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EFFECTS OF HEAVY METAL DUMPING ON SOIL, WATER AND PLANT WITHIN AKURE, ONDO STATE

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ABSTRACT

The levels of heavy metals contaminations of both soil and water were investigated at Ondo state waste dumping site at Igbatoro road, new stadium scrap market and FUTA research farm. Eight different heavy metals (Zn, Cr, Cu, Cd, Pb, Co, Fe and Ni) were measured in eight sampling units of soil, four from each dump site. These heavy metals were also analysed for water samples from four sampling units, two samples from each dump site and for maize plant, four samples, three from dumpsite and one from FUTA research farm as control. Physical properties of soil were analysed and classified to be sandy clay loam. Soil and water pH were determined using pH meter, with values range from 6.62 to 7.90. Atomic Absorption Spectrophotometer was used for the determination of the heavy metals in the soil and water samples. The mean values of heavy metals in soil from both dump sites range between 205.00 and 0.03 for Fe and Cd respectively. The concentration of heavy metals analyzed of soil samples from both dump sites were high but were within the Dutch and WHO standard. The mean concentration of Cd, Co, Ni, and Cr were low in the soil and maize planted while Cu, Zn, Fe and Pb were high in the soil, water and maize planted. It is evident that the wastes and metals dumped on these study areas are gradually affecting the quality of soil and groundwater through the production of acidic leachate.

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INTRODUCTION

Most of human activities at Ondo state refuse dump site along Igbatoro road, Akure and new stadium metals scrap market also in Akure released high amounts of heavy metals into the surface and ground water, soil and ultimately to the biosphere. The soil interface with crop plants in these areas are a major concern for accumulation of heavy metals in food contaminations. Heavy metal concentration in the soil solution plays a major function in controlling metal bioavailability to plants (Ruqia, *et al*., 2015). The larger percent of the earth is filled with water and the remain part is filled with soil, the soil formed from the decomposition of rocks and organic matter for many years and it results in soil formation, the soil can be classified into three classes (sandy, loamy, and clay) these classes of soil are formed based on time, climate and weather. Water action in the soil also helps in soil formation and transport of soil minerals from one place to another within the soil. Soil comprises of different elements and these elements can be classified into micro and macro elements such as minerals, metals, etc but they are available in the soil in adequate proportions. Hence, human action has affected the soil, water, and soil elements. Some of these actions include dumping of wastes, mining, burning, farming operations, siting of buildings etc. These action increases concentration of elements present in the soil, water and surroundings (Adelekan and Abegunde, 2011). Due to increasing waste generation and disposition resulted into increased groundwater pollution, soil pollution, air pollution and unsuitability of the use of soils within the area for agricultural productivity purposes (Akinbile, 2012). As heavy metals cannot be degraded, they are continuously being deposited, accumulated and incorporated in crop plants due to probability of food contamination through the soil root interface. Though the heavy metals like Cd, Pb, and Ni are not essential for plant growth, they are taken up by plants in toxic forms.

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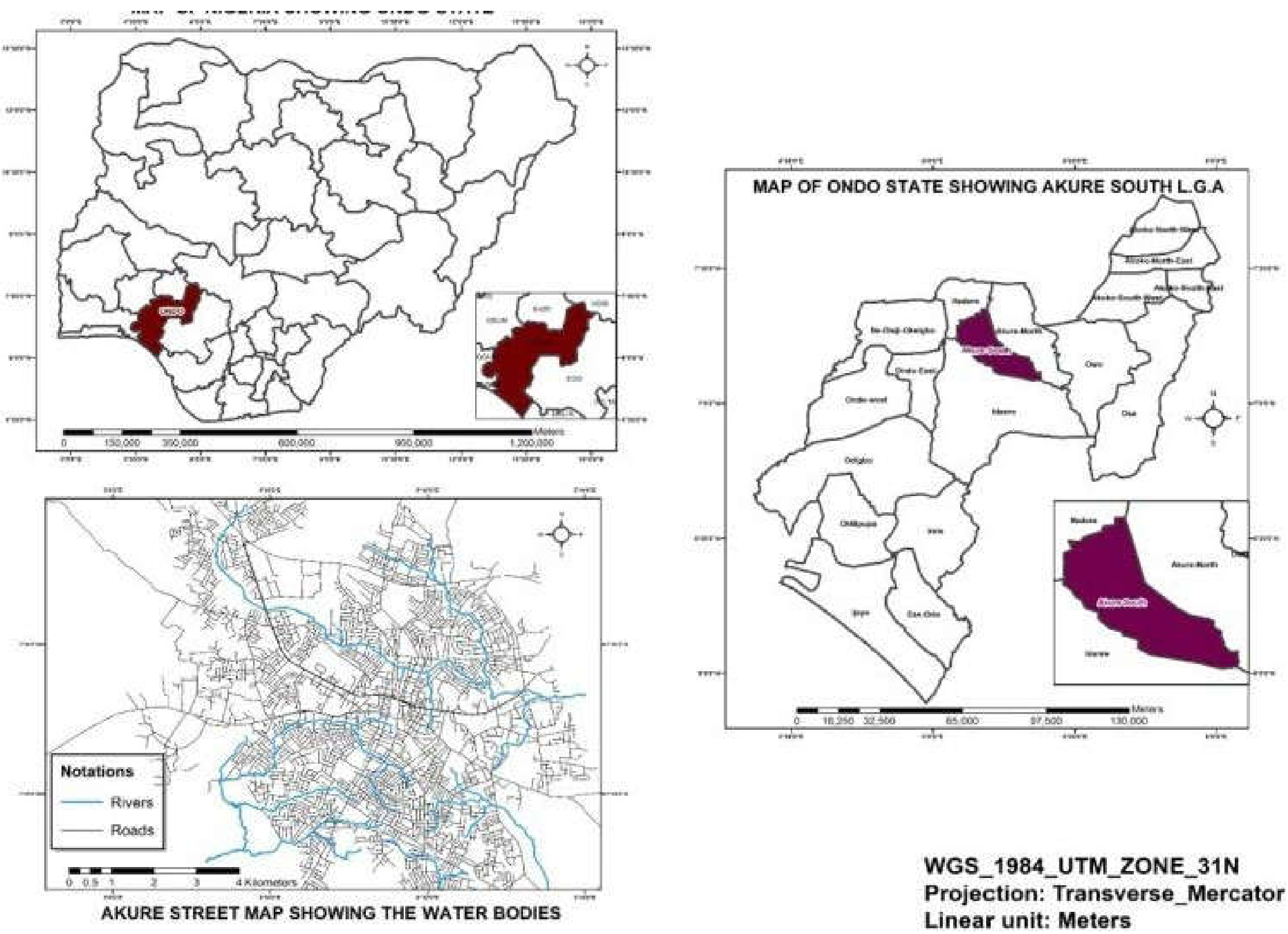

