International Journal of Global Affairs , Research and Development (IJGARD) Vol.1 No.2, 2023, 242-262, ISSN 2992-2488

EFFECTS OF AUTO-MECHANIC WORKSHOPS ON SOIL STRUCTURE , PHYSICO-CHEMICAL PROPERTIES AND HEAVY METALS IN WOJI AREA OF PORT HARCOURT; IMPLICATIONS FOR AGRICULTURE , ENVIRONMENT AND HEALTH

[1]Adah, J A, [2]Eyimoga, H.A, [3]Ibrahim, A.K, [4]Agboola , A.K, [4]Are, E.C and [4]Omalle, J. A

[1]Department of Geography and Environmental Studies, Ignatius Ajuru University of Education, Port-Harcourt, Nigeria
[2]Department of General Studies, Kogi State Polytechnic, Lokoja, Nigeria
[3]Department of Soil Science, Federal University, Kashere, Nigeria.
[4]Department of Soil and Environmental Management, Prince Abubakar Audu University, Anyigba, Nigeria.

Corresponding Author (Adah, J.A: adahjoyalewo910@gmail.com)

ABSTRACT

The study examined Impact of auto-mechanic workshops on soil structure , Physico-chemical properties and heavy metal concentration levels in Woji area of Obio/Akpor Local Government Area of Rivers State and implications for Agriculture , environment and health.. It used experimental research design and relied on primary data generated through laboratory analysis of soil samples collected at depths 0-30cm from five randomly selected experimental sites and one control. Standard field and laboratory procedures were employed in data collection and analysis. Four specific objectives and three hypotheses guided the study. Data for the four hypotheses were tested using one-sample chi square, ANOVA and two-sample z-test. ***Ho₁*** *was upheld and implied that there was no significant variations in soil pH across the five experimental sites; pH levels in the soil of the area ranges from 5.2 to 7.1 and a mean occurrence of 6.02 as against 6.2 for the control; soil temperature ranged from 25.7 to 27.4^{0}C with a mean of 26.66^{0}C as against 26.8^{0}C for the control; The soils of the area predominantly sandy particles (87.14%), silt (11.58%), and clay (1.84%).* ***Ho₂*** *was rejected meaning that, there were significant differences in the occurrence of the heavy metals across the five experimental sites;* ***Ho₃*** *was rejected, signifying a significant difference in the levels of the physico-chemical parameters and heavy metals between the control and the mean values from the five experimental sites. The mean values for Iron (Fe) for the five experimental sites were 32.78mg/kg, Nickel (Ni) 23.65mg/kg, Cupper (Cu) 14.17mg/kg, Lead (Pb) 20.62mg/kg, Magnesium (Mg) 11.32mg/kg, Cadmium (Cd) 9.14mg/kg, and Zinc (Zn) 42.28mg/kg.Zinc (Zn) had the highest mean value (42.28mg/kg) while Cadmium (Cd) had the least mean figure of 9.14mg/kg. Whilst in the control, Iron (Fe) was 9.6mg/kg, Nickel (Ni) 4.5mg/kg, Cupper (Cu) 1.6mg/kg, Lead (Pb) 9.47mg/kg, Magnesium (Mg) 33.2mg/kg, Cadmium (Cd) 3.48mg/kg and Zinc (Zn) 12.4mg/kg. It was concluded that the activities of aut mechanic workshops negatively affected the soil structure, physico- chemical properties and heavy metals concentrations negatively and have far reaching effects on agriculture, environment and health Based on the findings, the study recommended thus: proper siting and monitoring of mechanic workshops activities; regular evaluation of the soil to guard against excessive contamination by auto-mechanic workshop activities in the area as well as construction of effective drainage channels*

Key Words: **Effects, soil structure, Physico-Chemical Properties, Heavy Metals, Agriculture, Environment**

1.0 INTRODUCTION

Environmental pollution is a serious problem the world over and millions of people suffer from the health problems of waste generated by human activities. This involves soil chemicals that affect the food chain. In most developing countries like Nigeria, there are many auto mechanic repair shops due to the high demand for passenger cars, which are mostly used cars. This contributes significantly to soil pollution in most cities. Waste automotive oils contain deposits, oxidation products, water and metal particles due to engine wear, oil additives and organic and inorganic chemicals used in metals. Infiltration into groundwater and groundwater is harmful to the environment.

Contaminated soil can alter plant metabolism and cause fundamental changes in soil chemistry. This also creates a variety of health challenges.. Soil is very important for the functioning of terrestrial ecosystems and is a nutrient and water source for plants and animals. Soil pollution affects the amount of food, water and air we breathe. It poses a health risk to people and the environment. According to Adelekan & Abegunde (2010).Auto mechanic activities, such as indiscriminately dumping used motor oil to the ground, not only damage the soil, but also pollute and threaten clean drinking water. These pollutants also enter groundwater through drains. It severely degrades the land and pollutes the soil with heavy metals that are harmful to humans. These workshops may be characterized by various operators working in areas such as spraying and painting, welding, battery charging and repair, car servicing and maintenance (Adelekan & Abegunde, 2010).

The town of Port Harcourt is dotted with car repair shops, occupying almost all vacant lots along the main street, markets and streets. Waste from these workshops are indiscriminately dumped into all available spaces, thereby contaminating the soil and causing significant changes in soil chemistry and pH, plant growth, microbial growth. It has a great impact on a number of individuals and humans. For years, mechanic shop operators have indiscriminately dumped used oils, greases, and toxic liquids into the environment (floor) for their daily work.

These substances are usually rich in hydrocarbons and heavy metals that adversely affect the natural well-being of the environment.

Most operators indiscriminately dump these wastes and later absorbs into the soil or flushed them into nearby waters. This contaminates the water and is harmful when consumed or used raw. Nwachukwu *et al,* (2010) have shown that improper disposal of waste from mechanic workshops across the country raises serious environmental and health concerns. This waste includes waste oil from engine gear, charcoal from sheet metal tapping, scrap from grinding and soldering, and accidental spills of other liquids used in the shop. According to Udeani et al. (2009), a complex mixture of hydrocarbons is observed in petroleum products such as motor oil, diesel, gasoline and kerosene. These products are used regularly by mechanics in workshops.

Pollution is caused by the spillage and improper disposal of waste from auto repair shops. These products are available in small quantities or in large quantities.

When such a leak occurs, it is relatively likely that the hydrocarbon will reach the water table before it is immobilized on the soil or spreads horizontally on the water table.

It penetrates further into the interstitial spaces of the soil and the surface of the soil particles.

. In Nigeria, it is also common practice, especially by engine and generator mechanics, to dispose of large amounts of used motor oil (SEO) in gutters, drains, vacant lots and farms (Okonokhua *et al*. 2007). Illegal dumping of used engines is an environmental hazard with global impact

(Alabi *et al.*, 2013). When present in soil, used motor oil creates inadequate conditions for soil life due to inadequate soil aeration, soil nutrient immobilization, and low soil pH (Atuanya, 1987). heavy metals are considered serious pollutants due to their toxic, persistent and non-degradable environmental conditions. Extensive soil contamination by trace metals in and around auto repair shops means water areas (inside and outside the environment due to the continuous interaction between soil and water and the high dispersal rate in tropical rainforests. Surface water and groundwater) may be equally contaminated with trace metals (Nwachukwu *et al.*, 2010). Due to their persistence, heavy metals easily accumulate in the topsoil to toxic concentrations and eventually reach humans through the food chain, where they disrupt biological processes (Adesuyi *et al.*, 2015).

