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CONCENTRATION OF HEAVY METALS IN THE SOIL AND PLANTS AROUND WASTE DUMPSITES IN ENUGU METROPOLIS, NIGERIA

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ABSTRACT

Aims: The purpose of this project is to find the concentration of heavy metals in the topsoil and the plant around the waste dumpsite from Enugu municipal solid disposal sites. **Methodology and Results:** There was a collection of soil samples from four designated public municipal solid waste dumpsites in Enugu metropolis. The soil samples were collected at 10m intervals from the centre location point of each dumpsite at a constant depth. The sample collection design include centre (0 m) of the dumpsites, 10, 20, and 30m. However, the control sample was 65m away from the centre of dumpsites at the same depth. Plant samples were taken just at the centre (0m), and control measures were at 65m distance away from each dumpsite. The Goat grasses harvested were taken to the lab to determine and analyse heavy metals intake from the soil. These samples were analysed using atomic absorption spectrophotometer (AA320N) model. On the average, high concentrations of Zn, Fe, Mn, Cu, and Pb found in the soil samples collected at the centre of the dumpsites were 141.70, 121.5, 75.53, 70.33 and 64.53 mg/kg respectively. The results were statistically analysed and had significant effects between the samples ($p < 0.05$). **Conclusion, significance, and impact study:** The heavy metals studied were within the acceptable or permissible limit by WHO and FAO. However, the plant intake of zinc at Presidential that was beyond the maximum permissible level of 163.45 mg/kg Zn compared with FAO and WHO standard of 50 mg/kg.

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1. INTRODUCTION

The rapid growth in population and industrialization have not only put pressure on the natural environment but also resulted in huge quantity of waste generation. The world's population growth, increasing urbanization, rising standard of living and rapid developments in technology have contributed to an increase in both the amount and the variety of solid wastes generated by industrial, domestic and other activities (UNEP, 2001). Improper and indiscriminate disposal of solid waste lead to environmental pollution problems like; air, soil, water and land pollution which affect quality of life and plant. The solid waste problem is more noticed or pronounced in urban area because of migration of people from rural areas to urban in search of employment.

Today, in Nigeria, most cities are faced with waste management problems which Enugu State is not an exemption. This problem has increased the rate of environmental deterioration and declination with refuse dumped along and inside drainage systems or channels. As a result of this indiscriminate disposal, most of our soils are polluted due to introduction of chemicals to the soil which reduces its productive capacity. These toxic substances leach out and percolate through the soil layer below to contaminate the underground water. Soil is very important and vital resource for sustaining basic human needs, quality food supply and liveable environment (Wild, 1996). Municipal solid waste has been found to contain appreciable quantity of heavy metals such as: copper, zinc, lead, magnesium, cadmium, etc, which may end up in the soil and leached down the profile (Wuana and Okieimen, 2011). Heavy metals are found everywhere both in polluted and unpolluted soils. Heavy metals constitute a very heterogeneous group of elements widely varied in their chemical properties and biological functions (Rajeswari and Sailaja, 2014). Heavy metals are kept under environmental pollutant category due to their toxic effects on plants, animals and human being. Heavy metal contamination of soil result from anthropogenic as well as natural activities. Anthropogenic activities such as mining, smelting operation and agriculture have locally increased the levels of heavy metals such as Cd, Co, Cr, Pd, As and Ni in soil up to dangerous levels (Rajeswari and Sailaja, 2014; Sembiring *et al,* 2018). Heavy metals are persistent in nature, therefore get accumulated in soils and plants. Dietary intake of many heavy metals through consumption of plants has long term detrimental effects on human health (Olufunmilayo *et al*, 2014). Heavy metals can be introduced through high tension electricity supply lines, municipal solid wastes and building materials. Although these metals occur naturally in the earth's crust, they tend to be concentrated in agricultural soils because of irrational

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application of commercial fertilizers, manures, municipal and sewage sludge dumping containing heavy metals and of contamination caused by mining and industrial activities (McLaughlin *et al*., 1999; Gimeno *et al*., 1996; Grant *et al.*, 1998). All heavy metals are toxic at higher concentration. Other identifiable sources of heavy metals apart from municipal solid waste include; atmospheric deposition, manures and fertilizers, pesticides and insecticides and industrial discharge. These toxic residual chemicals from the soil reach human beings through fruits, vegetables and other food items. Heavy metals are not biodegradable and may accumulate in the environment. The accumulation crisis has threatened the assimilative and carrying capacity of the earth which supports life. The studies of heavy metals (density>5.54g/cm) in ecosystem have shown an indication of silent epidemic of environmental poisoning of ever-increasing metals in sub-humid tropical soils (Nriagu, 1989). Variety of environmental problems have emerged in modern time of which potentially toxic metal pollution is a major issue especially in urban soils and road side (Hossner, 1996; Shi *et al*.,2007; Madrid *et al*.,2002). However, the research aimed at studying the concentration of heavy metals in the Soil and Plants around some Waste Dumpsites in Enugu Metropolis, Nigeria. It is therefore conducted in order to create awareness on the sources and dangers of heavy metals to man and environment.

