

# Heavy Metal Distribution and Contamination Index across Urban Land Uses in Ojo Area, Lagos State Nigeria

Ogundele, F. O.<sup>1\*</sup>, Abalaka, L. D.<sup>2</sup>, Soyebo, E.A.<sup>1</sup>

<sup>1</sup> Department of Geography and Planning, Lagos State University, Nigeria

<sup>2</sup> Department of Architecture, Kaduna State University Kafanchan Campus, Nigeria

## Email Address

kunleoguns@yahoo.co.uk (Ogundele, F. O.)

\*Correspondence: kunleoguns@yahoo.co.uk

**Received:** 25 December 2017; **Accepted:** 9 January 2018; **Published:** 20 February 2018

---

## Abstract:

The study assessed the concentration of Zn, Fe, Pb, Cu, Mn and Cr in soils and contamination index found in residential, agricultural, market, institutional, mechanic workshop and filling station in Ojo area Lagos State. Random sampling technique was employed to collect 12 surface soil samples (2 soil samples for each land use) using a soil auger and analysed using standard laboratory procedures. The study found that the contents of Zn, Fe, Pb, Cu, Mn and Cr were far below WHO permissible level as the land uses generated very low quantities of heavy metals. The order of metal concentration was Fe>Cu>Zn>Mn>Cr>Pb; which implied that Fe and Cu had increased concentrations, while the order of land use with increased heavy metal contamination in the soil was mechanic workshop>agricultural>market>residential>institutional>filling station. Positive and significant associations between heavy metals were found between Fe and Zn, Mn and Zn, Mn and Cu, Cr and Zn, Cr and Cu and Cr and Mn. Results of contamination factor of heavy metal indicated low contamination factor. Also, the degree of contamination indicated low degree of metal contamination, while the pollution index revealed absence of pollution concern in spite of the numerous human activities in the area. Based on the results, the study suggested that though, the respective land uses had low heavy metal level, the soils around agricultural area and mechanic workshop should be monitored to control the gradual buildup of metals in the soil; because the activities carried out in these two land uses had the potential of increasing the content of heavy metal in the soil.

## Keywords:

Land Use Change, Contamination index, Heavy Metal, Ojo

---

## 1. Introduction

Globally, the geographic extent of urban development has undergone remarkable change in the last 50 years. This is so as virtually every urban area in the world has expanded substantially in land area in recent decades [1]. The changes of land use

patterns certainly provide many social and economic benefits. Despite the social and economic benefits, change in land use pattern come at a cost to the natural environment. Land use change can simultaneously cause both beneficial and harmful effects, because any change in land use has important consequences for many biological, chemical, and physical processes in soils and so, indirectly, the environment [2, 3]. Heavy metal concentrations in soil are associated with biological and geochemical cycles and are influenced by anthropogenic activities such as agricultural practices, industrial activities and waste disposal methods [4, 5; 6]. Heavy metals or trace metals is the term applied to a large group of trace elements which are both industrially and biologically important.

Heavy metal is the most widely used term for the large group of elements with an atomic density greater than  $6\text{g/cm}^3$  [7] The normal abundance of an element is commonly referred to by geochemists as background; this varies according to the geology and soil type of an area, with initial hydrological processes (including land runoff and through flow) provide the initial transportation of heavy metals. In an ideal world, heavy metal concentrations and movements limited by natural environmental conditions would pose for a more sustainable environment. However human (anthropogenic) influences have impacted significantly causing environmental implications most commonly pollution and contamination of subsurface soils and groundwater [6, 7, 8]. Heavy metal pollution can affect all environments but its effect is most long lasting in soils due to relatively strong adsorption of many metals on loamy and clay colloid of soil [9]. The changes in urban land use pattern mostly residential, industries, parking facilities and road networks among others have significant influence on the accumulation of heavy metals in the soil [8, 10].

Contamination of roadside soils with heavy metals arises from various sources such as vehicles, road wear, and slipperiness control industries. Trace metal concentrations, such as Cd, Cu, Zn, and particularly Pb in surface soils have been the focus of many investigations. Accumulation of these metals in surface soil is greatly influenced by traffic volume and motor vehicles, which introduce a number of toxic metals into the atmosphere [11]. Land use change is arguably the most pervasive socioeconomic force driving changes and degradation of ecosystems. Soil pollution by heavy metals as a result of human activities is causing serious ecological problems in many regions of the world. Metals which are discharged into soil at increased concentrations in sewage, industrial effluents or from mining operations can have severe toxicological effects on humans and aquatic ecosystems [3, 12].