Source: Olajuyigbe *et al*., (2015)

Figure 1. Map of Nigeria showing Ondo state and Ondo state showing Akure metropolis

Heavy metal concentration in the soil solution plays an important role in controlling metal bioavailability to plants (Ruqia, *et al*., 2015). The maximum allowable limits of heavy metals in soils and vegetables have been established by standard regulatory bodies such as World Health Organization (WHO), Food and Agricultural Organization (FAO) and Dutch Standard. The main purpose of this research are to determine the physical properties of soil at the study areas, determine pH value of water and soil samples at the study area, assess the level of heavy metals in both soil and water at the study area, compare metal contents of soil at Ondo State refuse dump site, new stadium metal scrap market, and FUTA research farm all in Akure with the maximum permissible levels set by Dutch standard/World Health Organization (WHO). The results are expected to create awareness among the public on the safety of consuming crops grown in these areas.

MATERIALS AND METHODS

Akure is one of the largest cities in Ondo State in terms of industrial establishment and infrastructural development. The study was conducted at the Waste Management Authority Yard situated along Igbatoro Road, new stadium metal scrap market, high school road and Federal University of Technology, all within Akure metropolis. The population of Akure in 1992 and 2002 grew from 2,312,535 to 2,983,433 and the projected figure for 2012 and 2022 are 8,856,467 and 4,984,900 people respectively (Olanrewaju and Ilemobade, 2009; Olubanjo and Fasinmirin, 2016). Akure, capital city of Ondo state of Nigeria located between Latitude 9°17'N and Longitude 5º18ºE as showing in Figure 1.

It has a tropical humid climate with two distinct seasons. Akure has a relatively dry season from November to March and a rainy season from April to October. Akure has an annual rainfall within the range of 1405 mm and 2400 mm of which rainy season accounts for 90% and the month of April marks the beginning of rainfall (Akinbile, 2012; Olubanjo and Fasinmirin, 2016). The major cities that share boundaries with Akure include Ikere in the north, Ondo in the south and Owo in the east and Igbara-oke in the west. The predominant soil in Akure is sandy-loam. The economy at the new stadium scrap market is hinged on metal waste imports and the processing of the goods. Most of the metal waste imports came from across the city, although some were from other town within the state. Various brands of metal products and non-biodegradable materials that were dumped include electronics, plastics, engine blocks, batteries, aluminum, stainless, zinc, lead, tin, copper, brass, foam, fridges, etc. The metal stayed on the soil as long as possible and due to leaching effects and water action metals dissolves into the soil. Estimated 50% to 75% of the electronics and metal dumped were unable to be salvaged and remain on the land. Also due to an uncertainty of how to manage electronic items, metals, plastics, foam, etc, about75% of the items are kept on the soil. The workers many of whom are boys and fall within the age of 18-50 years search for the metals copper, aluminum and iron to sell. The metals scraps are sold by workers, children and adults alike, to earn a living. The workers dismantled the electronic and metal waste with their bare hands and stones and other rudimentary tools with no protective equipment. The dumping site of Ondo state waste management at Igbatoro road Akure is a central place where all the waste generated within the state are deposit and it is enclosed with a fence to restrict movement and safe guard the waste dumped. Within the dumping sites, is a borehole, a building which houses some of the workers and the securities, they depend on the water from the borehole for survival. Most of the waste dumps on this site are burnt at time intervals and therefore causing environmental pollution and release of methane gas and other metals to the environment. The soil samples collection were from the dumpsite of Ondo state waste management authority along Igbatoro road, Akure and the new stadium strap metals market at high school road, Akure. Specific samples were collected with predetermined distances of 30 m to each other and at depths of 10 cm using soil auger, air dried, sieve through 2mm mesh and stored in polythene bag for analysis. Samples collected at Ondo State waste management authority dumping site at Igbatoro road, Oda were denoted as follows: sample collected where waste was freshly dumped as S_{OA}; sample collected where no burning took place but there was deposition of waste as S_{OB}; sample collected close to the sunk borehole as S_{OC} and sample collected where overturning had taken place as S_{OD} while samples collected at new stadium strap metals market along high school road were denoted as follows: sample collected where burning took place as $S_{NA;}$ sample collected where little metal were placed as S_{NB}; sample collected where more metals were placed as S_{NC}, sample collected where all elements were placed as $S_{ND.}$