2. RESEARCH METHODOLOGY

2.1 Study Area Description

Enugu is a city in Nigeria. It is the capital of Enugu State and also the center of a coalfield in Nigeria. The city has a steel rolling-mill plant, a cement plant, and gas work stations. It is located in South-astern Nigeria and the city is between $6^0$21'N and $6^0$30N and $7^0$26'E $7^0$30'E. The city has a population of 722,664 according to the 2006 Nigerian census (15th May 2007) and is located in a tropical rain forest zone with a derived savannah (Sanni, 2007). The city has a tropical savannah climate. Enugu's climate is humid and this humidity is at its highest between March and November (https://en.wikipedia.org/wiki/Enugu). For the whole of Enugu State, the mean daily temperature is 26.7°C (80.1°F) (Sanni, 2007). As in the rest of West Africa, the rainy season and dry season are the only weather periods that recurs in Enugu. The average annual rainfall in Enugu is around 2,000 millimeters (79 in), which arrives intermittently and becomes very heavy during the rainy season (https://en.wikipedia.org/wiki/Enugu). Other weather conditions affecting the

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city include Harmattan, a dusty trade wind lasting a few weeks of December and January. Like the rest of Nigeria, Enugu is hot all year round.

Figure 1 Map of Nigeria showing some major cities
Source: Nigerian Ministry of Environment

2.2 Sample Collection

Four dumpsites were selected for the study. These designated dumpsites were at different local government in Enugu except New market and Ngwo-Umueze which is located at the same local government. The Ngwo-Umueze is located at the rural area near market while new market is at urban area near market too. Their distance is about 7 minutes driving distance. Four samples from the contaminated soil, one sample for control measure, and two plant samples (both affected and control samples) totaling twenty-eight samples were collected from each dumpsite in Enugu Metropolis (Emene, Ngwo-Umueze, Presidential and New-Market). The five soil samples were taken from the centre (0 meter) of the dump sites, 10 meters, 20 meters and 30 meters and the control sample is 65 meters distance away from each of the dump sites at the same depth (0 - 15 cm). Plant samples were taken just at the centre (0 m) and control measures which is at 65 meters distance away from each dump sites. All samples were collected separately in different

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bags within two days and kept in polythene bags which have been washed with detergents solution rinsed with distilled water to avoid metal contamination of the sample.

2.3 Sample Analysis

The soil samples were air dried and grounded to fine texture separately and 1.0 gm of the sample was weighed and then passed through a 1 mm stainless steel sieve. The weighed soil sample was filled into a 150 ml conical flask, digested with an acid mixture of HNO_3: $HCLO_4$: HF of the ratio 3:1:3 respectively (Nwajei and Gagophien, 2000). The mixture was placed on a hot plate for three hours at 80 °C. The digest (extract) is filtered into a 250 ml standard volumetric flask and made up to the mark with distilled water and later transferred to pre-cleaned storage plastic containers for atomic absorption spectrophotometer analysis. Two grams (2 g) of plant samples (root) from all the dump sites were dry-ashes in an oven. The ash content was completely dissolved in 15 ml of 20 % HNO_3 (Amusan *et al*., 2005). The digest was filtered into 100 ml standard flask and made up to mark with deionized water. Heavy metals (Cu, Zn, Pb, As, Cr, Ni, Cd, Fe, and Mn) were analyzed for both sediment and plant samples using Atomic Absorption Spectrophotometer (AAS320N Model).

2.4 Statistical Analysis of Results

The results were analyzed using the SPSS statistical package. Analysis of variance (ANOVA) and Duncan’s multiple range tests were used to find out statistical (significant) differences between the studied samples.

