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Assessment of Heavy Metal Contamination of Soil around Auto Mechanic Workshops in Anyigba, Kogi State

Ayodeji B Ogunkolu, *Kogi State University, Anyigba*
Ogbole Moses, *Nigeria Defence Academy, Kaduna*
Adewale B Oyetunji, *Nigeria Defence Academy, Kaduna*
Abdulbasit Abudllahi, *Kogi State University, Anyigba*

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Assessment of Heavy Metal Contamination of Soil around Auto Mechanic Workshops in Anyigba, Kogi State.

[1] Ogunkolu Ayodeji Bolade, [2]Moses Ogbole, Oyetunji Adewale Bashir [1]Abudllahi Abdulbasit
[1]Department of Geography and Environmental Studies, Faculty of Social Sciences, Kogi State University Anyigba, Kogi State, Nigeria
[2]Department of Geography and Environmental Studies, Faculty of Arts and Social Sciences, Nigeria Defence Academy, Kaduna State, Nigeria
Corresponding Author Email: princeogunkolu4real@gmail.com

Abstract
This study assessed the heavy metals contamination at soil depth of (0 - 15 cm) in auto mechanic workshop in Anyigba. The laboratory result was subjected to statistical analysis using SPSS for descriptive statistics. The concentrations of the studied metals (Cd-0.32mg/kg, Zn-4.31mg/kg,Fe-6.70mg/kg, Pb-1.43mg/kg, Ni-0.44mg/kg,Cr-0.23mg/kg, Cu-3.90mg/kg, Mn-1.81mg/kg, and As-0.026mg/kg) in the soils from experimental sites were higher than the corresponding values from the control site ((Cd-0.26mg/kg, Zn-3.80mg/kg,Fe-5.40mg/kg, Pb-1.23mg/kg, Ni-0.31mg/kg,Cr-0.16mg/kg, Cu-3.38mg/kg, Mn-1.35mg/kg, and As-0.012mg/kg), and also, higher than the recommended limits given by the World Health Organization (WHO). The soil samples showed remarkably high levels of these metals (Fe, Zn, Cu, Mn, and Pb) above background concentrations. The distribution was in the following order Fe> Zn>Cu>Mn>Pb. Across the sampling locations and profiles, Fe and Zn gave the highest (154.58 mg/kg) while Mn and Pb gave the least (2.54 mg/kg) values respectively. The mechanic workshop soils represent potential sources of heavy metal pollution to the environment. The elevated levels of heavy metals in these soil profiles constitute a serious threat to humans live. The study therefore recommended that comprehensive waste management plan, establishment of mechanic villages and continuous education for the mechanics and users of auto-mechanic workshops should be adopted in the study area

Keywords: Heavy metals, Contamination, Auto Mechanic Workshops, Soil and Environment

Introduction

Soil plays a key role maintaining the proper functioning and sustaining the earth's ecosystems (Young and Crawford, 2004). The survival of mankind is tied on its productivity as a medium for plants to grow (Kabata-Pendias and Mukherjee, 2007). According to Wuana and Okieimen (2011) soil may contaminate through mine tailings, application of fertilizers, disposal of metal wastes, gasoline and paints, waste water irrigation, pesticides, spillage of petrochemicals, among others contribute significantly to soil contamination. Many studies have shown that areas with heavy vehicular traffic and higher tempo of anthropogenic activities of urban settlements have high soils contaminants than those with low vehicular traffic (Adelekan and Alawode, 2011). Activities around auto mechanic workshop can give rise to elevated levels of heavy metals and hydrocarbons in the environment. Based on the study of Ademola and Uchegbu (2010) auto repair activities are one of the major sources of increase in heavy metals concentration in Nigeria and this workshops according to Nwachkwu and Achilike (2010) and Nwachukwu, Feng and Alinner (2011) are widely found in clusters of open land in the vicinity of urbanized and semi-urbanized areas offering services that generates various waste products

Generation of wastes in auto mobile workshops is primarily through anthropogenic (artisan) activities. Such activities include dumping of metal scraps, used batteries, spent lubricants, condemned batteries, packaging materials, used lubricants and worn-out components from automobiles which poses a serious threat to soil and groundwater resources if such activities are not properly regulated and monitored consistently by authorities. Heavy metals emanating from anthropogenic automobile workshop introduce a number of metals into the soil around automobile workshops. Therefore, the improper disposal of this auto mobile waste products such as used engine oil and other solvents causes the gradual and eventual accumulation and ultimately contamination of the soils around the mechanic workshop which poses a serious health concern on the workers as well as impact on ecosystem and biodiversity. Heavy metals such as iron, zinc, selenium, copper manganese etc are nutritionally important to human, help in biochemical processes as well as maintaining normal metabolism in human while most of them while most

of them are deleterious even at trace amount. Therefore, unchecked industrial and human activities around auto-mechanic workshops especially in developing countries may contribute essentially to elevated levels of these metals, in surface and subsurface soils when compared to those contributed from natural processes. According to Ademola and Uchegbu (2010), soils may become contaminated by the accumulation of heavy metals and metalloids through emissions from the rapidly expanding industrial areas, mine tailings, disposal of high metal wastes, leaded gasoline and paints, land application of fertilizers, animal manures, sewage sludge, pesticides, wastewater irrigation, coal combustion residues, spillage of petrochemicals, and atmospheric deposition. Therefore, heavy metals pollution refers to cases where the contents of these elements in soils are higher than the maximum concentration, which has potential harmful effects on human, vegetation and animals.