Bioaccumulation of these heavy metals in man, animals and plants result in metal poisoning. Environmental heavy metal pollution is mainly of anthropogenic origin and results from activities such as fossil fuels, vehicular emissions, industrial emissions, landfill leachates, fertilizers, sewage and municipal wastes. These are surely the implication of changing land use pattern in the urban space mostly the change to industrial land uses [10]. Several studies have been carried out to assess of heavy metals in the soil under different land uses [7, 10, 13]. These studies examined heavy metal contaminations in the soils under motor parks, roadside, dumpsite, mechanic shops, industrial area, market/commercial land use and residential. These studies did not consider the various types of vehicular parking areas such as filling station that has the possibility of releasing metal into the soil. Human activities in this area have the likelihood of triggering heavy metal accumulation cum contamination in the soil. This study therefore will examine the contribution of this neglected land use

on the bioaccumulation of heavy metals in the soil. The study examined the spatial variation of heavy metal concentration under different urban land uses in Lagos State.

### ***1.1. Literature Review***

Literature shows that land use change can concurrently cause both beneficial and harmful effects, because any change in land use has important consequences for many biological, chemical, and physical processes in soils and so, indirectly, the environment [13]. Utang et al., [14] examined the impacts of automobile workshops on heavy metals concentrations in urban soils in Obio/Akpor LGA, Rivers State, Nigeria. Findings revealed that heavy metals were generally higher in soils under the influence of automobile workshop than the areas farther but Pb was higher than Hg and Cd. The mean values of Hg, Pb and Cd were 3.07, 91.03 and 5.63 mg/kg respectively in soils under the influence of automobile workshops and 0.03, 60.25 and 1.79 mg/kg, respectively in soils farther from the automobile workshop. Michael et al., [15] looked at the distribution of metals in the soil around a mega cement factory in Gboko, Benue State. The study showed that soil has been affected by anthropogenic activities, in particular the cement industry, leading to a high accumulation of heavy metals compared with the natural background levels. Similarly, [16] assessed soil contamination considering background concentrations and revealed that agricultural soils were more contaminated by heavy metals than green space soils. The study showed that external sources of heavy metals were mainly from pesticides, fertilizers, and atmospheric deposition. Yusuf [17] evaluated heavy metals in the soils of urban and periurban irrigated land in Kano, northern Nigeria. The result showed that the high density, heavily populated areas with activities, such as sewage and sludge disposal, with high concentration of traffic and automobile combustion are prone to danger of soil contamination with heavy metals especially Mn, Cu, Ni, Fe and Zn. Ghorbani et al., [13] studied the concentrations of heavy metals in three types of land uses including agricultural, natural and industrial lands of Golestan province. The results obtained indicated no significant heavy metals pollution, except for As (arsenic) and Se (Selenium) and especially in soils of agricultural lands which are affected by anthropogenic activities. These studies among several others have shown the possibility of different land uses to bring about heavy metal pollution. Also, few of these studies examined the level of heavy metal in filling stations which is one of the common land uses in urban areas due to their increasing demands.

## **2. Materials and Methods**

### ***2.1. Study Area***

Lagos State is located at 6°34'60"N and 3°19'59"E. The State is located within the low-lying coastal zone which stretches west ways from the Niger Delta to the Nigerian border with the Republic of Benin. It separates the main land sedimentary basin of south-western Nigeria from the coastline which dominated by a set of creeks, lagoons and rivers. Lagos State enjoys the West-African mansoom climate marked by district seasonal shift in wind air mass otherwise known as South-West trade wind which blows inland from the Atlantic Ocean between May and October. While the influence of Tropical continental air-mass otherwise known as North-East trade wind is experienced from November to April, which is characterized by the dry season. Lagos State is Nigeria's Prime City and commercial nerve centre with diverse transportation facilities that serve the daily needs of thousands of people in the state.

## 2.2. Types and Sources of Data

This study principally used primary data. The primary data required for this study included: data on the concentration of Zn, Fe, Pb, Cu, Mn and Cr in soils of different land uses and data on metal pollution indices (contamination pollution load index, contamination factors and degree of contamination). Data on the contents of Zn, Fe, Pb, Cu, Mn and Cr were collected using a soil auger at depth of 0 – 15cm in the following land uses: residential, agricultural, market, institutional, mechanic workshop and filling station. Data on metal pollution indices depended on surrogate data (combination of soil data obtained from the various land uses). Background rock value or concentration which is value of the metal equals to the world surface rock average given by Martin and Meybeck (1979) cited in [18] was used as the control. This background rock value or concentration enables the concentration of metals to be compared with those obtained from the various land uses.

