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ANALYSIS OF PHYSIOCHEMICAL PARAMETERS TO EVALUATE THE EFFECT OF POLLUTANTS ACCUMULATED IN A RIVER BED SEDIMENT

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ABSTRACT

The potential sources of water contamination are geological conditions, industrial and agricultural activities, and water treatment plants. Poor water quality affects not only aquatic life but the surrounding ecosystem as well. From the result the mean value of the Physiochemical parameters are; temperature is 28.16 ^{o}C, pH is 8.18, conductivity is 38.55, DO is 7.11 and TDS is 3.05. The values of water quality parameters collected from different point of the river were found to be within the recommended limits of WHO and NDWQS. The concentrations of the heavy metals were also measured and found to be well below the standard maximum concentrations. Similarly, the mean value of heavy metal concentration in the sediment were as follows; Cr = BLD, Cd = 0.059 mg/kg, Cu = 17.52 mg/kg, Zn = 1.753 mg/kg, and Pb = 0.025 mg/kg. Hence the result revealed that heavy metals

Introduction:

The pollutants accumulated in the river bed sediment mostly affect the bio-community through food chain for a long period of time, and this is as a result of suspended sediment adsorbs pollutants from flowing water in rivers and deposits onto the bed (Schleiss et, al. 2016). Heavy metals are persistent environmental contaminants that are very harmful because of their potentials to accumulate in different body parts. Most are extremely toxic because of their solubility in water, and even at lower concentrations they may have damaging effects because of the lack of good mechanisms for eliminating

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concentration in the sediment were within Food and Agricultural Organization (FAO)/WHO limit. Concentrations of heavy metals in the sediment and the water were within the recommended limit for fishing, irrigation and other domestic activities. Therefore, these metals have no immediate health threat on the surrounding ecosystem that are benefiting from River Taraba at Bali, but periodic monitoring of heavy metals in the River is recommended since the river serves as a source of fish, irrigational farming and other domestic activities for all-year-round.

Keywords: *Physiochemical parameters, River bed sediment, Heavy Metals, pollution.*

them, (Dissmeyer, 2000, Sharma *et al*., 2008). Prolonged intake of heavy metals through foodstuffs may lead to chronic accumulation in the kidney and liver of humans and animals causing disruptions of numerous biochemical processes, leading to cardiovascular, nervous, kidney and bone diseases (WHO, 1993; Jarup, 2003). Some heavy metals such as Cu, Zn, Mn, and Co act as nutrients for the growth of animals and humans when present in small quantities, whereas others such as Cd, As, and Cr act a s carcinogens (Trichopoulos, 1997) and, Hg and Pb are associated with the development of abnormalities in children (Pitot and Dragan, 1996). Aquatic systems enable hydrological cycling, climate regulation, and habitat provision for aquatic organisms. Heavy metal pollution in the aquatic environment has attracted global attention because of the environmental toxicity, persistence, and bioaccumulation of heavy metals, which can pose adverse effects on living beings and the entire ecosystem (Zang et al. 2014).

Sediment is considered as the largest pool of heavy metals in the aquatic environment. About 99% of the heavy metals load in aquatic systems has been found to ultimately precipitate onto the sediment. Heavy metal concentrations in the sediment are usually four or five times higher than that found in the overlying water (Yuan et al. 2011, FAO 2003). Sediment quality can reflect the heavy metal pollution status of the whole ecosystem. Thus, it is of great importance to measure the amount of heavy metals in the sediment to provide information on the heavy metal contamination of the entire aquatic ecosystem (Hasegawa et al 2010). Heavy metals enter aquatic ecosystem sediment via natural processes,

including atmosphere deposition, rock weathering and erosion, and hydrodynamic alteration, as well as via anthropogenic activities, such as industrial wastewater discharge and agricultural fertilizer leaching (Zang et al. 2014). In addition to heavy metals, large amounts of organic materials are released into water bodies and may be broken down by bacterial activities resulting in reduction of oxygen level or anaerobic conditions in the variety of the effluents (FAO 1983). All over the world, rivers and sea bodies end up as receptacle for chemicals, organic and heavy metal pollutants. This is mainly because most industries and factories are located near the bank of the river (WHO 2011, USEPA 1989). This has resulted in several cases of pollution in aquatic environments (Fawell, 1993, Hulsche et, al., 1992). Typical instances of river pollution in Nigeria have been reported: Challawa River in Kano, pollution of Calabar River, pollution in Aba River and a lot of others (Ayeloja *et, al*., 2014). The concentration of heavy metals in cases of river pollution depends on annual and seasonal fluctuations. River Niger is the third largest river in the world stretching 2,610 miles (4200 km) from Guinea through Mali and into Nigeria. River Niger serves as veritable source of large quantity of fish production for human consumption (Ayeloja *et, al*., 2014).