The increase in automobile repairs/workshops and their activities in Nigeria are partly due to the ever-increasing demand for personal vehicles, most of which are used "Tokunbo" vehicles. These have contributed remarkably to the problem of soil contamination in most cities (Ololade, 2014). A survey of Anyigba community indicates that there are several automobile workshops scattered all over the community from which used engine oils, lubricating oils and other solvents containing petroleum hydrocarbons are indiscriminately dumped or spilled on every available space by artisans in the business of auto-repairs. The number of mechanic shops in Anyigba has increased in recent years owing to the fact that there has been an upsurge in the number of vehicles in recent times. These vehicles as well as other machine parts require servicing when they develop a fault. Each of these workshops usually hosts a variety of artisans such as mechanics, welders, auto-electricians, sprayers and vulcanizes. The activities at the mechanic workshop generate wide varieties of wastes that are indiscriminately dumped on soils thereby contaminating the soil.

Automobiles used oil (waste) contains oxidation products, sediments, water and metallic particles resulting from machinery wears, used batteries, organic and inorganic chemicals used in oil additives and metals (European Environment Agency, 2007). Soil Percolation of leachates from these materials poses threats to groundwater. Unfortunately, information on the impact of automobile mechanics‟ Activities on the ecosystem is still very unavailable. The co-existence of toxic heavy metals and hydrocarbons (HCs) at many of the mechanics contaminated sites all over Nigeria and in other developing countries pose a severe threat to the environment. In fact, the presence of trace elements in soil is increasingly becoming an issue of global concern especially as soil constitutes a crucial component of rural and urban environment (United States Department of Agriculture 2001 and Lim, 2008).

Idugboe, Tawari, -Fufeyin, and Midonu, (2014) studied soil pollution in auto-mechanic villages in Benin City, Nigeria. The study showed pollution in the soils of the auto-mechanic villages which were due to the waste generated in the auto-mechanic market. Chokor and Ekanem (2016) studied the heavy metals contamination profile in soil from automobile workshops in Sapela, Nigeria. In Kogi state, Anyigba to be precise, there is little information as it relates to heavy metal pollution on the soil of auto mechanic workshops. Therefore, it is necessary to determine the concentration of heavy metal in soil around auto mechanic workshop in order to determine its usefulness for agricultural purposes. Unfortunately, there is inadequate information on heavy metals at auto mechanic workshops in Anyigba. Not only workers at these auto mechanic workshops are exposed to these heavy metals but also automobile owners who go for the repair of their automobile. This can likely lead to health hazard on the people especially when the pollution is ignored. Since heavy metals pollutant are released from the activities in these auto mechanic workshops (Loranger et al., 1994, EEA, 2007) and have various effects on human health as well as the environment (Tam and Wong, 2000, Yuan et al., 2004, Mohiuddin et al., 2010), it is important that heavy metal in soil is accessed. Because of the pollution associated with heavy metal at elevated concentration to human lives, soils in the environment. There is a need to know the levels of the heavy metal in this environment. The work is intended to give a base line data for future investigation of activities leading to temporary changes, in concentrations of heavy metals in the vicinity of automobile mechanic workshops in the Anyigba.

Study Area

Anyigba is a town in Dekina Local Government Area of Kogi State, Nigeria. The town is located between latitude 7°27' and 7°31'N and between longitude 7°09' and 7°12'E. Anyigba is also strategically located at the center of Igala land (Kogi East), with a total land area of 225.7 hectares, in which residential land use has the highest used percentage of 137.7 hectares (Adeniyi, 2005 and Musa, 2010). Anyigba is situated in part of the east limb of the Udi Plateau (Iji, 2007). It has a general elevation of 420 meter above sea level. The whole area consists of upper

cretaceous age which is of false embedded shale, sand clays and sand stone. Anyigba consist of deeply weathered regolith which account for the great depth of water table which in most cases approaches 204-300meters (Iji, 2007). Anyigba is located within the tropical area, thus the climate is governed by the processes that controls the tropical climate. However, it can be described as tropical wet and dry (Aw) climate using the Koppen's classification system. The wet season spread over a minimum of seven months and it extends from late April to October with the dry season spanning from November to March. Anyigba is located within the southern guinea savanna and the vegetation can be described as tropical wood land savanna. The soil of this study area is the lateritic type without laterite iron pan layer (Iji, 2007). It is red-yellowish in colour due to excess oxides (sesquioxide) on the surface. They are of the highly weathered type with soil texture of medium to coarse type. According to Ifatimehin et, al., (2006).

