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Heavy Metals Contamination in Urban Soils of Nigerian: A Review

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ABSTRACT
Improvement in transport routes within the towns and cities of Nigeria leads to a variety of activities and create a lot of opportunities which range from vehicle repairs, vulcanizing and welding, auto electricity works, battery charging, as well as sales of vehicles spare parts and street hawking among others, along these routes. These activities help in the discharge of heavy metal elements into the air, water and soils, exposure to these toxic elements have adverse effect on human health. Studies conducted in different towns and cities of Nigeria on the level of heavy metals contamination in soil indicated that most urban centers of Nigeria have elevated concentration of these metals. Most of the studies reported high levels of Pb, Zn, Mn, Cu, Ni, Cd, Co and Fe. Although few of these heavy metals found in the road side soils or within the urban environment are within the maximum limit approved by the World Health Organization and the European Union, but majority exceed the maximum limit as reported by the different authors.
Keywords: heavy metals, urban soil, contamination, pollution, Nigeria

INTRODUCTION
1.0 Urban Soil Contamination
According to United States Department of Agriculture (USDA, 2011), soil contamination or soil pollution is caused by the presence of xenobiotic chemicals or other alteration in the natural soil environment. It is typically caused by industrial activities, agricultural chemicals or improper disposal of wastes. The most common chemicals involved are petroleum hydrocarbons, polynuclear aromatic hydrocarbons, solvents, pesticides, lead and other heavy metals. Contamination is correlated with the degree of industrialization and intensity of chemical usage. The concern over soil contamination stems primarily from health risks, from direct contact with the contaminated soil, vapors from the contaminants and from secondary contamination of water supplies within and underlying soil.
Mapping of contaminated soil sites are time consuming and expensive tasks, requiring extensive amounts of knowledge in geology, hydrology, chemistry, computer modeling skills and Geographic Information System (G.I.S) in environmental contamination, as well as an appreciation of the history of industrial chemistry.
In North America and Western Europe, the extent of contaminated land is well known, with many countries in these areas having a legal framework to identify and deal with the environmental problem. Developing countries tend to be less tightly regulated despite some of them having undergone significant industrialization (USDA, 2011).

2.0 Sources of Urban Soil Heavy Metals
The sources of heavy metals emanate from vehicles fuel combustion, lubricant oil, tire wear, brake wear, road abrasion (Johansson and Westerlund, 2001; Winter and Slenta, 2010). Cadmium (Cd) emission comes mainly from lubricant oil consumption and tire wear. Zinc (Zn) comes from tyre wear and

galvanized parts such as fuel tanks (Falahi-Ardakani, 1984). Brake wear is the most important source for Copper (Cu) and Lead (Pb) emissions. Lead (Pb) comes also from exhaust gases and worn metal alloys in the engine (Winter and Slenta, 2010).

Studies on heavy metal contamination of roadside soils revealed that concentrations were influenced by factors such as traffic volume (Chen, *et al.,* 2010), highway characteristics (Bai, *et al.,* 2009), road and roadside terrain (Saeedi, *et al.,* 2009), roadside distance, wind direction (Jaradat and Momani, 1999), rainfall (Chen, *et al.,* 2010) and local economy (Li, *et al.,* 2001). Chen, *et al.,* (2010) further submitted that high, traffic volume results in increased level of heavy metal content in the roadside soils.

Some trace elements such as Cu and Zn are essential for human health, but in high concentrations, Cu can cause health problems such as anaemia, liver and kidney damage and stomach and intestinal irritation (Wuana and Okieimen, 2001). On the other hand, Cd and Pb at extremely low concentrations may result in toxicity and lead to cancer (Willers, *et al.,* 2001). Through runoff along roads, heavy metals may percolate underground water sources, particularly where people rely on shallow wells as their predominant water sources. It has been reported that heavy metal contents in soils decrease exponentially with distance away from the roads (Brady and Weil, 1996) and most of the deposited metal particles remain in the 0–5 cm layer of the roadside topsoil (Bai, *et al.,* 2009).