Suspended sediment adsorbs pollutants from flowing water in rivers and deposits onto the bed. However, the pollutants accumulated in the river bed sediment may affect the bio-community through food chain for a long period of time (WHO, 2006). Singare *et al.* (2011), also reported that heavy metals entering into the rivers from various sources are adsorbed onto suspended particulates and form free metal ions and soluble chemical complexes that are available for uptake by aquatic organisms Many toxic metals such as arsenic, lead, nickel, cadmium, copper, mercury, zinc, and chromium present in untreated or allegedly treated industrial effluents are carried by rivers in variable amounts. Aquatic systems enable hydrological cycling, climate regulation, and habitat provision for aquatic organisms. Heavy metal pollution in the aquatic environment has attracted global attention because of the environmental toxicity, persistence, and bioaccumulation of heavy metals, which can pose adverse effects on living beings and the entire ecosystem (Hulscher et al. 1992, Zang et al. 2014). Sediment is considered as the largest pool of heavy metals in the aquatic environment. About 99% of the heavy metals load in aquatic systems

has been found to ultimately precipitate onto the sediment (Schleiss et, al. 2016, Suthar et, al. 2009). Heavy metal concentrations in the sediment are usually four or five times higher than that found in the overlying water (Yuan et al. 2011). Thus, sediment quality can reflect the heavy metal pollution status of the whole ecosystem. Consequently, it is of great importance to measure the amount of heavy metals in the sediment to provide information on the heavy metal contamination of the entire aquatic ecosystem (Hasegawa et al 2010). Heavy metals enter aquatic ecosystem sediment via natural processes, including atmosphere deposition, rock weathering and erosion, and hydrodynamic alteration, as well as via anthropogenic activities, such as industrial wastewater discharge and agricultural fertilizer leaching (Zang et al. 2014).

A heavy metal is a member of a loosely defined subset of element that exhibits metallic properties. It's mainly includes the transition metals, some metalloids, lanthanide and actinides. Many different definitions have been proposed, some based on density, some based on atomic number or atomic weight and some on chemical properties or toxicity (Jarup, 2003). Certain heavy metals are nutritionally essential for healthy life when present in small quantities and are refer to as the trace-elements (e.g. iron, copper, manganese and zinc). While some heavy metals are toxic or poisonous to the body (e.g. lead, mercury, cadmium, Chromium and Arsenic) (Sharma *et al.*, 2008). These elements enter into water through weathering, industrial activities and through agricultural activities. Heavy metals are also used in industrial application such as in the manufacture of pesticides, batteries, alloys, electroplated metal parts, textile dyes, steel etc. (Osman *et al.*, 2007).

Heavy metal pollution is a great concern to the environment is widespread and non-degradable. It seems to be man`s worst endeavor in his attempt to augment industrial development. Heavy metals are bio-accumulative and relatively stable as well as toxic/carcinogen and therefore require close monitoring. Increasing human influences through heavy metal pollution have over the years led to the depletion of our aquatic biodiversity. As a result, several important endemic fish species have become threatened. Realizing this, concern for the assessment of heavy metals in fish species of most water bodies have increasingly been gaining ground throughout the world (Pande and Sharma, 1999, Sharma *et al.*, 2008). Fish accumulate toxic metals directly from water and

diet, and contaminant residues may ultimately reach concentrations hundreds and thousands of times above those measured in the water, sediment and food (Hu et, al. 2013). These metals are known to be environmentally stable, non-degradable and induce toxic effect. Heavy metals are normal constituents of aquatic environment that occur as a result of pollution principally due to discharge of untreated wastes and agricultural activities into the rivers (Shirkanloo *et al.*, 2015; Osman *et al.*, 2007).

