Journal of Fisheries & Livestock Production
ISSN: 2332-2608

Abdulraheem et al., J Fisheries Livest Prod 2017, 5:2
DOI: 10.4172/2332-2608.1000233

Research Article Open Access

The Effect of Refuse on Fish, Water and Sediment of River Sokori, Abeokuta, Ogun State, Nigeria

Abdulraheem I, Ojelade OC and Adeosun FI*

Department of Aquaculture and Fisheries Management, Federal University of Agriculture, Abeokuta, Nigeria

Abstract

Inflow of excessive quantities of organic matter into natural waters is doubtless the oldest and most widespread form of water pollution. Physical and chemical characteristics of the Sokori River in Nigeria were examined in this study. Sediment samples were collected from four locations (Sokori, Isale-gbehin, Kuto and Ijaye) along the River. Samples collected were analyzed for heavy metal (Zn, Cr, Cd, Cu, and Pb) concentration and physical and chemical parameters of the river were also determined. Data collected were statistically analyzed using one-way ANOVA test and mean differentiated using least Significant Difference (LSD) at $p<0.05$. The result shows no significant difference in the physical and chemical parameters at all the locations sampled. However, there were heavy concentrations of Zn, Pb and Cu beyond the acceptable limits and thereby poses threat to the fish and health risk to several rural communities who rely heavily on the river primarily as their source of domestic water. The study therefore concludes that discharge of refuse into water bodies can lead to build up of heavy metals in the water and thus there is need for continuous pollution monitoring and management program of surface water and sediment of this water body and other Rivers especially those close to urban areas and industries.

Keywords: River Sokori; Organic matter; Sediment; Water pollution; Monitoring

Introduction

Rivers are very important part of human natural heritage. They have been widely utilized by mankind since the beginning of time such that there are few, if any, still in good quality or "natural" condition. One major result of human activities on rivers is that of discharge of chemicals, containing a lot of heavy metals, into the waters. These activities include domestic activities, agricultural production, mining, industrial production, power generation, and forestry practices which lead to deterioration in water quality and quantity that impact not only the aquatic ecosystem, but also the availability of safe water for human consumption [1].

One prevailing issue in the scientific community prominent in workshops, seminars, conferences is water quality. It is a serious global issue in developing countries and countries whose economy is under transition. Water quality refers to the physical, chemical and biological characteristics of water [2] and the quality of a river at any time is a function of the lithology of the basin, atmospheric inputs, climatic conditions and anthropogenic inputs [3]. The river system, comprising both the main course and the tributaries, is a major source of fresh water supply. It serves as a one-way carrier of significant load of matter in dissolved and particulate form from both natural and anthropogenic sources. On the other hand, rivers play a major role in assimilating or transporting municipal and industrial wastewater and runoffs from agricultural, mining and industrial activities. These wastewater discharges constitutes a constant source of pollution [4] whereas surface runoff is a seasonal phenomenon, largely akik effected by climate within the basin [5]. Seasonal variations in precipitation, surface runoff, interflow, groundwater flow and pumped in and outflows have a strong effect on river discharge and, subsequently, on the concentration of pollutants in river water [6]. In many regions of the world, especially, those with high population density, river water pollution is becoming increasingly evident.

Pollution of aquatic environment in Nigeria occurs from different sources with its consequence effects on the aquatic ecosystem. Studies reveals that the major causes of pollution are Industrialization and Urbanization, Agriculture Activities, Petroleum Activities, Effluent from Abattoirs and Other Food Processing Outlet and household waste mainly due to overpopulation, local soil erosion, inadequate water use management and intensive deforestation, increase in industrial activities and a greater exploitation of natural resources [7]. These changes have brought about a huge increase both in the quantity of discharge and the range of pollutants that reaches the aquatic environment and in turn have led to various deleterious effects on aquatic resources and ecosystem health [8,9]. Aquatic organisms, including fish, accumulate pollutants directly from contaminated water and indirectly *via* the food chain.