The soil particle size analysis was carried out using the following apparatus: mechanical stirrer, stopwatch, analytical balance, hydrometer, thermometer and reagent. In the analysis of soil particles, each sample collected was oven dried and weighed into a beaker and reagents was added, allow soaking for some minute and stirred with mechanical cup for some minutes. This was done using the standard laboratory procedure and analytical methods [APHA, 2005; Olubanjo and Fasinmirin, 2016). Water holding capacity and total porosity were determined based on the standard procedures (Dorrah, *et al*., 2010).The following apparatus were used for the analyses: Analytical Balance, Perforated Cylinder, spatula, water tray, oven and desiccator. A perforated cylinder with wet filter paper was weighed and recorded (W_1). The sieved soil was transferred into the cylinder filled to the top with the aid of spatula. The soil was saturated in the tray, removed after saturation and allowed to drain and weigh (W_2). The saturated soil sample was dried up in the oven at 105º for 36hours and cooled in the desiccators and weighed (W_3).

Calculation

Water holding capacity

$$= \frac{\text{maximum water absorbed by soil}}{\text{Oven − dried weight of soil}} \times \frac{100}{1}$$

$$= \frac{W_2 - W_3}{W_3 - W_1} \times \frac{100}{1} \qquad (Equ\ 2.1)$$

$$\textbf{Total porosi} = \frac{\text{Weight of water in saturated soil}}{\text{Volume of soil}}$$

$$\times \frac{100}{1} \; (\,Equ\ 2.2\,)$$

Soil pH was determined using pH meter model Jenway 3015 and buffer solution of pH 4 and 9 (Dorrah*et al*., 2010). The soil samples were weighed into 100 ml of conical flask and 20ml of distilled water was added into the flask containing the samples and stirred the flasks with the samples, allowed to stand for about 30minutes and the pH meter is standardize with buffer solution before placed into the soil samples in the conical flask. The procedure used in extraction of the following selected metals Zn, Cu, Fe, Ni, Cr, Co and Pb in soil was to digest the soil samples, and then placed 1grm of soil samples in a conical flask and 15ml of Aquaregial was added, and allowed to stay for about 20 minutes. The digested and resulting solution was filtered and distilled water was added to make it up to 50ml. Soil samples were collected into extracting tube and HCL was added and stirred and allowed to settle and filter. Ca and Mg were extracted with ammonium acetate and Zn, Fe, Cu, Mn, and Pb were extracted using Atomic Absorption Spectrometer (AAS) 210VCP Model (Dorrah *et al*., 2010). The water samples were collected into plastic bottles that had been pre-cleaned with concentrated nitric acid and finally rinsed with distilled water. The samples were collected from the well which is 30 m away from the dump site and 20 m deep, also from the borehole on the dump site which is 120 m deep.

The samples collected from the borehole and from the well were denoted as $W_{OP.}$ Also, samples were collected from two wells which is 25 m deep and 30 m away from the metal dump area at the new stadium metal scrap market and denoted as W_{NP}. The raw water samples were filtered using a Whatman No. 42 filter 9 cm. The pH of the water samples were determined using digital analyzer model 691 pH-Meter (Swiss Made). Then 100 ml of the filtrate was measured into a beaker with the addition of 15 ml concentrated nitric acid solution and 10 ml of 50% concentrated hydrochloric acid solution (Wufem, 2009). The content was evaporated to almost dryness on a hot plate, 7 ml of 50% concentrated hydrochloric acid added and heated for 10 minutes. The solutions were allowed to cool, and then distilled water added to each and filtered into a 100 ml Pyrex volumetric flask using a Whatman No. 42 filter, 9cm. The 100 ml each of the water samples were used for the heavy metal determination using AAS (Perkin Elmer 400Atomic Absorption Spectrophotometer). Maize was planted at three locations on the dumping sites to check the effect of heavy metals on the maize fruits and one control location at Federal University of Technology, Akure research farm. Maize samples denoted as M_{N1} for location one, M_{N2} for location two, M_{N3} for location three and Federal University of Technology, Akure research farm as M_C as location four. The procedure used in extraction of selected metals such as Zn, Cu, Fe, Ni, Cr, Co, Ca and Pb from maize fruit was carried out by dividing maize into a smaller sample using knife. It is crushed and placed into extracting tube and HCL is added and stirred, allow to settle, filtered, undergoes digestion and Zn, Fe, Cu, Co, Cr, Ca, Ni and Pb were extracted using Atomic Absorption Spectrometer (AAS) VGP 210 Model.