## 2.3. Sampling Technique

Random sampling techniques were employed. The sampling technique was used to select the following land uses: residential, agricultural, market, institutional, mechanic workshop and filling station. Also, random sampling technique was used to collect soil samples. In each selected land use, surface soil samples were randomly collected from two points using a soil auger. The two soil samples at each site were collected and stored in a plastic bag. In all, 12 surface soil samples were collected (two soil samples for each land use). The collected surface soil samples were stored in black polythene bags, properly labeled, geo-referenced, air-dried and taken to the laboratory for analysis of Zn, Fe, Pb, Cu, Mn and Cr.

## 2.4. Method of Data Collection and Analysis

Surface soil samples from the identified land uses were collected by the researcher. Soil auger and GPS, notebook and camera were used during data collection. Soil samples in all the land uses in the study were collected at a depth of 0 – 15cm using a soil auger. During data collection, quality assurance was strictly followed and soil samples were guided against any form of contamination. Data obtained were analysed using tables, averages, chart and Spearman's correlation.

## 2.5. Assessment of Heavy Metal Pollution Indices in the Soils

Soil result obtained from the laboratory on metals concentration in the soils of the respective land uses and the control was used to determine the following level metal pollution indices: contamination factor, pollution load index and degree of contamination.

- ✓ Contamination Factor ( $C_f$ ) which is the ratio of the concentration of each metal to the background or control concentration in the soil is defined thus:

$$\text{Contamination factor } (C_f) = \frac{\text{Heavy metal concentration in soils of the land uses}}{\text{Heavy metal concentration in the control soil}}$$

The  $C_f$  values show that  $C_f < 1$  as low contamination;  $1 < C_f < 3$  as moderate contamination;  $3 < C_f < 6$  as considerable contamination, while  $6 < C_f$  as very high contamination.

- ✓ Pollution load index in each land use was evaluated in order to assess the extent of metal pollution by employing the method based on the pollution load index (PLI) developed by Thomilson et al., (1980) cited in [19] as follows:

$$PLI = (Cf_1 \times Cf_2 \times Cf_3 \times Cf_4 \dots Cf_n)^{1/n}$$

Where  $n$  is the number of metals studied and  $Cf$  is the contamination factor. The  $PLI$  provides simple but comparative means for assessing a site quality. A  $PLI$  value close to one indicates heavy metal loads near the control or background level, while values above one indicate soil pollution. Therefore, soils with  $PLI$  value of more than 1 are polluted, whereas values less than 1 indicate no pollution [20].

- ✓ Degree of contamination is defined as the sum of all contamination factors ( $Cf$ ) for a given set of pollutants [19, 21]. Where  $Cf$  is contamination factor and  $n$  is the number of analysed elements. It is defined as follows:

$$Cd = \sum Cf$$

$Cd$  values of  $Cd < 5$  implies low contamination;  $5 < Cd < 10$  means moderate contamination;  $10 < Cd < 20$  shows considerable contamination, while  $20 < Cd$  implies very high contamination.

### 3. Results and Discussion

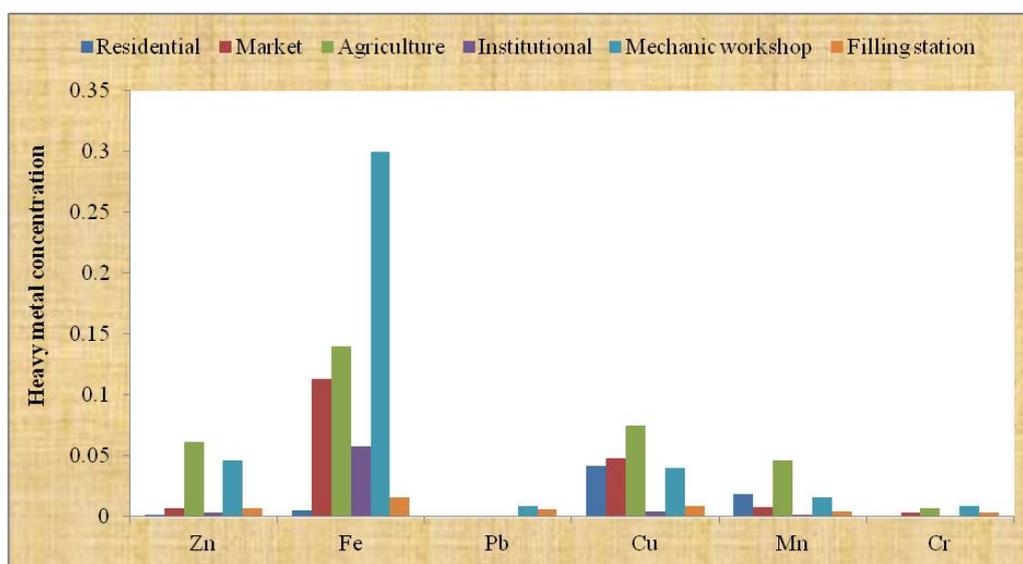
#### 3.1. Spatial Variation in Heavy Metal Contents in the Soil

