

Determination of Heavy Metals Contamination in Stream Waters at Four (4) Different Locations in Abeokuta South Local Government Area of Ogun State, Nigeria

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ABSTRACT: The main objective of this study is to determine the levels of heavy metal concentration in streams. This is because majority of indigenes uses stream water for other domestic activities apart from drinking as an alternative to ready pipeborne water. Water from four different locations in Abeokuta South Local Government (Shodubi, Kolobo, Mercy Road and Oloke) Abeokuta South West Nigeria. Water samples were collected from four different areas from upstream and downstream channel. This was between May-June 2015. The water samples were digested according to standard method and tested for Iron (Fe), Copper (C), Zinc (Zn) and Lead (Pb). The samples were determined using Atomic Absorption spectrophotometer. Result showed that Oloke stream had the highest concentration of Iron (Fe) 4.45mg/l, followed by Kolobo Road 3.89mg/l, and Mercy Road 3.30mg/l, Shodubi 2.90mg/l. Cu 0.14mg/l, 0.05mg/l, 0.05mg/l, 0.05mg/l respectively as above. Zinc was highest at Oloke stream water 0.30mg/l, followed 0.21mg/l at Kolobo and 0.19mg/l at Shodubi least at 0.15mg/l at Mercy road white Lead (Pb) was determined in all the water samples as an indicator of (BDL) below detection limit. In general the result showed an indication of pollution hazard given the toxicity of the metals.

I. INTRODUCTION

Water quality is fundamental to the health and sustenance of aquatic ecosystems and hydrology. The advantages of renewable freshwater to humans include; water for drinking, irrigation, production of fish, industrial uses and for such in streams uses as recreation, transportation and waste disposal Jackson (7).

Heavy metal contamination in rivers is a major water quality issue in many fast growing cities. This is because improvements in water and sanitation infrastructure have not kept pace with population growth and urbanization in most developing countries Maltby et al (9). This is because metals enter rivers and lakes from different sources, such as rocks and surface water, decomposing dead organic matter, fallout of atmospheric particulate matter and from man's activities; all enroute to the water bodies Oyewale (13).

These trace metals enter streams from variety of sources, which can be either natural or anthropogenic Bem and Ahmed (5).

Trace 'metals contamination are important due to their potential toxicity per the environmental and human being Nelson et al (10), Adams et al (1).

