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DETERMINATION OF THE PRESENCE AND LEVEL OF HEAVY METALS IN SOILS OF AUTOMOBILE WORKSHOPS IN AWKA, ANAMBRA STATE

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ABSTRACT: *This study determined the presence and levels of heavy metals in automobile workshop soils in Awka Anambra state. Soil samples were collected from four automobile workshops. The soil samples were analysed for heavy metal contents; Lead (Pb), Manganese (Mn), Zinc (Zn), Nickel (Ni), Copper (Cu), Chromium (Cr), Mercury (Hg), and Iron (Fe). The soil samples were digested and the filtrate subjected to quantitative analysis using Atomic Absorption Spectroscopy (AAS). One-way Anova, and one sample t-test, were used to test the hypotheses postulated. The results indicated the presence of all the metals under consideration in the soil samples. The concentrations of the metals in the soils of the automobile workshops were compared with NESREA (National Environmental Standards and Regulations Enforcement Agency) standard and the result showed that Cu in sample A was greater than the standard while others were below it; Cr in sample D was lower than the standard while others were above it; metal contents of Zn, Pb, Cd, and Ni in all samples were below the standard while Fe and Mn limits were not specified by NESREA. The study concluded that the activities of automobile workshops contaminate soil with heavy metals which automatically have direct and indirect effect man as it can be transported through the food chain. It is hence recommended that: regulatory bodies be set up to monitor the activities of automobile workshops and policies be enacted whereby automobile workshops should be located very far from residential areas. Further research should be carried out to ascertain the effects of those heavy metals on plants, groundwater, and human health.*

KEYWORDS: presence and level, heavy metals, soils, plants, automobile

INTRODUCTION

Background to the Study

A heavy metal is any element (metal or metalloid) that has high density. Heavy metals are natural constituents of the earth's crust, but indiscriminate human activities have drastically altered their deposition, geochemical cycles and biochemical balance. This results in accumulation of metals in soils and plant parts. Heavy metals, when introduced into the natural and built environment become pollutants which in turn deplete the quality of the environment and threatens the stability of the ecosystem. Major sources of heavy metals are weathering, agricultural and industrial activities, as well as automobile workshops (Khan, Cao, Zheng, Huang, and Zhu, 2008; Iwuoha, Osuji, and Horsfall, 2012).

Literatures reviewed showed that Heavy metals contaminate soils, plants and water bodies and become a threat to the survival of man (Singh and Kalamdhad, 2011). This has become a global concern especially in the oil producing regions of the world. An example of the catastrophic impact

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of heavy metals and other hydrocarbons was seen in the Exxon Valdez oil spill which occurred in Prince William Sound, Alaska, on March 24, 1989 with an estimated crude oil spill of between 260,000 to 750,000 barrels (Samuel and William, 1989). Prolonged exposure to heavy metals such as Cadmium, Copper, Lead, Nickel, and Zinc can cause deleterious health effects in humans. On a global scale, environmental pollution resulting from heavy metal contamination has become a great threat to both the biotic and abiotic components of the environment. In 1956, cases of minimata disease were reported in Japan (Harada, 1995). The disease affects the brain by causing insanity and leading to death. This is as a result of water pollution by industrial effluents which contained methyl mercury.

Plants have the ability to take up and sequester heavy metals and other hydrocarbons and hence, pose health risk and hazards to humans and the ecosystem through direct injection or contact with contaminated soil, the food chain (soil-plant-human or soil-plant-animal-human), drinking of contaminated ground water, reduction in food quality (safety and marketability) via phytotoxicity, reduction in land usability for agricultural production causing food insecurity, and land tenure problems (McLaughlin, Zarcinas, Stevens & Cook, 2000; and Ling, Shen, Gao, Gu & Yang, 2007). The adequate protection and restoration of soil ecosystem contaminated by heavy metals require their characterization and remediation. The main threats to human health from heavy metals are associated with exposure to lead, cadmium, mercury and arsenic.