The result in Table 1 and Figure 1 show the spatial concentration of heavy metal in soil across different land uses in Ojo area Lagos State. The result showed that the mean content of Zn in the studied land use soils ranged from 0.002 to 0.061mg/kg (Table 1). The concentrations of Zn reported in this study are fall below the range of 6.23 to 141.1mg/kg reported by [22] in Lagos State. It is also below the range of 25.87 to 198.32mg/kg reported in Lagos State by [23]. The result showed that increasing level of Zn contents was found in agricultural area (0.061mg/kg) and mechanic workshop (0.046mg/kg). The general result shows that soils across the sampled land uses in the area have low Zn input, which implies that the land uses generate low amount of Zn. Though with increasing concern in agricultural and mechanic workshop land uses. These land uses show sign of Zn contamination in the future which is unconnected to the nature of activities carried out in them. The concentrations of Zn in the soils of the various land uses fall within WHO threshold 300mg/kg for Zn concentration in the soil [24]. High Zn content in the soil interrupt the activity in soils, and can negatively influence the activity of microorganisms and earthworms, thus retarding the breakdown of organic matter. High Zn content can cause anemia, nervous system disorders, damage to the pancreas and lowered levels of “good” cholesterol. On zinc-rich soils only a limited number of plants have a chance of survival.

Fe content ranged from 0.005 to 0.140mg/kg with high and low concentrations observed in agricultural area (0.140mg/k) and residential area (0.005mg/kg). The concentrations of Fe reported in this study are fall below the range of 1.77 to 28.91mg/kg reported by [22] in Lagos State. It is also far within the range of 12.8 to 46.8mg/kg reported in Lagos by [25]. The contents of Fe in the studied land uses are within WHO permissible level of 5000mg/kg set in soil indicating very low Fe concentration in the studied soils and land uses. It also means that the studied land uses in Ojo area generate very low quantities of Fe. Implying that the activities carried

out in the diverse land uses do not result in Fe pollution. The land uses with level of Fe of future concern were agricultural and market area. The activities in these areas need to be properly managed to reduce Fe pollution. More so, the mean content of lead (Pb) in soils of the different land uses ranged from 0.006 to 0.009mg/kg with low and high values recorded in mechanic workshop and filling station. Pb was not detected in residential, agricultural, market and institutional land uses which simply means that these land uses do not generate Pb; hence, the absence of pollution or concentration in the respective soils.

The mean concentration obtained in this present study is far lower than the range of 30-50 mg/kg reported by Nriagu (1992) cited in [23] as the typical concentration of lead in urban soils of African cities which means its concentration in the respective soils is not a cause for concern. The Pb values in this study are far below the values reported in Lagos State by [23] with range of 5.57 to 69.2mg/kg. It is far below the range of 1.12 to 59.8mg/kg reported by [22]. The concentration of Pb in the soil within the limit of 100 mg/kg and 70mg/kg set out by WHO. It therefore means that the concentration of Pb in soils of the respective land uses is not harmful to biotic lives. Atuanya and Oseghe [26] noted that higher lead concentration in soils has toxic effect on microorganisms inhabiting the soil which consequently alters the flora and fauna of a location. According to [27]), Pb is not an essential element and it is well known to be toxic and its effects have been more extensively reviewed than the effects of other trace metals. Pb can cause serious injury to the brain, nervous system, red blood cells, and kidneys. Exposure to Pb can result in a wide range of biological effects depending on the level and duration of exposure. Various effects occur over a broad range of doses, with the developing young and infants being more sensitive than adults. Pb poisoning, which is so severe as to cause evident illness, is now very rare. Pb performs no known essential function in the human body, it can merely do harm after uptake from food, air, or water.



