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Assessment of the Levels of Fe, Ni and Cu in Soil along the Bank of River Kaduna, Nigeria

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Abstract

The concentrations of Fe, Ni and Cu in soil samples along the Bank of River Kaduna, Nigeria were investigated using Energy Dispersive X-ray Fluorescence (EDXRF) techniques. The results indicated that the mean concentration of Fe, Ni and Cu re 30,420 ± 70.0, 32.4 ± 6.4 and 11.2 ± 3.8 mg/kg respectively the mean values obtained in this study are below the world average of 38,000, 40 and 30 mg/kg for Fe, Ni and Cu respectively and are within the common ranges of 7,000 – 550,000, 5-500 and 2-100 mg/kg for Fe, Ni and Cu respectively.

Keywords: Soil, river, X-Ray fluorescence concentration Fe, Ni and Cu.

Introduction

The environment contains an abundance of man-made and natural radionuclide, as well as polluting heavy metals[1]. Many heavy metals and radionudides (radionuclide contaminants) occur naturally in the earth's soil[2]. While trace amounts of heavy metals are not harmful to humans, some even being necessary in our diet, accumulation over time can cause serious illnesses[3-5]. Heavy metals can have toxic effects on humans when they contaminate the soil or the ground water[6-8]. Likewise, most naturally occurring radionuclide are at low levels and are not a public health concern[9].

Soils are receptacles for heavy metals released from industrial activities, municipal water, water sludge, urban composts, road traffic, atmospheric deposits and chemicals used in agriculture and spread out into the environment[10,11]. Heavy metals are persistent in the environment; they are non-thermo degradable and thus readily accumulate to toxic levels[12]. Many soils especially those in hazardous water sites are contaminated with heavy metals such as Ni, Cu, En and Pb etc. heavy metal contamination of arable soils through industrial and anthropogenic activities is a serious problem in Nigeria[13].

In this research, the percentage concentrations of Fe, Ni and Cu in soil samples collected from selected locations of Kaduna metropolis, Nigeria were determined using Energy Dispersive X-ray Fluorescence (EDXRF) spectrometer model minimal.

Material and Methods

Five (5) soil samples were collected at five (5) different locations along the bank of river Kaduna, Nigeria namely; Gamji Recreational Area (GRA), Kabala Costain (KC), Nasarawa (NS), UnguwanRimi (UR) and Zango (Zg) as shown in figure -1, at 10cm depth using a mechanical digger. The 10cm depth was carefully chosen as the appropriate depth to obtain the samples in line with the facts established that these pollutants are highly absorbed to clayey materials and organic matters in the study areas[14].

The five (5) soil samples collected from the sampling locations were pretreated by oven drying them at a regulated temperature of 50^0c for 48 hours. After drying, a series of mesh size 35μm was used to remove large undesirable particle sizes[15].

The dry test samples were analyzed using the energy dispersive X-ray florescence (EDXRF) to determine the concentration of the metals (pollution in the soil samples.

Results and Discussion

Soils collected from the sampling locations were analyzed using Energy Dispersive X-Ray Fluorescence (EDXRF) method. It was found out that the concentrations of the elements varied from one sampling location to another. Ferential statistics and one-way ANOVA were used to compare the % weight table-1 and concentrations table-2 of Fe, Ni and Cu across Gamji Recreational Area (GRA), Kabala Costain (KC), Nasarawa (NS), Zango (ZG) and UnguwanRimi (UR).

Iron (Fe): The mean concentration values of Fe is 30,420.0 ± 70.0 mg/kg in range between 14,500 ± 50 to 50,800 ± 90.0 mg/kg with highest concentration of 50,500 mg/kg from KC>GRA>UR>ZG>>NS figure-2.

The soil collected from KC had the highest enrichment of Fe when compared to the other sampling locations. This could be attributed to higher impact of anthropogenic practices in the area, which is in agreement with the findings of some investigations who worked in similar situations[16-20].