Hence this study aimed at assessing the physical and chemical parameters of the water and the effects of refuse on the water body, fish and water sediment in the Sokori River in Abeokuta, Ogun State.

Materials and Methods

Study area

The study area (Abeokuta) is located in the sub-humid tropical region of Southwestern Nigeria its geographical coordinates are 7°9′ 0″ North and 3° 21′ 0″ East). The town is about 81 km south-west of Ibadan and 106 km North of Lagos and at an altitude of about 157 m above sea level, the landscape has undulating characteristics due to the formation of granite rocks. The city enjoys a tropical climate with distinct wet and dry seasons with dry period of about 130 days. The mean annual rainfall and temperature are about 1,270 mm and 28°C

***Corresponding author:** Adeosun FI, Department of Aquaculture and Fisheries Management, Federal University of Agriculture, Abeokuta, Nigeria; Tel no: +234 (0) 902-742-7974; E-mail: adeosunfi@yahoo.com

Received April 17, 2017; **Accepted** April 27, 2017; **Published** May 04, 2017

Citation: Abdulraheem I, Ojelade OC, Adeosun FI (2017) The Effect of Refuse on Fish, Water and Sediment of River Sokori, Abeokuta, Ogun State, Nigeria. J Fisheries Livest Prod 5: 233 doi: 10.4172/2332-2608.1000233

respectively while the estimated mean annual potential evaporation is 1,100 mm. The city is underlain by crystalline pre-Cambrian Basement complex of igneous and metamorphic origin noted for their rather poor groundwater bearing properties. The city is drained mainly by River Ogun which passes through and divides the city into two, and the drainage pattern is dendritic. The study area which covers a geographical area of 1,256 square kilometers has a population of about 605, 461 and comprise of Abeokuta South, Abeokuta North, parts of Odeda and Obafemi-Owode Local Governments of Ogun State of Nigeria. The main occupation of the indigenes is farming, fishing, local textile making (Adire) trading, and pottery.

The study was conducted on river Sokori in Abeokuta, Ogun State, Nigeria. The River Sokori discharges into the Lagos Lagoon. River Sokori is a perennial river which has a coordinate of 3°28´E and 8°41´N at its source in River Ogun and 3°35 É and 6°35´N in the point where it empties into the Lagos Lagoon. River Sokori has an elevation of about 76 m.

Samples and physical and chemical parameters were collected and measured at four different locations along the River Sokori (Sokori, Isale-igbehin, Kuto and Ijaye).

Samples collection

River sediment collection: Sediments sample were directly collected from the four locations (Sokori, Isale-igbehin, Kuto and Ijaye) along the Sokori River. The samples were collected in a nylon cellophane bag and kept air tight condition to avoid further exposure to air. Sixteen [5] sediment samples were collected at the different locations.

After collection, some portions of sediment samples were dried in a vacuum oven at 105°C until constant weight. The sediments were sieved using a 2 mm sieve, lightly ground in an agate mortar for homogenization and prepared for analysis of heavy metal test.

Physical and chemical parameters determination: The following physical and chemical parameters (temperature, dissolved oxygen, pH, electrical conductivity and total dissolved solid) were taken and recorded at the different locations using a multipurpose water parameters test kit. The transparency of the River at the different locations was determined with the use of Secchi Disc which is an instrument for determining the transparency of any water body. The depth of the River was determined using a straight iron rod which was lowered into the River to reach the bottom, the point at which water cut the rod was marked and measured with the use of measuring tape and recorded in situ. Manufacturers' instruction for the water test kits was strictly adhered to Data Analysis/Laboratory Procedure.

The samples after storage were digested for the extraction of heavy metals (Zn, Cr, Cd, Cu, and Pb) in the laboratory.

Digestion procedure

Materials Used for sample digestion

1. Heating source (e.g., block digester, hotplate, water bath) capable of maintaining a sample extract temperature of 95 ± 5°C, Fume cupboard, Gloves and nose mask, Conical flask, Measuring cylinder, Standard flask, Beakers, Electronic weighing balance, Filter paper.

