# LEVEL OF HEAVY METAL ACCUMULATION IN SOILS AND PLANTS WITHIN RESIDENTIAL DUMPSITES IN EZEAGU LOCAL GOVERNMENT AREA OF ENUGU STATE, NIGERIA

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**Abstract**
Heavy metal accumulation in soils and plants poses serious environmental threat to people who live and engage into vegetable farming within these areas. This study aims at determining the accumulation of heavy metals in soil and *Talinum triangulare* at selected dumpsites at Ezeagu L.G.A of Enugu State. Soil samples were collected from four (4) locations, three dumpsites and a control site at 0-15cm and 16-30cm depths respectively. A total of twenty-four (24) soil samples were collected in triplicate, Six (6) from each of Iwollo-Oghe, Amansiodo and Akama-Oghe dumpsites and ESPOLY field (control). Each soil sample were collected using soil auger and were put in a labeled transparent polythene bag and transported to the laboratory for analytical procedure. Twenty-four plant (*Talinum triangulare*) samples were also collected from the four locations. The soils samples were analysed for their heavy metal content, physical and chemical properties while the plant samples were analysed for their heavy metal contents. The result of the soil analysis showed that heavy metal accumulation at 0-15cm soil depth had significant difference($p<0.05$) for Boron and Zinc, but no significant difference($p<0.05$) was observed in Iron(Fe) across the four treatment locations and that heavy metal accumulation at 16-30cm soil depth, significant difference($p<0.05$) were observed in the heavy Metals-Iron(Fe), Boron(B) and Zinc(Zn) across the four treatment locations. Iron, Zinc and Boron values in the soil were found to be within the set critical concentration values. Zinc and Boron concentrations in *Talinum triangulare* were found to be higher above the set critical concentration values. It is recommended that vegetable crops should not be planted within dumpsites to avert food poisoning from heavy metals.

## 1. Pendahuluan

The term “heavy metals” is used widely to refer to a group of metals and semimetals (metalloids) that have been associated with contamination and potential toxicity to the environment and various species of organisms. They have specific gravities greater than 5 g/cm$^3$ or specific gravity at least five times that of water and are known to exist naturally in the earth’s crust (Duffus, 2002). More recently, the definition has been broadened to include naturally occurring elements with atomic number greater than 20 (Ali and Khan, 2018; Ali *et al.,* 2019).

Without a doubt, heavy metals are important constituents for plants and humans when present only in small amounts. Some micronutrient elements may also be toxic to both animals and plants at high concentrations. For instance, copper (Cu), chromium (Cr), fluorine (F), molybdenum (Mo), nickel (Ni), selenium (Se) or zinc (Zn). Other trace elements such as arsenic (As), cadmium (Cd), mercury(Hg) and lead(Pb) are toxic even at small concentrations (Divrikli *et al.,* 2006). Heavy metals, being persistent and non-biodegradable, can neither be removed by normal cropping nor easily leached by rainwater (Khadeeja *et al.,* 2013). They might be transported from soil to groundwater and so may be taken up by plants, including crops. For this reason, the knowledge of metal-plant interactions is also important for the safety of the environment (Divrikli *et al.,* 2006).

There has been increasing interest in determining heavy metal levels in public food supplied. However, their concentration in bio-available form is not necessarily proportional to the total concentration of the metal (Opaluwa *et al.,* 2012; Nwachukwu *et al.,* 2010). The quality of the ecosystem becomes altered when heavy metals find their way, somehow, into it through human and natural activities, which involve soil, water and plant interaction. These activities are one of the most pressing concerns of urbanization in developing countries like Nigeria, which result in the problem of solid, liquid and toxic waste management. Such waste may be toxic or radioactive (Onibokun and Kumuyi, 1996; UNDP, 2006). Such waste management problems include heaps of uncontrolled garbage, roadsides littered with refuse, streams blocked with rubbish, the prevalence of automobile workshops and service stations, inappropriately disposed of toxic waste and disposal sites that constitute a health hazard to residential areas (Adewole and Uchegbu, 2005; Rotich *et al.,* 2006; Ebong *et al.,* 2008; Okoro *et al.,* 2013). The occurrence of uncontrolled urban sewage farming is a common site in African cities, which exposes consumers of such produce to poisoning from heavy metals (Ebong *et al.,* 2008).

