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ASSESSMENT OF SOME SELECTED HEAVY METALS IN THE ENVIRONMENT OF VEHICLE SPARE PARTS DEALERS' MARKET ALABA NAZE IN OWERRI WEST.

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Abstract—**Waste dump at the site includes food wastes, chemicals, such as effluents from auto mechanic activities, deposits of heavy metals. Certainly, all wastes occupy space and for many countries, the disposal and management of these wastes are ancient problems. One cannot overlook the possible hazards that can be created as a result of a long-term increase in heavy metal concentration in the soil. A residence time of about 1000 – 3000 years has been estimated for the heavy metals such as Ni, Pb, Mn, and Fe, in temperate zone. This means that these metals remain distributed for a very long time in the soil in large amounts, ranging PAH from 0.01- 8.26 (5.49 ±1.469037) mg/kg, Sulphte from 16.6 – 28.5(22.666 ± 1.985028) mg/kg, Nitrate from 1.21 – 3.56 (2.596 ± 0.425131) mg/kg, Phosphate from 0.016 – 2.9 (1.4812 ± 0523898) mg/kg, are present in Naze village of Alaba auto spare parts market environments.**

Keywords— **Metals exhibit toxicity in their positive ionic form, Fuel - guzzling cars, Mercury and lead are widely used in technology, molten magma**.

I. INTRODUCTION

A typical city usually has mechanic villages in proportion to its population and activities, but some cities have more. Environmental pollution is one of the major challenges in the modern human society (Hazrat Ali et al., 2019). Heavy metals are potential health risk, lead, cadmium, arsenic and mercury are very carcinogenic, while others are toxic.(Philip Njoku Obasi. and Bennard Benedict Akudinobi, 2020). The larger the city, the larger is the number of such mechanic villages containedin it. With the European and American automobile industries moving towards greener electric cars, the international trade on used motor vehicles is presumed to increase dramatically. As a result, great numbers of old fuel - guzzling cars of all models are expected to stream into the Atlantic coast of West Africa and largely to Nigeria and also to other developing countries in this first quarter of the century (Gartz 2006). Urban areas where the mechanic village concept is in practice will react to the increased supply by establishing more mechanic villages, whereas those not already practicing mechanic villages may buy the concept.

It is presumed that there are environmental threats associated during activities like overhauling of vehicle engines, metal fabrication and automobile panel beating, reasonable amount of spent engine oil and metal fillings are deposited on top soil (Uchegbu, 2008). Painting of vehicles and tire vulcanizing are other activities that negatively affect the qualities of soils around automobile workshops. Soils polluted with spent engine oil had reduced soil microbial activity and reduced soil fertility status (McGrath et al., 1995). With this practice as they may amount to greater soil and other environmental pollution. The desire to reclaim these lands for agricultural purposes is of paramount important. Soil quality determines its actual and potential use. For example, the quality of soil intended for agricultural use depends on the concentration of heavy metals on it. These wastes introduce foreign microorganisms, organic and inorganic matter, in addition to indigenous micro flora. (Anyikwa, S. O et al., 2019). Heavy metals are persistent in the environment, contaminate the food chains, and cause different health problems due to their toxicity (Hazrat Ali et al., 2019.)

Heavy metals refer to any metallic chemical element that has a relatively high density and is toxic or poisonous even at low concentrations. Furthermore, heavy metals are a group of names for some metals and metalloids which are toxic to living organisms beyond a certain limit. They are metals with density greater than $5g/cm^3$ and include the following: Aluminium, Arsenic, Beryllium, nickel, selenium, bismuth, cadmium, chromium, cobalt, copper, lead, mercury, thallium, tin, titanium, zinc, etc. (Ademoroti, 1996). These metals are released by soil formation processes in nature. Most recently, interest in research of evaluating the level of heavy metal concentration around soils of auto mechanic workshops (case study) has been stimulated as a result of the growing concern expressed by government over the large acres of land covered by these mechanic workshops, and the strong desire to introduce best management practices to combat the adverse

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effect heavy metal concentration have both on the ecosystem. (D. S. Malik and P. K. Maurya, 2016) Soil quality determines its actual and potential use. For example, the quality of soil intended for agricultural use depends on the concentration of heavy metals in it.