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Vol. 5, Issue 4, April 2016

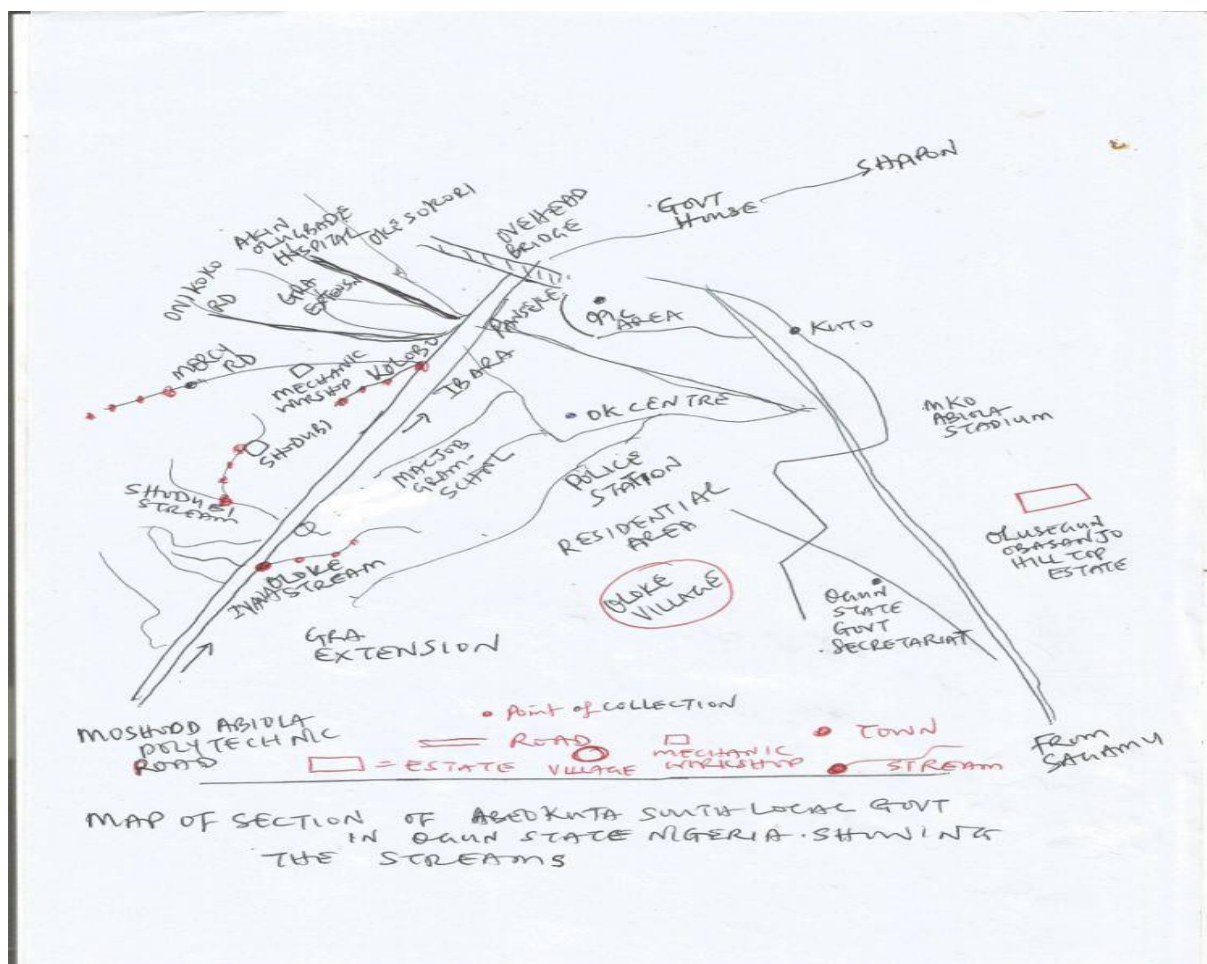
Some of the metals e.g. Cu, Fe, Mn, Ni, and Zn are essential as micronutrients for the life process of animals and plants while many other metals such as Cd, Cr, Pb, and Co have no known physiological activities Karouna (8), Ogunfowokan (11), Argyraki et al (3).

The objectives of this research are to characterize the distribution of heavy metals in surface water within the study area in Abeokuta South Local Government Area of Ogun State, Nigeria, and to use the data obtained to know the extent of deleterious dangers inherent in the use of water and proffer solutions.

II. MATERIAL AND METHODS

The study area

Abeokuta south Local Government area is one of the major local government in Ogun State, South Western Nigeria.



The streams taken as study sites are in a close section due to different activities that surround the area. Among which are residential industrial, high population density areas.

Oloko stream emerges from a village near the Government Residential Area (GRA) while Shodubi stream is a catchment area of high density populated area. Kolobo stream is in busy business hub and activities from artisans (mechanics, welders, carpenters e.t.c). Mercy road stream is away from Kolobo but adjoining high activities of different business area. The different spot of collections are close to the stream 10m to each other.

Sampling and procedure

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

Four sampling points were selected within the Abeokuta South Local government area of Ogun State, Nigeria. The sampling points are indicated in Figure 1 sampling was done once every month from the month of December, 2006 to April, 2007 (dry season). Samples were collected into sterile screw capped plastic container. Prior to sample collection all bottles were washed with dilute nitric acid followed by distilled water and were dried in an oven. Before taking water samples, the bottles were rinsed three times with the water to be collected. The sampling bottles were labeled with dates and sampling source. Collected water samples were stored in a cooler at 40C. Temperature, conductivity and pH of the samples were measured on site. All the analyses were done by standard methods according to APHA AWWA (2).