RESULTS AND DISCUSSION

Table 1a and b show the mean values of soil physical properties collected at Ondo State refuse dump site and new stadium scrap metals markets, Akure. From the results shown in tables, the pronounced soil class is sandy-clay-silt using the USDA textural class triangle which was about 90.00% and 88.00% of the total soil sample analyzed for soil at Ondo state refuse dump site, Igbatoro road and new stadium scrap metals market, Akure respectively.

Table 1a. Mean values of physical properties of soil samples collected at Ondo state refuse dumping site along Igbatoro road, Akure

Samples	MC %	WHC %	Porosity %	Sand %	Clay %	Silt %	Soil Class
S_{OA}	35	37	36	54	27	24	Sandy clay loam
S_{OB}	44	52.5	49	55.5	31	13.5	Sandy clay loam
S_{OC}	34	43	44.5	49.5	31	19.5	Sandy clay loam
S_{OD}	35	39.5	46.5	42.5	33	24.5	Sandy clay loam

Table 1b. Mean values of physical properties of soil samples collected at new stadium metals scrap market, high school area, Akure

Samples	MC %	WHC %	Porosity %	Sand %	Clay %	Silt %	Soil Class
S_{NA}	36	38.5	34.5	51	30.5	18.5	Sandy clay loam
S_{NB}	41	48	48	45.5	31	23.5	Sandy clay loam
S_{NC}	39.5	34.5	48.5	40	31	17	Sandy clay loam
S_{ND}	36	42.5	43	49	26.5	24.5	Sandy clay loam

Table 2a. Mean pH values soil samples collected at Ondo state refuse dumping site along Igbatoro road

Samples	pH values
S_{OA}	7.12
S_{OB}	7.36
S_{OC}	6.79
S_{OD}	7.64

Table 2b. Mean pH values of soil samples collected at new stadium scrap market, high school area, Akure

Samples	pH values
S_{NA}	6.98
S_{NB}	7.71
S_{NC}	7.03
S_{ND}	7.25

The proportion of sand at the formal was 42.50% to 55.50%, of silt was 13.50% to 24.50%, of clay was 27.00% to 33.00% while the sand proportion was 40% to 51%, of clay was 26.5% to 33% and of silt was 17.00% to 24.50% at the later. These results showed that sand decreases farther away from the dump site is a reflection of reduction in organic matter, based on the distance away from the dump site (Keller, 2005). Ibitoye (2001) and Akinbile (2012) made similar observation in their studies which indicated a decrease in sand within the refuse dump area. Also, stated that the lower level of sand within 0 - 10 m may be as a result of organic matter binding effect. The higher level of clay within 10 – 15m may have occurred due to erosion, which removed loose particles from there surface. The mean moisture content of the soil for the two sites ranges from 34.50% to 44.00% in both locations and it decreased with the increase of the distance away from the refuse dump and/or scrap metals. This resembles the observations reported by Silva and Kay, (1997) and Moura *et al.*(2005) in their studies. The moisture content of the soil within the refuse dump was higher (34.50% - 44.00%) as compared to soil at scrap metals market (36.00% – 41.00%). This was associated with the increase in activity of organisms and high organic matter (Lemtiri *et al.* 2014). The moisture content within the metal dumping site was higher as this was associated with the protection or shed provided by the dumped metals from the direct impact of sunlight that evaporates moisture from the soil. Water holding capacity (WHC) mean value ranges from 34.50% to 52.50% in the two locations. It decreases with the increase of distance away from the refuse dump. Water holding capacity in table 1a and b was high because of high organic matter within the dump and clay content distribution at refuse dump site while the soil samples at scrap metals market was only high where there is no such presence of scrap metals (Akinbile, 2012).

The mean values of porosity in refuse dump site and scrap metals market range from 36.00% to 49.00% and 34.50% to 38.50% respectively. The values decreased with increase in the distance from the refuse dump with high clay content and low sand proportion. The results were similar to that of Ibitoye, (2001) and Akinbile *et al*., (2016). It was noticed that the observed colours of samples were dark but samples from the refuse dump area were darker which was the result of organic matter and little of heavy metals decomposition (Akinbile, 2012). The mean pH values ranged from 6.79 to 7.71 in both locations as shown in table 2a and b. The pH range for soil at refuse dump site is from 6.79 to 7.64 (Table 2a). They decreased slightly with the increasing distance from the refuse dump site. This could be as a result of high exchangeable bases content around the refuse dump (Akinbile, 2012). The major effect of soil acidification on plants included the reduction in nutrient supply, increased concentration of metal ions in solution, especially of aluminum, and including those of manganese, copper and zinc that may be toxic, nitrogen fixation by legumes may be reduced unless Rhizobium strain is acid-tolerant (Dorrah *et al*., 2010). The mean pH values of soil analyzed for soil sample collected from new stadium metal scrap market ranges from 6.98 to 7.71 (Table 2b). The value decreased slightly with the increasing distance from the metal dumping site. This could be the result of high concentration of heavy metals and their reaction with water around the metal dumping center (Adelekan and Abegunde, 2011). The table 3a shows the mean concentration of heavy metals in soil sample, S_{OA} ranged from 0.03 to 118.70 mg/kg dry weight. The concentration of Fe was the highest among the heavy metals studied (118.70 mg/kg dry weight) while Cd was the lowest with 0.03 mg/kg dry weight. The mean concentrations of Cr, Co, Ni, Pb, Cu and Zn in soil sample S_{OA} are 0.18 mg/kg, 0.06 mg/kg, 0.98 mg/kg, 0.75 mg/kg, 0.63 mg/kg and 2.10 mg/kg respectively.