Furthermore, some plants are tolerant to these heavy metal concentrations, they become more concentrated as animals feed on plants and enter into man through the food chain. As trace elements, some heavy metals are essential to maintain the metabolism of the human body. However, at higher concentrations in the body, they result in long-term health problems. For example, cadmium can be absorbed by crops and is consumed by humans in sufficient amounts.(M. Rahim, I, et al 2016). The metals can cause diarrhea and over time, liver, and kidney damage (Hart, et al 2004).

In order words, wastes of auto mechanic village sites include food wastes, chemicals, deposits of heavy metal, spent engine oil, etc. Certainly, the disposal and management of waste are ancient problems. An increase in population and developmental, technological advancement have led to a gradual change in the practice of flare of wastes indiscriminately at auto mechanic villages. One cannot overlook the possible hazards that can be created as a result of long-term increased concentration of heavy metals in the soil. A residence time of about 1000-3000 years has been estimated for the heavy metal Mn, Ni, Pb, and Zn in temperate zones (Bowen, 1997). This means that these metals remain distributed for a very long time in the soil in large amounts. Heavy metals have a great ecological significance due to their toxicity and accumulative behaviour (Pures, 1985).

However, the impact of heavy metals on the environment is a concern to the government, regulatory agencies, and the public (Page and Chang, 1985, Feigin et al, 1991, Tiller, 1992). The concern is the contamination of soil resources by potentially toxic metals from the auto mechanic villages all over the cities. Uncontrolled input of heavy metals is undesirable because once accumulated in soils, the elements are generally very difficult to remove. Subsequent problems include toxicity to the plant's tissues, considered to be harmful to the health of humans and animals that consume them.

According to Meagher et al, (2000), these wastes are acidic and have the ability to withhold nutrients in the soil and make them unavailable for plant roots, i.e., the absorption will be insufficient for plant roots. Most metals exhibit toxicity in their positive ionic form when they combine with non-metallic elements.

Table1.1: Maximum Permissible Limits of Some Heavy Metals are shown below:

S/N	**Heavy Metals**	**EPA Acceptable Limits (mg/kg).**
1	Arsenic (As)	13.0
2	Beryllium (Be)	0.59
3	Cadmium (Cd)	0.6
4	Chromium (Cr)	16.2
5	Copper (Cu)	19.6
6	Lead (Pb)	36.0
7	Mercury (Hg)	0.06
8	Nickel (Ni)	18.0
10	Silver (Ag)	0.55
12	Zinc (Zn)	95.0

Heavy metals can enter soil, water, and air by industrial, automobile and municipal waste, or even from acidic rain breaking down soils and releasing heavy metals into streams, lakes, rivers and groundwater (Laur et al,2004).

II. ORIGIN OF HEAVY METALS

There exist heavy reserves of heavy metals on the earth's crust. The core of the earth is metallic. The earth's crust is about one-quarter metals. 83 of all the 105 elements now existing in the periodic table are metals. Metals in the earth's crust vary greatly in abundance. They include aluminium, iron calcium, sodium, potassium, magnesium, and titanium. Trace heavy metals are present in a few milligrams per kilogram in soil. Though they are lacking in abundance, they are not lacking in significance. Mercury and lead are widely used in technology. They are so toxic that minute quantities will destroy life (Ademoroti, 1996).

In nature, the individual concentrations of heavy metals do not exceed 1000mg/kg of soil. In fact, most of them have average concentration of less than 100mg/kg. However, ore minerals containing high concentrations of one or more heavy metals also occur and these constitute the main commercial sources of the particular metal. Alloway (1995) noted that trace elements occur as constituents of primary minerals in igneous rock which crystallize from molten magma. They become incorporated into these minerals by isomorphous substitution in the crystallization. This constitution is governed by the ionic charge, ionic radius and electro-negativity of the major elements involved and the trace element replacing it. The trace constituents of common rock-forming minerals include olivine which comprises the following metals: Ni, Co, Mn, Li, Zn, Cu, Mo; hornblende contains Ni, Co, Mn, Sc, Li, V, Zn, Cu, Ga; Garnet contains Mn, Cr, Ge; magnetite contains Zn, Co, Ni, Cr, V, etc.

