# Assessment of Soil Quality of Automobile Mechanic Workshops in Obio/ Akpor Local Government Area of Rivers State, Nigeria

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## ABSTRACT

Scientists wanted to find out if the soil around car repair shops in some neighborhoods in Nigeria has dirty metals in it. These metals can come from things like car parts and oils used at the workshops. To do this, they took small samples of dirt from four different areas where cars are fixed. They also took some samples from nearby places that weren't car workshops to see what normal soil looks like. The scientists used special tools to measure how dirty the soil is and found that, overall, the soil is somewhat polluted, especially in one area called Rumuosi. Because of this, they think it's important to make rules and take action to clean up the soil and keep the environment safe. They suggest that people who run the workshops should follow better practices to prevent more pollution and that cleaning the dirty soil would help make the environment healthier. They tested the soil to see how much of certain metals like lead, cadmium, manganese, iron, and copper were there. They found that these metals were in the soil, especially iron and manganese, and sometimes the levels were higher than in the clean areas. This means the soil near the workshops is getting polluted with these metals, likely because of the work done there.

**Keywords:** soil quality, automobile mechanic workshops operation and activities.

## INTRODUCTION

Pollution is a big problem around the world. Many people get sick because of harmful chemicals and waste that humans produce. The soil, which is the ground we walk on, also collects this waste from people and factories. When humans and factories don't control their waste, more dangerous metals, called heavy metals, end up in our environment. These metals are very heavy and include things like mercury, lead, manganese, arsenic, and copper. Heavy metals are elements that are much denser than water. Some of these metals occur naturally in the earth, in rocks and soil, but when humans do certain activities, like working on cars, they cause more of these metals to build up in the environment. For example, in Nigeria, activities like fixing cars at mechanic workshops can make the levels of heavy metals in the soil and water go up too high. This is dangerous because too many heavy metals can harm plants, animals, and even people.

For example, car emissions often include chemicals from paints, oils, and fluids, which add more heavy metals to the environment. Waste from car repairs can also leak into rivers, lakes, and underground water because land, air, water, and soil are all connected. Studies have shown that areas with many car repair activities have higher levels of dangerous metals like cadmium, copper, lead, nickel, and zinc than normal. The main sources of these metals are lead in gasoline and zinc from tires.

There are many car repair shops all over Obio/Akpor, especially along busy roads and markets. These shops often throw their waste on the ground everywhere, which pollutes the environment. The waste from these shops contains harmful metals that can hurt plants and animals. It also kills helpful tiny microbes in the soil that clean up pollution. Since the water underground is very close to the surface in this area, these dangerous metals can also get into the water we drink. Because of this pollution, people are worried, and scientists want to study the soil around these workshops to see how clean or dirty it is.

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# MATERIALS AND METHOD

## Study Area

Obio/Akpor is next to other areas: Ikwerre to the north, Port Harcourt city to the south, Oyibo to the east, and Emeoha to the west. The city of Port Harcourt, which is an important city in Nigeria, is made up of Obio/Akpor, Eleme, and Port Harcourt city areas. This city sits on solid ground and is about 66 kilometers from the Atlantic Ocean. Port Harcourt is a busy city with lots of business activities and is one of the biggest cities in Rivers State. This study is about four communities called Eliozu, Elelewon, Rumuosi, and Choba. These communities are in a place called Obio/Akpor, which is part of Rivers State in Nigeria. Rivers State is in a region called the Niger Delta, in Nigeria.