Table 3a. Mean values of heavy metals of soil samples collected at Ondo state refuse dumping site, Igbatoro

Heavy metals								
Samples	Cr (mg/kg)	Cd (mg/kg)	Co (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	Fe (mg/kg)
S_{OA}	0.18	0.03	0.06	0.98	0.75	0.63	2.10	118.70
S_{OB}	0.13	0.03	0.05	1.64	3.91	1.34	6.12	141.22
S_{OC}	0.17	0.03	0.07	2.21	7.51	8.98	14.35	161.50
S_{OD}	0.15	0.05	0.10	1.85	3.93	5.45	14.10	175.65

Table 3b. Mean values of heavy metals of soil samples collected at new stadium metal scrap market

Heavy metals								
Samples	Cr (mg/kg)	Cd (mg/kg)	Co (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	Fe (mg/kg)
S_{NA}	0.09	0.04	0.05	2.63	5.63	11.91	14.72	193.5
S_{NB}	0.12	0.06	0.07	3.74	11.50	8.76	14.01	193.5
S_{NC}	0.08	0.03	0.09	2.26	4.67	3.81	12.35	205.00
S_{ND}	0.11	0.02	0.07	3.19	7.58	7.33	13.95	200.00

The maximum concentration for the heavy metals in sample, S_{OA} was Fe (141.22 mg/kg dry weight) and the minimum value being Cd (0.03 mg/kg dry weight). The heavy metals in this soil sample had its mean concentration ranging from0.03to 141.22mg/kg dry weight (Table 3a). Thus, the mean concentrations of Cr, Co, Ni, Pb, Cu and Zn in soil sample S_{OB} are 0.13 mg/kg, 0.05 mg/kg, 1.64 mg/kg, 3.91 mg/kg, 1.34 mg/kg and 6.12 mg/kg respectively. The mean concentrations obtained for heavy metals in soil sample, S_{OC} ranged from 0.03 to 161.5mg/kg dry weight (Table 3a). The highest concentration being iron was 161.5 mg/kg dry weight for Fe while the lowest value was Cd (0.03 mg/kg dry weight). Thus, the mean concentrations of Cr, Co, Ni, Pb, Cu and Zn in soil sample S_{OC} are 0.17 mg/kg, 0.07 mg/kg, 2.21 mg/kg, 7.51 mg/kg, 8.98 mg/kg and 14.35 mg/kg respectively. The mean concentration range for the heavy metals in soil sample, S_{OD} was from 0.05to175.65 mg/kg dry weight (Table 3a). Fe also had the highest value (175.65 mg/kg dry weight) while the lowest value was Cadmium (Cd) being 0.05 mg/kg dry weight. Moreover, the mean concentrations of Cr, Co, Ni, Pb, Cu and Zn in soil sample S_{OD} are 0.15 mg/kg, 0.10 mg/kg, 1.85 mg/kg, 3.93 mg/kg, 5.45 mg/kg and 14.10 mg/kg respectively. The table 3b shows the mean concentration of heavy metals in soil sample, S_{NA} and it ranged from 0.04 to 193.50 mg/kg dry weight. The concentration of Fe was the highest among the heavy metals studied (193.5 mg/kg dry weight) while Cd was the lowest with 0.04 mg/kg dry weight. The mean concentrations of Cr, Co, Ni, Pb, Cu and Zn in soil sample S_{NA} are 0.09 mg/kg, 0.05 mg/kg, 2.63 mg/kg, 5.63 mg/kg, 11.91 mg/kg and 14.72 mg/kg respectively. The heavy metals in soil sample, S_{NB} had its mean concentration ranging from 0.06 to 193.5 mg/kg dry weight (Table 3b).

