



# Assessment of Heavy Metal Concentration and Fractionation in Selected Dumpsite Soils within Ibadan Metropolis, Nigeria

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## **Author's contribution**

*The sole author designed, analyzed and interpreted and prepared the manuscript.*

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## **ABSTRACT**

Dumpsites are gradually turning into farm land with the belief that they must have accumulated necessary nutrient element required for plant growth and thus making some farmers to use refuse dumpsite material for composting not minding the type of waste that are involved and what they are actually made up off. This study therefore investigated the concentrations of heavy metals in selected dumpsite soils and various forms to determine their mobility with the view to crystallize their extent of contamination to the soil when used for farming activities. Two dumpsites (Bodija dumpsite (BD) and Olukunle dumpsite (OD) were purposively selected from Ibadan South Western Nigeria based on different waste distributions at the depth of 0-20 cm. The metals investigated include: Cd, Pb, Cu, Zn, As, Cr and Ni. Sequential extraction method was used to assess the redistribution of heavy metals from which total heavy metals were earlier determined by acid digestion with aqua regia solution. Treatments were laid out in a completely randomized design with four replicates. Data collected were analyzed using descriptive statistics and T-test. The mean concentrations (mg/kg) of total HM were 100.9, 48.9, 57.8, 16.6, 49,022.0 and 3,627.3 for As, Cr,

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Cu, Ni, Pb and Zn respectively with coefficient of variance ranging from 1.31% for Ni to 141.2% for Pb. There was no significant difference ( $t=1.70$ ;  $p>0.05$ ) in metal concentration in both BD and OLD soil.

The residual fraction was the most predominant in the soils with the exception of Pb and Zn. The average metal concentration over soil samples were 307.6, 2,390.8, 1,666.8 and 4,448.8 for the exchangeable, reducible, oxidizable and residual fractions respectively. Only Zn had an appreciable amount (54.3%) associated with the exchangeable fractions while the oxidizable fraction was highest for Pb (79.1%) in soil BD and Zn (78.4%) in soil OD. It is therefore paramount to create awareness on the health hazard inherent in planting on refuse dumpsite soil without ascertaining its heavy metal status because of the possibility of metal uptake in the edible parts of crops. This could be detrimental to human health and the ecosystem at large.

*Keywords: Dumpsite; heavy metals; fractionation; contaminated soils; sequential extraction.*

## 1. INTRODUCTION

Heavy metal pollution is a major problem across the globe due to its great consequence on human health, plant and the ecosystem. Increase in population and urbanization had contributed to enormous generation of both industrial and municipal waste in urban centers in Nigeria. An estimate of 7.6 million tons of municipal solid waste was dumped per day in developing countries as reported by [1]. Furthermore, some of these wastes contain heavy metals which eventually are adsorbed onto soil surface and found their ways into plant and finally end up in the human system [2]. Generally, heavy metals can accumulate in human cells and disrupt the functions of vital organs and glands like the heart, brain, kidney, and bone and the liver. They also in addition displace vital nutritional minerals from their origin, hindering their biological functions [3]. Specific signs of toxicity are displayed by individual metals. The following symptoms had been generally reported to be associated with Cadmium, lead, mercury, zinc, copper and aluminum poisoning: gastrointestinal (GI) disorder, diarrhea, stomatitis, tremor, hemoglobinuria causing a rust-red color to stool, ataxia, paralysis, vomiting and convulsion, depression and pneumonia when volatile vapours and fumes are inhaled [4,5]. The nature of the effect of metal Contamination could be toxic (acute, chronic or sub-chronic), neurotoxic, carcinogenic, mutagenic or teratogenic [5]. Heavy metal in plant induces oxidative stress which causes cellular damage and disturbance of cellular ionic homeostasis [6].

Investigation had shown that some of these dumpsites are gradually turning into farm lands where vegetables are cultivated for the cities dwellers [7,8]. Furthermore in an attempt to avoid the exorbitant price being charged for the purchase of fertilizer, some farmers have

resorted to the use of composted material to fertilize their soils to improve crop production thereby introducing heavy metals into their crops not knowing that heavy metal are embedded in their compost. Plant on the other hand takes up these metals via the root into the harvestable parts. This becomes possible because metals come in the ionic form which makes it easy for uptake through plant root and easy translocation into the stem and the aerial parts of the plant.