. One of the main causes of heavy metal growth in the Nigerian ecosystem is the activity of auto mechanics (Adewale and Uchegbe, 2010). These car repair shops are located in vacant lots near towns and cities.(Nwachukwu *et al.*, 2011). Within the cluster, some specialize in the electrical aspects of car repair, while others specialize in brake repair, spray painting, car battery charging, welding, soldering, and more. Each of these activities produces different types of waste (gasoline, diesel, contaminated areas). (Motor oil and paint) can be disposed of by simply dumping it in a nearby bush or surrounding area. The effects of mechanical site pollution from these activities have been shown to produce harmful waste. Therefore, it is necessary to continuously monitor the type, quantity, direct harmful effects, current disposal methods, and potential environmental impacts. s of soil and the impact of auto mechanic workshops and heavy metals and their Implications for Agriculture , the environmental and health in the Woji area of the Obio /Akpor municipality in Port Harcourt, Rivers State.

The specific objectives of this study was to examine the impact of auto mechanic workshops on soil physico-chemical properties and heavy metals in Woji area of Port Harcourt, Rivers state.

1. Ascertain the level of soil pH across five experimental sites around mechanic workshops in the area
2. Determine the level of concentration of heavy metals in the soil across the five experimental sites of the area.
3. Determine the particle size distribution of the soil around the workshops in the area.

Ascertain possible variations in the level of occurrence of the heavy metals between the control and experimented sites in the soil.

Several researchers have looked at the effects of heavy metals on the soil and humans in various places, but none has talked about policy formulation regarding the education of mechanics and also nobody has researched on this topic in Wojitown. This study aims to fill that gap and ascertain if the results would be the same.

The following research hypotheses were developed

1. There is significant difference in the pH level across the five experimental sites in the area.
2. There is significance variation in the occurrence of heavy metals in the soils affected by the activities of mechanic workshops in Woji area of Port Harcourt.
3. There is significant difference in mean level of occurrence of the heavy metals between the control sites and the experimented sites.

2.0 LITERATURE REVIEW.

2.1 Conceptual framework

2.1.1 Concept of Soil pollution

Soil is an important source of minerals and water for plants and animals, so it is very important for the proper functioning of terrestrial ecosystems. It is also a natural resource for humans. Without land, the earth would be as barren as the moon, or lifeless (Misra and Mani. 2009). Despite its importance, soils are often contaminated by human activity and are reflected in the high horizontal and vertical variability caused by anthropogenic effects on soil formation and development (Fong *et al.*, 2008). Various things such as municipal waste treatment, industrial waste, military testing, agricultural practices, etc. affects the soil in the form of toxins. Substances that enter the soil system remain and accumulate at toxic concentrations, becoming sources of pollutants in the soil (Misra and Mani. 2009). The 4,444 pollutants that remain and accumulate in the soil include fertilizers, organic waste, organic pesticides, radionuclides and other inorganic toxic compounds (Misra &Mani. 2009; Jia et al., 2010). Soil is the top layer of the earth on which plants grow and is more than just "dirt." It is a very important resource extracted from rocks and minerals.

Soil formation takes hundreds to thousands of years. Good soil is composed of 45% minerals, 5% organic matter, 25% water and 25% air. Good soils are black or brown and bad soils are yellow or reddish. The Soil is divided into sandy, clayey and loamy silts.

2.1.2Soil Deterioration

Soil deteriorates when the concentration of pollutants on the surface becomes very high, the country's biodiversity is compromised, and health is compromised. Soil pollution as part of land degradation is caused by the presence of artificial chemicals or other changes in the natural environment of the soil. The most common causes of soil pollution from human activity include the construction of industry, mining, waste, agriculture, livestock, cities and transportation infrastructure. The most commonly used chemicals are petroleum, hydrocarbons, polycyclic aromatic hydrocarbons (Naphthalene, Benzoapyrene, etc.), solvents, pesticides, lead and heavy metals. Other causes of soil contamination include erosion, loss of organic carbon, increased salinity, compression, acidification, and chemical contamination.

Impact of Soil Contamination

The health impact of exposure to soil contamination depends on the type of pollution. Chronic exposure to chromium, lead and other metals, petroleum, solvents, and many pesticide and herbicide formulations can cause cancer or other chronic health problems. Natural substances such as nitrates and ammonia and industrial or artificial concentrations of livestock manure can cause health hazards to soil and groundwater. There are fundamental changes in soil chemistry that can result from the presence of many dangerous chemicals. These changes can manifest themselves in changes in the metabolism of endemic microorganisms and arthropods that inhabit certain soil environments. Concentrations of persistent DDT substances for poultry consumers lead to weakened eggshells, increased chicken mortality, and the potential for species extinction. Soil pollution alters plant metabolism and often reduces crop yields.

Soil quality

Soil quality is a combination of the chemical, physical, and biological properties of the soil. (Doran&Safe, 1997). Soil quality and center of gravity can be synonymous, but the center of gravity can be different. Indeed, according to Doran, soil quality can be broadly defined as the

ability of soil to perform or function according to its potential and will change over time due to human use and management of natural events.

Soil quality index

Since soil quality cannot be measured directly, indicators are used to provide guidance. They are divided as follows.

Physical Indicators

The physical properties of soil are estimated by its texture, bull density, porosity, water retention, tread depth penetration, resistance to penetration (Karlen *et al*, 2001) organic matter. Additions can improve all these properties. Biological indicators: Soil quality is strongly influenced by microbiological intervention processes (nutrient circulation, nutrient volume, aggregate stability), so soil quality biological indicators are reported to be very important. (Doran & Prekins, 1994; Abawi and Widmer, 2000). .. Biological indicators of soil quality that are commonly measured include soil organic matter, respiration, microbial biomass (total number of bacteria and fungi) and mineralized nitrogen (Caddish and Giller 1997); Feller *et al.*, 2001) Increased carbon content is indicated by increased microbial biomass and increased respiration. (Sparling *et al*., 2003).

2.1.3 Chemical Indicators

Small farmers often use large amounts of soil nutrients to achieve high yields (Sanchez and Swanminathan, 2005). Available nutrients also change with the addition of inorganicfertilizers, the incorporation of covered crops, and the addition of other organic fertilizers in the form of fertilizers and compost (Stocking, 2003). Soil quality indicators provide information on the ability of soil to provide mineral nutrients that depend on the pH of the soil. Soil pH is the degree of acidity or alkalinity of the soil. It affects plant growth by affecting the availability of phytonutrients, the availability of toxic metals, and the activity of soil microorganisms. Chemical properties include bulk density, aggregate stability, and resistance to penetration.

Soil is the top layer of the Earth's crust on which plants grow. Also, (Kang *et al.*, 1990) A complex environment of minerals, organic matter, water, gas and living organisms. According to Turgeon (2006), soil is a natural, unconsolidated mineral or organic matter just on the surface of the earth that serves as a medium for plant growth. It also supports many organisms beneath its surface. Soil formation depends on the base metal, climate, local terrain, organisms, and when the soil was formed. Soil is classified by its structure and composition (Monger *et al.*, .2006). The proportions of the ingredients vary depending on the type of soil, but typical soils are about 45% minerals, 25% air, 25% water and 5% organic matter. All of this combines to provide excellent drainage, ventilation and organic matter. (Enger & Smith 2008).