3.0 Urban Soil

Bockheim, (1974) gives a definition of urban soil: “as a soil material having a non-agricultural, man-made surface layer more than 50cm thick that has been produced by mixing, filling, or by contamination of land surfaces in urban and suburban areas.” This implies that the soil has been disturbed in a portion of the profile, or perhaps the entire profile may consist of fill, and that man is the primary agent of the disturbance. The mixing, filling and contamination creates a soil material that is unlike its natural counterpart. Mixing of soil material occurs when the soil is scraped away, stockpiled and re-spread, or it may be transported to another location and spread as topsoil.

3.1 Characteristics of Urban Soil

Bockheim, (1974) identified general characteristics of urban soils. These are;

1. Great vertical and spatial variability
2. Modified soil structure leading to compaction
3. Presence of a surface crust on bare soil; usually hydrophobic
4. Modified soil reaction usually elevated
5. Restricted aeration and water drainage
6. Interrupted nutrient cycling and modified soil organism activity
7. Presence of anthropogenic materials and other contaminants (like heavy metals)
8. Modified soil temperature regimes

3.2 Causes of Urban Soil Contamination

Accidental spills of oil
Acid rain
Intensive farming
Deforestation
Genetically modified plants
Nuclear wastes
Landfill and illegal dumping
Agricultural practices
Mining activities
Heavy metals from vehicle brake linings
Automobile exhaust etc.

4 .0 Heavy Metals

The term heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentrations (Skoog, *et al.,* 1991). Examples of such heavy metals include mercury, cadmium, arsenic, chromium, copper, lead, zinc, manganese, iron, etc. that may exist as natural component of the earth's crust. They cannot be biodegraded or destroyed and to some extent, may enter human body through food, drinking water and air. As trace elements, some heavy metals such as copper, selenium and zinc are essential to maintain the metabolism of the human body, however, at higher concentration, they may lead to poisoning. Heavy metal poisoning could results for instance, from drinking water contamination (e.g. lead pipes), high ambient air concentration near the heavy metal emission sources, or through intake via the food chain (Alloway, 1990). Heavy metals in soils are derived from the soil parent material (lithogenic source) and various anthropogenic sources, most of which involve several metals. There are many different anthropogenic sources of heavy metal contamination affecting both agricultural and urban soils. However, localized contamination from a predominant single source, such as a metal smelter can have a marked effect on soils, vegetation and possibly on the health of the local population, especially in countries where there are inadequate emission controls and soil quality standards. In general, soils at industrial sites can have distinct groups of heavy metal contaminants, which depend on the respective industries and their raw materials and products. Soils in all urban areas are generally contaminated with Lead (Pb), Zinc (Zn), Cadmium (Cd) and Copper (Cu) from traffic, paint and many other non-specific urban sources. Although the heavy metal composition of agricultural soils tends to be more closely governed by the parent material, inputs from sources such as deposition of long-distance, atmospherically-transported aerosol particles from fossil fuel combustion and other sources, organic material applications and contaminants in fertilizers can also be significant. Removal of Lead (Pb) from petrol and paints, changes in the type and structure of industries and strict regulations on atmospheric emissions and waste water discharges have resulted in a general reduction in the loads of metal reaching soils in many countries. However, historic contamination still affects soils in many areas and may have impacts for decades or even centuries afterwards (Brian, 2011).