The maximum concentration for the heavy metals was Fe (193.5 mg/kg dry weight) and the minimum value being Cd (0.06 mg/kg dry weight). Thus, the mean concentrations of Cr, Co, Ni, Pb, Cu and Zn in soil sample S_{NB} are 0.12 mg/kg, 0.07 mg/kg, 3.74 mg/kg, 11.5 mg/kg, 8.76 mg/kg and 14.0mg/kg respectively. The mean concentration range for the heavy metals in soil sample, S_{NC} was from 0.03to 205 mg/kg dry weight (Table 3b). Fe also had the highest value (205 mg/kg dry weight) while the lowest value was Cd (0.03 mg/kg dry weight).Moreover, the mean concentrations of Cr, Co, Ni, Pb, Cu and Zn in soil sample S_{NC} are 0.08 mg/kg, 0.09 mg/kg, 2.26 mg/kg, 4.67 mg/kg, 3.81 mg/kg and 12.35 mg/kg respectively. The mean concentrations obtained for heavy metals in soil sample, S_{ND} ranged from 0.02 to 200mg/kg dry weight (Table 3b). The highest concentration being iron (Fe) was 200 mg/kg dry weight while the lowest value was Cd (0.02 mg/kg dry weight). Thus, the mean concentrations of Cr, Co, Ni, Pb, Cu and Zn in soil sample S_{ND} are 0.11 mg/kg, 0.07 mg/kg, 3.19 mg/kg, 7.58 mg/kg, 7.33 mg/kg and 13.95 mg/kg respectively.The Dutch and WHO permissible limit of heavy metals in soil for chromium are 100 and 1.3 mg/kg respectively. The highest value for chromium in soil samples from both dump sites was 0.18 mg/kg which is lower to both Dutch and WHO recommended values. The Dutch and WHO standard for Cadmium are 0.8 and 0.02 mg/kg respectively. The highest value of Cadmium of soil samples from both the dumpsite was 0.06 mg/kg which is lower than the recommended values. The Dutch and WHO standard for Cobalt are 9.00 mg/kg and 50.00 mg/kg respectively. The highest value of Cobalt in all the soil samples from both dumpsites is 0.10mg/kg which is lower than recommended values.

The Dutch and WHO standard for Nickel are 35.00 mg/kg and 10.00 mg/kg respectively. The highest value of Nickel in all the soil samples from both dumpsites is 3.74 mg/kg which is lower than the recommended values. The Dutch and WHO standard for lead are 83.00 mg/kg and 2.00 mg/kg respectively. The highest value of lead in all the soil samples from both dumpsites is 11.50 mg/kg which is lower than Dutch recommended value (83.00 mg/kg) but higher than WHO recommended value (2.00 mg/kg), indicating the presence of poison in the soil from the dump sites. The Dutch and WHO standard for Copper are 36.00 mg/kg and 10.00 mg/kg respectively. The highest value of Copper in all the soil samples from both dumpsites is 11.91 mg/kg which is lower than Dutch recommended values but higher than WHO standard for Copper. The Dutch and WHO standard for Zinc are 140.00 mg/kg and 50.00 mg/kg respectively. The highest value of Zinc in all the soil samples from both dumpsites is 14.72 mg/kg which is lower than recommended values. The WHO standard for Iron is 20.00 mg/kg. The highest value of Iron in all the soil samples from both dumpsites is 205.00 mg/kg which is higher than the WHO recommended value (Zaigham *et al*., 2012; Ogundele *et al*, 2015). The mean pH values of water samples collected from Ondo state refuse dumping site (W_{OP}) was 7.26 (Table 4). Although, the value exceeded the WHO pH standard for drinking water which is 7.0. This may be because of acid contents and reaction of metals and other substances dumped on the site. The mean pH values water samples of water samples collected from new stadium metals scrap market(W_{NP})was 7.56 (Table 4).

Table 4. Mean pH values of water samples collected at Ondo state refuse dumping site along Igbatoro road and new stadium scrap market

Samples	pH values
W_{OP}	7.26
W_{NP}	7.56

Table 5. Mean heavy metal values of water samples collected at Ondo state refuse dumping site along Igbatoro road and new stadium scrap market

Heavy metals								
Samples	Cr (mg/l)	Cd (mg/l)	Co (mg/l)	Ni (mg/l)	Pb (mg/l)	Cu (mg/l)	Zn (mg/l)	Fe (mg/l)
W_{OP}	ND	ND	ND	ND	0.06	0.33	0.91	2.53
W_{NP}	0.03	ND	0.02	ND	0.22	0.04	0.02	0.3

Note: ND means Not Detected

The pH value is slightly acidic and this may be as a result of accumulation of acidic metals and its reaction with water both on surface and in underground soil (Adelekan and Abegunde, 2011). The table 5shows the mean concentration of heavy metals in two water sample denoted as W_{OP} and W_{NP} respectively. In water sample $W_{OP,}$ Iron (Fe) has the maximum mean values of 2.53 mg/land the minimum mean value being 0.00 for Cd, Cr, Co and Ni. The heavy metals in water sample W_{OP} had its mean concentration ranging from 0.00 to 2.53 mg/l. Thus, the mean concentrations of Pb, Cu and Zn in water sample W_{OP}were 0.06 mg/l, 0.33 mg/kg and 2.53mg/l respectively. Also, Iron (Fe) also had the highest value of 0.3 mg/l while the lowest value was Cd and Ni (0.00 mg/l). The mean concentration range for the heavy metals in water sample $W_{NP}$was from 0.00 to 0.3 mg/l. Moreover, the mean concentrations of Cr, Co, Pb, Cu and Zn in water sample W_{NP} were 0.03 mg/l, 0.02 mg/l, 0.22 mg/l, 0.04 mg/l and 0.02 mg/l respectively. The Dutch and WHO standard for Chromium are 2.50 mg/l and 0.10 mg/l respectively. The highest value of Chromium in the water samples from both dumpsites is 0.03mg/l which is lower than recommended values. The Dutch and WHO standard for Cadmium are 0.06 mg/l and 0.01 mg/l respectively. The highest value of Cadmium in the water samples from both dumpsites is 0.00mg/l which mean there are no traces of this heavy metal in the water samples from both dump sites. The Dutch and WHO standard for Cobalt are 0.70 mg/l and 100.00 mg/l respectively. The highest value of Cobalt in the water samples from both dumpsites is 0.02 mg/l which is lower than recommended values.