The mobility and bioavailability of heavy metal depend absolutely on their speciation or chemical forms. These forms are determined by sequential extraction technique, this method give vivid information about metal affinity to the soil components together with the strength to which they are bound to the soil matrix [9]. Also heavy metal fractions can give detail about soil origin, biological and physicochemical availability, and their mode of occurrence, mobility and transportation of trace metals [10]. Several extraction scheme had been employed and described in literature but the Tessier et al. [10] has been widely used. This procedure has been able to identified six chemical or geochemical forms of heavy metals [11-13]. This method however had given way to a method that only involved four chemical or geochemical forms using the modified Community Bureau of Reference (BCR) as described by [14]. Three different extraction procedures were used to establish the extractability and to predict the phytoavailability of heavy metals in the soils. The following fractions were identified with the BCR methods; Exchangeable and acid extractable, reducible form (Fe/Mn oxide bound), the oxidizable forms (organic matter and sculpture bound) and the residual form (residual/silicate).

This study therefore aimed at determining the concentration of Ni, Cr, Pb, Zn, Cd, and Cu and As in selected dumpsite in Ibadan and

investigate their environmental contamination risk between the different chemical speciation forms. The result of this study is vital as it will provide information on the metal status of dumpsite for farmers who may likely use the land for farming activities and for those who are in the habit of using refuse waste material for compost.

## 2. MATERIALS AND METHODS

### 2.1 Description of Study Site

This study was carried out at two locations: Agronomy Department, University of Ibadan, Oyo State, Nigeria and Purdue University, West Lafayette, Indiana State, United State of

America. Four soil samples were collected for this study from dumpsites located in Ibadan. Ibadan has a mean annual rainfall of 1289 mm and mean annual temperature of 26.3°C [15]. Sampling site description is shown in Fig. 1.

### 2.2 Soil Sampling and Preparation

A total of two surface polluted soils (0-20 cm) were purposively selected at different locations within Ibadan municipal area in the central region of South Western Nigeria. These represent major dumpsites in the study area. Sampling was done with the aid of soil auger and spade. Triplicate soil samples were collected randomly from each