2. Reagents Used: Conc. Hydrochloric Acid (HCl), Distilled water, Conc. Trioxonitrate (V) acid (HNO_3), Conc. Tetraoxosulphate (VI) acid.

Sample preparation for sediment analysis

1 g of the soil sample was weighed and put into a digestion vessel (conical flask) after which 10 ml of concentrated nitric acid and 5 ml of concentrated sulphuric acid were added to it. This was repeated for all the soil samples including the control samples. The samples were digested for about 2-3 minutes at 95 ± 5°C and then allowed to cool for about 20-24 hours Soil samples were filtered using Wattman no 1 filter paper. The digest was made up to 50 ml using a 50 ml standard flask and stored for analysis. A blank sample was also prepared. The digest was analyzed for heavy metals using Atomic Absorption spectrophotometer (AAS).

Data analysis

The data collected were statistically analyzed using the statistical package Social Sciences 16.0. A variance analysis ($p<0.05$) of total metal concentrations among different sampling sites was performed using one-way ANOVA test and mean differentiated using least Significant Difference (LSD) at $p<0.05$.

Results

Physical and chemical parameters

The result of the physical and chemical parameters as presented in Table 1 and Figure 1 shows that the mean values of all the parameters tested for were highest in Location A (Sokori). The lowest mean temperature (28.6°C) and pH (7.00) were recorded at Location B (Ijaye) while the lowest mean conductivity and TDS (198 mg/l) were recorded at Location C (Kuto). The lowest mean transparency (0.54 m) was recorded at Location D (Isale Igbehin). The lowest and highest (5.24 mg/l and 7.27 mg/l) mean dissolved oxygen however was recorded at Location B and A respectively. Location A (Sokori) presented the highest value (0.92 m) in term of depth while the lowest value (0.67 m) was recorded at Location C (Kuto). There was however no significant difference ($P<0.05$) in the mean of all the parameters tested for from the four locations.

Heavy metal concentrations

The total mean metal concentrations of heavy metals in the water sediment for each of the sampling site are shown in Table 2 and Figure 2 respectively. Mean metal contents ranges for the different metals are as follows: Lead: 40.3-62.3 mg/kg; Cadmium: 0.2-1.0 mg/kg; Chromium: 22.8-99.9 mg/kg; Copper: 40.0-77.7 mg/kg; Zinc: 195.0-279.6 mg/kg

Locations	Temp (°C)	pH	DO (mg/l)	Transparency (cm)	Conductivity (mμ)	TDS (mg/l)	Depth (m)
Sokori (A)	30.5^{a}	8.01^{a}	7.27	0.67^{a}	537^{a}	289^{a}	0.92
Ijaye (B)	28.6^{abc}	7.00^{abc}	5.24	0.65^{ab}	511^{ab}	256^{ab}	0.73
Kuto (C)	28.7^{abc}	7.24^{abc}	6.86	0.55^{abc}	395^{abc}	198^{abc}	0.67
Isale Igbehin (D)	29.4^{ab}	7.32^{ab}	5.76	0.54^{abc}	412^{abc}	205^{abc}	0.69
Total mean	29.3	7.39	6.283	0.6	463.75	237	0.753
Minimum	28.6	7	5.24	0.54	395	198	0.67
Maximum	30.5	8.01	7.27	0.67	537	289	0.92

Table 1: Mean values of Physical and chemical Parameters at the different locations Values are expressed in means. Means having same superscript on the same column are not significantly different at $p>0.05$.

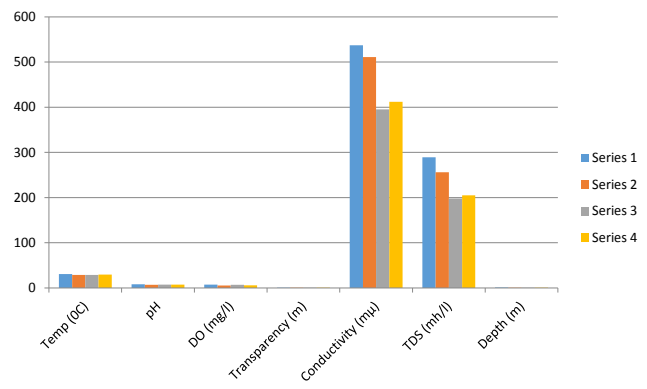

Figure 1: Mean physico-chemical parameters at the different locations.