4.1 Heavy Metals in Roadside Soils and Other Parts of Urban Areas of Nigeria

Okunola, *et al.*, (2011) conducted a research on heavy metals in roadside soils of different grain sizes from high traffic roads in Kano metropolis, Nigeria, roadside surface soil samples were collected from 10 locations along high traffic roads and a control site between December 2009 and September 2010. The samples were analyzed for particle size distribution, pH, organic matter content electrical conductivity, cation exchange capacity, and the concentrations of Cd, Ni, Pb, Cu, and Zn in different grain sizes. Generally, the results showed a decrease in the concentrations of all the studied metals during the wet season in the following order, Zn>Pb>Ni>Cu>Cr>Cd. Correlation of metal concentrations on traffic volume is low except for Pb, other sources seem to contribute significantly to the heavy metal burden of the soil. The ecological risk index indicates that the roadsides of Kano metropolis are suffering from high metal contamination, though ameliorated by rain.

Mashi, *et al.*, (2005) assessed the impact of various vehicular traffic densities on lead (Pb) accumulations in Katsina, a semi-arid urban area of Nigeria. This was achieved by collecting and analyzing samples of surface soils, fruits, kernels, leaves, and barks of *Balenites aegyptiaca* from locations of different vehicular traffic densities in the area, and analyzing them for lead, using atomic absorption spectro-photometry. The results obtained revealed that Pb concentration in the high, medium, low, and zero traffic density areas were, 75, 53, 35, and 12 $\mu g/g^{-1}$ respectively for the fruit pulp. They were also16, 13, 8, and 6 $\mu g/g^{-1}$ for fruit kernels and 44, 28, 17, and 9$\mu g/g^{-1}$ respectively for leaves. For tree barks, the values were 138, 97, 64, and 18 $\mu g/g^{-1}$ respectively, while for under-tree-canopy soil samples, the mean values were 99, 74, 44, and 17 $\mu g/g^{-1}$. In the case of outside-canopy soil samples, the mean values were 113, 91, 50, and 18 $\mu g/g^{-1}$ respectively, for the various classes of vehicular traffic densities. These results indicate a strong influence of vehicular traffic density on Pb emission into surrounding atmospheres and its subsequent precipitation on soil and components of *B. aegyptica* specie in the area. Of all the samples, tree bark should be the best index of assessing Pb pollution in the area, as it maintains the closest contact with the surrounding atmosphere. Since Pb has no known lower limit for human tolerance, there is an urgent need for Pb pollution control in the area to be effectively enforced.

Kakulu, (2002) in a study "Trace Metal Concentration in Roadside Surface Soil and Tree Back: A Measurement of Local Atmospheric Pollution in Abuja, Nigeria", used Atomic Absorption Spectrophotometry to analyze Cadmium, Copper, Lead, Nickel and Zinc concentrations in surface soils and tree barks from different districts of Abuja, Nigeria in order to determine the atmospheric trace metal input in the area. Elevated concentrations of some of the studied metals were observed in the soil and tree bark samples from the commercial/high traffic areas of the city compared to background values. In the soil samples, the average concentration of the metals were 0.6±0.4, 18.0±4.0, 281±39, 16±4 and 66±23 $\mu g\ g^{-1}$ dry weight for Cd, Cu, Pb, Ni and Zn, respectively, whilst the average concentrations in tree bark were 0.3±0.2, 12±4, 133±32, 13±3 and 61±10 $\mu g\ g^{-1}$ dry weight for Cd, Cu, Pb, Ni and Zn, respectively. The trend in trace metal levels suggested that automobile emissions were a major source of these metals, as the highest concentrations of Pb and Zn were recorded in the commercial areas of the city known for their high traffic densities. The levels of these metals in the study area were relatively low compared to the levels found in some larger and older cities in various countries worldwide.

Olajire and Ayodele, (1997) in their research to determined the concentrations of heavy metals in roadside soil and grasses from different locations in Ibadan metropolis and two highways. The levels found (in $\mu g/g^{-1}$) were: Cr - 20.6-104; Mn - 86.2-355; Fe - 1737-4455; Ni - 10.9-115; Cu - 8.94-80.5; Zn - 43.5-213; Cd - 0.18-2.70; and Pb - 205-730. There was no significant difference ($P < 0.10$) between the mean concentrations of these metals in the high and low traffic density areas suggesting that sources other than the automobiles also influence the levels of these metals in roadside soils and grasses.