2.1.5 Soil Profile

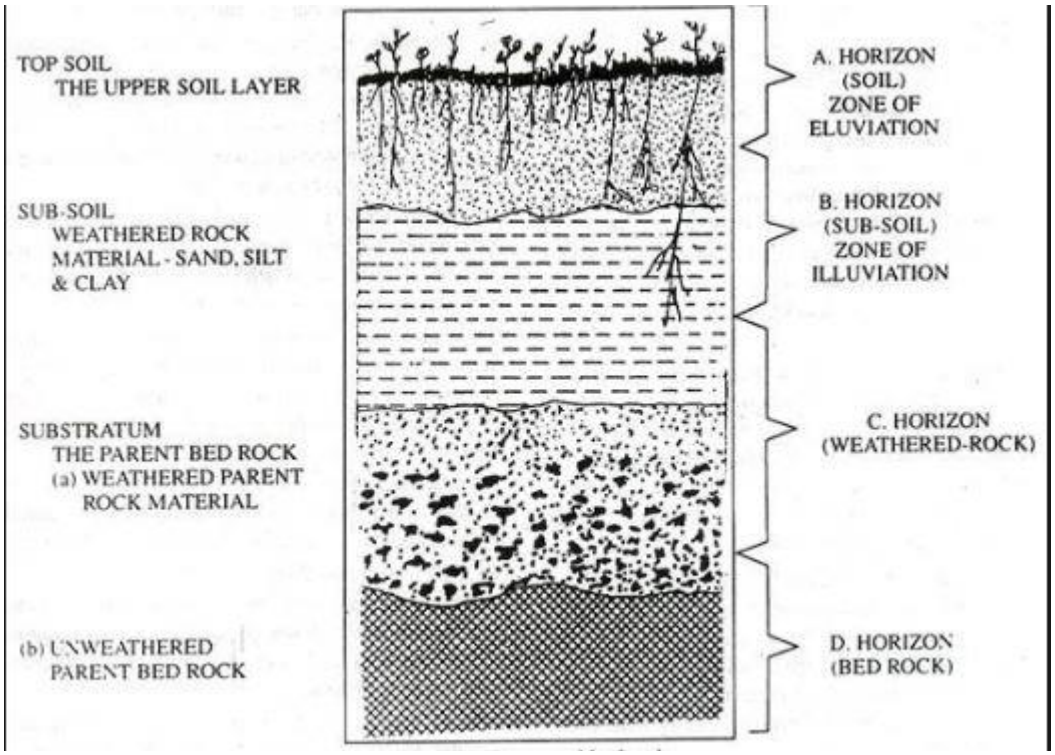

Figure 2.1 : Soil profile showing the horizons

Source: www.researchgate.net (2020)

Soil profile is the vertical sections through the soil from the surface down to the bedrock. These layers differ in appearance, thickness,and properties (Broderson, 2000) The horizons are parallel to the surface. A soil profile is defined as a vertical section of the soil exposing the layering. A standard soil has six layers; O, A,E,B C and R. Each layer is represented by a letter to indicate where it is in relation to the soil. (Kang and Tripathi, 1992).

2,1.6 Soil structure and texture:

Soil structure is the arrangement of particles in the soil while soil texture is the degree of fitness or coarseness in the soil. The main four types of soil structure are Platy (plate like)

Prismatic (Columnar)

Blocky

Granular (crumbs)

Soil particle size

Type of mineral particle	Size range
Very coarse sand	2.0- 1.0mm
Coarse sand	1.0- 0.5mm

Medium sand	0.5-0.25mm
Fine sand	0,25-0.10mm
Very fine sand	0.10-0.05mm
Silt	0.05-0.002mm
Clay	less than 0.002mm

Source (1FAS, 2003)

2.1.7 Heavy metal concept

Heavy metals are a group of metals / metalloids with atomic densities above 5 g / cm3. Examples include Hg, Pb, Cd, Mn, Cu. Heavy metals occur naturally and are found in soil and rocks. However, many years of human activity have resulted in high concentrations in the environment. Heavy metals occur naturally in many variations as chemical elements in the Earth's crust and can result in deposits in high concentrations. The contents of some industrially frequently used and emitted heavy metal crusts and common ore minerals are obtained from sulfide ores. Like the by-products of Cu ore, Bi is a by-product of Ph ore, and Hg and Cd are (mainly) by-products of Zn ore (Alloway.1990). Heavy metals are also called dense, low concentrations, toxic or toxic chemical elements (Lenntech, 2011).There have been many distinct definitions put forth. Some are based on density, some on atomic weight or number, some on chemistry, and some are based on toxicity (Duffus, 2002). They often include actinides, lanthanides, metalloids, and transition metals. They consist of 60 heavy metals. Precious metals like platinum, silver, and gold are included in this. Heavy metals including copper, lead, mercury, cadmium, chromium, and arsenic are examples of essential heavy metals. In ecosystems with significant concentration variations, heavy metals can be found naturally or as a result of human activities.They come from a multitude of sources and infiltrate the environment. They may come from man-made or natural sources. While harmful in large doses, some heavy metals (like zinc and copper) act as trace elements and aid in the body's metabolism. & other heavy metals in extremely low quantities (Lenntech, 2011). Due to their propensity to accumulate in plants, food, and animals, heavy metals pose a threat to both human and animal health (Ray, 1990). When a substance is bioaccumulating, it indicates that its body concentration rises over time relative to its concentration in the environment. Always, during absorption and storage, substances build up in the body more quickly than they can be digested or eliminated by the body. exposure to heavy metals has been associated with developmental delays, various cancers, kidney damage, and even death (Adulaziz and Mohammed, 1997).

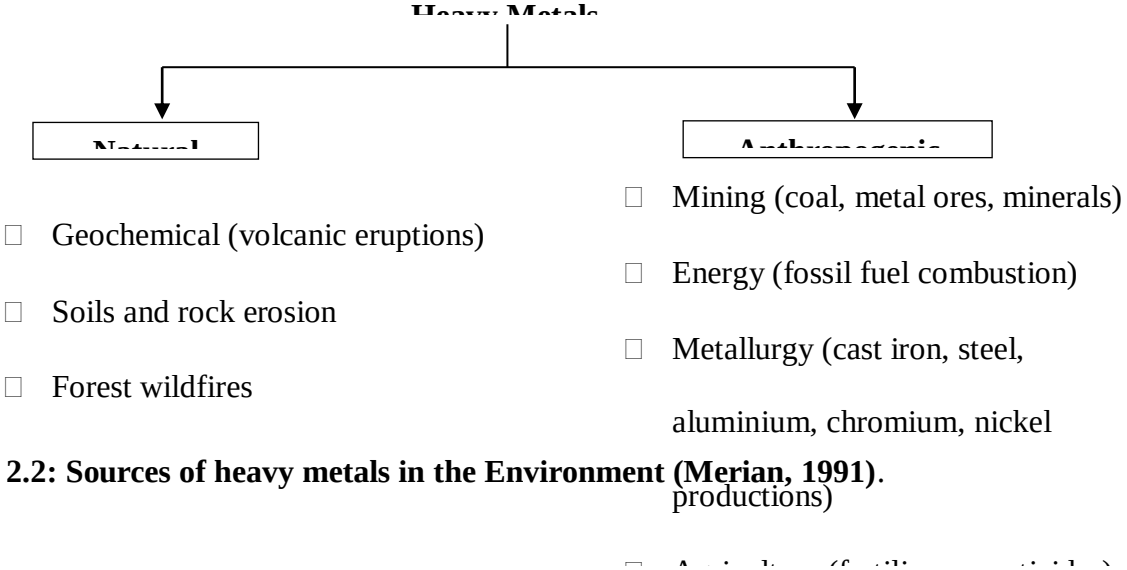

Figure 2.2: Sources of heavy metals in the Environment (Merian, 1991).

2.2 Theoretical framework

This study will address some of the environmental ethics and their theories. Environmental ethics examines the relationship between people and their environment. It deals with human moral and ethical obligations to the environment. Some of the models are: Behavioral change model. This model will motivate people to be more sensitive to environmental issues and therefore to act in an environmentally friendly way if they are better informed.