The total areal coverage of Anyigba measured 4206 hectares in this study. Five categories of land use types were identified, Vacant Land, Built-up Area, Cultivated Land, Vegetation and Stream. In most Nigerian cities, artisans take advantages of unused spaces, right of ways, easements, open spaces for utilities or facilities, underdeveloped land which are usually rented or arbitrarily occupied to practice their trade. This then mean that there is no regard for land use plans and this compromise the aesthetic quality of the environment. The landuse around auto mechanic workshops are always littered with dumping of metal scraps, used batteries, spent lubricants, condemned batteries, packaging materials, used lubricants and worn-out components from automobiles. These materials pose a serious threat to the soil and groundwater resources in the study area.

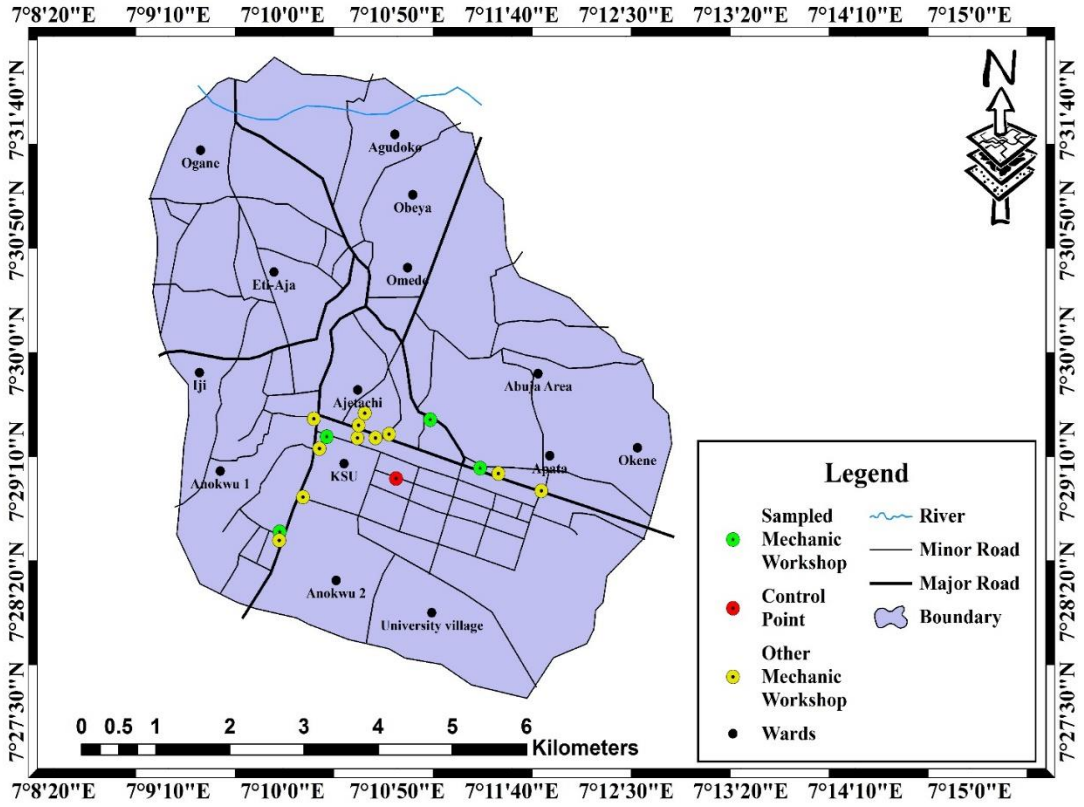

Figure 1: Anyigba the Study Area
Source: Department of Geography and Planning, Kogi State University (2019)

Materials and Methods

The data required for this study included the soil samples from selected auto mechanic workshops, heavy metal characteristics of the soil and environmental conditions observed around sampled locations. Soil samples were collected

at a depth of 0 – 15cm (top soil) using soil auger from 4 different points at the automobile mechanic workshop in order to get a representative sample (composite sample) and transferred directly into clean, sterile containers. A control soil sample was obtained from Kogi State University. The location of the control sample was at the same geology (sedimentary formations) with the study area. Soil for the determination of selected relevant Heavy metals was dried at an ambient temperature range (22 – 26oC), crushed in a porcelain mortar and sieved through a 2 mm (10 mesh size) stainless sieve. One gram of the dried fine soil sample was weighed into an acid washed, round bottom flask containing 10 cm3 concentrated nitric acid (HNO3). The mixture was slowly evaporated over a period of one hour (1) on a hot plate.

Each of the solid residues obtained was digested with a 3:1 concentrated HNO3 and HClO4 mixture for 10 minutes at room temperature before heating on a hot plate. The digested mixture was placed on a hot plate and heated occasionally to ensure a steady temperature of 150°C for over 5 hours until the fumes of $HClO_4$ were completely evaporated (Jacob et al., 2009). The mixture was allowed to cool to room temperature and then filtered using Whitman No.1 filter paper into a 50 cm3 volumetric flask and made up to the standard mark with deionized water after rinsing the reacting vessels, to recover any residual metal. The filtrate was then stored in pre-cleaned polyethylene storage bottles ready for analysis. Then samples for heavy metals content (cadmium, arsenic, copper, lead, mercury, nickel, and zinc) was determined using inductively coupled plasma atomic emission spectroscopy (ICPAES - Thermo Fisher ICAP 6300) as was described by Vittorin et al. (2011) and Adesuyi et al. (2018). The determinations of the heavy metals Cd, Co, Cr, Pb, Fe, Ni and Zn) were performed with from the final solution with the use of Alpha 4AAS, Chemical Tech. Analytical Euro model atomic absorption spectrophotometer. The instrument's setting and operational conditions were done in accordance with the manufacturer's specifications. The instrument was calibrated with analytical grade metal standard stock solutions. The result gotten from the laboratory was subjected to the use of SPSS for statistical evaluation for both descriptive and inferential statistics