Locations	Zn	Pb	Cr	Cu	Cd
Sokori (A)	279.6^{a} ± 144.2	62.3^{a} ±11.3	99.9^{a} ± 25.7	77.7^{a} ± 43.9	0.2^{bc} ± 0.3
Ijaye (B)	226.0^{ab} ± 144.2	50.4^{bc} ±11.3	27.9^{b} ± 25.7	55.0^{abc} ± 43.9	0.3^{b} ± 0.3
Kuto (C)	195.0^{abc} ± 144.2	40.3^{abc} ±11.3	22.8^{b} ± 25.7	40.0^{abc} ± 43.9	0.2^{bc} ± 0.3
Isale igbehin (D)	203.7^{abc} ± 144.2	60.6^{ab} ±11.3	95.8^{a} ± 25.7	69.4^{ab} ± 43.9	1.0^{a} ± 0.3
Mean	226.1 ± 144.2	53.4 ±11.3	61.6 ± 25.7	60.5 ± 43.9	0.4 ± 0.3
Max	279.6	62.3	99.9	77.7	1
Min	195	40.3	22.8	40	0.2

Table 2: Mean values of Heavy metals analysis of the sediments of the different locations (mg/l) Values are expressed in means. Means having same superscript on the same column are not significantly different at p>0.05.

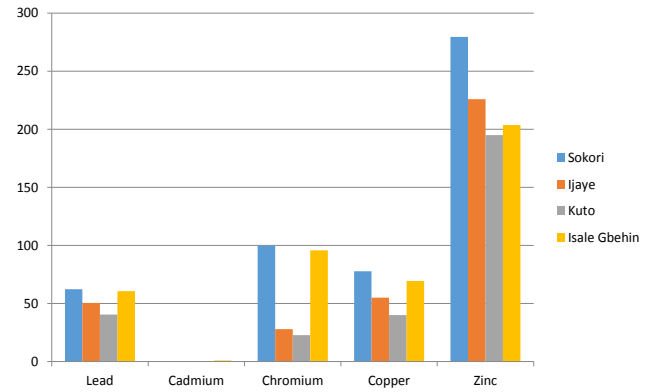

Figure 2: Heavy metals analysis of the sediment of the different locations (mg/l).

dry weights and thus allowing the arrangement of the metals from highest to lowest mean content as: Zn>Cr>Cu>Pb>Cd.

Discussion

Physical and chemical parameters

There were difference in mean temperature values at the different locations; there was however, no significant difference in the mean of the temperature value. The minimum and maximum temperature of 28.6-30.5°C according to Okayi [10] is normal for tropical waters for optimal growth of organisms. This also agrees with the mean temperature range recommended by WHO for optimal growth of fish. Result of this finding is also in line with the findings of Olalekan et al. [11] who reported similar temperature range in Ogun River between the dry and wet season.

The dissolved oxygen (DO) range observed in this study falls within the acceptable limit for fish survival. The lower level was expected owing to high level of organic matter being introduced and undergoing decomposition thus resulting in oxygen uptake. This is similar with the result of Umunakwe et al. [12] who reported that DO level in Aba River where within the acceptable limit prescribed by WHO and Federal Ministry of Environment.

This study also revealed that hydrogen ion concentration (pH) was generally higher than 7.0 at all sampled locations. The only exception was at Location B (Ijaye), where mean value obtained was 6.89. In similar studies, Tetsola [13]; Egborge [14] and Olalekan et al. [11] reported that River Ogun which is the source of the Sokori River was generally alkaline in nature (pH above 7.0). The Lower pH values recorded at Location B could be linked with the influx of humic substances into the River which were made available by proliferation of markets, sawmills and massive rural to urban drift and other anthropogenic activities there by making that source point acidic. However, the pH range at all points was still within the acceptable limit for fish survival [15].