Statement of the Research Problem

Generally, petroleum based activities such as oil prospecting, processing, distribution and auto mechanic workshops have been shown to generate heavy metals and hydrocarbon pollutants, which may disperse throughout the environment, leading to serious pollution problems (Okoye, Aso, and Tifwa, 2017). Some of the substances remain highly recalcitrant to biodegradation processes (EeLuiAng and Jeffrey, 2004).

Nigeria as a nation is faced with problems of heavy metal contamination especially in the most industrialized cities of the country. In early 2010, there was a case of Lead poisoning in Northern Nigeria. Ducks began to disappear in Zamfara as well as children became sick, suffering from vomiting, abdominal pain, headaches and seizures. After some periods of becoming ill, many of these children died. Investigations was conducted by a team from CDC-Nigeria (Centers for Disease Control and prevention), Nigerian Federal Ministry of Health, Nigerian Field Epidemiology and Laboratory Training Program, The World Health Organization and Medicine Sans Frontiers. They found out that water in most homes and community wells had high levels of Lead and children also had dangerous levels of lead in their blood (https://www.cdc.gov/onehealth/in-action/lead-poisoning.html).

Urbanization, technology and modernization resulting from diverse institutions coupled with the fact that Awka is a capital city; has led to the influx of people in search of white collar jobs or greener pastures. There are several automobile workshops in Awka to meet the vehicular needs of the populace. Most of these workshops are indiscriminately sited around homes and business premises. Awka does not have a general mechanic village as is found in other towns like Owerri, Abakaliki, Kaduna, Markurdi, and the host of others; that is to say that Awka mechanic workshop owners have the liberty to site their workshops wherever they so wish. They can one day, decide to convert the workshop to residence.

Used motor oils, metal scraps and chippings are being disposed into gutters and drains and they go directly to the soil of these workshops and pollute it, introducing diverse heavy metals and hydrocarbons into the soil which invariably, affects the physiochemical characteristics of the soil, making it unfit for agricultural purposes. Wash ups and storm water from these automobile workshops run into water bodies, others percolate downwards to the ground water sources and pollutes it. Some of the pollutants contained in these automobile workshop wastes are transferred to plants through the soil and water. This is because plants have the ability to extract and take up metals and hydrocarbons from soil and water. These pollutants will eventually get to man through the food chain and might result to metal poisoning. When used oils are poorly disposed off and if they contain some trace metals and other pollutants, it may pose great threat to human life and the environment (Angela, Chidiogo, Ifeanyi, Harriet, and Patrick, 2011).

Some plants (especially vegetables) grown in the polluted environment have the ability to absorb particulate trace metals from air, while some take up these trace metals directly from the soil through their roots. Eating of these plants by man and animals will introduce these metals into their body system, these metals in turn exert different degrees of toxicity particularly when they bio-accumulate in the body or bio-magnify among organisms (Foy, Chaney, and White, 1978).

Several works have been done on heavy metal contamination of soils of automobile workshops and its impacts on various properties of the soil in different cities of the country including Onitsha but very few looked at its presence and levels in soils. This work, therefore, is aimed at determining the presence and level of heavy metals in soils of automobile workshops in Awka, Anambra State. This will really be useful in recommending measures that would ensure the protection of the environment and the welfare of the people.

Aim and Objectives

Aim: The aim of this study was to determine the presence and level of heavy metals in soils of automobile workshops in Awka, Anambra state.

Objectives: To achieve this aim, the following objectives were pursued:

1. to identify the presence and levels of heavy metals in the soils of the selected automobile workshops and the control nearby soil, and
2. to compare the metal concentrations of automobile workshop soils with NESREA standards.

Research Hypotheses

1. H_0: There are no metal concentrations in soils from automobile workshops.
2. H_0: The heavy metal concentrations of the automobile workshop soils are not significantly above NESREA permissible limits.

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Study Area

Awka, the capital of Anambra state was the study area. It is located between latitudes 6° 13'N and 6° 15'N and longitudes 7° 4'E and 7° 6'E. Awka city is located in Awka South Local Government area of Anambra state. Awka is bounded by Okpuno in the North-West, Amansea in the North-east, Nibo and Amawbia in the South-west and Ezinato and Isiagu in the South-east. Awka is located between two major cities of Onitsha and Enugu which has informed its choice as an administrative centre for the colonial authorities and today as a capital for the Anambra state.