David, *et al.*, (2012) stated that vehicular emission has been found to constitute one of the major sources of soil pollution. They investigated the influence of vehicular emissions on the accumulation of heavy metal in the roadside soils of Ota metropolis, Ogun State, Nigeria. The main objective of the research was to determine the impact of heavy metals such as copper, cadmium, lead, manganese, nickel and sulphate from vehicular pollution on soils around Ota. Seven locations were selected on the basis of their high concentration of vehicular traffic. Three sites with low traffic concentration were also selected outside the seven locations to act as control sites. Samples were taken in a period of three months in the dry season. The concentrations of five heavy metals and sulphates in the samples were determined with anatomic absorption spectrometer. The concentrations of the heavy metals from the seven main sites were higher than in the control sites. The concentration of each heavy metal and sulphate in the seven locations was below the European Union regulatory standard. Although these concentration were below the European Union regulatory standard, these heavy metals and sulphates, which over time were washed by erosion into the local areas used for farming, may pose health hazards. The enhancement of fuel quality and the adoption of emission standards to mitigate the impact of vehicular emissions on human health should be made mandatory.

Abechi, *et al.*,(2010) stated that a study of heavy metals in roadside soils is critical in assessing the potential environmental impacts of automobile emission on the soil. Soil samples were collected and analyzed for the levels of Pb, Zn, Mn, Cu, Ni, Cd, Co and Fe using AAS. Results indicate the decreasing order of the average total heavy metals content for the studied metals: Fe > Zn >Mn>Pb> Cd > Cu. Except for Cd, all the metals were lower than the levels of those reported in other studies. The absence of Co and Ni indicate no pollution due to these metals. Correlation analysis between the studied metals and traffic volume (V) indicates significant positive correlation ($p < 0.05$) between Pb, Cd and Mn, and V. This further indicates that heavy metals pollution in the soil mostly originates from vehicular emissions.

Adedeji, *et al.*, (2013) investigated the concentrations of eight critical heavy metals in the roadside soils of selected urban centres in Ijebu-North Local Government Area of Ogun State, South West, Nigeria. Thirty-six composite soil samples were collected along the roadside based on distances to the roads. Physiochemical properties and concentrations of heavy metals (Cd, Cr,Cu, Fe, Mn, Pb, and Zn) in roadside soils in some selected locations were determined using atomic absorption spectroscopy. Accumulation of heavy metals in top soils is greatly influenced by traffic volume and all the heavy metals exhibited a significant reduction in the roadside soils with increasing distance from the road. Heavy metal concentrations in the roadside soils followed order of Zn>Pb>Fe>Cu>Mn>Cd>Cr. Concentration of Zn was 156.09 mg/kg in roadside soils of Ijebu-Igbo/Oru/Ago-Iwoye which is experiencing high volume of traffic, while it ranged from 10 – 47 mg/Kg for Ijebu-Igbo/Bajowa/Akanran road with low traffic volume. Pb concentration of 26.7 mg/kg was observed in Ijebu-Igbo/Oru/Ago-Iwoye road especially in centre of the city. Concentrations of all the heavy metals examined were below the EU guideline, however, the paper suggested a regular monitoring and assessment to ensure sustainable management of the urban environment and reduction of traffic-related contamination the of soil, plants and water.

Baba, *et al.*, (2014) in their research, "A Concentration of Heavy Metals" where iron, lead, manganese, zinc, chromium and copper were determined in road side soil samples collected from some major roads within Ilorin and its environs using Atomic Absorption Spectrophotometry. Concentration of iron was found to be the highest in the samples collected, followed by manganese, lead, chromium, zinc and copper in that order. Although, the main source of these heavy metals is the exhaust from motor vehicles, other sources such as road side deposition of motor engine oil, battery wastes, car tyres, use of metal containing pesticides to protect road side grasses, trees and flowers, the presence of iron benders, welders and electricians discharging metals with the environment and indiscriminate dumping of refuse on the roadside could also contribute significantly.