Open dumps are a source of various environmental and health hazards. The decomposition of organic materials produces methane, which may cause explosions and produce leachates, which pollute surface and groundwater and ruin the aesthetic quality of the land (Oyelola *et al.,* 2009). Automobile wastes include solvents, paints, hydraulic fluids, lubricants and stripped oil sludge; all results of activities such as battery charging, welding and soldering, automobile body works engine servicing and combustion processes (Adewole and Uchegbu, 2005; Utang *et al.,* 2013).

Most plants and animals depend on the soil as a growth substrate for their sustained growth and development. In many instances, the sustenance of life in the soil matrix is adversely affected by the presence of deleterious substances or contaminants. The entry of the organic and inorganic forms of contaminants results from the disposal of industrial effluents (Gowd *et al.,* 2010). The source of the organic and inorganic elements of the soil of the contaminated area was mainly from the unmindful release of untreated effluent on the ground (Shetty and Rajkumar, 2009). The contamination of soils with heavy metals or micronutrients in phytotoxic concentrations generates adverse effects not only on plants but also poses risks to human health (Murugesan *et al.,* 2008).

Afterwards, the consumption of contaminated vegetables constitutes an important route of heavy metal exposure to animals and humans (Sajjad *et al.,* 2009; Tsafe *et al.,* 2012). Abandoned waste dumpsites have been used extensively as fertile grounds for cultivating vegetables, though research has indicated that the vegetables are capable of accumulating high levels of heavy metals from contaminated and polluted soils (Cobb *et al.,* 2000; Benson and Ebong, 2005).

Contamination of soils, water and plants by heavy metals such as Copper, Lead, Zinc, etc, around dumpsites in Ezeagu LGA poses harm to consumers. The soil contamination by heavy metals can transfer to food, and most of the time, people suffer from some ailment without knowing exactly what the cause is. Some would even go as far as deliberately planting around dumpsites, believing that it's the best source of manure. This paper aimed to examine the level of accumulation of heavy metals- Iron(Fe), Boron(B) and Zinc(Zn) in soils and plants within waste dumpsites at Iwollo-Oghe, Amanshiodo and Akama-Oghe in Ezeagu Local Government Area of Enugu State.

## 2. Metode

### 2.1. Study Area Description

The study area comprises three dumpsites situated in Iwollo-Oghe, Akama-oghe and Amanshiodo, respectively, in the Ezeagu Local Government Area of Enugu State. Iwollo-oghe, which is called Owelloti dumpsite, is located at latitude 06°.43919′N and longitude of 07°16.28517′E. Akama-the dumpsite is located at a latitude of 06°16.44273′N and a longitude of 0716.303495′E, while Amanshiodo dumpsite is located at a latitude of 06°16.4418917′N and longitude of 07°16.3217133′E. The annual rainfall of Ezeagu is 2,281mm. Figures 2.1, 2.2 and 2.3 show the pictorial representation of the dumpsites, while Table 1 shows the dumpsites and their respective ages.

**Figure 1. A pictorial representation of Iwollo-oghe dumpsite.**

**Figure 2. A pictorial representation of Amansiodo Dumpsite.**

**Figure 3. A pictorial representation of Akama-oghe Dumpsite.**

**Table 1: General information about the three dumpsites.**

| Number | Site | Dumpsite location | Year of establishment | Age of dumpsite |
|---|---|---|---|---|
| 1 | A | Iwollo-Oghe | 2015 | 6 |
| 2 | B | Amansiodo | 2009 | 12 |
| 3 | C | Akama-Oghe | 2017 | 4 |

## 2.2. Collection of Samples

Soil samples were collected from four (4) locations, three dumpsites and a control site at 0-15cm and 16-30cm depths, respectively. A total of twenty-four (24) soil samples were collected in triplicate, Six (6) from each location. Each soil sample was collected using a soil auger and was put in labelled transparent polythene bags in readiness to be transported to the laboratory. A total of 24 plant (*Talinum triangulare*) samples were collected, six (6) from each location where the soil samples were collected. The locations are A (Iwollo-Oghe dumpsite), B (Amanshiodo dumpsite), C (Akama-Oghe dumpsite) and D (Enugu State Polytechnic, Iwollo's Field) (table 1). These soil samples were immediately taken to the laboratory for the analytical procedure to determine the level of heavy metals, zinc (Zu), boron (B), and iron (Fe), in the soil and plant samples.