According to Anambra state Ministry of Lands, it has an area of approximately 1,592,500m^2 or 159.25 hectares. It comprises of many areas that are being linked up by major and minor streets. Awka has an estimated population of 301.657 according to the 2006 Nigerian census (Nigerian Population Commission). The Imo Shale and Nanka Sand are capped by thick lateritic soils formed by the leaching and ferruginization of the top layers. The lateritic soils may be up to 15 m thick as seen in sand pits, roadsides, sections of gullies, valleys and stream channels. The soils are grey, yellow, brown and predominantly reddish in colour. NA typical profile starts from a zone transitional from the bedrock. In this zone the white colour of the fresh bedrock is changing to yellowish and/or brownish and the stratification structures are becoming faint. Above this there may be a mottled zone with the colour becoming progressively better defined as reddish brown to yellowish brown. This is the lateritic soil within which there may be differentially better consolidated boulders of ferruginous sandstone often quarried as building stone or for concrete aggregate. There may also be a progression of the process to the formation of the laterite crust which may assume textures from massive to scoreacious or vermiform. The topmost layer is usually the dark coloured topsoil with some humus (www.google.com/Awkacityrelief.html)

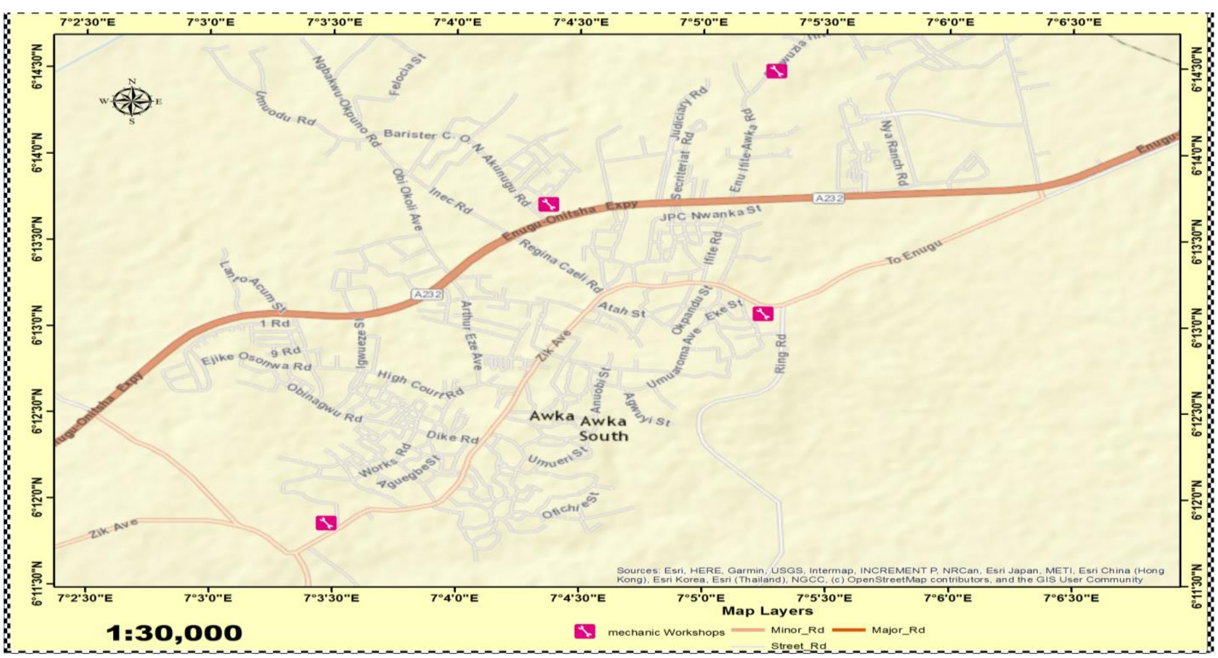

Fig 1.1: Map of Awka showing study area
Source: Excel Gis lab, Awka (2019)