Heavy metals also concentrate in the early stages of coal formation. Sandstones usually contain only low concentration of most elements because they consist mainly of quartz grains which have no trace constituents and little ability to absorb metals. Paedogenesis (soil formation) is the process by which a thin surface of soil develops on weathered rock material gradually increases in thickness and undergoes differentiation to form a soil profile. The soil profile consists of distinct layers differing in colour and/or texture and structure and is the unit of classification. With regards to soil-plant relationship of metals in cultivated soils, the properties and composition of the plough layer are of predominant importance because this uppermost layer of the profile contains the majority of the root mass. Within the soil profile, Ag, As, Cd, Cu, Hg, Pb and Zn are found concentrated in the surface horizons as a result of cycling through vegetation, atmospheric deposition and adsorption in the lower horizons of soil profile include L, Fe, Ga, Mg, Ni, Sc, Ti, V, and Zn which tend to be associated with translocated clays and higher oxides in trace metals.(M. A. Hashem, 2017)

III. EFFECTS OF HEAVY METALS ON BIOTIC COMPONENTS OF THE ENVIRONMENT

A hazardous substance is anything which, because of its physical or chemical quality, may cause illness or significantly contribute to the destruction of life. More specifically, a substance is said to be hazardous if it possesses any of the following characteristics: corrosively, toxicity, reactivity, and ability to ignite easily (Ademoroti, 1996). Most heavy metals are toxic, but the exact toxicity varies considerably; it also varies with chemical form. Heavy metals in the environment affect microorganisms, plants, animals, and humans. For example, soil microflora shows a strong tendency to accumulate lead at a high rate and its elevated concentrations in the soil make soil mineralization of organic nitrogen less effective (Bolshakov et al, 1989).

Soil microorganisms particularly sensitive to lead are the actinomycetes and bacteria assimilating organic nitrogen, and they may therefore serve as indicators of soil pollution by these metals (Bulako, 1991). Lead concentration $\geq$ 0.07mg/L interfered with biological purification of waste, while those $\geq$ 0.1mg/L are adversely affected by the activated sludge from sewage treatment plants (Grushko, 1972, 1979).

Inorganic lead compounds are, in general, less toxic to microorganisms than organic ones such as tri-alkyl and tetra-alkyl lead compounds (WHO, 1989).

IV. ENVIRONMENTAL AND HEALTH IMPLICATIONS OF SELECTED HEAVY METALS IN SOIL

Heavy metals are important pollutants threatening the health of population and natural ecosystem. Their accumulation in the soil environment from natural and anthropogenic sources is of concern because of its direct potential toxicity to biota and indirect threats to human health from contamination of ground water and accumulation in food crops (Martinez and Motto, 1999). While it has been generally assured that this metals are immobile in managed agricultural soils (Mc Bride, 1995), factors that enhance mobility could result in more plant uptake or leaching of the metals to groundwater.

Accumulation and movement of heavy metal in the soil as a result of addition of waste have been studied. In general, metals added to soil wastes particularly sewage sludge accumulates in the surface area of the soil (Cameron et al, 1997). According to Commerich et al, 1982; Chang et al, 1984; Dowdy and Volk, 1984, in an extensive review of heavy metal movement, concluded that movement was most likely to occur where heavy application of waste sludge are made to sandy, acid, low organic matter soils receiving high rainfall or irrigations. Concentrations of metal (particularly Mn and Zn) at depth well below the zone of incorporation were higher than those in a nearby-untreated soil. Direct leaching of metals has been reported by Larry et al, (1993) who observed increased leaching of Cd from a sludge-treated agricultural and by Cameron et al (1994) who demonstrated increased leaching of Zn from sludge treated soils.

Since soil microorganisms and their activities are crucial to the maintenance of soil fertility, there is considerable concern that metal addition could have permanent adverse effect on soil quality (Cameron et al, 1997.