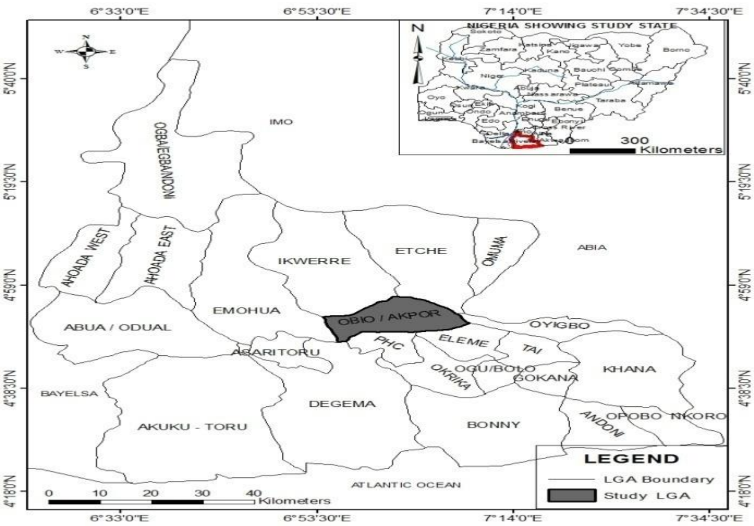


Figure 1. Rivers State Showing Obio/Akpor L.G.A.

Source: Rivers State ministry of land and survey 2024: updated.

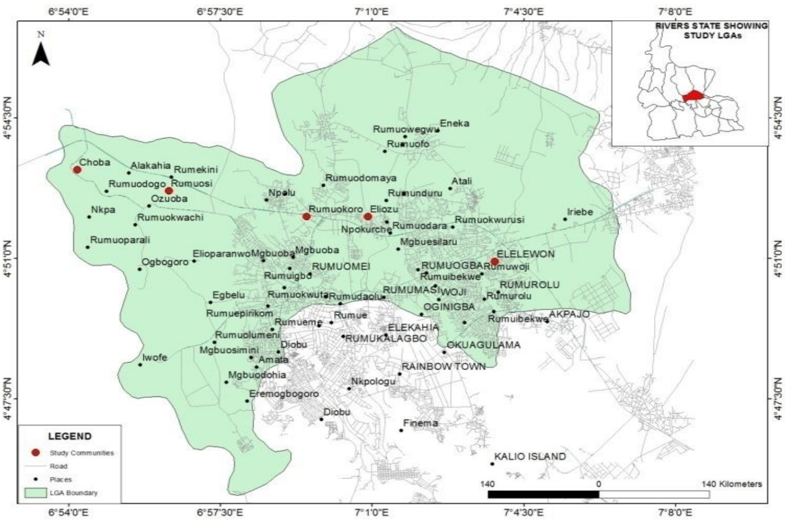


Figure 2: Obio/Akpor L.G.A showing the study area.

Source: Rivers State ministry of land and survey 2024: update

## Population of the Study

This study is about the dirt and soil found near car repair shops in Obio/Akpor, a place in Rivers state. The study looks at all the spots in that area, including the exact locations marked by their map coordinates. Scientists took samples of the soil from these spots to learn more about them.

### Sampling Techniques

Simple purposive sampling methods were used to determine the sample size of the study area.

The various strata of the study areas are; Eliozu, Rumuosi, Choba, and Elelewon communities in Obio/Akpor Local Government Area, and the control were also collected at Oginigba Opposite Next Cash and Carry Garden and Iriebe School to land by The Promise Glorious Ministry Garden.

There were inventories of all the automobile workshops in Obio/Akpor Local Government Area, a total of 48 mechanic workshops were identified as shown in

Table 1: Number of automobile workshops and the communities covered in the study area.

| Communities in Obio/Akpor Local Government Area. | Number of mechanic workshops. |
|---|---|
| Eliozu | 9 |
| Rumosi | 12 |
| Choba | 15 |
| Elelwon | 12 |
| Total | 48 |

### Methods of Data Collection

The soil samples were collected from the automobile workshops locations using soil auger at about 0- 20cm depth. The samples were collected along side with the geographical coordinate using Geographical Information System GPS (ARMIN GPS72H) as shown in table 3.2.

Twelve (12) samples were collected from four (4) different communities in the study areas and two samples were also collected from the Control sites. A total of fourteen (14) samples were collected.