## 2.3. Laboratory Analysis

Soil samples were air-dried, ground to fine dust, and sieved to pass through a 2mm sieve. One gram of the sieved soil sampled was weighed into a conical flask and digested with 10ml of 50% hydrochloric acid on a hot plate until 2–3ml of acid was left. The content was then filtered into a 50ml volumetric flask and made up to the mark with de-ionized water. The plant samples were washed, oven-dried at 80°C, pulverised to a fine powder and ashed in the furnace for three hours at 600ºC.1g of the ground plant material was weighed into a 50ml Kjeldahi flask, 25 of concentrated Nitric acid($HNO_3$)(16N,70%w/w) was added down the side of the flask and swirled until the plant material was thoroughly wetted.4ml of perchloric acid and 2ml of concentrated Tetraoxosulphate (VI) Acid ($H_2SO_4$) (36N,98%) was added, and the flask swirled to mix the contents thoroughly. The sample was warmed gently on a digestion rack. At the end of digestion, the mixture was heated strongly for 1 minute, cooled, and 40ml de-ionized water was added and allowed to cool again. The sample will be then filtered through Whatman N0.42 filter paper into 100 volumetric flasks and made up to the mark with de-ionized water. The concentrations of heavy metals in all the samples were determined using the Perkin-Elmer model 403 atomic absorption spectrophotometer. The pH of soil samples was determined in a 1:2.5 slurry of soil in water using a pH meter. The particle size of soil samples was determined using the hydrometer method.

## 2.4. Statistical Analysis.

Data collected were subjected to statistical analysis using SPSS version 2.0. One-way analysis of variance (ANOVA) was used to test the difference in metal concentrations among the dumpsites. The Duncan New Multiple Range Test was used to separate means (DNMRT) at a 5% level of significance ($P < 0.05$).

# 3. Results and Discussion

## 3.1. Heavy Metals, Soil Texture and pH values at 0-15cm Depth in Four Treatment Locations.

Table 3.1 shows heavy metal accumulation, soil texture and soil pH concentration at 0-15cm soil depth in four locations. Significant differences ($p<0.05$) were observed in the heavy metals Boron and Zinc, but no significant difference ($p<0.05$) was observed in Iron (Fe) across the four treatment locations. Among the significant heavy metals, Iwollo-Oghe, Amansiodo and Akama-Oghe varied more significantly when compared to the control (ESPOLY), which recorded the least significant values. Amansiodo differed most significantly($p<0.05$) in Boron and Zinc compared to the other treatment locations. Figure 3.1 shows that Zinc and Boron were highest in Amansiodo dumpsite soil when compared to other dumpsite soils at the 0-15cm depth.

Significant differences($p<0.05$) were recorded in the soil textures: clay, silt, fine sand and coarse sand across the four treatment locations. Per cent clay was highest($p<0.05$) in Akama-Oghe and ESPOLY (control) but least in Amansiodo. Per cent silt was also the highest($p<0.05$) and had the same level of significance in Iwollo-Oghe, Akama-Oghe and ESPOLY (control), with Amansiodo having the least level of significance. Fine sand was most significant in Akama-Oghe and ESPOLY (control) but least in Amansiodo, followed by Iwollo-Oghe. Coarse sand, on the other hand, was most significant in Iwollo-Oghe and Amansiodo but least in Akama-Oghe and ESPOLY (control). From the results, it can be deduced that Iwollo-Oghe and Amansiodo are characteristically coarse sandy and less fine sand and clay. The control site (ESPOLY) is comparatively significant for fine sand and moderate for coarse sand. There may be more percolation in Iwollo-Oghe and Amansiodo and less percolation in Akama-Oghe due to its significantly reasonable clay content, which is more impervious than sandy soil.

Significant differences($p<0.05$) were recorded in soil pH across the four treatment locations. Amansiodo dumpsite was highest, followed by ESPOLY (control), and then Akama-Oghe had the last at Iwollo-Oghe. The pH values show that Iwollo-Oghe and Akama-Oghe have slightly acidic soils whereas ESPOLY (control) and Amansiodo had slightly alkaline soils.