Digestion of samples for Fe, Cu, Zn, Pb determination

Digestion of the samples was done using concentrated nitric acid according to Wogu, (15). Concentrated nitric acid (5ml) was added to 50mL of sample of water in a 100mL beaker. This was heated on a hot plate to boil until its volume reduced to 20mL. Another 5mL of concentrated nitric acid was added and then heated for another 10mins and allowed to cool. About 5mL of nitric acid was used to rinse the sides of the beaker, the solution was quantitatively transferred into a 5mL volumetric flask and made up to the mark with distilled water. A blank solution was similarly prepared. Heavy metal analysis was done using Atomic Absorption Spectrophotometer (Model; Unicam 969) Calibration curves were drawn for each metal by running suitable concentrations of their standard solutions, from which the concentration of the elements were obtained by extrapolation. Average values of three replicates were taken for each determination. The absorbance of the blank was taken before the analysis of the samples.

Statistical analysis

Statistical analysis of the results at each site were carried out using both Microsoft Excel. (2003 Edition) and Statistical Package for Social Science (SPSS) software. The relationship between the elemental concentrations in water samples at each site were evaluated by linear regression and the determination of Pearson correlation coefficients. All errors were calculated at 95% confidence level.

III. RESULTS

Table 1: Average concentration of metals in shodubi stream water, with National International safety standard for water (mg/L).

	(mg/l) Concentration 1	(mg/l) Concentration 2	(mg/l) Concentration 3	Average Concentration (mg/l)	WHO standard	EPA Standard
Fe	2.90	3.69	4.19	3.59	0.3	1.0
Cu	0.05	0.04	0.03	0.04	1.2	0.1
Zn	0.19	0.40	0.10	0.23	3.0	5.0
Pb	BDL	BDL	BDL	BDL	0.01	0.05

There is relative increase in all the heavy metals. Only Fe the highest concentration than the WHO Standard in Shodubi stream.

Table 2: Average concentration of metals in kolobo stream water, with National and International safety standard for water (mg/L).

	(mg/l) Concentration 1	(mg/l) Concentration 2	(mg/l) Concentration 3	Average Concentration (mg/l)	WHO Standard	EPA Standard
Fe	3.89	2.43	1.93	2.75	0.3	1.0
Cu	0.05	0.06	0.07	0.06	1.2	0.1
Zn	0.21	0.34	0.42	0.32	3.0	5.0
Pb	BDL	BDL	BDL	BDL	0.01	0.05

Iron Fe is relatively higher in concentration while Zn and Cu are below WHO Standard.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

Table 3: Average concentration of metals in mercy road stream water, with National and International Safety standard for water (mg/l).

	Mg/l Concentration 1	Mg/l Concentration 2	Mg/l Concentration 3	Mg/l Average Concentration	Who Standard	EPA Standard
Fe	3.30	3.89	3.94	3.71	0.3	1.0
Cu	0.05	0.05	0.05	0.05	1.2	0.1
Zn	0.15	0.11	0.08	0.12	3.0	5.0
Pb	BDL	BDL	BDL	BDL	BDL	0.5

Iron is still very much higher than other metals. Zn and Copper are below the WHO Standard.

Table 4: Average concentration of metals in oloke stream water, with National and International Safety standard for water (mg/l).

	Mg/l Concentration 1	Mg/l Concentration 2	Mg/l Concentration 3	Mg/l Average Concentration	Who Standard	EPA Standard
Fe	4.45	6.55	7.35	6.11	0.3	1.0
Cu	0.14	0.09	0.04	0.09	1.2	0.1
Zn	0.30	0.36	0.41	0.36	3.0	5.0
Pb	BDL	BDL	BDL	BDL	BDL	0.5

Iron is very high at Oloke Stream due to higher human activities in the area.

IV. DISCUSSION

The aim of this study is to determine the levels of heavy metals in steam water in some parts of Abeokuta, Ogun State Nigeria using Atomic Absorption Spectrophotometer. The presence and concentration of four heavy metals Zn, Cu, Pb and Fe were determined.