Results and Discussions

Concentration of Heavy Metal in the Selected Auto-Mechanic Workshop in Anyigba

Table 1 present the result of heavy metals contamination concentration in the soil in four major auto mechanic workshops in Anyigba. The auto mechanic workshops included University Village (site 1), Old Egume road (site 2), Anyigba /Ankpa road (site 3), Idah road (site 4), and the control which was gotten Kogi State University. The soil was gotten from the depth of 0-15cm from each of the auto mechanic workshops and the control site respectively. Form the study, Copper was present in all the soil samples investigated (see table 1). The higher values of Copper was higher than the one at the control site (kogi State University) and this could be attributed to automobile wastes containing electrical and electronic parts, such as copper wires, electrodes and copper pipes and alloys from corroding vehicle scraps which have consistently littered the vicinity of the study area for a long time, with metals released from the corrosion gradually leaching into the soil through the activities of precipitation This result is corroborating the statement by Adelekan and Alawode (2011) that areas with heavy vehicular traffic and higher tempo of anthropogenic activities of urban settlements have high soils contaminants than those with low vehicular traffic. The result further indicated that there is a significant variation in heavy metals concentration in the soil with respect to the sites. At all sites, higher concentration of heavy metals was observed when compared to the concentrations of heavy metals found at the control site.

Cadmium (Cd)

The concentration of Cadmium (Cd) examined at various auto mechanic workshops showed mean value of.2975±.01708 mg/kg, while the control site shows the concentration of Cadmium to be 0.26mg/kg. The concentration of Cadmium observed at the auto mechanic workshops were found to be higher than that of the control site revealing the impact of automobile wastes in the soil. However, the concentration of cadmium recorded at all sites falls within the permissible limit of 0.5mg/kg which is the standard set by World Health Organization. The implication is that cadmium has low concentration in the soil at both the auto mechanic workshops and the control site respectively. The mean concentration of Cd in the study area was 0.2975 mg/kg (See table 1). This finding of Cd concentration in soil of auto mechanic workshop in Anygba do not conform with the study of Luter et al. (2011) who investigated heavy metals in soils of auto-mechanic shops and refuse dump sites in other parts of Makurdi, Central Nigeria, as well and reported a range of 0.6 - 3.5 mg/kg. The accumulation of Cd in the area studied is likely to come from lubricating oils, vehicle wheels and metal alloys used for hardening of engine parts. The enhanced concentrations of some of the metals may be attributed to the presence of additives consisting of metals in various proportions in lubricants used by auto mechanics. The elevated levels of these

metals in the soil profiles constitute a serious threat to both surface and ground water. High concentration of cadmium can cause dis-functioning of the kidney in man.

Table 1: Concentration of Heavy Metals Concentration in the Selected Areas

parameters	N	A-MW 1	A-MW 2	A-MW 3	A-MW 4	Range	Min	Max	Mean/standard deviation	Control site Kogi State University	WHO Standard(s)
Cd	4	0.29	0.32	0.30	0.28	.04	.28	.32	.2975±.01708	0.26	0.02
Zn	4	4.12	4.31	4.10	3.80	.51	3.80	4.31	4.0825±.21077	3.80	0.02
Fe	4	6.51	6.70	5.90	6.14	.80	5.90	6.70	6.3125±.36013	5.40	30
Pb	4	1.26	1.43	1.32	1.26	.17	1.26	1.43	1.3175±.08016	1.23	0.01
Ni	4	0.31	0.44	0.33	0.32	.13	.31	.44	.3500±.06055	0.31	0.2
Cr	4	0.22	0.21	0.19	0.23	.04	.19	.23	.2125±.01708	0.16	0.02
Cu	4	3.83	3.90	3.79	3.66	.24	3.66	3.90	3.7950±.10083	3.38	2.0
Mn	4	1.76	1.81	1.78	1.73	.08	1.73	1.81	1.7700±.03367	1.35	0.02
As	4	0.023	0.026	0.021	0.018	.01	.02	.03	.0220±.00337	0.012	0.009

Source: Authors Field Survey (2019)

Zinc (Zn)