2.2.1 Behavioral Change Model

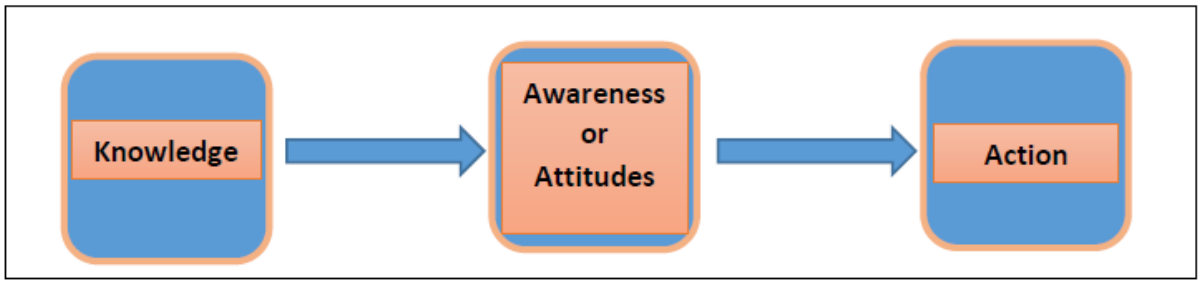

Fig. 2.3 Behavioural change mode

Source: Akintunde, 2017

The Behavioral Change Model is the basis for examining possible relationships between environmental knowledge, environmental awareness, and attitudes, and how these are transformed into behaviors or behaviors. Provide. Sufficient knowledge of environment variables does not necessarily mean good and sustainable environmental behavior. On the other hand, lack of knowledge or awareness of the environment need not indicate inadequate environmental practices. Therefore, other intervention factors such as location of control, intent of action, and personal responsibility need to be considered.

2.2.2 Theory of Environmentally Responsible Behaviour (ERB)

According to Hines *et al* (1987), the ERB theory contends that having an intention to act is a significant element influencing ERB. According to the Responsible Environmental Behaviour model, whether a person would engage in a behavior or not depends on their intention to act, locus of control (an internalized sense of personal control over the events in their own lives), attitudes, sense of personal responsibility, and knowledge. The model takes into account the key factors that affect each person's decision to acquire an ERB. The internal control center, in accordance with the concept, has a very significant impact on the intention to act, which greatly influences a person's ERB. The concept also emphasizes a connection between the attitudes of the control center andpeople and their intended actions. The control center, according to the model, had a direct impact on a person's attitude, which might result in better behavioral intention and better conduct. As a result, rather than emphasizing the unique effect of a single variable, the theory focuses more on the existing relationships between parameters that influence a person's behavior. For instance, in waste management procedur es, no single element is adequate to either initiate behavior or for behavior to alter. For instance, despite legislation from waste management officials forbidding such behaviors, people still throw trash in the center of the streets in the majority of Nigerian cities. Many of these litterbugs litter during odd hours when law enforcement is not around, while others are encouraged to litter because they witness others doing it, and some still manage to dispose of their trash properly.

According to these beliefs, research is relevant because when auto mechanics are informed of the dangers of carelessly disposing of used engines in the ground, they are better equipped to identify better alternative methods of disposal.

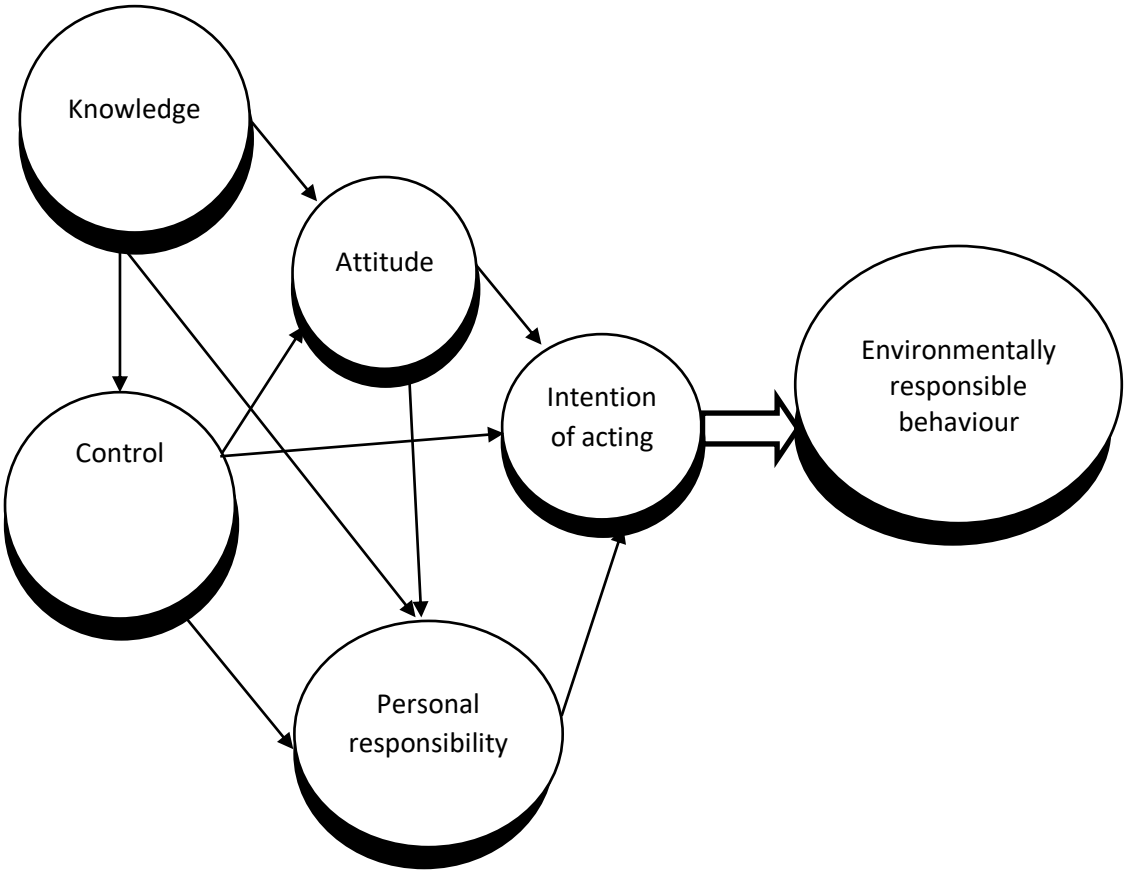

Fig 2.4: ERB Model

Source: Akintunde (2017)

2.3 Empirical Literature review

2.3.1. Yahaya (2016) Conducted an assessment of heavy metal levels in soil and well water at selected automotive plants in Lokoja. He assessed heavy metal levels in soil and well water at a specific auto mechanic workshop in Lokoja, Nigeria . He examined heavy metals at two different soil sample depths, and came to the conclusion that the mechanic's workshop was polluted with Pb, Ni and Cd. This reflects the human contribution of using metals with additives as lubricants. The soil is also moderately contaminated by these heavy metals due to the Underground Accumulation Index. He found that a well, two meters from the mechanicsworkshop, showed metal leaching due to mechanical activity. He recommends that the government builds mechanic villages away from human settlements and protect developed countries from the accumulation of metal pollutants to prevent their dire environmental impact. He added that there are legislation in place for this.

Njoku, *et al* (2018) studied the impact of mechanical village activities on selected soil properties of Abakaliki in southeastern Nigeria**.** . They observed that heavy metals in the mechanic's village were higher than recommended in the soil. Crops harvested in such degraded and polluted soil cause food poison when eaten by animals and humans. Therefore, in conclusion, it is recommended to apply some agricultural practices that can increase nutrients and reduce heavy metal content to obtain high yields and safe products, and eco-friendly mechanical villages in the potato river basin.