The result obtained in this study is in accordance to what Armitage, (4), obtained in his research. He found out the total average concentration of Iron ranged from (4.9-6.2mg/l), (0.20-0.41mg/l) of that zinc and (0.05-0.10mg/l) copper in stream water in the Niger delta. His results are similarly compared to the results obtained in this study which had an average concentration of (2.75 – 6.11mg/l) for iron,(0.12 – 0.36mg/l) for zinc and (0.03 – 0.13mg/l) for copper. Even though the Iron concentration is high compared to the standard Recommended by WHO (14) and EPA,(6) the Copper, Zinc and Lead concentration are with the range of standard Recommended.

The high concentration of iron (Fe) in these water bodies may be as a result of the continuous use of agrochemicals containing heavy metals which get into aquatic ecosystem through runoff from agricultural land since the stream passes through farmlands.

The Average concentration of metals in Shodubi stream water as well as the national and international standard for water (mg/l). The metals determined were iron (Fe) copper (Cu) zinc (Zn) and lead (Pb). The average concentration of metals determined ranged from 0.04mg/l 0.23mg/l and 3.59mg/l respectively the result showed the iron (Fe) had the highest average concentration which is extremely high than the standard recommended by WHO (14) (2010) and EPA (6) (1997) (Environmental protection Agency) copper (Cu) and zinc (Zn) are within the range of standard recommended while lead (Pb) is below detection limit. The high concentration of iron (Fe) may be as a result of the dissolve mineral containing iron that is being held in solution as stream water percolate through the rock since iron is one of the common metallic element found in the earth crust.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

The average concentration of metals in Kolobo stream water as well as the national and International standard for water (mg/l).the metals determined were iron (Fe) copper (Cu) zinc(Zn) and lead (Pb) the average concentration of metal determined ranged from 0.06mg/l, 0.3mg/l and 2.75mg/l respectively.

Olatunji & Osibanjo (12) obtained high concentration of heavy metals in the water samples during the dry seasons under the study period is due to the fact that water levels decrease in rivers, results in increase in concentration of the metals. As a result, the concentrations of the measured metals were higher during dry season than in wet season, except for Pb and Cd which were only slightly altered.

This is in agreement with this work as it was carried out during the dry season.

The result show that Iron (Fe) Had the highest average concentration which is extremely high than the standard recommended by WHO and EPA while copper (Cu) zinc and lead (Pb) are within the range of standard recommended

The high concentration of iron (Fe) in these water bodies may be as a result of the continuous use of agrochemicals containing heavy metals which get into aquatic ecosystem through runoff from agricultural land since the stream passes through farmlands

The average concentration of determined in mercy stream water showed the average concentration of Iron (Fe) obtaining is higher than the safety stander recommended by WHO and EPA an indication that the aquatic ecosystem is contaminated either from domestic waste dispose in the stream or from weltering activities of the people around the area.

The average concentration of metals in Oloke stream water with national and International safety standard from water in milligram per liter and the result obtained show that iron (Fe) is presence in excess quantity an indication that the river is contaminated with iron metal.

The higher concentrations of heavy metals in the stream water may be due to the washing of cars around the stream, farming and dumping of waste product. As heavy metals flow into the stream they adsorb to particulate matter and become heavier, setting at the bottom of the stream.

Lead Pb concentration in all the samples were below detection Limits (BDL), this could be attributed to the areas as well as the vegetable farmers around the streams have not been using lead (Pb) products.

Higher concentration of irons (Fe) in all samples might be due the catchment area, municipal or domestic wastes, urban storm water runoffs such as car batteries and other electrical wastes, agricultural wastes (fertilizers), leaching of metals from garbage and solid waste dump and geological weathering of parent rocks and atmospheric sources. Zinc is used in a wide variety of industrial, agricultural and consumer products.

V. CONCLUSION

The results obtained showed that over exploitation of the stream due to different human and natural activities affects the stream adversely and as such it is hereby recommended that renewable effort be made to channel the stream water and curtail human activities near them.

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