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LITERATURE REVIEW

This section discusses the findings from literatures as it pertains to this study.
The mechanic workshops as well as automobile waste dumps represent potential sources of heavy metal pollution to environment. Automobile workshops introduce a lot of heavy metals to the soil such as lead, arsenic, cupper and a host of others (Olanrewaju, Samuel, and Innocent, 2015; Pivic *et al*, 2014; Ojiako, and Okonkwo, 2013)). Heavy metals contained in soils of automobile workshop could be transferred indirectly to humans through consumption of contaminated plants and these results to both chronic and acute effects on human health (Hanna *et al*, 2000). This is because plants have the ability to take up trace metals from soils. Iwegbue, Isirimal, Igwe, and Williams. (2006) carried out a study on the Characteristic levels of heavy metals in soil profiles of automobile mechanic waste dumps in Nigeria. Soil samples were subjected to laboratory analyses where characteristic levels of heavy metals (Cd, Cr, Cu, Pb, Ni and Zn) of soil profiles of the automobile mechanic waste dumps were studied. The study found out 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 the background concentrations and limits for agricultural and residential purposes. Several studies have shown that activities in automobile workshops produce heavy metals which contaminate soils at varying degrees (Chinenye, Funke and Nnenaya, 2018). Some of them are present in soils of automobile workshops at levels beyond the permissible limits.

The impact of Automobile workshops on its immediate environment especially in areas with improper environmental disposal procedures can be devastating. In some area like the Warri/ Effurun, Nigeria auto-mechanic village, the concentrations of the metal were found to exceed most of the permissible limits (Samuel, Onoriode, Patience and Cordelia, 2015). Hence, the soil environment around the mechanic villages can be said to be polluted with various heavy metals. Studies reveal that majority of heavy metal concentrations of soil samples from automobile workshops were above background levels and threshold limits recommended for soils in some countries; such as the case of North Bank Mechanic Village Makurdi, Benue State, Central Nigeria (Aloysius, Rufus and John, 2013). When compared with soils from nearby control sites, heavy metal contents of soils from automobile workshops those from the automobile workshops are often higher (Olayiwole, 2011).

CONCEPTUAL FRAMEWORK

Concept of Environmental Quality

Environmental quality is a set of properties and characteristics of the environment, either generalized or local, as they impinge on human beings and other organisms. It is a measure of the condition of an environment relative to the requirements of one or more species and or to any human need or purpose (Johnson, Ambrose, Bassett, Crummey, Isaacson, Johnson, Lamb, Saul, and Winter, 1997). Environmental quality is a general term which can refer to varied characteristics that relate to the natural environment as well as the built environment, such as air and water purity or pollution, noise and the potential effects which such characteristics may have on physical and mental health caused by human activities. Environmental sustainability is the process of making sure current processes of interaction with the environment is as clean as naturally possible. An "unsustainable situation" occurs when natural capital is used up faster than it can

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be replenished naturally. Sustainability requires that human activity only uses nature's resources at a rate at which they can be replenished naturally. As buttressed by Ezeonu, Richard, Ephraim, Anike, and Ikechukwu, (2012), Africa generally and Nigeria in particular should imbibe maximally the benefit of using biotechnology in the maintenance of the quality of the environment.Environmental quality has always been one of the most important components of the quality of life (Rusen, 2012). The quality of environment really means the quality of life; it cannot be overemphasized. In Nigeria as a developing country, there is need to maintain the quality of our environment while we carry on with our developmental activities. The environment belongs to everyone and it is no secret that man today faces an environment that is hostile to his aspirations for a better life. Clearly the final answer lies in adherence to law governing the use of our resources of which land is an integral part. Thus, in shaping our environment for the enhancement of life, the interaction of technology and humanity should be at its core. It then becomes a necessity to device best management practices that address this issue and improve the quality of our environment which will eventually improve man's health.

Suffice it to say that the activities carried out in automobile workshops have direct impact on the environment which will eventually get to man through the food chains as seen in fig 1.2. The conceptual model provides an overview of the expected sources and waste generated into soil within the automobile mechanic sites and how it will impact on the quality of the environment. High concentrations of these Heavy Metals when compared with the permissible limits poses danger to human health and other animals and thus, since man is the only polluter of his own surrounding, soil pollution can be controlled by putting up many pollution awareness programs, enforcing laws and corresponding penalties on defaulters (Aloysius *et al*, 2013).