Chao Su *et al* (2014) In assessment of heavy metal contamination in soil worldwide: status, impact and remediation techniques pointed out that the types and content of heavy metals have increased recently with the development of the global economy. All this is because human activities have led to environmental destruction. Heavy metals are very dangerous for the environment and living organisms. It can accumulate through the food chain. Once soil is contaminated with heavy metals, it is very difficult to remediate

Sources of Heavy Metals:

Heavy metal pollution has a variety of sources, some of which come from transportation, agricultural waste, municipal waste and industrialization. Traffic, especially motor vehicle traffic, causes concentrations of heavy metals (Pb, Zn, Cd, Cr, Cu, etc.) in air and soil (Falahiardarkani, 1984). Heavy metals are produced from the combustion of leaded gasoline and from the dust produced by worn car tires.

2.3.9 Heavy Metal Contamination control

Soil contaminated with heavy metals can be controlled by physical or chemical means. Replace contaminated soil.

1. Large quantities of clean soil can be used to replace contaminated soil. Zheng *et al.* (2002) stated that all these methods are very material and labor intensive and therefore applicable only to small areas.

2. Electro-processing: A new technology that separates heavy metals by applying voltage. This method works best in low-permeability soils. (Hanson *et al.* 1992)

3. Adsorption method:

Heavy metals can be fixed with clay in the furnace

4. Soil washing: Contaminated soil can be removed by washing with reagents

5. Bioremediation: Plant treatments can be used to remove heavy metals by breeding certain plants to absorb them. Today, more than 400 of his species of these plants are found worldwide, some of which belong to the Brassicaceae family and include the genera Brassica, Alssum and Thlaspi are mentioned in Xing et al. Utilizing particular microbes to influence the soil's ability to absorb, precipitate, oxidize, and reduce heavy metals is known as microbiological cleaning According to John bosco *et al*. (2020), soil is the most important non-renewable natural resource. It is an actively functioning system that serves a variety of environmental activities, including the maintenance of the soil's quality. A variety of environmental elements, including climate, parent material, relief, creatures, and time factors, influence the complex mixture of living things, minerals, organic matter, water, and air. Because there are less and fewer different types of microorganisms in soil, disposing of used motor oil on land can result in a reduction in soil quality. Globally, these changes have an impact on soil quality, and the deterioration impedes both economic development and environmental health.. A soil's physical, chemical, and biological qualities are determined by its nutrient stocks and pools, which are influenced by the usage of the land and a number of other management considerations. The physical, chemical, and biological components/parameters all have a way of influencing the soil quality.

Impact of heavy metals on the soil and humans

Soil microorganisms and enzymic activities can be affected by heavy metals. Kandler *et al* (1997) indicated that the microbial biomass in the soil contaminated by Cu, Zn, Pb. and other heavy metals were inhibited severely. Research has showed that heavy metals in urban soils can go into human body through the skin, absorption, and inhalation of dust, etc and damages health, especially children's. They affect urban environmental quality and health through polluting food, water and the atmosphere. Yabe et al (2010) noted that the contaminated soil dust in the city was an important factor affecting human health. Heavy metals can destroy the liver, kidney, reproductive systems, nervous systems, urinary systems, immune systems. They are carcinogenic and mutantgenic.

The researcher analysed soil samples from different cities of the world and observed that heavy metal have caused a great damage. Babula (2008) observed that heavy metals in urban areas may go into the body directly through ingestion, skin contact etc.

2.3.8 Effects of Heavy Metals on Humans and Animals

Impact of heavy metals on the soil and humans Soil micro-organisms and enzymic activities can be affected by heavy metals. Kandler et al (1997) indicated that the microbial biomass in the soil contaminated by Cu, Zn, Pb. and other heavy metals were inhibited severely. Research has showed that heavy metals in urban soils can go into human body through the skin, absorption, and inhalation of dust, etc and damages health, especially children's. They affect urban environmental quality and health through polluting food, water and the atmosphere. Yabe *et al* (2010) noted that the contaminated soil dust in the city was an important factor affecting human health. Heavy metals can destroy the liver, kidney, reproductive systems, nervous systems, urinary systems, immune systems. They are carcinogenic and mutantgenic.

2.3.9 Remediation of heavy metals

Physical or chemical means can be used to control heavy metals contaminated soils:

1. Replacement of contaminated soils. A large amount of clean soils can be used to replace the contaminated ones. Zheng *et al*, (2002) noted that all these methods would cost a lot of material resources and manpower and so it can only be applied to a small area.
2. Electro kinetic remediation: This is a new technology whereby electric voltage is applied to extract the heavy metals. This method is better for soils with low permeability.
3. Absorption method: heavy metals can be fixed with clay in a furnace
4. Soil leaching : The contaminated soil can be washed with some reagents to remove them

5. Bioremediation: Phytoremediation can be used to remove heavy metal by planting certain plants to absorb them. Now more than 400 species of such plants have been found in the world, and miss of them belong to Cruciferae, including the genus Brassica, Alssum and Thlaspi (Xing, *et al.*, 2003). Microbial remediation refers to using some microorganisms to perform the absorption, precipitation, oxidation and reduction of heavy metals in the soil. Siegel *et al* (1986) found that fungi could secrete amino acids, organic acids and other metabolites to dissolve heavy metals and the minerals contain in them. Some animals living in the soil can also can also (maggots, earthworms etc) can take heavy metals in the soil. Wang et al (2007) proved that when the concentration of Cu was low in the soil, the activities and secretion of earthworms could promote the absorption of Cu by ryegrass.

2.4 Summary of literature review

Numerous studies have indicated that heavy metals are not only found in mechanic workshops but from other sources. They include emissions from transport, industrial wastes from power plants, metallurgical industries, chemical plants, dumpsites, household garbage, precipitation in the atmosphere etc also worldwide samples of urban and Agricultural soils have showed presence of heavy metals. Recent studies by (Babula et al (2008) showed that these heavy metals can go into the body through ingestion, skin contact etc. and can cause a lot damages and diseases. The increasing load of heavy metals is as a result of urbanization, population growth, and natural resources exploitation, increasing industrial operations, irrigation agriculture, and lack of environmental regulations. Nebo, (2018) analysis results shows that heavy metals were within permissible levels, but Johnbosco *et al* (2020) findings shows that the soils of Mechanic village in Owerri are heavily polluted with heavy metals. Also the findings from the study by Abdullahi *et al* (2019) shows that the soil from some selected auto mechanic workshops were polluted with heavy metals, some were beyond permissible levels.