The concentration of Zinc (Zn) examined at various auto mechanic workshops in the study area showed a range of 3.80-4.31mg/kg with a mean value of 4.0825±.21077mg/kg, while the control site shows the concentration of Zinc to be 3.80mg/kg (see table 1). The concentration of Zinc observed at the auto mechanic workshops were found to be higher than that of the control site revealing the impact of Zinc concentration in the soil. However, the concentration of Zinc recorded at all sites are above the permissible limit of 0.02mg/kg which is the standard set by WHO. The study location has no industry it is thus believed that the increase of Zn levels in the study area was from the auto mechanic shops, since this element is found as part of many additives to lubricating oils. The concentration may be due to factors such as age of the mechanic workshops, volume of work done on each site, types of automobile service or repairs, type of lubricant commonly used, mode of wastes disposal and type of soil. The concentration of Zn in this study is small compared with many other studies (Nwachukwu et al., 2011). Also, Onder et.al; (2003) reported that high concentration of Zinc in heavy traffic zones indicate that fragmentation of car tyres are likely source of the metal. Other possible sources of zinc in relation to automobile traffic in addition to wearing of brake lining are losses of oil and cooling liquid of vehicles and wearing of road paved surface (Osakwe, 2009). The high concentration of zinc recorded in the study area are probably as a result of the access road leading to many towns and many vehicles move to and fro from the towns to Idah and Ankpa road.

Iron (Fe)

The concentration of Iron (Fe) examined at various auto mechanic workshops showed a range of 5.90-6.70mg/kg with a mean value of 6.3125mg/kg, while the control site shows the concentration of Iron to be 5.40mg/kg (Table 1). The concentration of Iron observed at the auto mechanic workshops were found to be higher than that of the control site revealing the effect of automobile activities in the study area. However, the concentration of Iron recorded at all sites falls within the permissible limit of 30mg/kg which is the standard set by WHO. At this level in the soil, Iron has no relative effect on human health and agricultural activities. Although, excessive level of iron can seriously affect flora and fauna in water bodies. The high value of iron obtained agrees with what was obtained by Shinggu et al., (2002).The increase in iron content of the soil might be as a result of waste generated in automobile workshops in the study area which includes solvent, hydraulic fluid, spent lubricants, metal construction works, welding of metals and iron bending. This result corroborates the findings of Adewole and Ucheagbu (2010) where they noted that iron concentration in auto mechanic workshops carried out fall within the permissible limits set by the WHO. They further concluded that Iron is an important plant micronutrient, which is needed for physiological plant growth in small amount but may be increased due to

improper disposal of spent engine oil. Similarly, Aiyesanmi, (2005) observed that fossil fuel products are used leading to excess accumulation of heavy pollution

Lead (Pb)

The concentration of Lead (Pb) examined at various auto mechanic workshops showed a range of 1.26-1.43mg/kg with a mean value of 1.3175±.08016mg/kg, while the control site shows the concentration of Lead to be 1.23mg/kg (table 1). The concentration of Lead observed at the auto mechanic workshops were found to be higher than that of the control site revealing the impact of Lead concentration in the soil. The result from the study is in line with the study of Oguntimehin et al., (2008) who observed that the highest composition of heavy metals is found in waste oils. The values of Pb obtained in this study were lower than the 1162 mg/kg reported by Nwachukwu et al. (2011) for auto mechanic workshop area in Owerri, South-East Nigeria. The high concentration of lead in these areas attested to the overall high level of contamination of the environment with this metal and could easily be attributed largely to the activities in the auto mechanic in the study area. These levels of Pb is elevated by the amount of waste oil, presence of automobile emissions, and expired motor batteries indiscriminately dumped by battery chargers and auto mechanics in the surrounding areas. The result obtained shows a lower soil lead level as compared to what was obtained by Osu and Okereke (2010). The level of heavy metals in soil of auto-mechanic workshop in the study area depends on how long the workshop was established in that particular location. It is possible that these levels of Pb is elevated by the amount of waste oil, presence of automobile emissions, and expired motor batteries indiscriminately dumped by battery chargers and auto mechanics in the surrounding areas. Concern for Pb concentrations in auto-mechanic workshop soils whose level are above 500 µg/g may therefore arise principally due to the fact that the studied auto-mechanic workshop could also be identified as playground or near residential areas where children play about freely, and for children, ingestion of contaminated soil is the most significant pathway for Pb (Chaney, 1989; EPA, 1993). During the developmental years from 12 - 24 months, children are particularly prone to environmental soil Pb through hand-to-mouth behaviour

Nickel (Ni)

The concentration of Nickel (Ni) examined at various auto mechanic workshops showed a range of 0.31-0.44mg/kg with a mean value of.3500±.06055mg/kg, while the control site shows the concentration of Nickel to be 0.31mg/kg. The concentration of Nickel observed at the auto mechanic workshops were found to be higher than that of the control site. However, the concentration of Nickel recorded at all sites falls within the permissible limit of 0.2mg/kg which is the standard set by WHO. At this level in the soil, Nickel's mean is slightly above the standard set by WHO which mean it will have negative impact on human health. These concentrations of Nickel in the study area may be associated with sampling location: auto-mechanical workshops: since other authors such as Onianwa et al., (2001) and Francis, (2005) agreed that the degree of heavy metal pollution in urban areas varied according to location. Airborne particles emitted by brakes and wears from vehicle tyres can contain considerable amounts of nickel.