Mbah and Anikwe, (2010) investigated heavy metal concentration on roadside along a major expressway in south eastern Nigeria. Fifteen air dried surface soil samples were collected from 50cm – 1m (point A) and fifteen from 100m (point B) away from the roadside along a road with a distance of 170 km. Heavy metals were found in both points with highest concentration at 50cm – 1m (point A). Mean values 5205.11(Fe), 247.97 (Cu), 74.11 (Zn) 100.19(Pb) and 18.8 (Cd) mg/kg were recorded at 50cm – 1m while means values at 100m away from the roadside for Fe, Cu, Zn, Pb and Cd were 4890, 217.86, 64.08, 87.13 and 3.05 mg/kg, respectively. Variability of heavy metals ranged between 7 – 56% and 14 – 70% at 50cm – 1m and 100m, away from the road, respectively. At 50cm – 1m and 100m, Pb and Cd showed high variability with highest variability (70%) observed in Pb at 100m away from roadside. Results from the study showed that the studied soil contains higher levels of heavy metals nearer the roadside and constitute health risk to human and animal health when plants – based food stuffs grown along the area were consumed.

Uwah, *et al.*,(2014) in their work, Inductively Coupled Plasma – Optimal Emission Spectrometry (ICP-OES), Optima 2000, Perkin Elmer were used to analyze the levels of Mn, Zn, Cu and Pb in samples from roadside soils of four major roads in Maiduguri namely; Damboa, Baga, Bama and Kano roads in Maiduguri for possible heavy metals contamination due to anthropogenic activities. The results revealed that the roadside soils Cu levels ranged from 0.21±0.01 mg/kg in Damboa road to 2.51±0.02 mg/kg in Kano road. Pb was only detected in the road side soils of Kano road in the range of 0.03±0.00 to 0.11±0.01mg/kg. Mn levels obtained from the study ranged from 0.47±0.02 mg/kg in Bama road to13.83 ±0.01mg/kg in Baga road. Zn ranged from 0.07±0.02mg/kg in Bama road to 3.68 ±0.02 mg/kg in Damboa road. The concentrations of the heavy metals in the roadside soils were in the order: Mn> Zn > Cu >Pb. Possible accumulation of these heavy metals in the soils and eventual transfer to plants growing along the edges of the highways could occur as a result of continual usage of the roads by automobiles. This may also lead to accumulation of the heavy metals in the tissues of organisms that feed on the plants growing along the edges of the highways which may be transferred to other consumers in the food chain.

Iwegbue, *et al.*, (2006) studied the characteristic levels of heavy metals (Cd, Cr, Cu, Pb, Ni and Zn) of soil profiles of automobile mechanic waste dumps and reported that the concentration of heavy metals decreased with the depth of the profile and lateral distance from the dumpsites; the levels found in this study exceeded background concentrations and limits for agricultural and residential purposes; the distribution pattern of heavy metals in the soil profiles were in the order Pb> Zn > Cu> Cd > Ni > Cr, with the mechanic waste dumps representing a potential sources of heavy metal pollution to environment.

Similarly, soils at different dumpsites located within Ikot-Ekpene, South Eastern Nigeria and control soil samples taken 10 km away from the dumpsites were all analysed for the concentration of Na,Ca, Pb, Ni, Mn, Mg, Fe, P, N, Cu and Zn (Eddy, *et al.*, 2006). The result of the analysis shows that the dumpsites contain significant amount of toxic and essential elements, as significant difference existed between the concentration of these elements in the dumpsites and 10 km away from the dumpsite ($p > 0.05$).