3. RESULTS AND DISCUSSION

Tables 1 to 6 and Figures 1 to 6 show the results of the heavy metals from the four selected dumpsites. The Table 8 shows the concentration of heavy metals (mg/kg) in plant from the center (0 m) of the dump sites of the selected locations and control measure (65 m). It was found that the heavy metals concentrate more at the center of the dumpsite than the other distances. The heavy metals concentration reduces as distance increases from the center of the dumpsite. It was found that the concentration of Zinc and Iron were the highest especially at the Presidential road and their concentration is higher compared to other one dumpsite. This may be as a result of activities within the dumpsites such as mechanic workshops and residential. Zinc and Iron

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concentrations are rising unnaturally, due to anthropogenic additions. Most Zinc and Iron are added during industrial activities, such as mining, coal, and waste combustion and steel processing. Many foodstuffs contain certain concentrations of Zinc and Iron. Drinking water also contains certain amounts of Zinc, which may be higher when it is stored in metal tanks (Adefemi and Awokunmi, 2010). It was also observed that the plant intake of zinc at Presidential was beyond maximum permissible level which is 163.45 mg/kg Zn compared with FAO and WHO standard which is 50 mg/kg (www.scialert.net). Therefore, the goat grass at Presidential is detrimental to health because excess zinc found in the growing medium can compete with plant uptake of phosphorus, iron, manganese or copper and can cause their deficiencies in plant tissue (Sloup *et al*, 2016). Iron is within the permissible limit. Iron is required in largest amount by plant and an average soil contains about 50,000 mg/kg Fe, (Stevenson, 1986).

The average (mean) sequential order of concentration at different distance are as follows; Zn>Fe>Mn>Cu>Pb>Cd>Ni>Cr>As with values of (141.70, 121.50, 70.33, 64.63, 59.27, 34.40, 21.46, and 8.83 mg/kg), at 10 m distance; Fe>Zn>Mn>Cu>Pb>Cd>Ni>Cr>As with values of (112.15, 109.48, 62.00, 60.60, 60.50, 46.95, 33.86, 18.20, and 6.97), 20 m distance; Zn>Fe>Cu>Pb>Cd>Mn>Ni>Cr>As with values of (103.35, 102.63, 48.90, 46.88, 40.19, 36.94, 28.45, 12.65 and 5.57 mg/kg), 30 m distance; Fe>Zn>Mn>Cu>Pb>Cd>Ni>Cr>As with values of (93.03, 80.90, 52.12, 42.65, 34.10, 30.85, 24.95, 12.23 and 4.51 mg/kg) and finally at control distance; Fe>Zn>Cu>Mn>Pb>Cd>Ni>Cr>As with values of (81.55, 12.00,9.56, 8.70, 6.51, 5.18, 3.38, 1.92 and 1.55 mg/kg). On the average at center (0 m) distance from the difference four dumpsites (Ngwo Umueze, Presidential, New market and Emene), the concentrations (mg/kg) of Copper (15.20^c, 220.63^a, 33.40^b and 12.40^c), Zinc (150.50^b, 200.30^a, 150.30^b and 65.70^c), Iron (8.57^d, 178.90^a ,130.80^b, and 90.60^c), Manganese (9.70^d, 101.70^a , 66.30^b and 43.40^c), and Lead (75.70^c, 82.30^b, 90.20^a and 70.30^d) are exceptionally high to compare to other heavy metals. Similar observations have been reported by Adefemi and Awokunmi (2010), and Amusan *et al*, (2005) for Itagbolu dumpsite in Ogun State, Nigeria and Obafemi Awolowo University Ile-Ife central refuse dump respectively. From the Tables and Figures, it is also observed that there is a gradual reduction in the concentration of heavy metals as one moves few meters away from the center (0 m) of the dumpsite virtually in all the locations. In all of the samples, Iron, Zinc and Copper have the highest average concentration of the heavy metals both in soil and plant. This is

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because the dump sites are enriched with iron through metals deposit. Besides, iron has earlier been reported to be the most abundant mineral in Nigerian soil (Amusan *et al*, 2005).

Table 1 Mean concentrations (mg/kg) of heavy metals in soil from dump sites of selected locations in Enugu Metropolis