MATERIALS AND METHOD

Study Site

The study was carried out at River Taraba in Bali town, Bali Local Government Area of Taraba State, Nigeria. The town lies between latitude 7°46[1] and 7°54[1] of the equator and longitude 10°30[1] E and 11°00[1] E of the prime meridian (Topographic sheet, 1968). Bali is the largest Local Government in Taraba State with an estimated land area of 11.540 km^2 and a population density of about 211.024 (NPC 2006). The town is found in dry guinea savannah, with a tropical climate marked by two seasons; dry and rainy seasons. The dry season is from December to March, while the rainy season starts around April and ends in November occasionally, with 1350 – 1350 mm rainfall annually.

Samples collection and analysis

Samples were collected in River Taraba at Bali for six month. Sediments and water sample were collected from three 3 samplings points of the River. The water samples were collected from 0.5 m below the water surface. The upper 10 cm of the bottom layer sediment samples were taken. Each sediment core was packed separately in acid soaked clean polyethylene packets and conveyed to the Laboratory for analysis. The sediment samples were dried at 105°C to constant weight, ground and the fraction passing a BS20 sieve was stored in clean acid-soaked polyethylene packets at 20°C prior to digestion and the heavy metal analysis. The sample was weighed into a digestion tube and digest reagent was added. The mixture was digested completely by obtaining a clear solution. The solution was cooled and filtered through a Whitman filter paper. The mixture was used to analyze the heavy metals contents using AAS, based on the

manufacturers' instructions for each heavy metal (Rahman *et* al., 2015; Shirkanloo *et al.*, 2015).

Statistical analysis

The data were statistically analyzed by the statistical package, SPSS 16.0. The analysis was conducted to determine the quality of water and level of heavy metals pollution in River. The means value of the heavy metal concentrations in water and sediments were calculated by Microsoft Office Excel 2010.

RESULT AND DISCUSSION

Result

The table 1 below present the monthly record of physiochemical parameters (Temperature, pH, Conductivity, Dissolve Oxygen and Total Dissolve Solid) of River Taraba at Bali. The result revealed that the mean value of the water quality parameters at the study area are; temperature is 28.16 ^{o}C, pH is 8.18, conductivity is 38.55, Dissolve Oxygen is 7.11 and Total Dissolve Solid is 3.05. Consequently, water quality testing is an important part of environmental monitoring.

Table 1: Mean Value of Physiochemical Parameters of the River

Month	Temp. (^{o}C)	pH	Conductivity	DO	TDS
September	29.89	9.03	40.17	5.82	2.33
October	29.78	9.25	46.11	6.37	3.33
November	28.99	8.15	39.41	7.07	3.00
December	28.26	8.35	33.10	9.38	3.33
January	27.72	7.25	39.41	7.53	3.00
February	28.26	7.05	33.08	9.50	3.33
Mean value	**28.81**	**8.18**	**38.55**	**7.11**	**3.05**

The comparison for Heavy Metal Concentration (mgkg^{-1}) of Soil from the River with the International Standards is shown in table 2. The result show that the concentration of metals in the soil as compared with the international standard (FAO, WHO, and USEPA) were within the acceptable limit. FAO/WHO, (2006) reported that heavy metal pollution in sediment is one of the most serious

problems in water bodies, including rivers, which can cause secondary pollution when environmental conditions change.

Table 2: Heavy Metals Concentration ($mgkg^{-1}$) of Soil from the River as Compared with the International Standards.

Month	Pb	Cu	Cr	Cd	Zn
September	0.020	21.20	BDL	0.025	6.815
October	0.024	16.31	BDL	0.030	1.004
November	0.029	27.89	BDL	0.012	0.880
December	0.021	3.650	0.054	0.012	0.494
January	0.026	14.32	BDL	0.022	0.648
February	0.028	22.04	BDL	0.254	0.675
Mean value	**0.025**	**17.52**	**BDL**	**0.059**	**1.753**
WHO Std. 2004	-	-	0.009	6	123
USEPA 1990	40	-	25	0.6	110
FAO 1985	5	0.2	0.1	-	0.05