Chromium (Cr)

The concentration of Chromium (Cr) examined at various auto mechanic workshops showed a range of 0.19-0.23mg/kg with a mean value of .2125±.017080mg/kg, while the control site shows the concentration of Chromium to be 0.16mg/kg. The concentration of Chromium observed at the auto mechanic workshops were found to be higher than that of the control site. However, the concentration of Chromium recorded at all sites falls above the permissible limit of 0.02mg/kg which is the standard set by WHO. At this level in the soil, Chromium contamination in the soil is prominent. The concentration of chromium in the study area are in line with the finding of Victor et al. (2007) where they investigated quality of soil from auto mechanic workshop in Makurdi and as well as the findings of Tijani and Onodera, (2009), where they observed that chromium concentration from automobile soils in Oweri are within the permissible limits set by the WHO standard. However, they are higher than those reported by Oguntimehinl and Ipinmoroti (2008) in their study on evaluation of the status of heavy metal pollution of soil and plant (Chromolaena odorata) of Agbabu bitumen deposit area

Copper (Cu)

The concentration of Copper (Cu) examined at various auto mechanic workshops showed a range of 3.66- 3.90mg/kg with a mean value of 3.7950±.10083mg/kg, while the control site shows the concentration of Copper to be 3.38mg/kg. The concentration of Copper observed at the auto mechanic workshops were found to be higher than that of the control

site. However, the mean concentration of Copper recorded falls above the permissible limit of 2.0mg/kg which is the standard set by WHO. At this level in the soil, Copper has a massive concentration in the soil, which means the soil is contaminated. This result is corroborating with the statement by Adelekan and Alawode (2011) that areas with heavy vehicular traffic and higher tempo of anthropogenic activities of urban settlements have high soils contaminants than those with low vehicular traffic.

Manganese (Mn)

The concentration of Manganese (Mn) examined at various auto mechanic workshops showed a range of 1.73-1.81mg/kg with a mean value of 1.7700±.03367mg/kg, while the control site shows the concentration of Manganese to be 1.35mg/kg. The concentration of Manganese observed at the auto mechanic workshops were found to be higher than that of the control site revealing the impact of Manganese concentration in the soil. However, the concentration of Manganese recorded at all sites are above the permissible limit of 0.04mg/kg which is the standard set by WHO. At this level in the soil, Manganese concentration in the soil is prominent making the soil contaminated at all sites respectively. Manganese (Mn) is one of the elements found in abundant in the earth's crusts and is widely distributed in soils, sediments, rocks and water (Shrivastava and Mishra, 2011). This result is of public health importance as heavy metals in soil are toxic and some of the soluble metals may find their way into soil, rivers, lakes and streams resulting in pollution and may lead to geoaccumulation, bioaccumulation and biomagnifications in the ecosystems. Thus, it's possible for soil pollution to change whole ecosystem (Seifi et al., 2010). Although the levels Manganese (Mn) are above the control site, there was no soil quality criteria established for Mn for now (Karen, 2005). Considering the year of establishment of the auto mechanic workshop clusters and mean concentration observed in the study area as compared with the control sites revealed that the level of Mn in the soils investigated is building up and need to be monitored to prevent any further increase.

Arsenic (As)

The concentration of Arsenic (As) examined at various auto mechanic workshops showed a range of 0.018-0.026mg/kg with a mean value of .0220±.00337mg/kg, while the control site shows the concentration of Arsenic to be 0.012mg/kg. The concentration of Arsenic observed at the auto mechanic workshops were found to be higher than that of the control site revealing the impact of Arsenic concentration in the soil. However, the concentration of Arsenic recorded at all sites falls above the permissible limit of 0.009mg/kg which is the standard set by WHO. At this level in the soil, Arsenic has numerous concentrations in the soil in all sites respectively, meaning the soil in all site are contaminated. The implication of this is that prolong accumulation of arsenic in human causes central nervous system damage and may be detrimental to human health. The levels of arsenic concentration value obtained are higher than those reported by Iwegbue et al., (2013) and Idugbose et al.,(2014).

Sources of Pollution of Auto Mechanic Workshop and the Levels of Concentration Heavy Metals in Mechanic Workshop Within the Study Area

The sources of AMV pollution largely depends on the mechanic personnel, work area and practice. The engine oil of a running engine accumulates heavy metals and when indiscriminately disposed on the soil increases heavy metal load of the top. The heavy metals can also escape the surface of abandoned metal scrap via corrosion and leach into the surrounding soil. AMVs near or within gas stations have also been identified as major sources of heavy metal contaminations. Likewise, improper disposal of lubricating oil, used engine and motor oil by AMV workers is a major contributor of pollution. The environmental pollution caused by AMVs, has been a concern to public environmental health and safety. The common practice of open dumps and uncovered surface landfills in AMVs and adulterated gasoline largely contribute to higher pollution index of AMVs. The non-regularization of gasoline and petroleum product standards may continue to hamper any clean up approach. The reason is because higher concentration levels of Cu, Zn, Mn, Si, V, Mo and Fe are present in regular gasoline and petroleum products sold in Nigeria. They situation continues to deteriorate. For instance; study revealed that liters of used oil are disposed all over the study area which have a devastating consequence. Additionally, spills and leakages, accidents and sabotage often compound the problem. The non-implementation of environmental laws, bribery and corruption creates room for more challenges. Again, the jammed traffic flows at AMVs can increase vehicular exhaust emissions. Such vehicular emissions will eventually end up in soils or inhaled by humans. In the soil, studies have shown bioaccumulation of metals (Fe, Ni, Mn, Zn, Cu, Cd, Cr and Pb) at different concentrations in certain medicinal plants. Factors such as pH, organic matter, moisture content were at