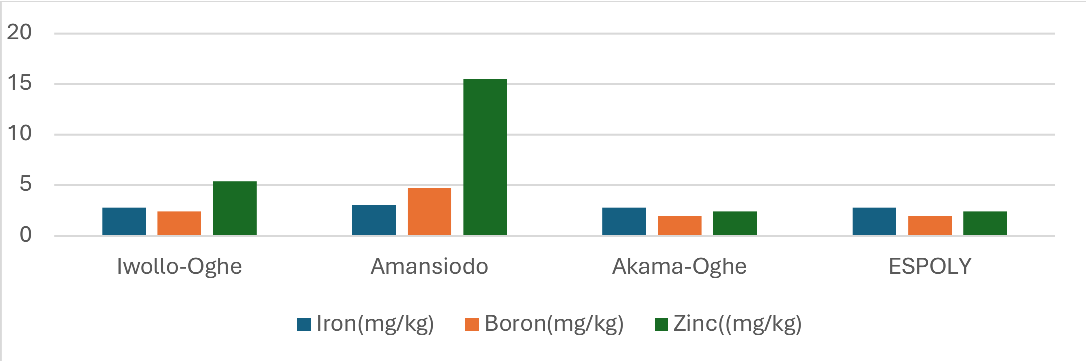


**Figure 4. Graph of heavy metals in soil at 0-15cm depth against dumpsite locations**

**Table 2. Heavy Metals Concentration, Soil Texture and pH at 0-15cm Depth in Four Locations.**

| PARAMETERS | LOCATION | | | | SEM |
|---|---|---|---|---|---|
| Heavy Metals | Iwollo-oghe | Amansiodo | Akama-Oghe | ESPOLY(Control) | |
| Iron (Fe)(Mg/kg) | 2.80 | 3.04 | 2.80 | 2.80 | 0.15 |
| Boron(B) (Mg/kg) | 2.38$^{b}$ | 4.75$^{a}$ | 1.94$^{c}$ | 1.94$^{c}$ | 0.43 |
| Zinc (Zn) (Mg/kg) | 5.40$^{c}$ | 15.50$^{a}$ | 2.40$^{b}$ | 2.40$^{d}$ | 0.52 |
| Soil Texture | | | | | |
| Clay% | 9.00$^{b}$ | 8.00$^{c}$ | 18.00$^{a}$ | 18.00$^{a}$ | 1.54 |
| Silt% | 11.00$^{a}$ | 7.00$^{b}$ | 11.00$^{a}$ | 11.00$^{a}$ | 1.32 |
| Fine sand% | 13.50$^{c}$ | 15.50$^{b}$ | 35.00$^{a}$ | 32.00$^{a}$ | 2.76 |
| Coarse sand% | 66.50$^{a}$ | 69.50$^{a}$ | 36.00$^{b}$ | 36.00$^{b}$ | 5.16 |
| Soil pH | | | | | |
| Soil Ph | 6.30$^{c}$ | 8.30$^{a}$ | 6.70$^{bc}$ | 7.35$^{b}$ | 0.24 |

Abc means with different superscripts within the rows differ significantly(p,0.05), SEM-Standard error of the mean.

## 3.2. Heavy Metals, Soil Texture and pH values at 16-30cm Depth in Four Treatment Locations.

Table 3.2 shows heavy metal accumulation, soil texture and soil pH concentration at 16-30cm soil depth in four locations. Significant differences ($p<0.05$) were observed in the heavy metals iron (Fe), Boron(B) and Zinc (Zn) across the four treatment locations. It was observed that Akama-Oghe and Iwollo-Oghe varied significantly($p<0.05$) when compared to the ESPOLY (control), which recorded the least significant values. Iwollo-Oghe differed most significantly($p<0.05$) in Iron when compared to the other treatment locations. Figure 3.2 shows that Zinc was highest in Amansiodo dumpsite soil while Boron was highest in Akama-Oghe dumpsite soil at the 16-30cm depth.

Significant differences($p<0.05$) were recorded in soil textures: clay, silt, fine sand and coarse sand across the four treatment locations. Per cent clay was highest($p<0.05$) in Iwollo-Oghe, followed by ESPOLY (control) and least in Amansiodo and Akama-Oghe, which had the same level of significance. Per cent silt was highest($p<0.05$) in Iwollo-Oghe, followed by ESPOLY (control) and least in Amansiodo and Akama-Oghe. Fine sand was most significant at ESPOLY (control), followed by Iwollo-Oghe but at least Amansiodo and Akama-Oghe. Coarse sand, on the other hand, was most significant in Amansiodo and Akama-Oghe, followed by ESPOLY (control) but least in Iwollo-Oghe. From the results, it can be deduced that Akama-Oghe and Amansiodo are characteristically coarse sandy and have less fine sand, silt, and clay soil textures. The control site (ESPOLY) is comparatively significant for coarse sand and moderate for fine sand, silt and clay. There may be more percolation in Akama-Oghe and Amansiodo and less percolation in Iwollo-Oghe and ESPOLY (control) due to their significantly reasonable clay contents, which are more impervious than sandy soil.