Location / Mean Distance			Cu	Zn	Pb	As	Cr	Ni	Cd	Fe	Mn
	A	0	15.70	150.50	75.70	5.33	20.45	40.30	50.30	85.70	90.70
1	B	10	12.70	123.40	55.20	3.45	18.30	30.10	41.20	83.00	77.40
	C	20	10.20	90.80	41.60	2.80	15.70	24.30	35.70	81.10	70.40
	D	30	9.80	55.70	30.17	1.98	12.20	20.20	27.21	80.20	60.70
	E	Control (65 m)	9.23	11.50	4.50	1.30	2.00	3.00	6.70	70.00	8.50
2	A	0	220.30	200.30	22.30	11.30	23.00	45.70	70.70	178.90	101.70
	B	10	190.30	160.30	78.70	9.70	20.20	35.30	57.30	160.30	90.30
	C	20	150.50	183.40	66.70	7.60	17.30	30.20	48.77	130.40	80.40
	D	30	140.50	161.80	50.40	5.30	15.70	27.30	40.30	121.20	77.30
	E	Control (65 m)	10.70	12.50	3.55	1.80	1.98	3.50	5.70	90.00	9.0
3	A	0	33.40	150.30	90.20	15.30	21.70	30.30	65.77	130.8	66.30
	B	10	28.70	113.7	70.60	12.40	18.70	36.70	47.60	120.30	50.11
	C	20	25.50	101.6	50.60	10.11	16.40	30.60	40.50	111.40	41.77
	D	30	20.30	75.30	35.30	9.50	11.30	25.70	30.20	90.70	50.33
	E	Control (65 m)	10.30	13.00	14.50	2.00	2.21	3.60	5.00	85.50	10.30
4	A	0	12.40	65.70	70.30	3.40	20.70	25.30	50.30	90.6	43.40
	B	10	10.70	40.50	35.70	2.33	15.60	33.34	41.70	85.00	30.30
	C	20	9.50	37.60	28.60	1.77	12.20	28.70	38.70	87.00	25.50
	D	30	9.22	30.53	20.44	1.50	9.70	26.60	25.70	80.00	20.11
	E	Control (65 m)	8.00	11.00	3.50	1.10	1.50	3.42	3.30	80.70	7.00
Average	A	0	70.33	141.70	64.63	8.83	21.46	35.4	59.27	121.50	75.53
	B	10	60.60	109.48	60.5	6.97	18.2	33.86	46.95	112.15	62.00
	C	20	48.90	103.35	46.88	5.57	12.65	28.45	40.19	102.63	36.94
	D	30	42.65	80.9	34.10	4.51	12.23	24.95	30.85	93.03	52.12
	E	Control (65 m)	9.56	12.00	6.51	1.55	1.92	3.38	5.18	81.55	8.7

NB: 1-NgwoUmueze, 2-Presidential, 3-New Market, 4-Emene

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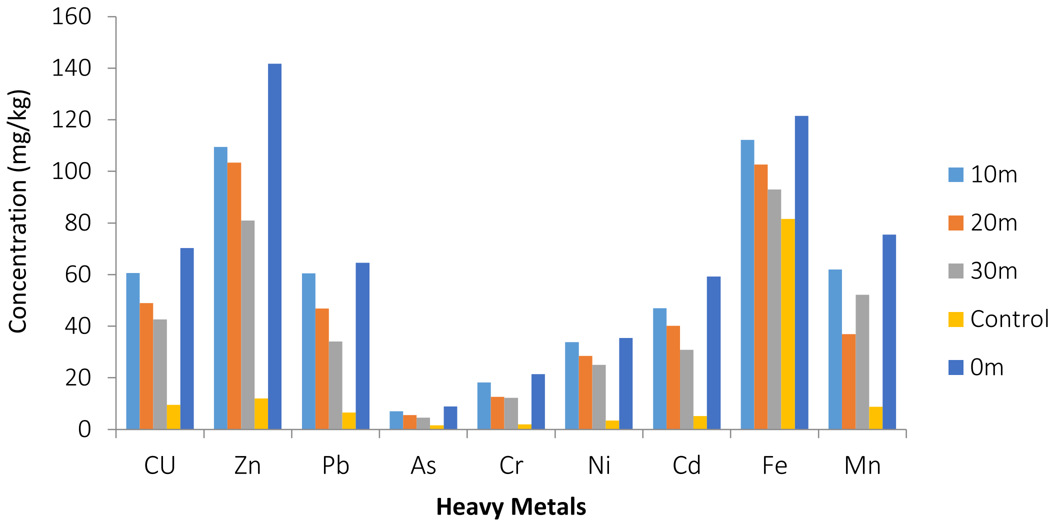

Figure 1 Mean concentration (mg/kg) of heavy metals in soil from dump sites

Table 2 Mean concentrations (mg/kg) at 0 m (center), (0 - 15) cm depth in four dumpsites in Enugu Metropolis

Heavy Metals	Dumpsites			
	Umueze	Presidential Road	New Market	Emene
Cu	15.20^{c} ± 1.15	220.63^{a} ± 1.15	33.40^{b} ± 1.15	12.40^{c} ± 1.15
Zn	150.50^{b} ± 1.15	200.30^{a} ± 1.15	150.30^{b} ± 1.15	65.70^{c} ± 1.15
Pb	75.70^{c} ± 1.15	82.30^{b} ± 1.15	90.20^{a} ± 1.15	70.30^{d} ± 1.15
As	5.33^{c} ± 1.15	11.30^{b} ± 1.15	15.30^{a} ± 1.15	3.40^{c} ± 1.15
Cr	20.45 ± 1.15	23.00 ± 1.15	21.70 ± 1.15	20.70 ± 1.15
Ni	40.30^{b} ± 1.15	45.70^{a} ± 1.15	30.30^{c} ± 1.15	25.30^{d} ± 1.15
Cd	50.30^{c} ± 1.15	70.70^{a} ± 1.15	65.77^{b} ± 1.15	50.30^{c} ± 1.15
Fe	8.57^{d} ± 1.15	178.90^{a} ± 1.15	130.80^{b} ± 1.15	90.60^{c} ± 1.15
Mn	9.70^{d} ± 1.15	101.70^{a} ± 1.15	66.30^{b} ± 1.15	43.40^{c} ± 1.15