favourable conditions to these pollutants. Similarly, oil effluents disrupt the physicochemical balance of the soil and affect soil degrading bacteria in the soil likewise soil invertebrates like earthworm and millipede. Also, the abundance of oil tolerant plants such as metal excluders or detoxifiers (Amaranthus Spinosus and Amaranthu shybridus) in AMVs indicates that spent oil type of pollution is prevalent in AMVs. Lichens are also common in AMVs and often indicate high levels of heavy metals pollution from battery, oil leakage and worn out tyre sources. On the other hand, artisans' activities in AMVs often contribute to indiscriminate disposal of wastes on the top soil and will eventually cause groundwater contamination. These unregulated activities reduce bioavailability of essential nutrients to plants in the soil, while increasing bioaccumulation of non-essential elements. Also, the absence of personal protective equipment endangers the AMV workers especially during servicing of malfunctioning vehicles and disposal of used engine oil. Thus, the sources of pollution in AMVs are numerous, prevalent and non-specific.

In order to have an idea about the levels of contamination of the soil which can be used for agricultural purposes, and now used as auto mechanic workshops, data obtained were compared with that from the control sample point. This implies that the operations of the mechanic shops around the agricultural sites are contributing to the increased concentration of heavy metals in the soil. The concentrations of all the heavy metals studied were above the background concentration level in the control soil indicating pollution. According to Puyate et al. (2007) the background value of an element is the maximum level of the element in an environment beyond which the environment is said to be polluted with the element. The average levels of these metals in the soil, in the auto-mechanic clusters indicate that they are not derived from the natural geology of the area as evident from the low level of metals in control samples. The heavy metals showed an increased distribution pattern of Pb>Fe>Cu>Mn>Cd>Zn as presented in Figure 2.

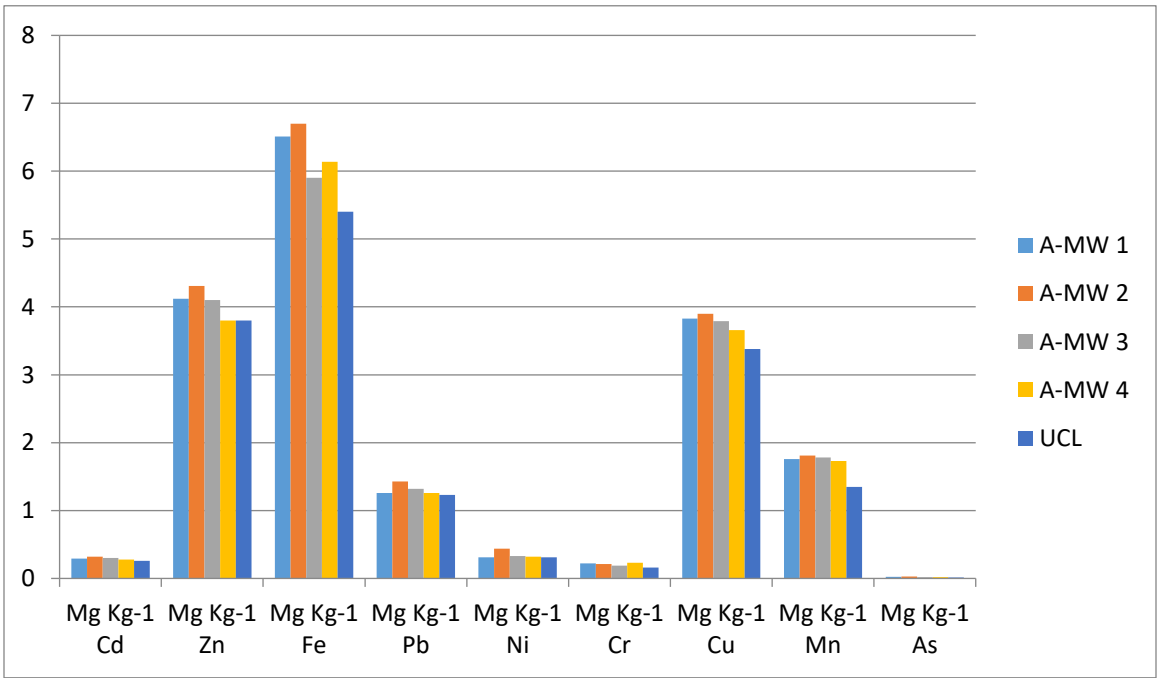

Figure 2: Concentrations of heavy metals at various auto mechanic workshops
Source: Authors Field Survey (2019)

The investigation in this study revealed that the soil in the auto repair workshop comprising auto-mechanic units and other allied artisans is grossly polluted with iron and lead. Phytoremediation is however recommended so as to remove these metals from the contaminated soil. The heavy metal contamination of the experimental soils obviously comes from the activities of the auto mechanic shops sounding the site. The high organic matter content which favour heavy metal binding might have contributed to the high levels of the studied metals and hence the contamination of the soil. If the increasing trend continues it could deteriorate the soil when the contaminants exceed the maximum acceptable limits.