Significant differences($p<0.05$) were recorded in soil pH across the four treatment locations. Amansiodo dumpsite was the highest, followed by Iwollo-Oghe, then ESPOLY (control) and Akama-Oghe with the least. The soil pH values show that Iwollo-Oghe, Akama, Iwollo and ESPOLY (control) had slightly acidic soils whereas Amansiodo had slightly alkaline soil.

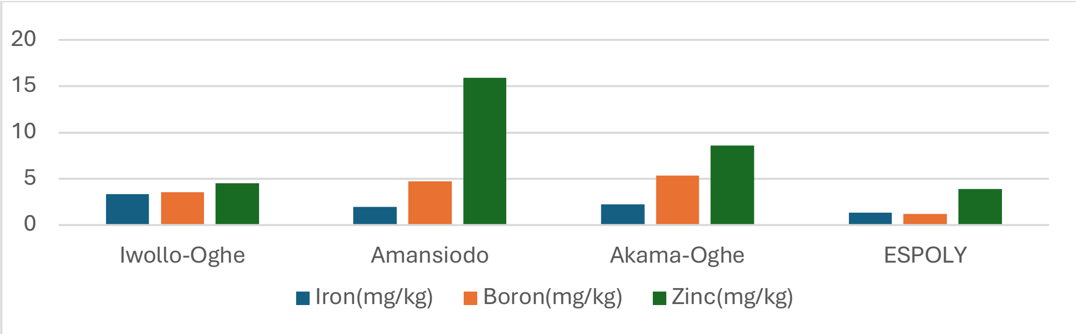


**Figure 5. Graph of heavy metals in the soil at 16-30cm depth against dumpsites in Ezeagu L.G.A**

**Table 3. Heavy Metals Concentration, Soil Texture and pH at 16-30cm Depth in Four Locations.**

| **PARAMETERS** | | **LOCATIONS** | | | **SEM** |
|---|---|---|---|---|---|
| Heavy Metals | Iwollo-Oghe | Amansiodo | Akama-Oghe | ESPOLY(Control) | |
| Iron (Fe)(Mg/kg) | 3.36[a] | 1.96[b] | 2.24[b] | 1.36[c] | 0.19 |
| Boron(B) (Mg/kg) | 3.56[c] | 4.75[b] | 5.35[a] | 1.19[d] | 0.41 |
| Zinc (Zn) (Mg/kg) | 4.50[c] | 15.90[a] | 8.60[b] | 3.90[d] | 0.51 |
| Soil Texture | | | | | |
| Clay% | 23.00[a] | 8.00[c] | 8.00[c] | 18.00[b] | 1.82 |
| Silt% | 23.00[a] | 7.00[d] | 9.00[c] | 13.00[b] | 1.72 |
| Fine sand% | 27.50[b] | 16.00[c] | 16.50[c] | 33.00[a] | 1.92 |
| Coarse sand% | 26.50[c] | 69.00[a] | 66.50[a] | 36.00[b] | 5.06 |
| SoilpH | | | | | |
| Soil Ph | 6.55[b] | 8.20[a] | 5.90[c] | 6.20[bc] | 0.25 |

Abc means with different superscripts within the rows differ significantly(p,0.05), SEM- Standard error of the mean.

## 3.3. Heavy Metals Concentration, *Talinum triangulare* in Four Locations.

Table 3.3 showed that Iron (Fe) concentration differed significantly($p<0.05$) at the four dumpsites. Iron (Fe)was highest($p<0.05$) at the Akama-Oghe dumpsite, followed by Amansiodo, whereas Iwollo-Oghe and ESPOLY (control)were the least. Boron was highest($p<0.05$) at Akama-Oghe, followed by Iwollo-Oghe and Amansiodo, with the same level of significance when compared to ESPOLY (control), which had the least level of significance. For Zinc(Zn), Iwollo was highest($p<0.05$), followed by Akama-Oghe, whereas Amansiodo and ESPOLY (control) were the least. Figure 3.3 showed that Zinc was highest in *Talinum triangulare* from Iwollo-Oghe dumpsite while Boron and Zinc were at the highest and the same level at Akama-Oghe dumpsite for *Talinum triangulare*.