The samples were thoroughly mixed and transferred into clean polythene bag and were labeled E1, E2, for Eliozu, R1, R2, R3 for Rumuosi, C1, C2, C3, C4, for Choba, EL1, EL2, and EL3 for Elelewon, and control 1 and 2 in line with the transect for the soils for onward laboratory analysis to determine their level of contaminations by heavy metals (Manganese Mn, Lead Pb, Iron Fe, and Cadmium Cd), and physicochemical parameters.

Table: 2 coordinate locations of the various samples collections GPS (ARMIN GPS 72H)

| Name/ locations | **Longitudes** | **Latitudes** |
|---|---|---|
| Choba, sample 1<br>(Redeem church) | **$6^0$92.2758** | **$4^0$88.720** |
| Choba, sample 2<br>(East west road) | **$6^0$92.225** | **$4^0$ 88.740** |
| Choba, sample 3<br>(Helena heaven) | **$6^0$ 91.516** | **$4^0$ 89.365** |

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| | | |
|---|---|---|
| Choba, sample 4<br>(Institute of Petroleum) | **$6^0$ 91.589** | **$4^0$ 89.730** |
| Elelewon, sample 1<br>(opp. Mosque | **$7^0$ 06.360** | **$4^0$ 85.138** |
| Elelewon, sample 2<br>(old refinery road) | **$7^0$ 06.587** | **$4^0$ 82.557** |
| Elelewon, sample 3<br>(Worji road) | **$7^0$ 06. 648** | **$4^0$ 82.358** |
| Eliozu, sample 1<br>(Skyfallmagaloung) | **$7^0$ 02.088** | **$4^0$ 85.935** |
| Eliozu, sample 2<br>(ABC Bus park) | **$7^0$ 02.124** | **$4^0$ 86.033** |
| Rumuosi, sample 1<br>(East west road) | **$6^0$ 95.410** | **$4^0$ 87.888** |
| Rumuosi, sample 2<br>(Abdul-quadri ventures) | **$6^0$ 95.324** | **$4^0$ 87. 890** |
| Rumuosi, sample 3 | **$6^0$ 92.779** | **$4^0$ 88.425** |
| Control -1 (Oginigba) | **$7^0$ 03.513** | **$4^0$ 82.706** |
| Control -2 (Iriebe) | **$7^0$ 11.298** | **$4^0$ 87.015** |

**Method of Data Analysis**

Sample analysis results are presented in mg/kg. Scientists have set safety levels to certain heavy metals to keep people safe. Some of these levels are also meant to protect fish, plants, and soil that get dirty water or waste from homes and farms.

In this study, we tested for the physicochemical and heavy metals parameters using apparatus and procedures as specified by AOAC (2005) described below.

**Determination of Heavy Metals** (Buck scientific VGP 2010/2011)**…… (6)**

**Apparatus**: Digestion bottles, Whatman No 9 filter paper, oven, and PerkinElmer Precise Analyst 200 atomic absorption spectrophotometer.

**Reagent**: 2 $MHNO_3$

**Procedure**: Approximately 1.0 gram of each soil sample was carefully weighed and transferred into individual 50-milliliter digestion tubes. To each tube, 10 milliliters of a 2 molar solution of nitric acid (HNO) were added to facilitate the digestion process. The samples were then subjected to digestion for duration of 2 hours, during which they were gently shaken every 20 minutes to ensure thorough mixing and effective breakdown of the soil matrix. After completing the digestion period, the resulting solutions were carefully filtered into clean 25-milliliter volumetric flasks to remove any particulate matter. The filtrates were then carefully diluted to the marked volume with deionized water, ensuring consistent volume and concentration across all samples. These diluted solutions were subsequently stored in polyethylene bottles to prevent contamination and degradation until they were ready for analysis. The prepared samples were analyzed for the presence and concentration of several trace elements, including lead (Pb), nickel (Ni), zinc (Zn), cadmium (Cd), chromium (Cr), copper (Cu), arsenic (As), beryllium (Be), barium (Ba), cobalt (Co), and mercury (Hg). The analysis was performed using a Buck Scientific VGP 2010/2011 Atomic Absorption Spectrometer, a precise instrument suitable for detecting and quantifying trace metal concentrations. To ensure accuracy and reliability of the results, blank determinations were also conducted by processing samples without soil to account for any background signals or contamination.