Moreover, the levels obtained for total dissolved solid (TDS) in the study area was higher at Sokori source point and lowest at Kuto source point reason could be due to the type of discharge entering into the River at these different points. However, the range falls within the acceptable limits as prescribed by WHO [15] and thus, do not pose any form of threat to the aquatic organism. The result of this study corroborates the finding of Ayobahan et al. [16] who recorded similar high level of TDS in two stations along the Benin River in their study when compared to other stations and attributed reason to the nature of activities going on in those stations.

The mean Electronic Conductivity values were observed to be highest at Sokori source point and lowest at kuto source point reasons could be due to the high levels of TDS at this station. This range is however acceptable for optimal growth of organisms in tropical waters as recommended by WHO [15]. Result is similar to that observed by Samuel et al. [17] who reported similar trend in the TDS with the electrical conductivity of River Galma in Zaria, Kaduna State. Also, Ayobahan et al. [16] observed similar trend in their study but attributed reason to the industrial activities at the locations with highest conductivity.

Heavy metal concentrations

The mean Lead, zinc, copper and chromium concentrations observed in the water sediment during this study in all the locations, were, according to the EPA guideline for heavy metal concentration in sediments (Table 3), moderately to heavily polluted with Pb, Cu, Cr and Zn with exception of Kuto that is not polluted with Cr. Reasons of heavy pollution could be due to industrial activities taking place in these areas. However, Cd was lower in the study at all locations than the recommended value for water pollution by EPA. In a similar research Wogu and Okaka [18] investigated 9 similar metals in the Warri River in Nigeria which receive effluent from industrial, agricultural, and urban sewage and reported that the concentration of Cd, Cr, Mn, and Ni in this river is higher than the stated standard level for it, and

Metal	Not polluted	Moderately polluted	Heavily polluted	Present study
Lead	<40	40-60	>60	40.3-62.3
Cadmium	-	-	>6	0.2-1.0
Chromium	<25	25-75	>75	22.8-99.9
Copper	<25	25-50	>50	40.0-77.7
Zinc	<90	90-200	>200	195.0-278.6

Table 3: EPA guideline for heavy metal concentration in sediments (mg/kg dry weight).

concluded that its water is harmful to the public health and hygiene. This finding also corroborates the findings of Ayobahan et al. [16] who investigated the water quality along the Benin River to determine the source of pollution using heavy metal concentration as a factor and reported the order of dominancy of the heavy metals investigated as follows Fe>Zn>Mn>Cr>Ni>Cu>Pb. They attributed reason to industrial activities taking place at the different locations along the River.

Studies have shown that heavy metals are used as indicator of pollution because of their high toxicity to human and aquatic life [16] and source of high concentrations of heavy metals in the aquatic ecosystems have been linked with effluents from industries, refuse and sewage [7,18,19].

The implication of the findings from the study on fish is that the DO in the water will be used up by bacteria that feed on decomposing organic material. This oxygen demand can literally suffocate fish and other aquatic organism. Refuse also contains large amounts of suspended particles of matter that prevents sunlight from reaching underwater plants that are the food source for so many aquatic species. Also, total solids (suspended and dissolved) can also cause abrasions on the gills of fish or delicate membranes of other organisms.

Conclusion

High heavy metals concentration observed among the various sampled locations requires urgent attention to curb the various activities of man ranging from industrial, agricultural and domestic that contributes to increase in the concentrations of these elements because of their health implications for the aquatic organisms and for man relying on the river for survival. There is therefore need for the authority to see to the activities taking place on, around and along this river in order to checkmate the introduction of toxic materials into the river. Since many variables and elements supplied to Sokori water clearly affect the water quality, it is necessary to reduce the external loads and to determine acceptable impact, without affecting the native biodiversity negatively [19].