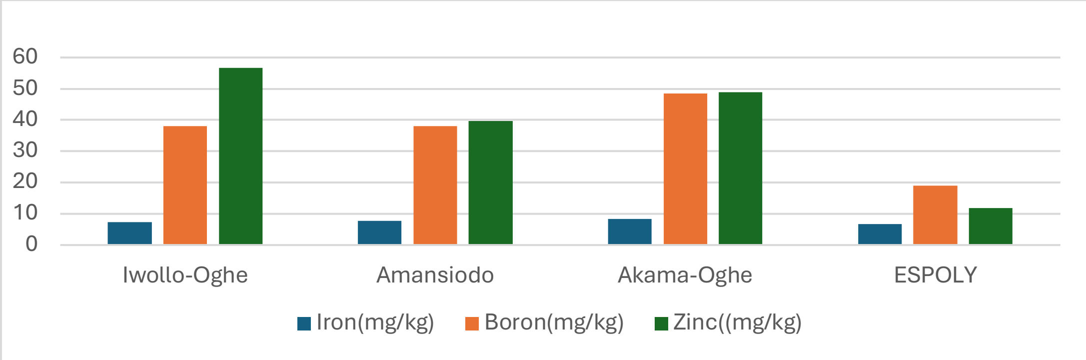


**Figure 6. A Graph of heavy metals in Talinum *triangulare* at waste dumpsites in Ezeagu L.G.A**

**Table 4. Heavy Metals accumulation in *Talinum triangulare* in Four Locations.**

| PARAMETERS | LOCATIONS | | | | SEM |
|---|---|---|---|---|---|
| Heavy Metals | Iwollo-Oghe | Amansiodo | Akama-Oghe | ESPOLY(Control) | |
| Iron (Fe)(Mg/kg) | 7.36c | 7.68b | 8.42a | 6.68c | 0.12 |
| Boron(B) (Mg/kg) | 38.00b | 38.00b | 48.40a | 19.00c | 3.24 |
| Zinc (Zn) (Mg/kg) | 56.76a | 39.60c | 48.84b | 11.88d | 5.13 |

Abc means with different superscripts within the rows differ significantly(p,0.05), SEM-Standard error of the mean.

## 3.4. Heavy Metals accumulation in the Soil.

Table 3.1 showed that heavy metal accumulation at 0-15cm soil depth had a significant difference ($p<0.05$) for Boron and Zinc. Still, no significant difference ($p<0.05$) was observed in Iron (Fe) across the four treatment locations. Among the significant heavy metals, Amansiodo, Akama and Iwollo varied more significantly compared to the ESPOLY (control), which recorded the least significant values. Amansiodo differed most significantly ($p<0.05$) in Boron and Zinc compared to the other treatment locations.

Table 3.2 showed that heavy metal accumulation at 16-30cm soil depth, significant differences ($p<0.05$) were observed in the heavy Metals-Iron (Fe), Boron(B) and Zinc (Zn) across the four treatment locations. It was observed that Afor-Oghe, Akama and Iwollo varied significantly ($p<0.05$) when compared to the control (ESPOLY), which recorded the least significant values. Iwollo differed most significantly($p<0.05$) in Boron and Zinc when compared to the other treatment locations.

However, the values of Zn obtained in this study are below the permissible limits of 1 – 900mg/kg in the soil (Kabata-Pendias and Pendias, 2001; Hague *et al.,* 2008). The pH value in this study is between 8.3 and 5.9, which is close in range to the study carried out by Pam *et al.* (2013) and Akoto *et al.* (2008), which showed that pH was between 6.36 and 6.4. This might be responsible for the low value of Zn obtained in this current study as compared to other studies. The concentration of Zn in this study decreased with an increasing depth at Iwollo-Oghe and Akama-Oghe dumpsites, which is in consonance with the result of Olufunmilayo *et al.,* (2014), whose study on dumpsite soil observed a decrease of Zn from the top layer of 0 – 15 cm: 15 – 30 cm and 30 – 45 cm depths.