Ekundayo and Obuekwe, (1997) conducted a Physico-chemical analysis of soil samples at an oil spill site of the Niger Delta Basin of Nigeria showed that the total hydrocarbon content of top soil layers ranged from 18.6 to 23.6 ppm in the heavy impact zone and the oil had penetrated to a depth of 8.4 m. The concentration of hydrocarbons in the medium impact zone ranged from 10.04 to 10.38 ppm while hydrocarbons were not detected in 85% of samples from the un-impacted reference zone. Heavy metal concentration measurements in the soil revealed a significant build-up ($P < 0.05$) of lead, copper and zinc in the heavy impact zone. Other quality parameters including electrical conductivity, exchangeable Cations, total nitrogen and available phosphorus in impacted soils were relatively low, while the total organic carbon was high compared with the reference site. Textural class of the soil from different depths showed a predominantly brown sand at the topsoil; loamy sand and grey coarse sand at medium depths, and grey coarse sand and grayish sandy clay at greater depths.

Another study by Inuwa *et al.*, (2007) investigated the concentration of trace metals in soil found around the major industrial areas of the North-western state of Nigeria using absorption spectrophotometry. The results obtained indicated that these metals on dry weight basis in the soil ranged between (0.1 to 0.7 µg/g) Cd, (14.2 to92.7 µg/g) Cr, (151.5 to 540 µg/g) Pb and (3.5 to 24.7µg/g) Ni, the results indicating relatively high concentrations of tested metals in industrial areas than those of the control sites. Similarly, the study of Igwilo, *et al.*, (2006) showed that the mean metal contents of soil samples from Otuocha agricultural river basin exceeded the WHO guidelines for the parameter in soil. Their result is as follows: Cd (0.07 to 3.345 ppm), Cu (4.38 to 13.54ppm), Pb (0.59 to 7.34 ppm) and Ni (0.36 to 5.64 ppm), revealing that the obtained values were higher for Pb, Cd, Cu, Ni and other measured parameters in soils from agriculturally active Otuocha river basin relative to the controls just as the study of Dewuyi and Opasina (2011)also showed high concentrations of Fe, Mn, Cu, Zn, Ni, Cd and Pb, and all the parameters were above control, and also exceeded FEPA and WHO guidelines.

5.0 Heavy Metals in Soils, Plant, Air etc.

Mashi, and Alhassan, (2007) presented the results of a research project on 6 heavy metals (Cd, Cu, Zn, Pb, Hg, and Cr) at 30 Fadama fields situated around Kano metropolis of Nigeria. Thirty(30) of the wastewater irrigated Fadama lands were selected and were representative of residential, industrial, commercial and mixed areas, but largely of residential landuses. Five additional Fadama lands not being irrigated with wastewater were selected to serve as control. Using grid sampling procedure, soil samples were selected from 0-15 cm and 20-30cm depths and analyzed for the selected heavy metals using atomic absorption spectrophotometery. T-test was used to compare the mean value of the metals for the Fadama lands under different landuse zones with those of the control. Analysis of the soil data collected showed that the metals were concentrated in higher amounts in the lower (20-30 cm) than the upper (0-15 cm) depths, which was an indication of downward movement of the metals in profiles of the soils. In the two soil depths, Zn was generally the most abundant, followed by Cr,Pb, Cu and Cd, while Hg was the least. The Fadama soils in areas of mixed land-uses with industrial as the dominant ones maintained the highest concentrations of the various metals. These results indicate clearly that Fadama soils are significantly polluted by industrial and household wastewater and there is a particular threat from Cr and Pb pollution. There is also evidence that the metals were accumulating at lower layers of the soil profile, suggesting that not only plants and soil, but even water bodies could be under the threat of heavy metal pollution in the area.