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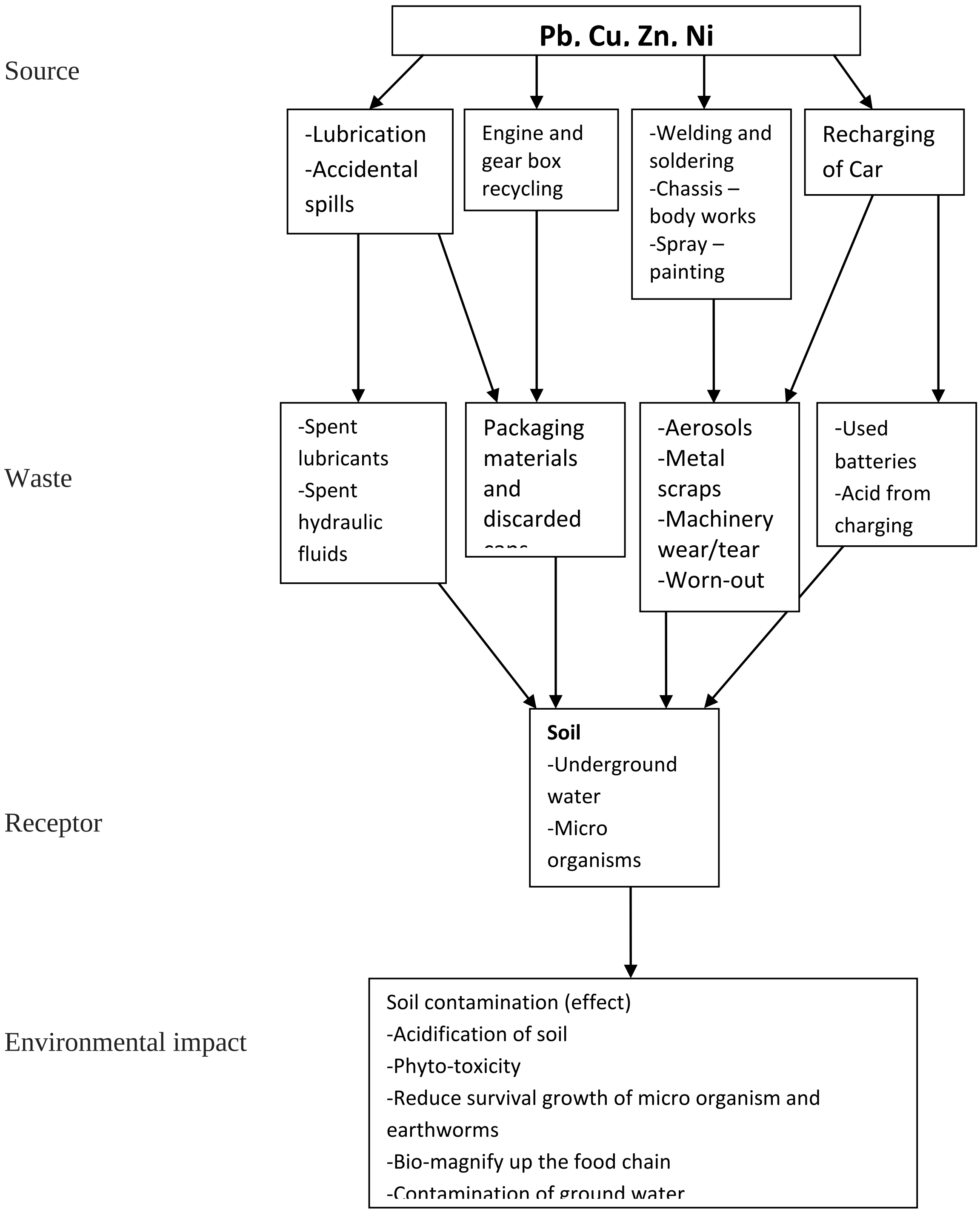

Fig. 1.2: A conceptual model for waste generation in automobile mechanic sites and the environmental impacts.
Source: Aloysius, (2013)