3.0 MATERIALS AND METHODS

1.6 The Study area

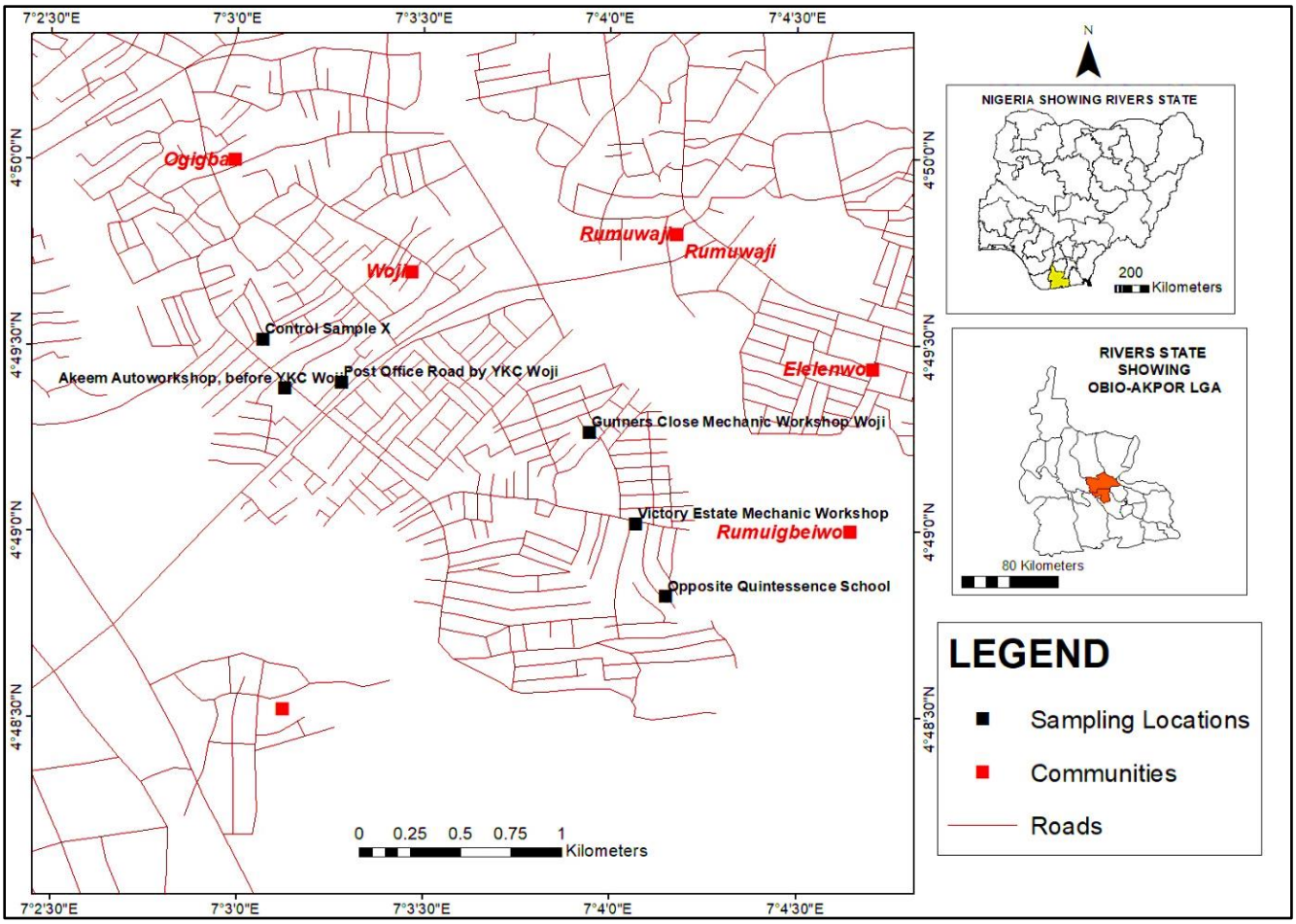

Fig 1.1: The Study Area showing Sampled point
Source: Digitalized original map, Ministry of Lands & survey, PH.

1.6.1 Geographical Location

Woji is located on latitude 4°47' 0" and $4^0$48'59''North of the equator and on longitude $6^0$59'22'' and 7^0 0' 3"East of the Greenwich meridian. See in fig. 1.1
The geographical location of Woji river are latitudes 4^0 50'25'' and 4^0 48'16''N and Longitudes 7^0 03'34''E and 7^0 04; 22' E.

1.6.2Relief

Woji is generally a lowland area, with an average elevation of about of about 30m above sea level. Its geology comprises basically of alluvial sedimentary basin of basement complex rocks

1.6.3 Vegetation and soil

This area has light rain forest and mangrove forest with raffia palms due to heavy rainfall. The soil is usually sandy or loamy it is leached from heavy rainfalls and underlain by a layer of

impervious pan. The soil found around Woji River catchment is made up of older sediments gotten from coastal plain sands. The soil profile shows clay, coarse sand, deep and very brown and porous with brown colour. It has mainly quartz and kaolinite minerals, It is low in fertility. Most of the rainforest vegetation has disappeared due to the speed of urbanization and land use change.

1.6.4 Drainage

Woji River hosts some main industrial hubs like the Trans Amadi Industrial region the south, shell industrial region to the west and Eleme Petrochemical and the Indorama Fertilizer Company to the South east. The northern axis is densely populated with lots of residential houses due to the industrial and commercial activities around it. This river is a tributary of the upper Bonny River with an average depth of 4.8m. It transits from salt to fresh water, its origin is from Okrika town to Mini-ewa, Rumuobiakani down to Woji, Oginigba, Okujagu communities. This River enters into Bonny Estuaries before flowing into the Atlantic Ocean. A lot of metal scraps from the dockyard, discharge from Abattoir, industrial effluents and water from all around are dumped into the river. The river is at the receiving of all the industrial activities of this area. Another obstruction to the river is the growth of water Hyacinth. These growth obstruct the river discharge and This river has a confluence with the creek at the refinery at Okujagu to form the main tributary which drains into the Bonny River.

1.6.5 Climate

The climate of Woji is sub equatorial, with heavy rainfall throughout the year, the rainy season is from February to November while dry season starts from November to February. The temperature varies between 22^0C and 27^0C

Woji and it has contributed to steady power supply in most part of Woji.

3.1 Research Design

The study adopted the use of experimental research design. It enabled the researcher to go into the field to observe and collect soil samples within the mechanic workshops for laboratory analysis

3.2 Nature and sources of data

The data for the study were collected from both primary and secondary sources of data. The primary source of data included soil samples the to be collected within vicinity of auto mechanic workshop inWoji The GPS was used to get the coordinatesof each sampled location. The secondary sources of data for this work was sourced from available textbooks, journals, dissertations, government gazettes, maps etc.

3.3 Population of study

Population of study includes the total number of parameters. This includes temperature, soil pH, particle size distribution and heavy metals. The Mechanic workshops comprises of their workers (e.g. mechanics, welders, battery chargers, painters and vulcanisers) .S From feasibility study, there are about 53 of such mechanic workshops around Woji area with each having at least 4 workers which is a total of 212.However, only 10 0f such workshops have approval from the Obio Akpor council in the area, Hence our concern is on these auto mechanic workshops See table 3.1 below.

Table 3.1: Approved (Obio/Akpor Council) Auto-mechanic Workshops in Woji Area of Port Harcourt

S/n	Approved Auto-mechanic Workshops
1.	Akeem Auto workshop before YKC
2.	Auto workshop by railway
3.	Post Office road mechanic workshop by YKC
4.	Gunners close mechanic workshop
5.	Auto workshop at Ogbatai
6.	Auto workshop at second Creekview
7.	Ifeanyi Auto workshop
8.	Victory Estate mechanic workshop
9.	Mechanic workshop opposite Quintessence School
10.	Auto workshop at Estate

Source: Researcher's Field work, 2021

3.4 Sample Size and Sampling Technique

About 50% of the total study population (mechanic workshops) was randomly selected through the use of simple random sampling technique. This gave us five experimental sites (mechanic workshops). That is five experimental sites (mechanic workshops) was used for the study plus one control site. See table 3.2 below.

Table3.2: Sampled/Selected Auto-mechanic Workshops

S/n	Approved Auto-mechanic Workshops	Elevation (M)	Sites GPS Coordinates
A.	Akeem Auto workshop before YKC	24	E007^{0}03'08" N04^{0}49'23"
B.	Post Office road mechanic workshop by YKC	28	E 007^{0}03'17" N04^{0}49'24"
C.	Gunners close mechanic workshop	23	E007^{0}03'57" N04^{0}49'16"
D.	Victory Estate mechanic workshop	17	E007^{0}04'05" N04^{0}49'01"
E.	Mechanic workshop opposite Quintessence School	21	E007^{0}04'09" N04^{0}48'49"
F.	Control site: First Creekview	17	E007^{0}03'04" N04^{0}004'30"

Source: Researcher's Field work, 2021

A control site in this work is defined to mean an area excluded from auto mechanic workshop i.e an area that does not have the presence or influence of mechanic workshops.