Iron (Fe) also decreased with an increase in depth for all the locations and was very low in concentrations. The low Iron content is in consonance with the result of Ezeifeka *et al.,* 2020. It is also below the normal concentration in soil (Table 4).

Boron(B) content generally decreased with an increased depth across the dumpsites and the control with low values. The Boron(B) status of arable soil has been extensively investigated throughout the world. The total B content in the surface soil ranges from 1-467mg/kg, and its average content ranges from 9-85mg/kg (Kabata-Pendias and Pendias, 1984). This implies that dumping of municipal wastes added between 6-33% more B to the soil to improve its productivity, although the

B content in this study within the dumpsites and outside the dumpsites is within the normal range. It should be pointed out, however, that although Boron is a rather deficient micronutrient in most soils, some soils over-fertilized with Boron may contain hazardous amounts of this element.

## 3.5. Heavy metal accumulation in plants

Table 3.3 showed that Iron (Fe) concentration differed significantly ($p<0.05$) at the four dumpsites. Iron (Fe) was highest($p<0.05$) at the Akama-Oghe dumpsite, followed by Amansiodo, whereas Iwollo-Oghe and ESPOLY (control) were the least. The concentration of Iron in Table 3.4 for *Talinum triangular* at the four dumpsites was normal when compared with the critical plant concentration of >20mg/kg set by Bowen,1979. Boron was highest($p<0.05$) at Akama-Oghe, followed by Iwollo-Oghe and Amansiodo, with the same level of significance when compared to the ESPOLY (control), which had the least level of significance. According to Table 3.4, the Boron concentration for all dumpsites was higher than the critical concentration of Boron in plants. Zinc (Zn) was highest ($p<0.05$) at Iwollo-Oghe, followed by Akama-Oghe, whereas Amansiodo and ESPOLY (control) were the least. The value of Zinc is higher than the value of Zinc in *Talinum triangulare* in the works of Oluwole *et al.* (2021). Table 3.4 shows that the critical concentration of zinc is 0.6mg/kg, which is far lower than the values in this study, which are higher and pose health risks.

**Table 5. Normal and Critical concentration ranges of heavy metals in soils and plants.**

| Elements | Normal range in soils(mg/kg) | Critical soil concentration(mg/kg) | Normal range in plants(mg/kg) | Critical plant concentration(mg/kg) |
|---|---|---|---|---|
| Zinc (Zn) | 1-50 | 300 | - | 0.60 |
| Lead (Pb) | 2-30 | >85 | 0.2-2 | >2 |
| Iron (Fe) | 40-500 | 5,000 | 20 | >20 |
| Boron (B) | - | 10 | - | 5 |

Source: (Bowen, 1979 and Kabata-Pendias and Pendias, 1984.)

## 3.6. Soil physicochemical properties

Table 3.1 and 3.2 showed the results of soil physicochemical properties across Iwollo-Oghe, Amansiodo and Akama-Oghe dumpsites for the two depths of (0-15cm and 16-30cm). The result of this study shows that Iwollo-Oghe and Amansiodo dumpsites had an increase in pH as depth increased. However, it presents a pH range (8.30 and 5.90) that suggests that the soil is slightly acidic, which means cation movement across the soil profile will be slow. The study carried out by Pam *et al.* (2013) and Akoto *et al.* (2008) showed that pH of between 6.36 and 6.4 relatively conforms to that from this study. Texturally, the dumpsite soils range from sandy-to-sandy loam and sandy-to-sandy clay loam. In the non-dumpsite soils in the two states, the dumpsites range from loam sandy to sandy loam. It is important to note that although sandy loam texture has been recommended as being suitable for waste disposal sites, soils with greater than 70% sand are highly unsuitable for waste disposal because they are highly permeable and allow large quantities of leachates to pass through the soil (Loughry, 1973).

# 4. CONCLUSION

Heavy metal accumulation in soils and plants within three waste dumpsites has shown generally that mobility into the soil is low. Fe, Zn and B are mostly higher in the topsoil than in the subsoil. Akama-Oghe dumpsite had the highest level of Zn and B at the 0-15cm depth, followed by Iwollo-Oghe and Amansiodo. The result of this study also shows that vegetable plants within dumpsite areas accumulate heavy metals, most times above the allowable limits, as was seen in *T Talinum triangulare arilium triangular* for Boron and Zinc. This poses health risks to the consumers of such vegetables. The soils across the dumpsites were found to be slightly alkaline and slightly acidic.

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