However, Aderinola *et al.,* (2009) reported varying concentration of heavy metals in surface water, sediments, fish and periwinkles of Lagos Lagoon. Their report showed that the mean levels of heavy metals in the sediments of Lagos lagoon were generally low and fell within the acceptable limits described by WHO and FEPA. The average concentrations for the heavy metals were (0.083 ± 0.035 mg/kg) As; (1.150 ± 0.090 mg/kg) Cd;(0.867 ± 0.075 mg/kg) Ni;(0.618 ± 0.193 mg/kg) Cr;(0.600 ± 0.272 mg/kg) Cu; (19.393 ± 6.649 mg/kg) Fe;(0.450 ± 0.598 mg/kg) Pb; (2.040 ± 1.049 mg/kg) Mn;(0.730 ± 0.337 mg/kg) Zn, while Iron, Manganese and Nickel were not defined. Equally, a study on

Ibeche (Ikorodu) Lagos lagoon area (Ladigbolu, *et al.,* 2011) reported higher concentrations of Fe, Cu, Pb, Cd and Zn when compared with the values in unpolluted sediment as well as the standards of the regulatory authorities (WHO, 1982 and FEPA, 1988).

6.0 Heavy Metals in Refineries, Industries and other Petrochemical complexes

Adeniyi and Afolabi, (2002) determined total petroleum hydrocarbons (TPH) and heavy-metal contamination in soils within areas of refined petroleum products handling in Lagos metropolis. Soil samples were collected randomly from two petrol stations, two auto-mechanic workshops, and a National Electric Power Authority (NEPA) station. Control samples were taken from two low-density residential areas. TPH were estimated gravimetrically following standard methods of TPH analysis, while the heavy metals were determined by atomic absorption spectro-photometry. Sites studied had higher levels of TPH and heavy metals compared to the control samples. For TPH, the petrol stations have mean values of 399.83±106.19 and 450.8390.58 μg/g, respectively; mechanic workshops, 362.60±185.84 and 428.55±119.00 μg/g, respectively; while the NEPA station has 356.20±210.30 μg/g compared to the control mean of 26.63±4.58. It was revealed that, improper handling of refined petroleum products are potential source of soil contamination in the sampled sites. This was indicated by the statistically significant levels of TPH and heavy metals observed between the control samples and those collected from the petroleum products handling sites. Bioremediation using microorganisms and plants is recommended.

Tobias, *et al.,* (2013) stated that; Diseases and their associated health defects are most often related to the quality of the total environment which in itself is also related to the quality and quantity of wastes generated in those areas, as partly defined by the nature of activities carried out by the populace. This environment-health relationship dynamics are particularly evident in most tropical environments like Nigeria where various environmental media are laden with sundry pollutants including metals, most of which are often furnished by wastes. This study aims at investigating the environmental metal load of Aba, a major commercial city in South-east Nigeria which is home to many artisanal, small- and medium-scale industrial activities, but presently experiencing waste-related menace. Randomly collected soil samples from different areas of Aba metropolis and a sub-urban community considered less polluted (to serve as control) were analyzed for heavy and non-heavy metals. Results show that while the mean of the estimated heavy metals in the six sites ranged from 0.31 ± 0 to 1293.75 ± 0 μg/g, for non-heavy metals it ranged between 55.01 ± 24.88 and 903.74 ± 1081.25. In the control site, the range is between 0 and 1293.75 ± 0 for heavy metals while for the non-heavy metals, it is between 72.73 ± 0 and 410.50 ± 0. The results indicate that the mean concentrations for most of the metals were high with respect to the Nigerian Federal Environmental Protection Agency (FEPA) and World Health Organization (WHO) standards. Findings in this study have serious implications for public health.

CONCLUSIONS

As the urban areas have high concentration of population density and intensive anthropogenic activities. These activities help in the discharge of heavy metal elements into the air, water and soils, exposure to these toxic elements have adverse effect on human health. Nearly all the concentration of the determine metals in town and cities of Nigeria are higher than the background values. Effective control of activities in the urban centres is the only remedy that could minimize the effects of these heavy metals on the population

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