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Vol.9, No.3 pp.18-32, 2021
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METHODOLOGY

Experimental research design was employed in this study. Soil samples were selected from automobile workshops which have lasted for about five years and above. All the soil samples were subjected to laboratory analysis to obtain their heavy metal contents. The laboratory analyses comprised of well-articulated and selected heavy metals (Pb, Hg, Ni, Cr, Cu, Mn, Fe, and Zn) that produced relevant result. The instruments used for this study was the Atomic Absorption Spectrophotometer (AAS) Bulk Scientific210/211 model. The data on NESREA standards on heavy metal permissible limits was also obtained.

The purposive sampling technique was employed in this study. Purposive sampling technique is a non-probability sampling method where the researcher will select aspect of the population on purpose. The researcher used this sampling method to purposively select four (4) automobile workshops which have lasted for about five (5) years which then constitute the sample size. The automobile workshops are:

I. Ifeco mechanic workshop, Nwangele Street, opposite prison, Awka (Sample A).
II. Ekene mechanic workshop, opposite glass house Amenyi (Sample B).
III. Auto mechanic workshop, adjacent to St. Anthony Catholic Church, Ifite (Sample C).
IV. Mechanic workshop cluster along Nnamdi Azikiwe expressway, after Roban Stores junction (Sample D)

This study was conducted with air dried 2mm sieved surface soil samples (0-15cm) collected from selected automobile workshops in Awka. Surface soil was used since Justin and Vivek, 2010; Ololade, 2014, reported that maximum contamination of heavy metals takes place in the top layers of the soil. Soil samples were collected using shovel and scoop (U.S EPA SOP, 2012). Composite sampling method was used for the collection of soil samples from the automobile workshops so as to get a good representation of the whole. These samples were kept in a clean airtight polythene bags immediately after sampling and transported to the laboratory for analysis of their heavy metal contents. The polythene bags were appropriately labeled with masking tape indicating soil from each automobile workshop. The laboratory used was Biotechnology laboratory, Nnamdi Azikiwe University (for heavy metals analysis).

PRESENTATION OF RESULTS/ ANALYSES

This section deals with the presentation and analysis of the primary and secondary data collected from experimental survey.

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Data presentation and analysis

1. To identify the presence and level of heavy metals in the soils of the selected automobile workshops.

Table 4.1: laboratory result of soil samples from the various automobile workshops soils.

SAMPLES / PARAMETERS	SAMPLE A	SAMPLE B	SAMPLE C	SAMPLE D
Fe (mg/kg)	1631.8	1579.95	1595.8	112.65
Cu (mg/kg)	197.5	77.6	62.5	0.4
Zn (mg/kg)	25.3	24.3	13.7	10.37
Mn (mg/kg)	11.15	4.35	4.55	10.1
Pb (mg/kg)	39.95	20.15	13.75	21.9
Cr (mg/kg)	241.05	133.7	143.35	0.33
Cd (mg/kg)	2.9	2.5	2.55	0.21
Ni (mg/kg)	4.1	6.4	6.35	8.64
Average	269.22	231.12	230.32	20.58

Source: researchers field work, 2019.

Key: Iron (Fe), Copper (Cu), Zinc (Zn), Manganese (Mn), Lead (Pb), Chromium (Cr), Cadmium (Cd), and Nickel (Ni).

Sample A- Ifeco mechanic workshop, Nwangele Street, opposite prison, Awka.
Sample B- Ekene mechanic workshop, opposite glass house Amenyi.
Sample C- Automechanic workshop, adjacent St. Anthony Catholic Church, Ifite.

Sample D- Mechanic workshop cluster along NnamdiAzikiwe expressway, after Roban Stores junction.
From the table 4.1, Iron (Fe) was highest in sample A and lowest in Sample D; Cupper (Cu) was highest in sample A and lowest in Sample D; Zinc (Zn) was highest in sample A and lowest in Sample D; Manganese (Mn) was highest in sample A and lowest in Sample B; Lead (Pb) was highest in sample A and lowest in Sample C; Chromium (Cr) was highest in sample A and lowest in Sample D; Cadmium (Cd) was highest in sample A and lowest in Sample D; while Nickel (Ni) was highest in sample D and lowest in Sample A.