Means with different superscripts are significantly different at p<0.05

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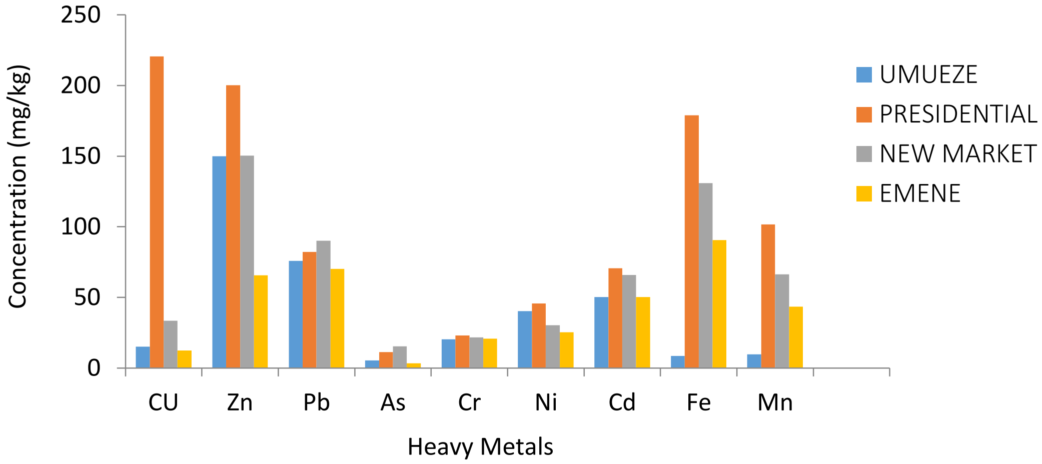

Figure 2 Mean soil heavy metal concentrations at 0 m (center) distance in four dumpsites in Enugu Metropolis

Table 3 Mean concentrations (mg/kg) at 10 m distance away, (0 - 15) cm depth in four dump sites in Enugu Metropolis

Heavy Metals	Dumpsites			
	Umueze	Presidential road	New market	Emene
Cu	$12.70^{c} \pm 1.15$	$190.30^{a} \pm 1.15$	$28.70^{b} \pm 1.15$	$10.70^{c} \pm 1.15$
Zn	$123.40^{b} \pm 1.15$	$160.30^{a} \pm 1.15$	$113.70^{c} \pm 1.15$	$40.50^{d} \pm 1.15$
Pb	$53.20^{c} \pm 1.15$	$78.70^{a} \pm 1.15$	$70.60^{b} \pm 1.15$	$35.70^{d} \pm 1.15$
As	$3.45^{b} \pm 1.15$	$9.70^{a} \pm 1.15$	$12.40^{a} \pm 1.15$	$2.33^{b} \pm 1.15$
Cr	$18.30^{ab} \pm 1.15$	$20.20^{a} \pm 1.15$	$18.70^{ab} \pm 1.15$	$15.60^{b} \pm 1.15$
Ni	$30.10^{b} \pm 1.15$	$35.30^{a} \pm 1.15$	$36.70^{a} \pm 1.15$	$33.34^{ab} \pm 1.15$
Cd	$41.20^{c} \pm 1.15$	$57.30^{a} \pm 1.15$	$47.60^{b} \pm 1.15$	$41.70^{c} \pm 1.15$
Fe	$83.00^{c} \pm 1.15$	$160.30^{a} \pm 1.15$	$120.30^{b} \pm 1.15$	$85.00^{c} \pm 1.15$
Mn	$77.30^{b} \pm 1.15$	$90.30^{a} \pm 1.15$	$50.11^{c} \pm 1.15$	$30.30^{d} \pm 1.15$