Acknowledgement

The authors are grateful to the technologist in the Department of Environmental Management and Toxicology, College of Environmental Resource Management, Federal University of Agriculture Abeokuta, Ogun State, Nigeria.

References

1. United Nations Environment Programme (2006) Water quality for ecosystem and human health. Published by the United Nations Environment Programme Global Environment Monitoring System (GEMS)/Water Programme: 132.1.
2. Adeyeye EI (2000) Determination of Major Elements in Fish, Associated Water and soil sediments from some freshwater ponds, Ghana. J Chem Publishing Company 322-327.
3. Shrestha S, Kazama F (2007) Assessment of surface water quality using multivariate statistical techniques: A case study of the Fuji River basin. Japan. Environ Model Softw 22: 464-475.
4. Azumi DS, Bichi MH (2010) Industrial pollution and heavy metals profile of Challawa River in Kano, Nigeria. J Appl Sci Environ Sanitation 5: 23-29.
5. Singh KP, Malik A, Mohan D, Sinha S (2004) Multivariate statistical techniques for the evaluation of spatial and temporal variations in water quality of Gomti River (India): A case study. Water Res 38: 3980-3992.
6. Vega M, Pardo R, Barrado E, Deban L (1998) Assessment of seasonal and polluting effects on the quality of river water by exploratory data analysis. Water Res 32: 3581-3592.
7. Emongor V, Kealotswe E, Koorapetse I, Sankwasa S, Keikanetswe S (2005) Pollution indicator in Gaberone effluent. J Appl Sci 5: 147-150.
8. Chindah AC, Braide AS, Sibeudu OC (2004) Distribution of hydrocarbons and heavy metals in sediment and a crustacean (shrimps-Penaeus notialis) from the bonny/new Calabar river estuary, Niger Delta. Ajeam-Ragee 9: 1-17.
9. Adeosun FI, Adam TF, Amrevuawho MO (2016) Effects of anthropogenic activities on the water quality parameters of Federal University of Agriculture, Abeokuta reservoir. International Journal of Fisheries and Aquatis Studies 4: 104-108.
10. Okayi RG (2010) Water quality and water quality management in aquaculture, Proceeding of the Conference of the Fisheries Society of Nigeria (FISON) 20-22.
11. Olalekan OI, Oladipupo SO, Habeeb AQ, Oluwaseun AB (2012) Influence of Human Activities of the Water Quality of Ogun River in Nigeria. Civil Environ Res 2: 36-48.
12. Umunakwe JE, Akagha CI, Aharanwa BC (2013) Influence of Industrial and Abattoir Waste on some Physicochemical and Bacteriological variables of Aba River. Civil Environ Res 3: 83-90.
13. Testola EA (1988) Distribution and Gender Relationship of the fishes in Warri River, Nigeria. Ph.D Thesis University of Benin, Department of Fisheries.
14. Egborg ABM (1994) Water Pollution in Nigeria: Biodiversity and Chemistry of Warri River. Ben Miller Books Nigeria Limited, Benin City.
15. World Health Organization (2007) Water for Pharmaceutical Use. In: Quality Assurance of Pharmaceuticals: A Compendium of Guidelines and Related Materials. 2nd Updated Edn. World Health Organisation, Geneva 2: 170-187.
16. Ayobahan SU, Ezenwa IM, Orogun EE, Uriri JE, Wemimo IJ (2014) Assesment of Anthropogenic Activities on Water quality of Benin River. J Appl Sci Environ Manager 18: 629-636.
17. Samuel PO, Adakole JA Suleiman B (2015) Temporal and Spatial Physico-Chemical Parameters of River Galma, Zaria, Kaduna State, Nigeria. Resources Environ 5: 110-123.
18. Wogu MD, Okaka CE (2011) Pollution studies on Nigerian rivers: heavy metals in surface water of warri river, Delta State. J Biodiversity Environ Sci 1: 7-12.
19. UNSD (1997) Glossary of Environment Statistics. unstats.un.org.