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2. To compare the metal concentrations of the automobile workshop soils with NESREA standards.
Table 4.2 laboratory result of soil samples from the various automobile workshops soils and NESREA's standard.

SAMPLES / PARAMETERS	SAMPLE A	NESREA STANDARDS	SAMPLE B	NESREA STANDARDS	SAMPLE C	NESREA STANDARDS	SAMPLE D	NESREA STANDARDS
Fe (mg/kg)	1631.8	NS	1579.95	NS	1595.8	NS	112.65	NS
Cu (mg/kg)	197.5	100	77.6	100	62.5	100	0.4	100
Zn (mg/kg)	25.3	421	24.3	421	13.7	421	10.37	421
Mn (mg/kg)	11.15	NS	4.35	NS	4.55	NS	10.1	NS
Pb (mg/kg)	39.95	164	20.15	164	13.75	164	21.9	164
Cr (mg/kg)	241.05	100	133.7	100	143.35	100	0.33	100
Cd (mg/kg)	2.9	3	2.5	3	2.55	3	0.21	3
Ni (mg/kg)	4.1	70	6.4	70	6.35	70	8.64	70
Average	269.22		231.12	NS	230.32		20.58	

Source: researchers field work, 2019.
NESREA STANDARDS: National environmental (chemical, pharmaceutical, soap, and detergent manufacturing industries) regulation, 2009.
Key: Iron (Fe), Copper (Cu), Zinc (Zn), Manganese (Mn), Lead (Pb), Chromium (Cr), Cadmium (Cd), Nickel (Ni) and NS (Not Specified).
From the table 4.2,

Iron (Fe) and Manganese (Mn) has no comparison because their values were not specified by Nesrea.
In sample A, Cupper (Cu) was greater than the permissible limit; Zinc (Zn) was lower than the permissible limit; Lead (Pb) was lower than the permissible limit; Chromium (Cr) was greater than the permissible limit; Cadmium (Cd) was lower than the permissible limit and Nickel (Ni) was lower than the permissible limit.
In Sample B, Cupper (Cu) was lower than the permissible limit; Zinc (Zn) was lower than the permissible limit; Lead (Pb) was lower than the permissible limit; Chromium (Cr) was greater than the permissible limit; Cadmium (Cd) was lower than the permissible limit and Nickel (Ni) was lower than the permissible limit.
In Sample C, Cupper (Cu) was lower than the permissible limit; Zinc (Zn) was lower than the permissible limit; Lead (Pb) was lower than the permissible limit; Chromium (Cr) was greater than the permissible limit; Cadmium (Cd) was lower than the permissible limit and Nickel (Ni) was lower than the permissible limit.
In Sample D, Cupper (Cu) was lower than the permissible limit; Zinc (Zn) was lower than the permissible limit; Lead (Pb) was lower than the permissible limit; Chromium (Cr) was lower than the permissible limit; Cadmium (Cd) was lower than the permissible limit and Nickel (Ni) was lower than the permissible limit.

TEST OF HYPOTHESIS

Hypothesis one: The heavy metal concentrations of the soils from the automobile workshops are not significantly different.

Statistical Tool Used: One–way ANOVA

Degrees of Freedom: 31.

Decision Rule: Accept the null hypothesis if the p–value is greater than or equal to 0.05.

Test Proper: The result (output) of test is presented in table 3 as shown.

Table 4.3: ANOVA for hypothesis one

Heavy metals from automobile workshops

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	306220.571	3	102073.524	.444	.723
Within Groups	6433484.506	28	229767.304		
Total	6739705.078	31			

Decision and Conclusion: From table 4.20, the p–value of the ANOVA test is 0.723, which is greater than 0.05. This means that the heavy metal concentrations of the soils from the automobile workshops are not significantly different from each other; that is, the concentrations of the heavy metals of the workshops are the same in the four locations, and none of the locations has significantly higher concentration than the other. With this, we accept the null hypothesis.