Means with different superscripts are significantly different at $p<0.05$

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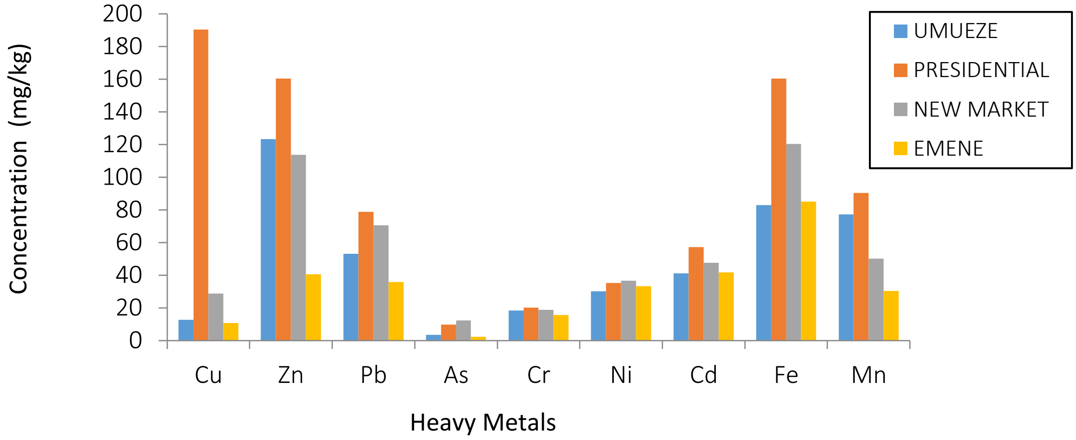

Figure 3 Mean soil heavy metal concentrations at 10 m away distance from the dumpsite in four dumpsites in Enugu Metropolis

Table 4 Mean concentrations (mg/kg) at 20 m distance away from the four dumpsites in Enugu Metropolis at (0 - 15) cm depth

Heavy Metals	Dumpsites			
	Umueze	Presidential road	New market	Emene
Cu	$10.20^{c} \pm 1.15$	$150.50^{a} \pm 1.15$	$25.50^{b} \pm 1.15$	$9.50^{c} \pm 1.15$
Zn	$90.80^{c} \pm 1.15$	$183.40^{a} \pm 1.15$	$101.60^{b} \pm 1.15$	$37.60^{d} \pm 1.15$
Pb	$41.66^{c} \pm 1.15$	$66.70^{a} \pm 1.15$	$50.60^{b} \pm 1.15$	$28.60^{d} \pm 1.15$
As	$2.80^{b} \pm 1.15$	$7.60^{a} \pm 1.15$	$10.11^{a} \pm 1.15$	$1.77^{b} \pm 1.15$
Cr	$15.70^{ab} \pm 1.15$	$17.30^{a} \pm 1.15$	$16.40^{a} \pm 1.15$	$12.20^{b} \pm 1.15$
Ni	$24.30^{b} \pm 1.15$	$30.20^{a} \pm 1.15$	$30.60^{a} \pm 1.15$	$28.70^{a} \pm 1.15$
Cd	$35.70^{c} \pm 1.15$	$48.77^{a} \pm 1.15$	$40.50^{b} \pm 1.15$	$38.70^{bc} \pm 1.15$
Fe	$81.10^{d} \pm 1.15$	$130.40^{a} \pm 1.15$	$111.40^{b} \pm 1.15$	$87.00^{c} \pm 1.15$
Mn	$70.40^{b} \pm 1.15$	$80.40^{a} \pm 1.15$	$41.77^{c} \pm 1.15$	$25.50^{d} \pm 1.15$

Means with different superscripts are significantly different at $p<0.05$

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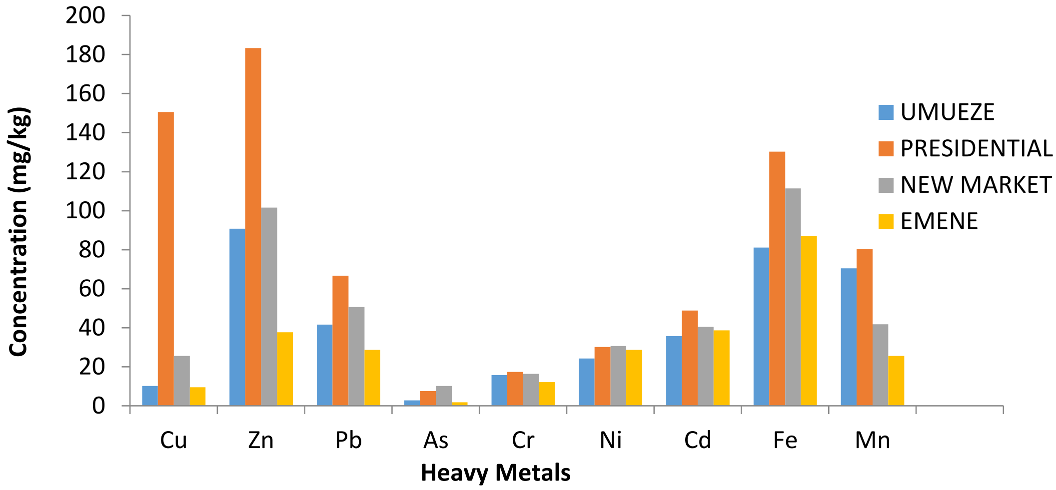