Some heavy metals such as Cu and Zn are essential plant nutrients and in addition to low fertilizer soils, may actively provide beneficial quantities of metal which are normally in short supply. However, at high concentrations, heavy metals can be phytotoxic and may result in reducing plant growth and/or enhanced metal concentrations in plant (Cameron et al, 1997).

V. MATERIAL AND METHODS

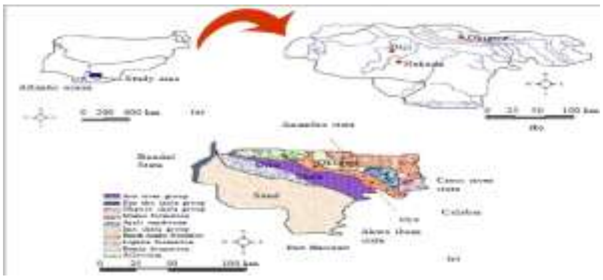
DESCRIPTION OF THE STUDY AREA (OWERRI)

Owerri the capital of Imo State in Southeast Nigeria is located within the latitude of $5^{O}10'$ and $5^{O}67'$Nand longitude of $6^{O}36'$ and $7^{O}28'$E. The State is bounded in the North-West by Anambra State, on the south by Rivers State while on the East by Abia State.

The state is comprised by two main geographic regions the coastal plain and the plateau encampment zones. The soil of the coastal plain is sandy/loam and vegetation. Two distinct seasons exist, the dry and rainy season. The rainy season lasts from March to October with peak of rainfall in July and a short dry spell in August popularly known as “August break”. Annual rainfall ranges from 2259mm to 2500mm. mean temperature is 27^{O}C while relative humidity is about 70-80% (MSS, 1984).

Two main river basins are Niger Basin and the Imo River Basin. The principal tributary of the River Niger in the state is

the Orashi River, which receives the Njaba Local Government Area and joins the Orashi near Oguta Lake of Niger Delta (Nnomka.2002).
The biggest industry in the state is Education, with about 1,208 primary schools and 365 secondary schools and about 9 tertiary institutions. Inhabitants are mainly Igbos and speaking Ibo language fluently. However, there are pockets of other ethnic groups such as Hausas, Yorubas, Efiks, Ibibios, etc. as well as foreigners. Major religion is Christianity. The main occupation of the people is agriculture, there are civil and public servants as well as fishermen and traders and also sand miners.



Map of Eastern Nigeria Showing the Study Areas.

Sample locations
The Alaba spare parts markets have some minor mechanic. The market is located at Naze in owerri west Local Government Area of Imo State of Nigeria. The spare parts dealers and some mechanics covers an area of about 30.5km^2. From the distance around the sites, (0-50m), (50-100m),(100-150m) and (150-200m) respectively from each of sampling points in a transect was collected with the aid of meter rule for distance and a soil auger for four different depths in different locations within the area, including control.

Table 1.2: Summary of auto spare parts, mechanic activities generating wastes.

S/N	**Activity**	**Activity Contribution to soil pollution**
1.	Servicing of vehicle engines	Discharging dirty engine oil on the ground
2.	Repair of transmission systems.	Spilling of transmission oil on the ground.
3.	Repair of fuel tanks. Pouring of petrol	Pouring of petrol and diesel on bare ground.
4.	Repair or charging of batteries.	Pouring of electrolyte on the ground. Discarding lead plates on waste dumps on site.
5.	Repair of braking systems.	Spilling of brake fluid on bare ground.
6.	Repair of clutch systems.	Spilling of clutch fluid on ground
7.	Overhauling of vehicle engines.	Discharge of engine oil, sludge and interior scrapings on the ground.
8	Panel beating) of vehicle bodies and scraping of old vehicle body coats.	Metal bits, metallic colour coats and dusts are scraped to bare ground
9.	Grinding, threading, wiring and other working of metal parts during repair.	Metal bits are filed onto bare ground, waste wires and solders are dropped
10.	Greasing and oiling of parts.	Greases and oils spill on the ground.
11	Welding and soldering of vehicle parts	Discarding of waste solder and electrodes on soil dumps

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VI. MATERIALS AND LABORATORY EQUIPMENT

The materials are listed as follows: A spade, A soil auger, 100cm meter rule, A role of cellophane (polyethylene bags), A cutlass, Global Positioning System (GPS), Safety boots, Sack bags, and hand gloves.