**Figure 1.** Heavy metal concentration across different urban land uses in Ojo.

The mean concentration of copper (Cu) across the various land uses ranged from 0.004 to 0.075mg/kg (Figure 1). High Cu values were found in agricultural area, while institutional area had the lowest concentration of Cu. The Cu values reported in this study are far lower than the range of 0.93 to 131.7mg/kg reported by [22]. It is also below the range of 2.40 to 6.60mg/kg reported in Lagos State by [28]. The level of Cu

recorded across the various land uses in the present study is lower falls within WHO 100mg/kg threshold for the concentration of Cu in the soil. The result in Table 1 shows that the respective soils have low Cu content implying low anthropogenic influence or inputs. Copper is the third most used metal in the world. Copper is an essential micronutrient required in the growth of both plants and animals. According to [27], in humans, Cu helps in the production of blood haemoglobin. In plants, Cu is especially important in seed production, disease resistance, and regulation of water. Copper is indeed essential, but in high doses it can cause anaemia, liver and kidney damage, and stomach and intestinal irritation [27]. Thus, the Cu level reported in the present study does not pose any threat to biotic lives.

Also, the result in Table 1 and Figure 1 showed that the mean concentration of manganese (Mn) across the various land uses ranged from 0.002 to 0.046mg/kg. High Mn values were found in agricultural area, while institutional area had the lowest concentration of Mn. The level of Mn recorded across the various land uses in the present study is lower falls within WHO 200mg/kg threshold for the concentration of Mn in the soil. The result obtained shows that the respective soils have low Mn content also implying low anthropogenic influence or inputs. Manganese is one of the most abundant metals in soils. Manganese is one out of three toxic essential trace elements, which means that it is not only necessary for humans to survive, but it is also toxic when too high concentrations are present in a human body. When people do not live up to the recommended daily allowances their health will decrease. But when the uptake is too high health problems will also occur. The uptake of manganese by humans mainly takes place through food, such as spinach, tea and herbs. Manganese effects occur mainly in the respiratory tract and in the brains. Symptoms of manganese poisoning are hallucinations, forgetfulness and nerve damage. Manganese can also cause Parkinson, lung embolism and bronchitis. When men are exposed to manganese for a longer period of time they may become impotent.

The mean content of Cr in the soil of the various land uses ranged from 0.001 to 0.009mg/kg (Table 1). The Cr content reported in this study is far lower than those reported in Lagos State by [28] of range 0.24 – 2.20mg/kg. It is also far below the values reported by [23] with range of 1.58 to 347mg/kg. The contents of Cr obtained across the soils are far lower than the values of 80mg/kg maximum permissible level in soil set by EU. Also, the concentrations of Cr in the soils of the various land uses fall within WHO 100mg/kg maximum threshold [24]. It therefore means that the land uses generate low quantities of Cr. The concentration of Cr in the soils may vary considerably according to the natural composition of rocks and sediments that compose them. The levels of chromium in the soil may increase mainly through anthropogenic deposition, as for example atmospheric deposition, also dumping of chromium-bearing liquids and solid wastes as chromium byproducts, ferrochromium slag, or chromium plating baths. The result depicted in Table 1 identifies the order of metal concentration in soil of the sampled land uses is as follows: Fe>Cu>Zn>Mn>Cr>Pb; which implied that Fe and Cu have increased concentrations in soils across the different land uses. Also, the order of land use with increased heavy metal contamination is as follows; mechanic workshop>agricultural>market>residential>institutional>filling station. It therefore means that mechanic workshop and agricultural generate more heavy metal resulting in increased concentrations in the soil.

**Table 1.** Heavy metal contents in soils across land uses.

Land uses	Mean concentration of heavy metal					
	Zn (mg/kg)	Fe (mg/kg)	Pb (mg/kg)	Cu (mg/kg)	Mn (mg/kg)	Cr (mg/kg)
Residential	0.002	0.005	0	0.042	0.019	0.001
Market	0.007	0.113	0	0.048	0.008	0.003
Agriculture	0.061	0.14	0	0.075	0.046	0.007
Institutional	0.003	0.058	0	0.004	0.002	0
Mechanic workshop	0.046	0.3	0.009	0.04	0.016	0.009
Filling station	0.007	0.016	0.006	0.009	0.004	0.003

### 3.2. Association Between Heavy Metals

The information in Table 2 shows the associations between metals in soils across the various land uses in Ojo. This was achieved using Spearman's correlation. The result showed that there were positive and significant associations between Fe and Zn ( $\rho = 0.725$ ,  $p < 0.01$ ), Mn and Zn ( $\rho = 0.658$ ,  $p < 0.01$ ), Mn and Cu ( $\rho = 0.865$ ,  $p < 0.01$ ), Cr and Zn ( $\rho = 0.752$ ,  $p < 0.01$ ), Cr and Cu ( $\rho = 0.666$ ,  $p < 0.05$ ) and Cr and Mn ( $\rho = 0.787$ ,  $p < 0.01$ ). The positive correlation coefficients suggest that an increase in one metal will result in an increase in another metal and vice versa. For instance, an increase in the content of Cr in the soil will bring about a corresponding increase in the content of Mn. This applies to other metals with positive correlation coefficients. The negative correlation coefficients imply that increase in a metal content will result in a decrease in another metal. For instance, an increase in the content of Pb in the soil will bring about a corresponding decrease in the content of Cu. This also applies to other metals with negative correlation coefficients. The positive association between the variables implies that they are likely influenced by similar anthropogenic and natural factors, while the negative associations mean that the various variables are not influenced by similar anthropogenic and environmental factors [29].