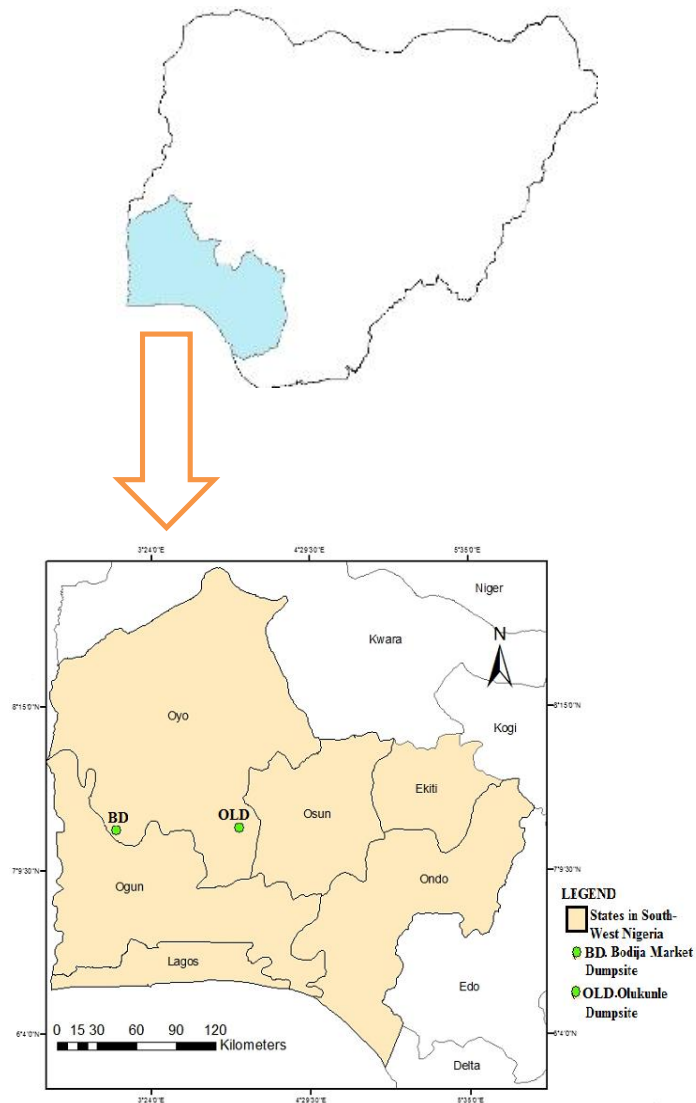


Fig. 1. Map of South-western Nigeria showing polluted soil sample site in Ibadan metropolis

location at different points, mixed and bulked to form a composite sample, out of which representative samples were air-dried, crushed and sieved through a 2 mm sieve and for each location after which they were bagged in clean polythene containers to prevent further contamination. Samples were further ground and passed through a 0.5 mm sieve for organic carbon and total nitrogen analysis.

### 2.3 Routine Soil Analysis

All glassware used in this study were pre-washed with  $\text{HNO}_3$  and rinsed with deionize water and all the chemicals used were of analytical grade purchased from Sigma Aldrich, USA Chemical analyses were carried out using the recommended chemical soil test. Procedures for the North Central Region, U.S.A [16] were used. The pH and electrical conductivity of soil samples were measured with a soil: water ratio of 1:2 using pH meter. Total Nitrogen was measured by an automated carbon and Nitrogen analyzer using the principles of oxidative combustion-chemiluminescence. Concentrations were then determined by comparing them to known standards. Total carbon was determined by combusting the sample and converting all carbon to carbon dioxide. The carbon dioxide was measured using a non-dispersive infrared gas analyzer. Available P was extracted with Melich III and regressed to weak bray P data. Exchangeable cations were extracted with 1M  $\text{NH}_4\text{OAC}$  and CEC was obtained by summing the meq exchangeable bases per 100 kg (cmol/kg) and meq exchangeable acidity per 100 g (cmol/kg). Exchangeable acidity was estimated from the SMP buffer pH measurement: meq acidity per 100 g = 12 (7.0 - SMP buffer pH). Particle size analysis was determined using Bouyoucos technique as outlined by [17].

### 2.4 Total Heavy Metals (Pb, Cd, Ni, Cr, Cu and Zn) and Fractionation Experiment

Acid digestion with aqua regia solution (Hydrochloric acid and Nitric acid in ratio 3:1) was used to evaluate the total heavy metal content of the soil [18]. Inductive couple plasma –Mass spectrophotometer was used to read the total metal concentration. The acid digested soil-metal analysis was performed in triplicates.

Metal fractions in the soils were determined using sequential extraction technique by [14] with a little modification in the volume of the aqua regia reagent used. The following fractions were

determined ; (Fractions A) Exchangeable and acid extractable- (0.11M  $\text{CH}_3\text{COOH}$ -extractable); (Fraction B) Reducible form – (0.1M  $\text{NH}_2\text{OH-HCl}$ -extractable); Fraction C the oxidizable forms – (8.8M  $\text{H}_2\text{O}_2$ )/ 1M  $\text{CH}_3\text{COONH}_4$ -extractable) of the metals and the residual form (Fraction D) which was computed as the sum of fractions A, B & C and subtracted from the total content. Heavy metal contents in the digests were analyzed using ICP-MS. Appropriate metal standard solution and controls were prepared and read with the machine before determining the metal contents of each sample. This was done for both total metal and metal fractions.

### 2.5 Statistical Analysis

The data collected were evaluated using excel to calculate mean, standard deviation and coefficient of variance for each sets of values. T test was also used to test for significant difference in metal concentration at the two sites.