Laboratory equipment

Oven, Plastic tray, Filter mesh, Weighing balance, electronic pH meter, Beaker and filter paper, Atomic Absorption spectrophotometer.

Table1.3: GPS Co-Ordinates of Sampling Locations

Sampling	GPS parameter	1	2	3	4			
SP_A Owerri	Northern Eastern	50^0 87^1 36^{11} 16^0 24^1 84^{11}	50^0 87^1 58^{11} 16^0 26^1 21^{11}	50^0 87^1 16^{11} 16^0 25^1 73^{11}	50^0 87^1 45^{11} 16^0 27^1 70^{11}			
Control Point	Northern Eastern	50^0 91^1 28^{11} 16^0 25^1 07^{11}	48^0 24^1 44^{11} 23^0 $27^1 21^{11}$	54^0 06^1 34^{11} 12^0 32^1 77^{11}	56^0 09^1 38^{11} 21^0 29^1 14^{11}			

VII. THE METHOD OF COLLECTION IS CALLED RANDOM SAMPLING.

The soil samples were collected at 0-15cm, 15-30cm, 30-45cm and 45-60cm depths respectively and then transferred into well labelled polyethylene bags for storage and for laboratory analysis. The samples were collected on a slightly cloudy dry day with low sun intensity at around 11am -6pm. This was done on the 15th day of June 2016.

Results

Table 1.4: Descriptive statistics of heavy metals concentration and edaphic variables at the vehicle spare parts and mechanic village.

	Descriptive Statistics of Heavy Metal Concentration & Edaphic Variables at the MV				
N/O	**Parameters**	**Minimum**	**Maximum**	**Mean**	**Standard Error**
1	pH	5.48	6.36	5.77	0.1556
2	TOC %	0.13	0.716	0.53475	0.136722
3	TPH (mg/kg)	0.14	318.28	175.214	50.84564
4	PAH (mg/kg)	0.01	8.26	5.49	1.469037
5	Sulphate (mg/kg)	16.5	28.5	22.666	1.985028
6	Nitrate (mg/kg)	1.21	3.56	2.595	0.425131
7	Phosphate (mg/kg)	0.016	2.9	1.4812	0.523898
8	Rate of Infiltration	2.7	6.87	4.23	0.925914
9	Moisture Content %	18	45.5	31.875	5.613878
10	Cadmium (mg/kg)	0.007	0.05	0.0278	0.007262
11	Nickel (mg/kg)	0	0.034	0.0192	0.006398
12	Lead	0.003	0.071	0.0324	0.01098

	(mg/kg)				
13	Iron (mg/kg)	0.021	2.21	0.6462	0.404762
14	Chromium (mg/kg)	0.015	0.083	0.0462	0.013496
15	Copper (mg/kg)	0.0107	0.789	0.36274	0.141345

Table 1.5: shows that pH ranged from 5.48 – 6.36 (5.77 ± 0.1556) mg/kg, Toc from 0.13 – 0.716(0.53475 ± 0.136722) mg/kg, Tph from 0.14 – 318.28 (175.214 ± 50.84564) mg/kg, PAH from 0.01- 8.26 (5.49 ±1.469037) mg/kg, Sulphate from 16.6 – 28.5(22.666 ± 1.985028) mg/kg, Nitrate from 1.21 – 3.56 (2.596 ± 0.425131) mg/kg, Phosphate from 0.016 – 2.9 (1.4812 ± 0523898) mg/kg, Rate of Infiltration from 2.7 – 6.89 (4.23 ± 0.925914) mg/kg, Moisture Content from 18 – 45.5 (31.875 ± 5.613878) mg/kg, Cadmium from 0.007 – 0.05 (0.0278 ± 0.007262) mg/kg, Nickel from 0 – 0.034 (0.0192 ± 0.006398) mg/kg, Lead from 0.003 – 0.071 (0.0324 ±0.01098) mg/kg, Iron from 0.015 – 0.083 (0.6462 ± 0.404762) mg/kg, Chromium from 0.015 – 0.083 (0.0462 ± 0.013496) mg/kg, Copper from 0.0107 – 0.789 (0.36274±0.141345) mg/kg, Zinc from 0.071 – 3.282 (1.872 ± 0.556384) mg/kg, Manganese from 0.0026 – 0.01 (0.0065 ± 0.001628) mg/kg,The textural classification composed of sand ranging from 15.01 – 24. 16 (21.1025 ± 2.06596) mg/kg, Silt from 61.54 – 75.23(67.8475 ± 2.838821) mg/kg, Clay from 2.32 – 16.38 (10.6675 ± 3.144274) mg/kg, etc.