Discussion

Heavy metal pollution in sediment is one of the most serious problems in water bodies, including rivers, which can cause secondary pollution when environmental conditions change. The values of Physiochemical parameters collected from different point of the river were found to be within the recommended limits of WHO and NDWQS. The mean value of the physiochemical parameters at the study area are; temperature is 28.16 ^{o}C, pH is 8.18, conductivity is 38.55, DO is 7.11 and TDS is 3.05. The concentrations of the five heavy metals (Cu, Zn, Cd, Pb, Cr,) were also measured and found to be well below the standard maximum concentrations. The parameters that affect the quality of water in an environment is classified into three properties namely; physical, chemical or biological factors. Physical properties of water quality include temperature and turbidity. Chemical characteristics involve parameters such as pH and dissolved oxygen. Biological indicators of water quality include algae and phytoplankton (Zang et al. 2014). These parameters are relevant not only to surface water studies of the ocean, lakes and rivers, but to groundwater and industrial processes as well. Water quality monitoring can help researchers predict and

learn from natural processes in the environment and determine human impacts on an ecosystem. Heavy metal pollution in sediment is one of the most serious problems in water bodies, including rivers, which can cause secondary pollution when environmental conditions change. Suspended sediment adsorbs pollutants from flowing water in rivers and deposits onto the bed. However, the pollutants accumulated in the river bed sediment may affect the bio-community through food chain for a long period of time (WHO, 2006). Singare *et al.* (2011), also reported that heavy metals entering into the rivers from various sources are adsorbed onto suspended particulates and form free metal ions and soluble chemical complexes that are available for uptake by aquatic organisms Many toxic metals such as arsenic, lead, nickel, cadmium, copper, mercury, zinc, and chromium present in untreated or allegedly treated industrial effluents are carried by rivers in variable amounts.

Aquatic systems enable hydrological cycling, climate regulation, and habitat provision for aquatic organisms. Heavy metal pollution in the aquatic environment has attracted global attention because of the environmental toxicity, persistence, and bioaccumulation of heavy metals, which can pose adverse effects on living beings and the entire ecosystem (Hulscher et al. 1992, Zang et al. 2014). Sediment is considered as the largest pool of heavy metals in the aquatic environment. About 99% of the heavy metals load in aquatic systems has been found to ultimately precipitate onto the sediment. Heavy metal concentrations in the sediment are usually four or five times higher than that found in the overlying water (Yuan et al. 2011). Thus, sediment quality can reflect the heavy metal pollution status of the whole ecosystem. Consequently, it is of great importance to measure the amount of heavy metals in the sediment to provide information on the heavy metal contamination of the entire aquatic ecosystem (Hasegawa et al 2010). Heavy metals enter aquatic ecosystem sediment via natural processes, including atmosphere deposition, rock weathering and erosion, and hydrodynamic alteration, as well as via anthropogenic activities, such as industrial wastewater discharge and agricultural fertilizer leaching (Zang et al. 2014).

CONCLUSION

Contaminants in the water can affect the water quality and consequently the human health. The potential sources of water contamination are geological conditions, industrial and agricultural activities, and water treatment plants. To

study this problems the physiochemical parameters (temperature, pH, conductivity, DO and TDS) and concentration of heavy metals (Cr, Cd, Cu, Zn, and Pb) in water and sediment were investigated in River Taraba at Bali. The mean value of the physiochemical parameters at the study area are; temperature is 28.16 ^{o}C, pH is 8.18, conductivity is 38.55, DO is 7.11 and TDS is 3.05. The values of physiochemical parameters collected from different point of the river were found to be within the recommended limits of WHO and NDWQS.

The concentrations of the heavy metals were also measured and found to be well below the standard maximum concentrations. Similarly, the mean value of heavy metal concentration in the sediment were as follows; Cr = BLD, Cd = 0.059 mg/kg, Cu = 17.52 mg/kg, Zn = 1.753 mg/kg, and Pb = 0.025 mg/kg. Hence the result revealed that heavy metals concentration in the sediment were within the Food and Agricultural Organization (FAO)/WHO limit. Concentrations of heavy metals in the sediment and the water were within the recommended limit for fishing, irrigation and other domestic activities. Therefore, these metals have no immediate health threat on the surrounding ecosystem that are benefiting from the River, but periodic monitoring of heavy metals in the River is recommended since the river serves as a source of fish, irrigational farming and domestic activities for all-year-round. These measurement efforts of water quality can also assist in restoration projects or ensure environmental standards are being met.

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