## 3. RESULTS AND DISCUSSION

### 3.1 Physical and Chemical Properties of the Experimental Soils

The physical and chemical properties as well as the heavy metal concentrations of the soil used for the study are contained in Tables 1 and 2. The pH of Bodija refuse dumpsite (BD) soil was 7.7, while that of Olukunle dumpsite (OLD) soil was 6.3. Cation exchange capacity (CEC) was greater in BD (23.1 cmol/kg) soil than in OLD (1.5 cmol/kg). Soil organic matter was high across the soil samples. Total Nitrogen in OLD (3.7 g/kg) soil was more than in OLD (0.6 g/kg). The exchangeable bases in the soil varied, with (BD) soil having the highest K, Ca and Mg with the following values respectively; 3.53, 17.3 and 2.3 cmol/kg while OLD soil had these values in same order; 0.2, 0.3 and 0.2 cmol/kg. Available phosphorus (P) was 1 mg/kg in soil (OLD) and 197 mg/kg in soil BD. The soils were generally in the sandy loam textural class.

### 3.2 Total Heavy Metal Concentrations in Experimental Soils

The soils were analyzed for the following metals: As, Cd, Cr, Cu, and Ni, Pb and Zn as shown in Table 2. Some of their concentrations were higher than the FAO and USEPA critical levels for heavy metals. The concentration of the Arsenic was highest in soil OLD (157 mg/kg) and the least were recorded in soil BD (44.65 mg/kg).

**Table 1. Some basic chemical and physical properties of the experimental soils**

	Soils	
	Soil BD (Bodija market dump site)	Soil OLD (Olukunle dumpsite)
<b>Soil properties</b>	<b>Values</b>	
pH(H <sub>2</sub> O)	7.5	6.3
CEC(cmol/kg)	23.1	1.5
OM(g/kg)	35	31
N(g/kg)	3.7	0.6
Ca (cmol/kg)	17.25	1.0
Mg(cmol/kg)	2.33	0.29
K(cmol/kg)	3.53	0.2
Available P (mg/kg)	197	1
<b>Particle size distribution (g/kg)</b>		
Sand	753	649
Clay	69	55
Silt	178	296
Textural class	Sandy loam	Sandy loam

**Table 2. Total heavy metal concentrations (mg/kg) in the experimental soil samples**

Heavy metals	Soil BD	Soil OLD
As	44.65±1.64	157.08±27.64
Cr	58.97±2.71	38.78±2.47
Cu	37.60±1.78	77.91±4.38
Ni	16.80±1.0	16.49±2.00
Pb	92.25±8	97951.73±9156.70
Zn	6708.12±635	546.11±34.77
	T stat = 1.70	

*P* = 0.107 NS, *P* significant at  $\leq 0.05$   
 Key; Soils: BD- Bodija refuse dump site,  
 OLD- Olukunle Dumpsite

Cr concentration was 38.78 mg/kg in BD soil and 58.97 mg/kg in soil OLD. Copper (Cu) was 37.60 mg/kg in soil BD and 77.91 mg/kg in soil OLD. Nickel concentration (16.80 mg/kg) in BD soil was slightly higher than in soil OLD (16.47 mg/kg). Lead (Pb) concentration was extremely high in soil OLD (97,951 mg/kg) than in soil BD (92.25 mg/kg) Zinc concentration was very high in soil BD (6,708 mg/kg) when compared to its concentration in soil OLD (546.11 mg/kg). There was no significant difference ( $t=1.70$ ;  $p > 0.05$ ) in metal concentration in both BD and OLD soil.

### 3.3 Heavy Metal Fractions ( $\mu\text{g/g}$ ) in the Experimental Soils

The chemical fractions of Arsenic (As) Chromium (Cr), Copper (Cu), Nickel (Ni), Lead (Pb) and Zinc (Zn) shown in Tables 3 and 4 were similarly

dominated by the residual and the reducible fractions, except for Chromium which only had the exchangeable and acid extractable form in the least proportion and its reducible forms were not detected in all the Soil Samples.

### 3.4 Exchangeable Fractions / Acid Extractable

The exchangeable fractions of all the metals were low as shown in Table 3. However Zn had about 55% of its concentration associated with this fraction in soil (BD). There were no detectable level of Cr in this fraction in soils OLD.