Figure 4 Mean soil heavy metal concentrations at 20 m away distance from the dumpsite in four dumpsites in Enugu Metropolis

Table 5 Mean concentrations (mg/kg) at 30 m distance away from the four dump sites in Enugu Metropolis at (0 - 15) cm depth

Heavy Metals	Dumpsites			
	Umueze	Presidential road	New market	Emene
Cu	$9.80^{c} \pm 1.15$	$140.50^{a} \pm 1.15$	$20.30^{b} \pm 1.15$	$9.22^{c} \pm 1.15$
Zn	$55.70^{c} \pm 1.15$	$161.80^{a} \pm 1.15$	$75.30^{b} \pm 1.15$	$30.53^{d} \pm 1.15$
Pb	$30.17^{c} \pm 1.15$	$50.40^{a} \pm 1.15$	$35.30^{b} \pm 1.15$	$20.44^{d} \pm 1.15$
As	$1.98^{c} \pm 1.15$	$5.30^{b} \pm 1.15$	$9.50^{a} \pm 1.15$	$1.50^{c} \pm 1.15$
Cr	$12.20^{ab} \pm 1.15$	$15.70^{a} \pm 1.15$	$11.30^{b} \pm 1.15$	$9.70^{b} \pm 1.15$
Ni	$20.20^{b} \pm 1.15$	$27.30^{a} \pm 1.15$	$25.70^{a} \pm 1.15$	$26.60^{a} \pm 1.15$
Cd	$27.21^{bc} \pm 1.15$	$40.30^{a} \pm 1.15$	$30.20^{b} \pm 1.15$	$25.70^{c} \pm 1.15$
Fe	$80.20^{c} \pm 1.15$	$121.20^{a} \pm 1.15$	$90.70^{b} \pm 1.15$	$80.00^{c} \pm 1.15$
Mn	$60.70^{b} \pm 1.15$	$77.30^{a} \pm 1.15$	$50.33^{c} \pm 1.15$	$20.11^{d} \pm 1.15$

Means with different superscripts are significantly different at p<0.05

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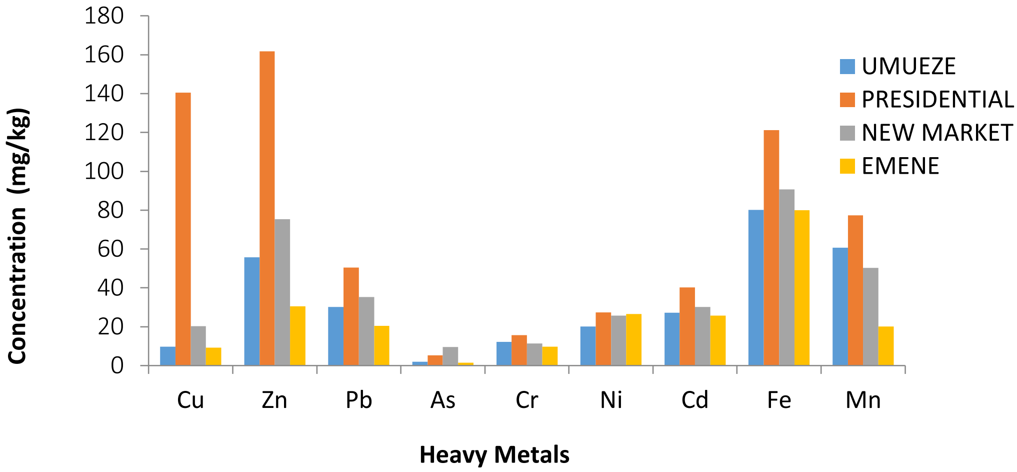

Figure 5 Mean soil heavy metal concentration at 30 m distance in four dumpsites in Enugu Metropolis

Table 6 Mean concentrations (mg/kg) at the control distance in four dump sites in Enugu Metropolis at (0 - 15) cm depth