The results of the spectrophotometric analysis on the soil sample from the mechanic village Owerri, are summarized in table 1, 2,3,4,5, etc.

PH was highest (6.36) at the depth of 15 -30cm and least (5.48) at the depth of 30- 45cm in sampling point.

VIII. INFLUENCE OF PH ON HEAVY METAL CONCENTRATIONS

Table 1.6: Relationship between Ph and Heavy Metal concentrations Using Correlation coefficient (r).

Heavy Metals	Ni	Fe	Pb	Mn	Zn	Cr
pH	0.778^{xx}	0.839^{x}	0.716^{xx}	0.817^{xx}	0.638^{xx}	0.621^{xx}
Heavy Metals	**Cd**	**Sand**	**Silt**	**Clay**	**B/D**	**M/C**
pH	0.740^{xx}	0.594^{xx}	0.480^{xx}	0.586^{xx}	0.203^{xx}	0.507^{xx}

xx = significant at p, 0.01.
B/D = bulk density.
M/C = moisture content.

Table 4.4 shows that at p < 0.01, pH exerted high significant influence on all the heavy metals measured.

IX. DISCUSSION OF RESULT

The result obtained in this study showed that the concentration of heavy metals insome soil samples at the Alaba auto spare parts and mechanic market in Naze owerri west were higher than those at the control location and equally international standards such as WHO and FEPA. This indicates the leachate from the topsoil carried high concentrations of toxic inorganic contaminants that can cause pollution of the soil. The acidic pH recorded in the soil indicates unsuitable soils for farming because both macro and trace metals are controlled by the soil pH. At such a level there tend to be an increased micronutrient solubility and mobility as well as increased heavy metal concentration in the soil (Ogbonna et al, 2008).

Textural classification is one of the several variables that affect the behavior of soil pollution. This study revealed that there existsa mixture of sand, clay, and silts at all the sampling depths. The high sand composition (>67.8475%), atdepths of 0 – 15cm and 15 – 30cm at sampling point could allow large quantity of leachates from heavy metals to permeate the groundwater tables. Sand has a high percolating rate but does not provide sufficient protection against groundwater pollution.

Similarly, the clay composition (<16.66%) in all the dumpsites could encourage infiltration of pollutants into groundwater table. Surface water that infiltrates the soil cover increases the rate of waste decomposition and eventually causes leachate to leave the soil waste and create pollution problems

X. CONCLUSION

The density of Alaba auto spare parts and mechanic market in Naze owerri west L.G.A activities affects the degree of heavy metal enrichment in soils within the village. Naze village has a large slope and drainage area, with much workshop density, which supports wider dispersion of metal contaminants from the auto spare parts and mechanic market, thereby reducing metal concentration in the soil.

Heavy metal concentration and pH values at the mechanic were all higher than at the control location depths. PH exerted

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very high influences on all the heavy metals measured at the sampling locations with acidic pH leading to higher bioavailability of heavy metals. Fe, Pb, Zn, and Mn concentrations were high, increasing pressure of heavy metals on the soil is responsible for the high acidic pH at the auto spare parts and mechanic soil.
Heavy metal concentrations and edaphic variables differed significantly across the sampling depths.

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