### 3.5 Reducible form (Fe/Mn Oxide Bound)

The reducible fractions of sampled metals in the two soils were below 50% of all the total metal content. However, about 30% of total Zn in soil BD was associated with this fractions while minimal concentrations of As, Cr, Cu and Pb were recorded in same soil. In soil OLD, Cu concentration found in the reducible form was more than the other metals having about 38% of its total in this fractions and Pb about 27% of its total concentration as shown in Table 3.

### 3.6 Oxidizable form (Organically Bound +Sulphur Bound)

The oxidizable fractions of Arsenic, Chromium and Nickel were not detected in all the soil samples. In BD soil, Pb had the highest concentration (79%) of its total content associated with the oxidizable fractions; the least was recorded for Zn (8%). Even though Zn in soil OLD was predominantly associated with the oxidizable fraction with 78% of its total value. Lead was followed with 49% of its total contents and Cu had the least of about 29% of its concentration associated with the oxidizable fraction (Table 4).

### 3.7 Residual Fractions in Soil Samples

Arsenic, Cr and Ni had larger portion of their total concentration associated with the residual fraction in BD soil. The least concentration was about 7% of total Zn while Pb had 10% of its total in this fraction. In OLD soil, Chromium was predominantly associated with the residual fractions. Appreciable amount of As (74%), Ni (89%) and Pb (54%) were in the residual fractions, notwithstanding, Zn had the least value associated with this fraction (Table 4).

**Table 3. Exchangeable and reducible fractions (Fe/Mn oxide bound) of metals in soil samples**

Metals	Exchangeable metal fractions		Reducible fractions (Fe/Mn oxide bound)	
	BD	OLD	BD	OLD
As	0.35±0.02 (0.79%)	ND	0.88±0.84 (1.97%)	36.07±2.21 (22.96%)
Cr	1.14±0.17 (1.93%)	ND	ND	ND
Cu	1.14±0.17 (1.93%)	1.78±0.40 (2.28%)	ND	30.32±5.76 (38.92%)
Ni	2.41±0.25 (14.35%)	ND	ND	1.74±0.68 (10.55%)
Pb	1.14±0.30 (1.24%)	ND	8.78±3.7 (9.5%)	26447.57±737.8 (27.00%)
Zn	3677.55±53.4 (54.82%)	5.86±1.21 (1.07%)	2061.19±117 (30.73%)	103.34±2.83 (18.92%)

Key; ND- Not detected, BD- Bodija dumpsite,  
OLD- Olukunle dumpsite

**Table 4. Oxidizable and residual fractions of metals in soil samples**

Metals	Oxidizable fractions		Residual fractions	
	BD	OLD	BD	OLD
As	ND	ND	43.41 (97.22%)	34.20 (74.30%)
Cr	ND	ND	57.83 (98.06%)	38.78 (100%)
Cu	ND	22.64±20.6 (629.06%)	57.83 (98.06%)	23.17 (29.73%)
Ni	ND	ND	14.39 (85.65%)	14.75 (89.45%)
Pb	72.98±2.10 (79.11%)	18942.18±81.0 (19.34%)	9.35 (10.14%)	52561.98 (53.66%)
Zn	529.87±103.57 (7.90%)	433.51±148.58 (78.38%)	439.51 (6.55%)	3.40 (0.62%)

Key; ND- Not detected, BD- Bodija dumpsite,  
OLD- Olukunle dumpsite

#### 4. DISCUSSION

The physico-chemical properties of soils characteristics show that BD soil was slightly alkaline while that of OLD was slightly acidic. An alkaline soil may not favor metal mobility due to high sorption of these metals in them while low pH condition may enhance metal solubility and possible movement into water column and subsequent leaching into underground water. The chemical properties of metals in the soil and their retention in soil solid phase are affected by pH. Metals become soluble and available with increase in the pH of the soil and are therefore available for plant uptake [19,20]. The pH of these soils also falls within the optimum range for soil nutrient availability for plant uptake according to [21].