Heavy Metals	Dumpsites			
	Umueze	Presidential road	New market	Emene
Cu	9.23 ± 1.15	10.70 ± 1.15	10.30 ± 1.15	8.00 ± 1.15
Zn	11.50 ± 1.15	12.50 ± 1.15	13.00 ± 1.15	11.00 ± 1.15
Pb	4.50^b ± 1.15	3.55^b ± 1.15	14.50^a ± 1.15	3.50^b ± 1.15
As	1.30 ± 1.15	1.80 ± 1.15	2.00 ± 1.15	1.10 ± 1.15
Cr	2.00 ± 1.15	1.98 ± 1.15	2.21 ± 1.15	1.50 ± 1.15
Ni	3.00 ± 1.15	3.50 ± 1.15	3.60 ± 1.15	3.42 ± 1.15
Cd	6.70 ± 1.15	5.70 ± 1.15	5.00 ± 1.15	3.30 ± 1.15
Fe	70.00^d ± 1.15	90.00^a ± 1.15	85.30^b ± 1.15	80.00^c ± 1.15
Mn	8.50 ± 1.15	9.00 ± 1.15	10.30 ± 1.15	7.00 ± 1.15

Means with different superscripts are significantly different at $p<0.05$

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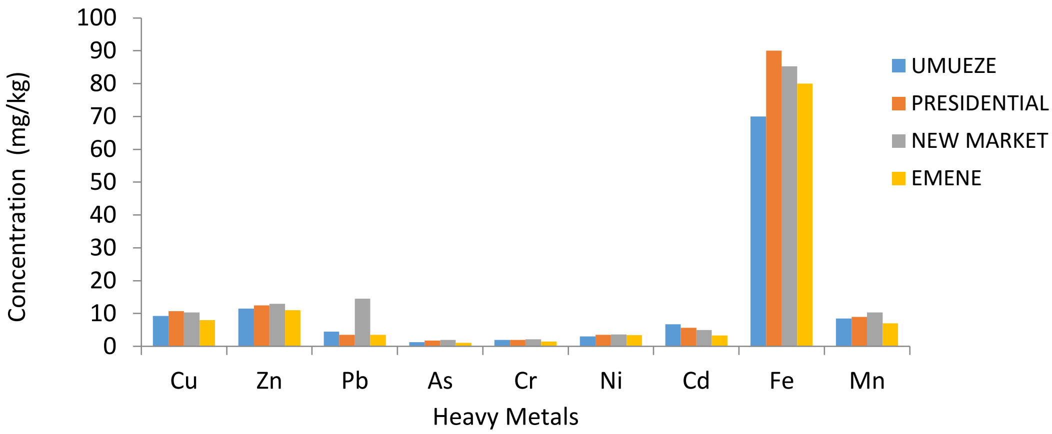

Figure 6 Mean soil heavy metal concentration at control sites of four dumpsites in Enugu Metropolis

Table 7 Mean concentration (mg/kg) of heavy metals of plant at center of dumpsites and control (65 m away) in Enugu Metropolis

Location/Distance (m)		Cu	Zn	Pb	As	Cr	Ni	Cd	Fe	Mn
Umueze	Centre	4.55	26.82	12.32	1.84	7.84	13.66	18.45	36.00	21.40
	Control	0.92	1.32	0.50	0.20	0.66	1.01	1.27	20.22	1.56
Presidential	Centre	150.11	163.45	32.60	2.54	10.47	16.20	25.20	93.54	35.30
	Control	2.50	1.01	1.50	0.32	0.55	0.22	1.50	25.22	1.10
New Market	Centre	23.11	110.20	35.30	5.32	14.86	17.23	23.93	98.80	28.56
	Control	3.33	1.23	1.20	0.60	0.77	0.11	1.32	29.30	1.23
Emene	Centre	0.50	0.70	0.60	0.10	0.70	1.20	0.33	45.00	0.80
	Control	0.30	0.80	0.20	Nill	0.30	0.43	0.10	1.30	0.20

4. CONCLUSION

The study shows how concentration of heavy metals decreases as the distance fathers away from the center of each dumpsite. It also shows the mean values of the heavy metals concentration at the center of the dumpsites as 70.33 mg/kg for Copper, 141.70 mg/kg for Zinc, 64.63 mg/kg for Lead, 8.83 mg/kg for Arsenic, 21.46 mg/kg for Chromium, 35.40 mg/kg for Nickel, 59.27 mg/kg for Cadmium, 121.50 mg/kg for Iron and 75.53 mg/kg for Manganese. The results obtained in plant from the study area at control level fall within the acceptable limits by World Health Organization (WHO) and Food and Agriculture Organization (FAO) except at the Presidential where Copper and Zinc content of heavy metals were higher to compare to the recommended

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maximum limit of Zinc and Copper in plants (www.scialert.net). There are no possible health risks that may arise for now from heavy metal pollution in plant in the study area. Zinc, Copper and Iron were found most concentrating both in the soil and plants, this may be due to the fact that they are trace elements which are essential for normal health growth and reproduction of plants

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