**Table 2.** Zero order correlation matrixes.

Variables	Zn	Fe	Pb	Cu	Mn	Cr
Zn	1					
Fe	0.725**	1				
Pb	0.386	0.492	1			
Cu	0.463	0.284	-0.104	1		
Mn	0.658*	0.353	0.000	0.865**	1	
Cr	0.752**	0.542	0.479	0.666*	0.787**	1

\*\*Correlation is significant at the 0.01 level (2-tailed).

\*Correlation is significant at the 0.05 level (2-tailed).

### 3.3. Contamination Factor (CF)

Table 3 showed result of the contamination factor for each element and across different land uses. The result indicated that the mean level of metal contamination ranged from 0.000 to 0.001. Based on Hakanson classification cited in [30], the values across the land uses fall under the category of low contamination factor. These metals had low contamination in the soils of the various land uses implying that the anthropogenic activities carried out in these land uses did not result in soil contamination. It therefore implies that the activities are no threat to heavy metal

generation and pollution. In all, results of the contamination factor imply that the soils in Ojo and across the land uses have low contamination for the respective metals.

**Table 3.** Contamination factor of metal in Ojo soils.

Land uses	Mean contamination factor					
	Zn	Fe	Pb	Cu	Mn	Cr
Residential	0.000	0.000	0.000	0.001	0.000	0.000
Market	0.000	0.000	0.000	0.002	0.000	0.000
Agriculture	0.000	0.000	0.000	0.002	0.000	0.000
Institutional	0.000	0.000	0.000	0.000	0.000	0.000
Mechanic workshop	0.000	0.000	0.001	0.001	0.000	0.000
Filling station	0.000	0.000	0.000	0.000	0.000	0.000

### 3.4. Degree of Contamination of Metal (CDEG)

Table 4 gives information on the mean degree of contamination (Cd) which is the sum of all contamination factors (Cf) for a given set of pollutants [19]. The result showed that the degree of contamination ranged from 0.000 to 0.003 indicating low degree of metal contamination across the different land uses. Looking at the values for respective land uses, it showed that all the land uses portrayed low degree of metal contamination. The percentage of contamination across the land uses showed that 100% of the land uses demonstrated low degree of contamination (LDC). This means that the activities carried out in these land uses do not need to be put under control. This suggests that the human activities around Ojo do not favour heavy metal contamination in soils of the area.

**Table 4.** Mean degree of metal contamination in Ojo soil.

Land uses	Cdeg
Residential	0.001
Market	0.002
Agriculture	0.003
Institutional	0.000
Mechanic workshop	0.002
Filling station	0.001

### 3.5. Pollution Load Index (PLI)

The PLI value in Table 5 was 0 which was below unity ( $>1$ ). This implies the absence of metal pollution. Thus, the PLI of soils in Ojo obtained from different land uses indicates the absence of pollution concern in spite of the numerous human activities in the area.

**Table 5.** Pollution load index (PLI).

Land uses	PLI (mean values)
Residential	0
Market	0
Agriculture	0
Institutional	0
Mechanic workshop	0
Filling station	0

## 4. Conclusions

The study has shown that anthropogenic factors or activities are responsible for the accumulation of heavy metals in Ojo soil, Lagos State. In spite of the diverse human activities, there is no pollution concern of metal in the study soil. This implies that the respective human activities generate low metal in the soil; as such are not threat to metal contamination. This is further portrayed by the low level of metal contamination and degree of metal contamination in soils across the studied land uses. The study shows that the contents of Zn, Fe, Pb, Cu, Mn and Cr are far lower than WHO permissible limits. In today's rapid urbanization and increasing human population, the two important elements that the Town Planners have to deal with are primarily land and water. Rapid urbanization processes has increased the rate of land use changes with inherent implication on heavy metal pollution. The issue of metal pollution has increased rapidly due to the rapid growth of urban population. The result obtained in this study has shown the need of urban planning around Ojoo to maintain the low level of metal contamination.