Therefore, the auto mechanic workshops have negative effect on the soil through heavy metal contamination. The mechanics should be taken through safe disposal of their waste from their operations so as to limit the discharges which contain these heavy metals. Examination of levels of heavy metals in the crops grown at the experimental site and the effect on the growth and the yield is recommended for further studies

Auto-mechanic workshop 1 shows that Fe (Iron) is more concentrated in the soil with the value of 6.51mg/kg, while Zn (Zinc) with the value of 4.12mg/kg, Cu (Copper) with the value of 3.83mg/kg, while Mn (Manganese) with the value of 1.76mg/kg, Pb (Lead) with the value of 1.26mg/kg, Ni (Nickel) has the value of 0.31mg/kg, Cd (Cadmium) with the value of 0.29mg/kg, Cr (Chromium) with 0.22mg/kg and As (Arsenic) with 0.0023mg/kg which is the lowest in this workshop with the distribution pattern of Fe>Zn>Cu>Mg>Pb>Ni>Cd>Cr>As. The soil sample taken from auto-mechanic workshop 2 indicates that Fe (Iron) is more concentrated in the soil with the value of 6.70mg/kg, while Zn (Zinc) with the value of 4.31mg/kg, Cu (Copper) with the value of 3.90mg/kg, while Mn (Manganese) with the value of 1.81mg/kg, Pb (Lead) with the value of 1.43mg/kg, Ni (Nickel) has the value of 0.44mg/kg, Cd (Cadmium) with the value of 0.32mg/kg, Cr (Chromium) with 0.21mg/kg and As (Arsenic) with 0.0026mg/kg which is the lowest in this workshop with the distribution pattern of Fe>Zn>Cu>Mg>Pb>Ni>Cd>Cr>As. Auto-mechanic workshop 3 indicates that Fe (Iron) is more concentrated in the soil with the value of 5.90mg/kg, while Zn (Zinc) with the value of 4.10mg/kg, Cu (Copper) with the value of 3.79mg/kg,while Mn (Manganese) with the value of 1.78mg/kg, Pb (Lead) with the value of 1.32mg/kg, Ni (Nickel) has the value of 0.33mg/kg, Cd (Cadmium) with the value of 0.30mg/kg, Cr (Chromium) with 0.19mg/kg and As (Arsenic) with 0.0021mg/kg which is the lowest in this workshop with the distribution pattern of Fe>Zn>Cu>Mn>Pb>Ni>Cd>Cr>As. Auto-mechanic workshop 4 shows that Fe (Iron) is more concentrated in the soil with the value of 6.14mg/kg, while Zn (Zinc) with the value of 3.80mg/kg, Cu (Copper) with the value of 3.66mg/kg, while Mn (Manganese) with the value of 1.73mg/kg, Pb (Lead) with the value of 1.26mg/kg, Ni (Nickel) has the value of 0.32mg/kg, Cd (Cadmium) with the value of 0.28mg/kg, Cr (Chromium) with 0.23mg/kg and As (Arsenic) with 0.0018mg/kg which is the lowest in this workshop. Leading to the distribution pattern of Fe>Zn>Cu>Mn>Pb>Ni>Cd>Cr>As. While at the control site all Fe, Zn and Cu are prominent in this site and the lowest is As (Arsenic).

Conclusion and Recommendations

This research determined the levels of some important heavy metals at 0-15cm depth of the soils sampled. The combined use of different approaches for evaluating soil heavy metal contamination facilitates a comprehensive interpretation of the soil characteristics in terms of the background influences. The auto mechanic workshop environment is getting polluted, particularly with Fe, Zn, and Cu, based on the concentration of heavy metal. This is a reflection of anthropogenic contribution which might partly result from the use of metal containing additives as lubricants. The mechanic workshop environment is getting polluted, particularly with Pb, Ni and Cd based on the enrichment factor. This is a reflection of anthropogenic contribution which might partly result from the use of metal containing additives as lubricants. There was an indication of an uneven distribution of the metals in soils from various locations, though there was no significant difference in metal distributions between them. Consequent upon our findings, it is recommended that

- Continuous monitoring and further studies on the level of these heavy metals should be carried out in the near future and at intervals to ascertain long-term effects of this anthropogenic impact. This should also involve larger coverage with studies on nearest surface water around such locations.
- That government should provide appropriate places that will serve as automobile village where auto repairs are kept at safe distances from human habitation. This may not be necessary in developed countries where measures are already put in place to legislate against deposition of metal pollutants.
- Education and legislation on management of wastes in place such as auto-mechanic workshops should be intensified to forestall the effects of heavy metal related wastes on the environment, particularly on groundwater.

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