The organic matter content of the soils was high according to [22] which is an indication that these soils could have a great impact on the sorption of metals that are present in them. Also organic matter is important because of its relationship with metals most especially Copper. Soil organic matter had been reported to be a major soil property that greatly affects sorption of heavy metal because they contain functional groups that are capable of complexing metals [23,24]. Higher Organic matter content had been reported to be peculiar characteristics of waste contaminated soil [25]. The high total nitrogen content in soil BD is probably because of the nature of the various wastes in this dumpsite which comprises mainly of municipal and domestic wastes. However, Total N from OLD dumpsite is low as a result of the industrial waste deposited over a long period of time which may



have an adverse effect on the soil Nitrogen. More so this element is one of the limiting nutrient elements in tropical soils. Soil BD could have greater ability to hold and retain both metals and nutrient elements because of its high CEC (23.1) (cmol/kg) than OLD soil that is characterized with low CEC.

The high P values in soil (BD) could be attributed to excessive burning of the wastes on the dumpsite which is a normal practice for dumpsite in that area. Another reason for the high P could also be attributed to the high organic matter content of the soil that had been earlier reported for this soil. In soil OLD the P content was low. The high K content recorded for BD Soil could be as a result of the nature of the parent material. The large quantity of ashes deposited on the soil through burning could also be a source of soluble K [26]. The value of K recorded for soil OLD was also above the critical level according to [27]. Magnesium is essential for photosynthesis in plants and its value in soil BD is above the critical value reported by [27] and that in OLD soil is within the critical values for South-Western soils in Nigeria. Calcium content in BD soil was high while that of OLD soil was low. The texture of the soils were sandy loam, these soil had higher sand content than silt and clay, reflecting the parent material from which they were formed. [28] reported that loamy and clay textured soils as those that have high moisture holding capacity and loamy sands and sand have low moisture holding capacity. Therefore, they could also have the potential to leach heavy metals as they will not be able to hold them as reported by [29].

The concentration of heavy metals in the experimental soil varies considerably probably because of the source and the years of contamination. The concentration of As in both soils exceeded the limit range for soils recorded for UK (20 mg/kg) and Canada (37 mg/kg) [30]. This could be a problem due to the probability of plant uptake of this metal.

The critical permissible level for chromium in soil by USEPA and Great Britain according to [31] is 50 mg/kg and only BD soil exceeded this limit while OLD soils fall below it. This could be as a result of the waste containing colored polythene bags, and discarded plastic wastes [32] which were the major waste from BD being very close to a very big market in the city.

Copper a micronutrient is good for plant but high concentration can have an adverse effect on plant growth. Its higher concentrations in OLD soil could be as a result of biodegradable waste introducing metallic copper into the dumpsite according to [33]. The concentration of Nickel was below the permissible value from USEPA. Lead concentration was extremely high in soil OLD. This value was higher than the permissible value proposed Pb value by [34,35] NEPCA, 2010 for agricultural soils. The reason could be attributed to waste from the defunct battery industries dumped at this site; however, Lead in BD soil was below this limit.

The very high concentration of Zn in BD soils (6708 mg/kg) could be due to the fact that the categories of waste in this dumpsite may be high in pollutants of Zn origin. High concentration of Zn is enough to cause phyto-toxicity in plant with symptoms such as chlorosis, reduction in leaf production due to wilting of plant leaves and stunted growth. Zinc from OLD soil was also higher (300 mg/kg) than the permissible level recommended by USEPA. Though metal concentrations from the two sampled soil do not differ significantly, the concentration of As, Cu and Pb in OLD soil were higher than those from BD soils. This could be attributed to the different wastes that contain metals from various sources being deposited on the dumpsite. While OLD soil is characterized with battery waste disposal mixed with other industrial waste, BD soil had domestic and municipal waste.

The potential of migration of metals in soil system depends on the chemical form of the metals. Chromium and Arsenic concentrations were found mostly in the residual fractions in all the soil samples. [36,37] had reported that metals found mostly in residual fractions could be due to the sandy nature of the soil which resulted in the co-precipitation of the metals with various silicate species consequent to their adsorption into the mineral lattice. This fraction can be used as a guide to the degree of pollution of the soil. The smaller the percentage of metals found in these fractions, the greater the pollution that will be generated [38]. There was also no detectable level of Cr in the Fe and Mn oxide fractions. This implies that Cr in this fraction was tightly held and its release into the soil solution will be slow and as such may not pose any problem of pollution to the environment and groundwater [39].