In trying to effectively plan the city or Lagos State, urban planners need to take into cognizance the environmental implications of allocating a piece of land or an area for development. Such implications or consideration should be on the effects of metal contamination and pollution on available water sources, vegetation and soil and the overall consideration of the human health. Infrastructural developments with inherent metal pollution should be properly monitored and necessary remediation measures put in place. Though, the respective land uses have low heavy metal level. The soils around agricultural land use and mechanic workshop should be monitored to control the gradual buildup of nutrient in the soil. The activities carried out in these two land uses have the potential of increasing the content of heavy metal in the soil if not adequately monitored. The contents of Fe and Cu should be regularly monitored by government agencies because their concentration in the soil is showing some degree of increased in comparison to others. Increased level of these metals can have health effects on the people as well as other biotic elements in the environment.

### **Conflicts of Interest**

The authors declare that there is no conflict of interest regarding the publication of this article.

### **References**

- [1] Tang, Z.; Engel, B.A.; Pijanowski, B.C.; Lim, K.J. Forecasting land use change and its environmental impact at a watershed scale. *Journal of Environmental Management*, 2005, 76: 35–45.
- [2] Goulding, K.W.T.; Blake, L Land use, liming and the mobilization of potentially toxic metals. *Agriculture, Ecosystems and Environment*, 1998, 67, 135–144.
- [3] Hu, B.; Jia, X.; Hu, J.; Xu, D.; Xia, F.; Li, Y. Assessment of heavy metal pollution and health risks in the soil-plant-human system in the Yangtze River Delta, China. *Int. J. Environ. Res. Public Health*, 2017, 14, 1042.
- [4] Usman, S.O.A.; Ayodele, J. T. Bioaccumulation of four heavy metals in leaves of *Calotropisprocera*. *J. Chem. Soc. Nig.*, 2002, 27: 26 – 27.
- [5] Uwah, E.I.; Ndahi, N.P.; Ogugbuaja, V.O. Study of the levels of some agricultural pollutants in soils, and water leaf (*Talinumtriangulare*) obtained in Maiduguri, Nigeria. *J. Appl. Sci. Environ. Sanita*, 2009, 4(2): 71 – 78.

- [6] Li, W.; Wang, D.; Wang, Q.; Liu, S.; Zhu, Y.; Wu, W. Impacts from land use pattern on spatial distribution of cultivated soil heavy metal pollution in typical rural-urban fringe of northeast China. *Int. J. Environ. Res. Public Health*, 2017, 14, 336.
- [7] Beighton, R. Heavy metals in soils: Investigation into an urban area of Bristol. Available online: <http://www.troopers-hill.org.uk/Flora/SoilsInvestigation.pdf> (Accessed: 19/6/ 2016).
- [8] Ashrafzadeh, S.; Lehto, N.J.; Oddy, G.; McLaren, R.G.; Kang, L.; Dickinson, M.D. et al., Heavy metals in suburban gardens and the implications of land-use change following a major earthquake. *Applied Geochemistry* (2017), Available online: <http://dx.doi.org/10.1016/j.apgeochem.2017.04.009> (Accessed: 4/1/ 2017).
- [9] Ekere, N.R.; Ukoha, O. P. Heavy metals in street soil dusts of industrial market in Enugu, South East, Nigeria. *International Journal of Physical Sciences*, 2013, 8(4): 175-178.
- [10] Abad, J. R.S.; Khosravi, H.; Alamdarlou, E. H. Assessment the effects of land use changes on soil physicochemical properties in Jafarabad of Golestan province, Iran. *Bull. Env. Pharmacol. Life Sci.*, 2014, 3 (3): 296-300.
- [11] Çiçek, A.; Koparal, A.S.; Aslan, A.; Yazici, K. Accumulation of heavy metals from motor vehicles in transplanted lichens in an urban area. *Commun. Soil Sci. Plant Anal.*, 2008, 39: 168-176.
- [12] Mondol, M.N.; Chamon, A.S.; Faiz, V.; Elahi, S.F. Seasonal variation of heavy metal concentrations in water and plant samples around Tejgaon Industrial area of Bangladesh. *Journal of Bangladesh Academy of Sciences*, 2011, 35 (1): 19-41.
- [13] Ghorbani, H.; Moghadas, N.H.; Kashi, H. Effects of land use on the concentrations of some heavy metals in soils of Golestan Province, Iran. *J. Agr. Sci. Tech.*, 2015, 17: 1025-1040.
- [14] Utang P. B.; Eludoyin O.S.; Ijekeye C.L. Impacts of automobile workshops on heavy metals concentrations of urban soils in Obio/Akpor LGA, Rivers State, Nigeria. *African Journal of Agricultural Research*, 2013, 8(26): 3476-3482.
- [15] Michael, A.T.; Daniel, U.D.; Jibrin, U.; Benard, A.B. Distribution and variation of heavy metals and soil properties around a mega cement factory in Gboko, Benue State, Nigeria. *International Journal of Science and Technology*, 2015, 4 (7): 351 – 360.
- [16] Mirzaei, R.; Teymourzade, S.; Sakizadeh, M.; Ghorbani, H. Comparative study of heavy metals concentration in topsoil of urban green space and agricultural land uses. *Environ Monit Assess*, 2015, 187:741.
- [17] Yusuf, M.A. Evaluation of heavy metals in the soils of urban and periurban irrigated land in Kano, northern Nigeria. *Bayero Journal of Pure and Applied Sciences*, 2010, 3(2): 46 – 51.
- [18] Saikia, B.J.; Goswami, S.R.; Borah, R.R. Estimation of heavy metals contamination and silicate mineral distributions in suspended sediments of Subansiri River. *International Journal of Physical Sciences*, 2014, 9(21): 475 – 486.