The Dutch and WHO standard for Nickel are 2.10 mg/l and 0.20 mg/l respectively. The highest value of Nickel in the water samples from both dumpsites is 0.00 mg/l which mean there are no traces of this heavy metal in the water samples from both dump sites. The Dutch and WHO standard for lead are 1.70 mg/l and 0.05 mg/l respectively. The highest value of Lead in the water samples from both dumpsites is 0.22 mg/l which is lower than Dutch standard value but higher than WHO recommended values indicating the presence of poison in the water. The Dutch and WHO standard for Copper are 1.30 mg/l and 2.00 mg/l respectively. The highest value of Copper in the water samples from both dumpsites is 0.33 mg/l which is lower than the recommended values. The Dutch and WHO standard for Zinc are 24.00 mg/l and 5.00 mg/l respectively. The highest value of Zinc in the water samples from both dumpsites is 0.91 mg/l which is lower than both recommended values. The WHO standard for Iron is 1.00 mg/l. The highest value of Iron in the water samples from both From the result, Iron (Fe) and Lead (Pb) has the greater value from analysis taken which is as a result of electronics materials which contain more heavy metals compare to waste disposal, also because metal consist of more than one elements i.e. other alloys. Mechanic workshop close to the well, Lead (Pb) from car batteries and other metals like carbides are washed down to the well by leaching and infiltration. This causes variation in result gotten from Ondo state dumping site. Table 6 shows the result of samples of maize plant analyzed at various locations in new stadium metal scrap market and FUTA research farm. The Dutch and WHO standard for Chromium are 2.50 mg/l and 1.30 mg/l respectively. The highest value of Chromium in the samples of maize plant from all the sampling units including control is 0.01mg/l which is lower than recommended values. The Dutch and WHO standard for Cadmium are 0.06 mg/l and 0.02 mg/l respectively. The highest value of Cadmium in the samples of maize plant from all the sampling units including control is 0.00 mg/l which means there are no traces of Cadmium in all the samples. The Dutch and WHO standard for Cobalt are 0.70 mg/l and 50.00 mg/l respectively. The highest value of Cobalt in the samples of maize plant from all the sampling units including control is 0.01mg/l which is lower than recommended values. The Dutch and WHO standard for Nickel are 2.10 mg/l and 10.00 mg/l respectively. The highest value of Nickel in the samples of maize plant from all the sampling units including control is 0.00 mg/l which means there are no traces of Nickels in all the samples. The Dutch and WHO standard for lead are 1.70 mg/l and 2.00 mg/l respectively. The highest value of Lead in the water samples from both dumpsites is 0.07 mg/l which is lower than both recommended, it indicates there is no presence of poison in the maize. The Dutch and WHO standard for Copper are 1.30 mg/l and 10.00 mg/l respectively. The highest value of Copper in the samples of maize plant from all the sampling units including control is 0.20 mg/l which is lower than both recommended values. The Dutch and WHO standard for Zinc are 24.00 mg/l and 0.60 mg/l respectively. The highest value of Zinc in the samples of maize plant from all the sampling units including control is 0.66 mg/l which is lower than Dutch standard but higher than WHO recommended values. The WHO standard for Iron is 1.00 mg/l. The highest value of Iron in the samples of maize plant from all the sampling units including control is 1.96 mg/l which is higher than recommended values by WHO (Lemtiri *et al.*, 2014). From result obtained from the planted maize at Ondo state waste dumping site, iron has the highest concentration with cadmium having the lowest concentration. This was because of waste disposed on the soil and the decay of small metals, which decayed on the soil alongside with the wastes.

Table 6. Heavy metals extracted from maize planted at new stadium metal scrap market and FUTA Research farm

Heavy metals								
Samples	Cr (mg/l)	Cd (mg/l)	Co (mg/l)	Ni (mg/l)	Pb (mg/l)	Cu (mg/l)	Zn (mg/l)	Fe (mg/l)
M_{N1}	0.01	ND	0.01	ND	0.07	0.2	0.52	1.55
M_{N2}	0.01	ND	0.01	ND	0.06	0.16	0.66	1.96
M_{N3}	ND	ND	ND	ND	0.01	0.04	0.08	0.14
M_{N4}	ND	ND	ND	ND	ND	ND	ND	0.07

Note: ND means Not Detected

The maize root absorbed these heavy metals from the soil and man consumed these heavy metals either by man or animals and the metals are accumulated in human body which leads to different diseases in man after a long time of accumulation (Ruqia *et al*., 2015).