Most species of Cu like Cr was found in the residual fractions of BD and 100% of Cr in OLD soil, while the same soil only had a little portion soluble of Cu associated with it. This is in consistence with the findings of [40,41]. They reported that Cu was found in the soil in the residual forms. Copper usually have high affinity for organic ligand and this may result in complex formation which will greatly increases its mobility in soil. This may be responsible for its associated with the Iron and Manganese oxide in the reducible fractions and oxidizable form in the organic fractions in soil OLD. [42,41] had also reported that Cu was the most abundant metal in the organic matter fractions. As pH increases more Cu are complexed with organic matter and become unavailable. This could be the reason why very low concentration of this metal was found in the exchangeable / acid extractable fractions in all soils.

Nickel was present in all the fractions except in the organic forms. Large amount of Ni was mostly found in the residual form in all the soil types. Earlier report by [43,13,44,45] had indicated that Ni in its natural origin form is mainly associated primarily in soil with the residual fractions. Although, only soil OLD was associated with the Fe/Mn oxide fractions and this oxide has been reported to control the mobility of Ni in polluted soils according to [11].

The high organic matter Pb bound to BD soil could be attributed to the fact that Pb has a strong affinity for organic matter and the formation of its complexes may greatly increase the mobility of Pb in soil as reported by [42-46]. Furthermore, the pH above 6 makes Pb to either be adsorbed on clay surfaces or form Pb carbonate. The residual form of Pb was highest in soil OLD (53.66%), while BD was very low (10.14%). The observed result shows that most of the Pb in this study existed in the non – residual fraction of Fe-Mn oxide and organic matter than the residual fraction. The slow release of Pb into the environment can be a potential hazard to human health and the environment through ingestions as those in the non-residual fraction can be released slowly.

High percentages of Zn were not associated with the residual fraction like it was the case with some of the metals reported in this study. The association of Zinc with the reducible fraction has been reported earlier by several other scientists [11,47]. Appreciable amount of Zn in the oxide form was recorded in soil samples BD and OLD.

The dominance of the Fe/Mn oxide bound Zn have also been reported earlier by [11,48]. Zinc associated with organic matter fractions were fairly small low (<9%) in all the soil samples except for OLD (78.38%). Metal bounded to the organic matter are temporarily inaccessible but can be solubilized by chemical oxidation. The fractions bounded to the exchangeable/acid extractable forms were not negligible and they followed this order: BD>OLD. Metals associated with the exchangeable fractions are however bioavailable and mobile, while a change in the pH of the soils can also release this fraction into the environment.

## 5. SUMMARY AND CONCLUSION

The concentration of heavy metals from the various dumpsite examined in this study exceeded the normal level in soils according to [49] and USEPA. Furthermore, all the metals have their higher concentrations in the residual fractions which posed no problem to the ecosystem except when the soil undergo reduction reaction which is the only condition that makes them available. Arsenic also has appreciable concentrations in the reducible form which could be released when the soil undergoes reduction reactions while low concentrations were associated with the exchangeable fractions just like Chromium. Chromium concentrations were not detected in the oxidizable and reducible forms. Highest Cu concentration associated with the reducible fraction was found in OLD soil while other soil types also recorded substantial concentration in these fractions. However, all the soils had low concentrations in the exchangeable fractions except Zn and can be easily available for plant uptake. Lead and Zinc were also associated with the reducible fractions. This fraction (reducible) with time could also be available for plant uptake.

It is therefore paramount to desist from the habit of planting on refuse dumpsite soil, knowing that metals in them bio accumulate and can be taken up by the plant ending up in the food chain and finally in the human system causing serious problem. Further policies which will prevent the indiscriminate disposal of both industrial and municipal wastes should be enacted. There is also the need to test for the physiochemical parameter of dumpsite material to be used as compost that will be applied to the soil to enhance its fertility.



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## COMPETING INTERESTS

Author has declared that no competing interests exist.

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