3.5 Methods of Data collection

A feasibility studies was carried out weeks before the actual survey so as to sensitize the mechanics and also to gain easy access to the site on that day. The soil samples were collected using the soil auger at depths of 0 – 30cm was taken from the mechanic workshops. They were labelled, and put into a cellophane bag and transported to the Laboratory for analysis. Also the GPS was used to ascertain coordinates of each of the location.

3.6 Method of Data Analysis

The data was analysed using various statistical tools. The **ANOVA** and **Chi- square.**

3.7 Laboratory procedure and Instrumentation

For the collection of the main data (soil samples) for the study, the major instruments used in the field include open auger, hand GPS, calibrated meter rule, cellophane bags, and small transparent rubber plates with cover, masking tape, hand gloves, shovel. Soil samples were collected from one (control site) and five (observed/experimental sites) in the area. At each site, the GPS was used to get the location of each point of sample collection. The shovel was used to dig a small pit of $30cm^2$ with a depth of 40cm. the open auger was used to collect soil sample that were packaged into the cellophane bags and well sealed to preserved soil moisture. Each sample was well labelled using the masking tape and biro.

The samples were then taken to BGI Laboratory Limited (No. 278 PH/Aba Express Way opposite Shell RA, Rumuokwurusi Port Harcourt) for laboratory analysis in order to determine composite soil properties and extent of soil physicochemical properties of both the control and observed samples. The examination include soil particle sizes for SSC (Sand, Silt and Clay); whereas the physicochemical parameters examined include soil pH, temperature, nitrogen, phosphorus, total organic carbon (TOC) and potassium.

4.0 RESULTS AND DISCUSSIONS

4.1 Data Presentation

Table 4.1: Laboratory Analytical Report for Soil Samples

S/n	Parameter	METHOD	Sample A	Sample B	Sample C	Sample D	Sample E	Mean	Control F
1	Ph	Electrometric	6.3	7.1	5.3	5.2	6.2	**6.02**	6.2
2	Temp (^{O}C)	APHA -2550-B	27.2	26.7	25.7	26.3	27.4	**26.66**	26.8
3	Fe (mg/kg)	ASTM D3559	67.8	6.6	25.8	40.5	23.2	**32.78**	9.6
4	Ni (mg/kg)	ASTM A4655	28.5	6.8	25.3	27.5	30.15	**23.65**	4.5
5	Cu (mg/kg)	ASTM D3559	32.2	7.3	25.5	2.8	3.03	**14.17**	1.6
6	Mg(mg/kg)	APHA 3111B	14.3	5.7	24.8	1.8	10.02	**11.32**	33.2
7	Cd (mg/kg)	ASTM B6543	2.10	5.9	25.1	8.3	4.3	**9.14**	3.48
8	Pb (mg/kg)	ASTM D4323	34.54	16.4	14.4	19.4	18.34	**20.26**	9.47
9	Zn(mg/kg)	ASTM D355	42.3	23.8	43.5	76.4	25.4	**42.28**	12.4

Source: Researcher's Field Work, 2021

The pH level in the soil of the area ranges from 5.2 to 7.1 and a mean occurrence of 6.02 as against 6.2 for the control. In terms of spatial spread, the highest figure of 7.1 was recorded at sample B while the least figure of 5.2 was recorded at sample D. While some of the soils indicated alkaline, others (especially at location B) was neutral. Soil temperature ranges from 25.7 to 27.4^0C with a mean of 26.66^0C as against 26.8^0C for the control. The highest value of 27.4^0C was recorded at sample location E, while the least value of 25.7^0C was recorded around sample C.

Iron (Fe) values range from 6.6 to 67.8mg/kg with a mean of 32.78mg/kg as against 9.6mg/kg for the control. The highest value of 67.8mg/kg was recorded at sample A whilst the least value of 6.6mg/kg was recorded at sample location B. Nickel (Ni) values range from 6.8 to 30.15mg/kg with a mean value of 23.65mg/kg across the five experimental sites as against 4.5mg/kg for the control. The highest value of 30.15mg/kg occurs at sample E whilst the least value of 6.8mg/kg occur at sample B.

Cupper (Cu) values range from 2.8 to 32.2mg/kg with a mean of 14.17mg/kg across the area as against 1.6mg/kg for the control. The highest value of 32.2mg/kg was recorded at sample A while the least value occurred at sample D. Lead (Pb) occurrence level in the soils ranges from 14.4 to 34.54mg/kg with a mean of 20.62mg/kg as against 9.47mg/kg for the control. The highest value of 34.54mg/kg was recorded at sample A while the least figure of 14.4 occurred at sample C. Finally, Zinc (Zn) occurrence level in the five experimental sites range from 23.8 to 76.4mg/kg with a mean of 42.28mg/kg as against 12.4mg/kg for the control.

Magnesium (Mg) occurrence range from 1.8 – 24.8mg/kg with a mean of 11.2mg/kg as against 33.2mg/kg for the control. The highest value of 24.8mg/kg was recorded at sample C while the least figure of 1.8mg/kg occurred at sample D. Also, the occurrence of Cadmium (Cd) range from 2.10mg/kg to 25.1mg/kg with a mean of 9.14mg/kg as against 3.48mg/kg for the control. The highest figure of 25.1mg/kg was recorded at sample C while the least value (2.10mg/kg) occurred at sample A

Table 4.2: Laboratory Analytical Report of Soil Characterization in Woji, Port Harcourt

Samples	**% Silt**	**% Clay**	**%Sand**
A	15.9	2.4.	81.7
B	5.8	2.8	94.2
C	11.9	1.2	86.9
D	17.9	1.5	80.6
E	6.4	1.3	92.3
Mean	**11.58**	**1.84**	**87.14**
F	18.2	2.6	79.2

Source: Researcher's Field Work, 2021

In terms of soil particle characterization, the soil of the area is chiefly characterized by sandy soil. Mean occurrence of silt in the soil of the area was 11.58%, 1.84% clay, and 87.14% sand.

Table 4.4 Showing the variation in the occurrence of heavy metal

Source: Researchers field work, 2021

67.8	6.6	25.8	40.5	23.2
28.5	6.8	25.3	27.5	30.15
32.2	7.3	25.5	2.8	3.03
14.3	5.7	24.8	1.8	10.02
2.10	5.9	25.1	8.3	4.3
34.54	16.4	14.4	19.4	18.34
42.3	23.8	43.5	76.4	25.4

.

4.3 Discussion of Findings

The study was able (arising from the test result of hypothesis one) to ascertain that there is indeed no significant difference in level of occurrence of soil pH across the five experimental soil samples. This means that the soils of the area have the same level of impact on the soil pH due to the activities of the auto-mechanic workshops.

Objective two was aimed at determining possible significant variation in the level of occurrence of the physicochemical parameters and heavy metals across the five experimental sites. This was actualized. The test result of hypothesis two (apart from the laboratory analytical report of the various samples) revealed that there is significant variation in the occurrence of these soil parameters across the five experimental soil samples in the area. Both findings of objective one and two are in line with the findings of Igwe (2021) who examined the impacts of certain land use activities (including mechanic workshops) on soil quality in Port Harcourt Metropolis; and Ottoh (2019) who looked on the impact of deforestation on soil physico-chemical parameters in Andoni Local Government Area of Rivers state.

The soil of the area is chiefly characterized by sandy soil. Mean occurrence of silt in the soil of the area was 11.58%, 1.84% clay, and 87.14% sand. There is significant difference in the occurrence of the parameters between the control and the experimental sites. Findings on objectives three and four is in line with the works of Sterling (2019) and Ukpere & Aziba-alua (2018) which argued that areas of increase population and land use pressures is associated with high rate of deforestation and loss of soil nutrients; but is at variance with that of May *et al* (2019).

Judging from the laboratory report on the soil samples, there is a minute variance in the occurrence of soil pH, temperature, particle characterization and the heavy metals concentration level. Whereas the laboratory analytical report of some of the parameters showed no sign of pollution in some of the sites, in others the report proved that the level of the various parameters indicate potential threat to soil pollution arising from the activities of mechanic workshops in the area.

