar reports were documented by Wangboje and Oronsaye (2001).

In the present study, the mean concentrations of cadmium recorded at all the four sampling stations were greater than the value (0.04mg/L) reported by Obasohan and Oronsaye (2000) and the value (0.01mg/L) reported by Obasohan et al. (2006) for Ogba River. However, the mean concentration of copper and lead reported at all sampling stations in this study were higher than 0.49mg/L (Cu)and 0.02mg/L (pb) reported by Obasohan *et al.* (2006). The high values reported in respect of iron, copper and lead may reflect inputs from increased urbanization in Minna metropolis.

CONCLUSION

The results showed that high pollution levels in River Chanchaga may have reduced the abundance of its fisheries resources.

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