Conclusion

The main objectives of this research work were to determine the effect of heavy metals, physical and chemical properties of soil, water and plant. The results obtained after the soil samples collected at both Ondo state refuse dump site and new stadium metal scrap market analyzed indicated that regardless of different waste dumps, heavy metals are introduced into the soil that resulted into pollution of soil and underground water in the study. In view of these, the following conclusions were drawn from the research work. The physical properties of soil samples collected both at the refuse dumping site and new stadium metal scrap market based on the USDA textural triangle shows that the soil particles in the study areas is sandy-clay-loam which resulted leaching of heavy metals into the soil with high adsorption ratio. The concentration of heavy metals of soil samples analysed from both study areas were within the limit of Dutch and WHO standard. Also, the mean concentration of Cd, Co, Ni, and Ca were low in the soil with high values of Cu, Zn, Fe and Pb in maize planted, but not beyond the recommended standard. Through rainfall, the reaction of soil pH with heavy metals on the study areas increase such that an increase in metal reaction occurs with a corresponding increase in metal transportation to maize planted and groundwater in the study area. The quantities of heavy metals detected in ground and surface waters within the study areas were within the Dutch target and WHO values, notwithstanding measures should be taken to prevent gradual pollution of soil and groundwater contamination to the point of putting the health of people, livestock, aquatic plants and animals at risk in the study area.

REFERENCES

Adelekan B.A. and Abegunde K.D. 2011. Heavy metals contamination of soil and groundwater at automobile mechanic villages in Ibadan, Nigeria. *International Journal of the Physical Sciences.* 6(5): 1045-1058.

Akinbile C.O. 2012. Environmental Impact of Landfill on Groundwater Quality and Agricultural Soils in Nigeria. *Soil and Water Resources*. 7(1): 18-26.

Akinbile C.O., Ajibade, F.O. & Ofuafo O. 2016. Soil quality analysis of dumpsite environment in a University community in Nigeria. *Journal of Engineering and Engineering Technology,* 10(2):68-73.

APHA 2005. Standard methods for the examination of water and waste water. (Washington, DC American Public Health Association), USA.

Dorrah S.S., Golchin A. and Ahmadi S. 2010. The effects of hydrophilic polymer and soil salinity on corn growth in sandy and loamy soils. *Soil, Air, Water.*38:584-59.

Ibitoye A.A. 2001. Effects of municipal refuse dump on soil and water quality in Azure metropolis. *Journal of Applied Soil Science* .2:16-24.

Ibitoye, A. A. 2006. Laboratory Manual on Basic Soil Analysis. 2: 6-15.

Keller J.M. 2005. The influence of selected liquid and soil properties on the propagation of spills over flat permeable surfaces pacific Northwest National Laboratory-15058. Richland, Washington.

Lemtiri A., Colinet G., Alabi T., Cluzean D., Zirbes L., Haubruge E. and Francis F. 2014. Impacts of earth worms on soil components and dynamics. A review. *Biotechnol. Agron. Soc. Environ.* 18(11): 121-133.

Moura E.G., Moura N.G., Marques E.S., Pinheiro K.M., Costa Sobrinho J.R.S. & Aguiar A.C.F. 2009. Evaluating chemical and physical quality indicators for a structurally fragile tropical soil. *Soil Used and Management*. 25:368-375.

Ogundele D.T., Adio A.A. and Oludele O.E. 2015. Heavy metal concentrations in plants and soil along heavy traffic roads in north central Nigeria. *J. Environ Anal. Toxicol*. 5:334.

Olajuyigbe A.O., Adegboyega S.A., Popoola O.O. and Olalekan, O.A. 2015. Assessment of urban land use and environmental sensitive area degradation in Akure, Nigeria using remote sensing and GIS techniques. *European Scientific Journal*. 11(29): 318 - 339

Olarenwaju O.O. and Ilemobade O.A. 2009. Waste to wealth: A case study of the Ondo State integrated waste recycling and treatment project Nigeria. *European Journal of Social Science*.8: 7-14.

Olubanjo O.O. and Fasinmirin J.T. 2016. Pollution effects of solid waste disposal on ground water and soils in Akure, Nigeria. *Nigeria Journal of Soil and Tillage Research.. 2*: 66-76.

Ruqia N., Muslim K., Muhammad M., Hameed R., Naveed U.R., Surrya S., Noheed A., Muhammad S., Mohib U. and Zeenat S. 2015 Accumulation of heavy metals in soil, water and plant. *J. Pham Sci. and Resources.* 7(3): 89-97.

Silva A.P. and Kay B.D. 1997. Estimating the least limiting waterrange of soils from properties and management. *Soil Science Society of AmericaJournal*. 61:877-883.

Wufem B.M., Ibrahim A.Q., Gin N.S., Shibdawa M.A., Adamu H.M. and Agya P.J. 2009. Levels of heavy metals in Gubi dam water Bauchi, Nigeria. *Global Journal of Environmental Sciences.* 8: 29-37.

Zaigham H., Zubair A., Khalid U.K., Mazhar I., Rizwan U.K. and Jabar Z.K.K. 2012. Civic pollution and its effect on water quality of river Toi at district Kohat. *Research Journal of Environmental and Earth Sciences*. 4(5): 334-339.

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