Nickel (Ni): From table 2 the mean concentration of Ni is 32.4 ± 6.4 mg/kg in range between 22.0 ± 5.0 to 44.0 ± 10.0 mg/kg with highest value of 44.0 ± 10.0 mg/kg obtained and followed the other KC> UR>GRA>ZG figure-3. The low percentage of Ni in the sampling locations could be attributed to lesser impact of anthropogenic sources of pollution in these areas[18-20].

Copper (Cu): The percentage concentration of Cu obtained from all the sampling location showed that GRA had the highest value followed by KC and ZG figure -4. The percentage age weight of the metal was found out to be very low in these locations. The metal was not detected in NS and UR. This is agreement with the reports of other investigators[21,22].

The mean concentration of Cu is 11.2 ± 3.8 in range between 12.0 ± 5.0 to 260 ± 5.0 mg/kg GRA the concentration KC and ZG figure-4 age weight of the metal was found out to be very low in the locations. The metal was not detected in NS and UR. This is in agreement with the reports of other investigation[23,24].

In all the sampling locations Fe was found to have the highest percentage followed by Ni and Cu. The ANOVA (P = 0.0923>0.05) indicated that there is no significant different in the metals across the five locations. In other words all the locations have similar pattern of metal concentrations.

Similarly, the ANOVA (0.000<0.05) showed that there is a significant difference in the relative abundance of the various metals. Hence, some metals are more abundant than others in all the locations. In all the sampling locations, the amount of Fe, Ni and Cu were below the tolerable limit[25].