- [19]Yekeen, T.A.; Onifade, T. O. Evaluation of some heavy metals in soils along a major road in Ogbomoso, southwest Nigeria. *Journal of Environment and Earth Science*, 2012, 2 (8): 71 – 79.
- [20]Harikumar, P.S.; Nasir, U.P.; Mujeebu Rahma, M.P. Distribution of heavy metals in the core sediments of a tropical wetland system. *Int. J. Environ. Sci. Te.*, 2009, 6: 225-232.
- [21]Hakanson, L. Ecological risk index for aquatic pollution control: a sedimentological approach. *Water Res.*, 1980, 14: 975–1001.
- [22]Adesuyi, A.A.; Njoku, K.L.; Akinola, M.O. Assessment of heavy metals pollution in soils and vegetation around selected industries in Lagos State, Nigeria. *Journal of Geoscience and Environment Protection*, 2015, 3, 11-19.
- [23]Olukanni, D.O.; Adeoye, D.O. Heavy metal concentrations in road side soils from selected locations in the Lagos Metropolis, Nigeria. *International Journal of Engineering and Technology*, 2012, 2 (10): 1743 – 1752.
- [24]Chiroma, T.M.; Ebewe, R.O.; Hymore, F.K. Comparative Assessment Of Heavy Metal Levels In Soil, Vegetables And Urban Grey Waste Water Used For Irrigation In Yola And Kano. *International Refereed Journal of Engineering and Science*, 2014, 3 (2): 01 – 09.
- [25]Adu, A.A.; Aderinola, O.J.; Kusemiju, V. An assessment of soil heavy metal pollution by various allied artisans in automobile , welding workshop and petrol station in Lagos State, Nigeria. *Science Journal of Environmental Engineering Research*, 2012, 1 – 8.
- [26]Atuanya E.I.; Oseghe E.O. Lead Contamination and microbial lead tolerance in soils at major road junctions in Benin City. *J. Appl. Sci. Environ. Mgt*, 2006, 10 (2): 99 – 104.
- [27]Wuana, R.A.; Okieimen, F. E. Heavy metals in contaminated soils: a review of sources, chemistry, risks and best available strategies for remediation. 2011. Available online: <https://www.hindawi.com/journals/isrn/2011/402647/> (Accessed: 21/2/ 2016).
- [28]Anyakora, C.; Ehianeta, T.; Umukoro, O. Heavy metal levels in soil samples from highly industrialized Lagos environment. *African Journal of Environmental Science and Technology*, 2013, 7(9): 917-924.
- [29]Iwara, A.I.; Njar, G.N.; Deekor, T.N.; Ita, A. E. Effect of Adiabo abattoir on the water quality status of Calabar River in Odukpani, Cross River State, Nigeria. *Continental J. Environmental Sciences*, 2012, 6 (2): 36 – 43.
- [30]Jafaru, H.M.; Dowuona, G.N.N.; Adjadeh, T.A.; Nartey, E.K.; Nude, P.M.; Neina, D. Geochemical assessment of heavy metal pollution as impacted by municipal solid waste at Abloradjei waste dump site, Accra-Ghana. *Research Journal of Environmental and Earth Sciences*, 2015, 7(3): 50-59.



© 2017 by the author(s); licensee International Technology and Science Publications (ITS), this work for open access publication is under the Creative Commons Attribution International License (CC BY 4.0). (<http://creativecommons.org/licenses/by/4.0/>)