Hypothesis two: The heavy metal concentrations of the automobile workshop soils are not significantly above NESREA permissible limits.

Statistical Tool Used: One Sample T–Test

Degrees of Freedom: 3.

Decision Rule: Accept the null hypothesis if the p–value is greater than or equal to 0.05.

Test Proper: The result (output) of test is presented in appendix C.

Table 4.4: Results for hypothesis three

S/No	Parameter	NESREA Standard	Mean	P–Value	Remark
1	Fe (mg/kg)	NS			
2	Cu (mg/kg)	100	84.50	0.732	Below standard
3	Zn (mg/kg)	421	18.4175	0.000	Significantly above standard
4	Mn (mg/kg)	NS			
5	Pb (mg/kg)	164	23.9375	0.000	Significantly above standard
6	Cr (mg/kg)	100	129.6075	0.592	Below standard
7	Cd (mg/kg)	3	2.0400	0.217	Below standard
8	Ni (mg/kg)	70	6.3725	0.000	Significantly above standard

Decision and Conclusion: From table 4.21, we can see that two heavy metals (Fe, and Mn) do not have any standard set by NESREA while others have their minimum permissible limits as set by NESREA. We can

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also observe that copper (Cu), chromium (Cr), and cadmium (Cd) have their concentrations to be below NESREA standard and at the same time not significant. Then zinc (Zn), lead (Pb) and nickel (Ni) all have their mean concentrations to be significantly above NESREA standards. The conclusion here is that the heavy metal concentrations of the soils are not significantly above NESREA permissible limits; with this, the null hypothesis will be upheld. Nevertheless, it should be known that heavy metals have the ability to bioacccumulate and biomagnify. Suffice it to say that the metal concentration from these sites will come to overshoot NESREA's permissible limits over time if precautionary measures are not taken.

SUMMARY OF FINDINGS

Summary of the Study

The study analysed the heavy metal contamination of automobile workshop soils in Awka. The result showed that all soil samples had heavy metals in them. The study compared the level of heavy metal among the soil samples. Sample A-Soil had the highest level of metal contents with an average value of 269.22 while sample D-Soil had the least metal content with an average value of 20.58. Also, control A-Soil had the highest level of metal contents with an average value of 193.56 while control D-Soil had the least metal content with an average value of 17.90. Generally, from soil samples, (tables 4.1) Iron had the highest pollution rate while Cadmium had the least. Comparism between the metal contents in the automobile workshop and NESREA's standard; there's no specified limit from NESREA for Iron and Manganese. For Copper, sample A was above NESREA's standard while other samples were below it. All samples were below the standard for Zinc, Lead, Cadmium, and Nickel. For Chromium, sample D was below standard while samples A, B, and C were above the standard.

The proposed null hypotheses were tested using statistical package for social sciences (SPSS). The test statistics proved that the heavy metal concentrations of the soils in the workshops are the same in the four locations, and none of the locations has significantly higher concentration than the other and they are not significantly above NESREA permissible limits. Considering the fact that heavy metals have the ability to bioacccumulate and biomagnify, the metal concentration from these automobile workshop soils will come to overshoot NESREA's permissible limit over time if precautionary measures are not taken.

CONCLUSION

Based on the findings of this study, the following conclusions are drawn: heavy metals in excess are toxic to the environment and automobile workshops are one of the major sources of heavy metals in the environment due to the kind of activities being carried out there coupled with the fact that automobile workshop wastes are often indiscriminately disposed of. The study concluded that having high density of these workshops in a locality would mean danger to both plants and animals since these metals have the ability to bioaccumulate, biomagnify, and can be transferred from soil to plant, plants to animals, and humans. Suffice it to say, these metals could have direct or indirect effects on human health.

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Recommendations
Consequent upon the findings of this study, the following recommendations are made;
1. Mechanic villages should be built in different locations far from towns.
2. Government should set up regulatory bodies to monitor the activities of automobile workshops especially in the area of waste disposal.
3. Owners or operators of automobile workshops as well as the populace should be sensitized on the impacts of the activities of the automobile workshops on the environment and the risks associated with human exposure to heavy metals.
4. Further studies should be carried out in areas not covered by this study.

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