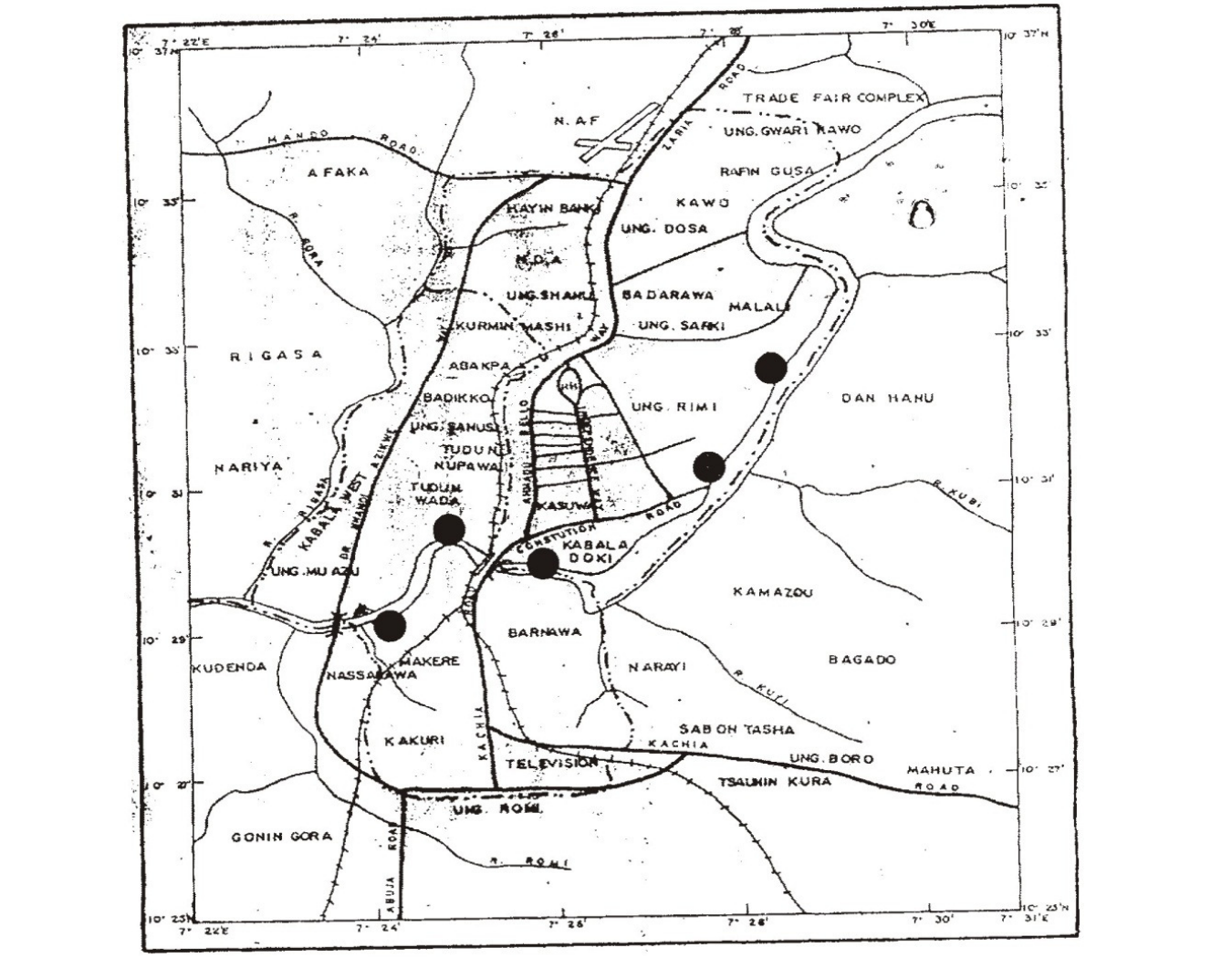

Figure-1
Map of kaduna metropolis showing the sampling locations

Table-1
Percentage weight of Fe, Ni and Cu in soil

S/No	Location	Percentage weight					
		Fe		Ni		Cu	
		% weight	SadErr	% weight	SadErr	% weight	SadErr
1	GRA	3.52	0.0008	0.0032	0.0006	0.0026	0.0005
2	KC	5.08	0.0009	0.0044	0.0022	0.0018	0.0009
3	NS	1.45	0.0005	0.0022	0.0005	0.0010	0.0002
4	UR	2.88	0.0007	0.0035	0.0006	0.0010	0.0003
5	Zg	2.28	0.0006	0.0029	0.0006	0.0012	0.0005

Table-2
Concentration in ppm (mg/kg) for Fe, Ni and Cu

S/No	Location	Concentration in mg/kg		
		Fe	Ni	Cu
1	GRA	35, 200 ± 80.0	32.0 ± 6.0	26 ± 5
2	KC	50, 800 ± 90.0	44.0 ± 10.0	18 ± 9
3	NS	14,500 ± 50.0	220. ± 5.0	10 ± 2
4	UR	28,800 ± 7.0	350 ± 6.0	10 ± 3
5	Zg	22,800 ± 60	29.0 ± 5.0	12 ± 5
	Mean	30,420 ± 70.0	32.4 ± 6.4	15.2 ± 4.8