4.3.1 Soil Particle Characterization (Properties)

Generally, soils are made up of four basic components namely minerals, air, water and organic matter in their respective percentage. However, apart from the biological components of soil, soil characteristics is made up of two primary properties namely physical and chemical. These two main properties define the nature of any particular soil. The proportion and or percentage

occurrence of both physical and chemical properties of any soil determines the use of that particular soil. Sterling (2019) argued that in most soils (whether tropical, humid, temperature or arid), minerals represent about 45%, water and air, about 25% each, and 2 to 5% organic matter. Sterling (2019) opined that the mineral portion is made up of three distinct particle sizes such as sand, silt and clay. of all, sand is the largest particle and is largely quartz. It also contains other minerals in small amount.

It is important to state here that quartz contains no plant nutrients; also, sand does not hold nutrients because it is easily leached arising from rainfalls. This is a major problem in the study area as sand make up about 87.14% of the soil of the area. Although silt particles are much smaller than sand particles, silt is also mainly quartz. Clayey soils are usually the smallest particles, it also contains high amounts of plant nutrients. It retains both nutrients and water hence, it is most productive than sand.

Soil texture is determined by the relative proportion of the three main types of soil particles or soil separates; sand, silt and clay. Soil density (bulk density) is a measure of the ability of the soil to stick together. Soil temperature and colour are most time, self-defining. Resistivity refers to the resistance of the soil to electrical conductivity and affects the rate of corrosion of metal and concrete structures (Ottoh, 2019; Essang, 2018; Wilson, *et al*, 2017). For convenience and for the purpose of this study, the physical properties of soil herein analyzed, defines the texture and structure of soil which also forms the soil basic characteristics examined in this work.

Generally, soil texture is concerned with the proportions of sand, silt and clay components of a particular soil. A loamy soil which is found in parts of the study area for instance, contains these three soil particles in almost equal proportions while a sandy-loamy soil (the type present in most part of the study area is a mixture of larger amount of sand and a smaller amount of clay. A clayey-loamy soil is made up of larger amount of clay and small amount of sand. Since the soils in the area is composed of sand (87.14%), silt (11.58%) and clay (1.84%), this implies that the soil texture is chiefly sandy and can best be described of chiefly sandy-loamy, and partially clayey in some parts.

4.3.2 Soil pH Level in the Area

Soil pH constitute part of the chemical properties of the soil. Soil pH is a major determinant of the acidity or alkaline nature of any soil.

The soils in Woji area of Port Harcourt has an average (mean) pH of 6.02 for the experimental sites and 6.2 for the control (table 4.1), indicating that the soil of the area is basically acidic. Further exposure to chemical wastes by auto-mechanic workshops could spell doom on the soil pH of the area.

4.3.3 Heavy Metals Concentration Level in the Soil of the Area

As expected, there is spatial difference in the occurrence of the various heavy metals across the area. Mean value for Iron (Fe) for the five experimental sites was 32.78mg/kg as against 23.65mg/kg for Nickel (Ni); Cupper (Cu) 14.17mg/kg, Lead (Pb) 20.62mg/kg, Magnesium (Mg) 11.32mg/kg, Cadmium (Cd) 9.14mg/kg, and Zinc (Zn) 42.28mg/kg.Zinc (Zn) had the highest mean value (42.28mg/kg) while Cadmium (Cd) had the least mean figure of 9.14mg/kg.

Whilst in the control, Iron (Fe) was 9.6mg/kg, Nickel (Ni) 4.5mg/kg, Cupper (Cu) 1.6mg/kg, Lead (Pb) 9.47mg/kg, Magnesium (Mg) 33.2mg/kg, Cadmium (Cd) 3.48mg/kg and Zinc (Zn) 12.4mg/kg. The high mean values recorded for the five experimental sites is as a result of the impact of the auto-mechanic workshops around such places.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study established the occurrence of heavy metals , distorted soil structure as well as soil physical and chemical properties , due the activities of auto mechanic workshop workers

Auto-mechanic workshops impacts negatively on the soil in any environment where these activities are common. This is through the indiscriminate disposal or release of certain chemical substances (e.g. carbide, oil and grease, etc.) . Their activities have far reaching negative effects on agriculture , the environment and health

5.2 Recommendations

Relevant government agencies should ensure that there is proper sitting of mechanic workshops in the area, also their activities should be regularly monitored and evaluated to guard against excessive contamination of the soil by these auto-mechanic workshops

Regular and continuous enlightenment campaigns through the media, town hall meetings, on-the-site inspection and education of auto-mechanic workshops operators/workers should be carried out to really educate and inform the people on the environmental effects of indiscriminate disposal of auto-mechanic workshops wastes.

Proper drainage channels should be constructed, tp prevent contamination of nearby soils , rivers , streams and other water bodies

REFERENCES

Adelekan, & Abegunde (2010). Heavy metals contamination of soils and ground water at automobile mechanic Village in Ibadan, *Nigeria. Int'l Journal of the Physical Sc..*

Adesuyi, A.A, Ngwoke, M.O, Akinola K, Kelechi, N. (2016) Assessment of Physicochemical characteristics of sediments from Nwaja creek, Niger Delta Nigeria. Dec 2015, *journal of Geo Science and Environment protection 04 (0)*

Adesuyi, A.A, Nnodi, V.C. Njoku, K.L, Jalaosa, A (2015) Nitrate and Phosphate Pollution in surface water of Nwaja Creek, Port Harcourt, Niger Delta Nigeria. *International Journal of Geology. Agricultural and Environmental Science 3 (5): (4 – 20)*

Chao Su, LiQuin Jiang, Wenjun Zhang (2014). A review on heavy metal contamination is the soil worldwide: Situation, impact and remediation techniques. *Environmental Skeptics and critics , 2016, Vol. 5 iss. 1*

Jia, M, MacBride D, Vare,N.K, Zainal, S.R, Leroy, C. (2010). The patterns and dynamics of genomic instability in metastatic pancreatic cancer.
Journal of agricultural and food chemistry 2000 ACS publications.

Lenntech, W.T, (2009.) Chemical Properties. Health and Environmental Effects of Copper.

May, A.B. & Thundale, S.K. (2016) *Soil Studies for beginners.* Ontario: Pearl Books Ltd

Nebo C.U., Udom G.J. & Ehirin C.N. (2018) Contaminant Impact Assessment of Automobile Workshop on soil and ground water resource in Port Harcourt, Nigeria. *International Journal of Science Inventions Today 7(3), 451-463.*

Njoku, H.A, Azi, F., Odo, M.O, Okorie P, *(2018)* Heavy metals and mircobial safety assessment of raw and cooked pumpkin and Amarantus viridis leaves grown in Abakaliki in Nigeria.

Nwachukwu, M.A, Feng, H, Akinnor, J. (2010). Assessment of heavy metals pollution in soil and their implication within and around mechanic villages; *Int.J Environ. Sc Tech 7 (2) : 347 – 358*

Ottoh, M.A. *(2019). Impact of deforestation on soil physicochemical properties in Andoni Local Government Area of Rivers State. Unpublished M.Sc. Dissertation,* Department of Geography and Environmental Studies, Ignatius Ajuru University of Education, Port Harcourt

Sterling, P.C. ***(2019).*** *Deforestation and Soil Degradation.* London: Stallion Publishing House

Wang. Q. Cui, Y, Liu X, Dong, Y & Chrisie P, (2003). In Soil contamination and plant uptake of heavy metals at polluted sites in china.

Yahaya M., (2016). Evaluation of levels of heavy metals in soils and wells within selected Auto mobile mechanic workshops in Lokoja in Nigeria.