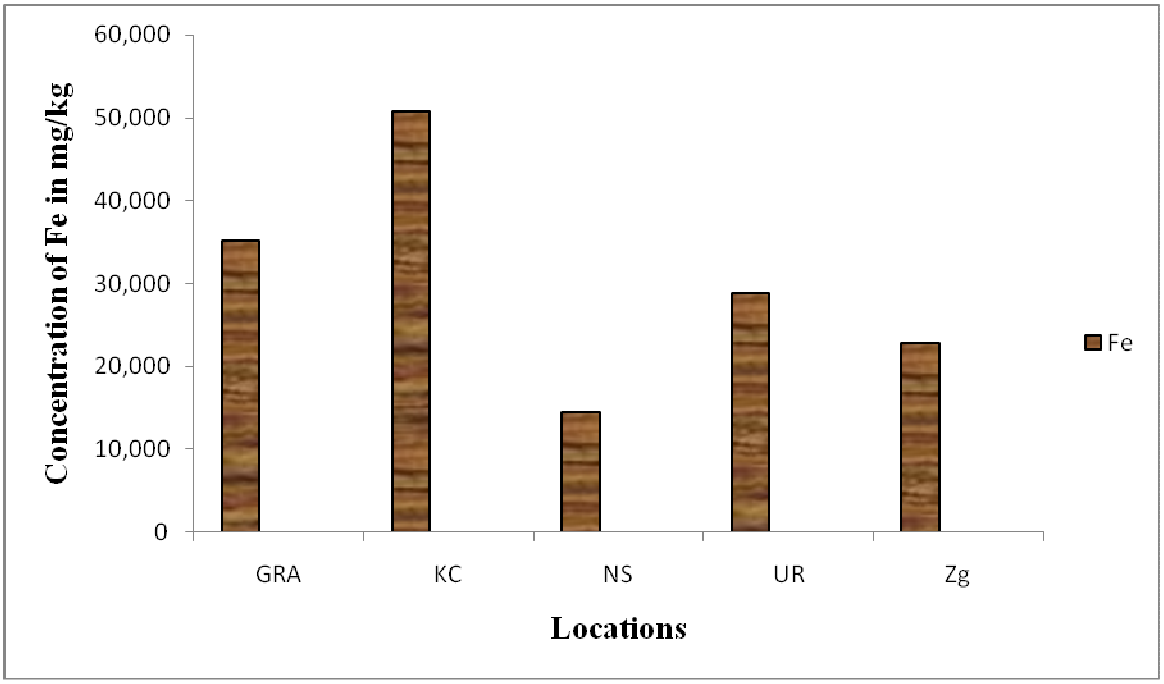

Figure-2
Plot of Concentration of Fe in mg/kg by Location

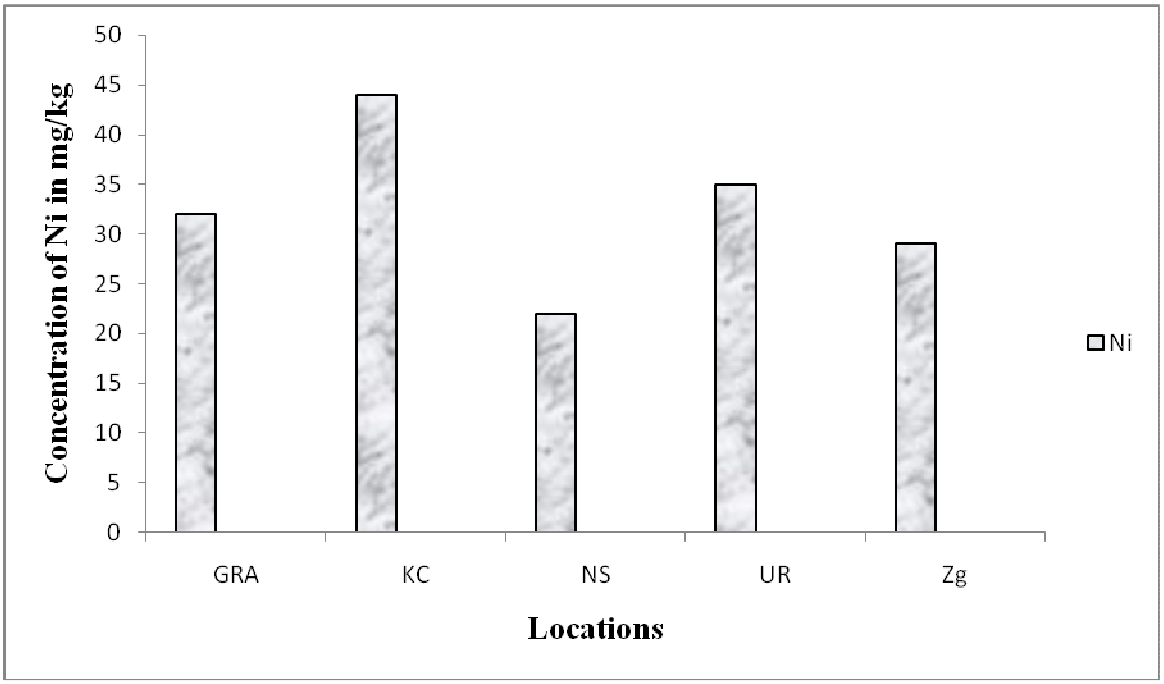

Figure-3
Plot of concentration of Ni in mg/kg by location

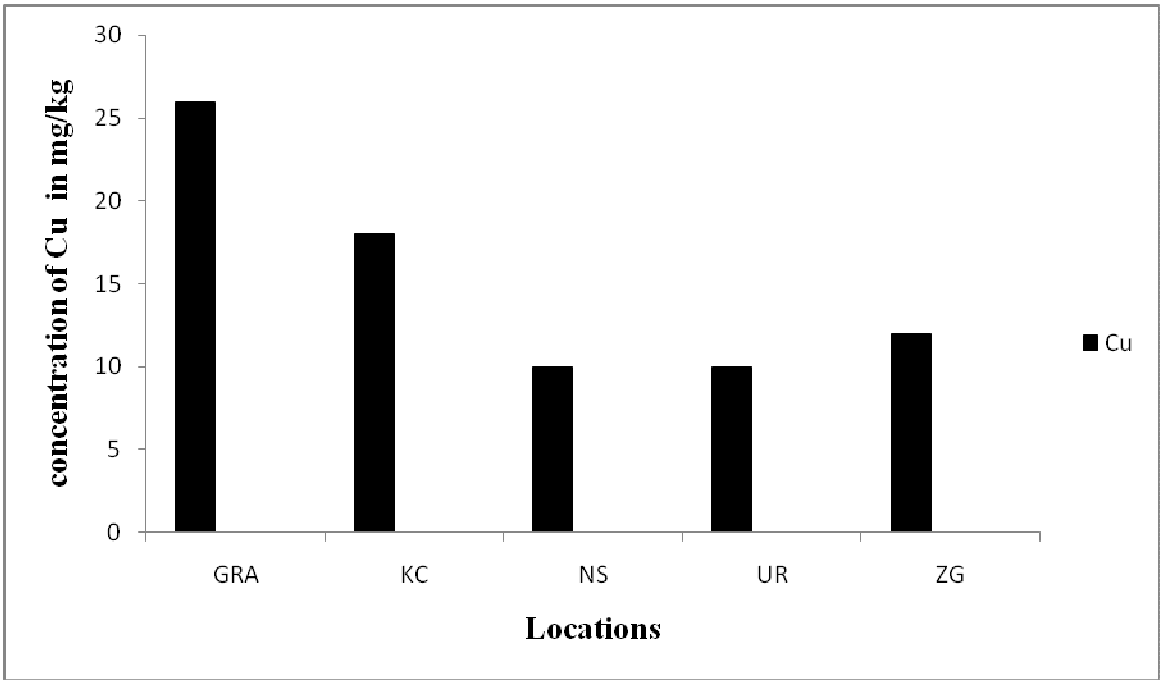

Figure-4
Plot of Concentration of Cu in mg/kg by Location

Conclusion

The concentration of Fe, Ni and Cu in soil along the Bank of River Kaduna Nigeria were investigated and the results showed that Fe has a mean concentration of 30, 420 ± 70.0 mg/kg in range between 14,500 ± 50 to 50,800 ± 90.0 mg/kg, Ni has a mean concentration of 32.4 ± 6.4mg/kg in range between 22.0 ± 5.0 to 44.0 ± 10.0 mg/kg in NS and UR. The mean concentrations Fe, Ni and Cu in this study compared well with other published studies and the values are less than the world wide average values of 38,000, 40 and 30mg/kg for Fe, Ni and

Cu respectively and the concentration obtained in this study is below the tolerable limit.

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