**Calculation**

$$\text{Heavy metal concentration (mg/kg)} = \frac{(M - B) \times V}{W}$$

Where:

M = Concentration (mg/L) of metal in the sample solution from AAS reading.

B = Concentration (mg/L) of metal in the blank solution from AAS reading

W = Weight (g) of soil sample used for digestion

V = Final volume (mL) of the digestion.

## RESULTS AND DISCUSSION

Results of analyzed soils collected in close proximity from 12 locations are presented alongside with the control experiment of the soil taken far way from automobile workshops. The heavy metals tested for are Lead (Pb), Cadmium (Cd), Iron (Fe), Manganese (Mn) and Copper (Cu) alongside with the physicochemical analysis.

**Physicochemical Characteristics In Soil Of Mechanic Workshops In Obio/Akpor Lga.**

Table 3 shows a summary of the important soil properties, like how the soil feels and what it’s made of, for samples collected from the mechanic workshop area. This also shows the average levels of soil properties, and comparison with controls that is, an area far away and not affected by the activities of automobile workshops.

**pH**

The soil samples exhibited alkaline characteristics, with pH values ranging from 6.44 to 8.91. Among the sites, Eliozu recorded the highest average pH level of 7.62, closely followed by Choba, which had an average pH of 7.60. Rumuosi's soil had an average pH of 7.02, while Elelewon experienced the lowest pH reading of 6.64, as detailed in Table 3. The control samples showed an average pH of 6.79, which was generally lower than the pH values observed across all the study locations, except for Elelewon, where the pH was comparable. It is important to note that soil pH plays a crucial role in influencing solute concentrations, as well as the processes of sorption and desorption of contaminants within the soil matrix. Additionally, the availability of heavy metals in soil is known to be pH-dependent (Iwegbue et al., 2006; Gonzalez-Fernandez et al., 2008). Most of the soils examined in this study fell within the pH range of 6.0 to 9.0, a range in which many metals tend not to exist in their free, soluble form. Consequently, within this pH interval, metals are less likely to be bioavailable for uptake by plants and microorganisms (Porteus, 1985).

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### Electrical conductivity

The measured electrical conductivity (EC) values across the sampled sites ranged from a minimum of 1090 µS/cm to a maximum of 1320 µS/cm. Among the locations, Choba exhibited the highest average electrical conductivity, registering a value of 1250 µS/cm. This was followed by Elelewon, which had an average EC of 1170 µS/cm, and Eliozu, with an average of 1130 µS/cm. The site with the lowest average electrical conductivity was Rumuosi, where the EC was recorded at 1110 µS/cm. When considering the control samples, the overall average electrical conductivity was observed to be 1100 µS/cm. This value was notably lower than the average EC values obtained from soil samples collected from all the other sites, indicating a slight variation in soil properties across locations. It is important to note that none of the measured electrical

Conductivity values exceeded the critical threshold of 4000 µS/cm, a level at which soils are typically classified as saline according to Donahue and Miller (1990). This suggests that, despite the variation in EC among the different sites, none of the soils were considered saline, which has implications for soil suitability and plant growth in these areas.

### Soil Organic Matter

The soil organic matter ranged from 2.3 – 10.8 %. The Elelewon had the highest average soil organic matter of 7.63 %, followed by 6.67 % in Eliozu, 5.46 in Rumuosi and the

Table 3 Physicochemical characteristic of soil samples collected in Mechanic workshop in Obio/Akpor LGA.

| SAMPLE NAME | Ph | Conductivity, | TOC, % | Nitrate, mg/kg | Phosphate, mg/kg |
|---|---|---|---|---|---|
| Choba I | 6.44 | 1130 | 2.42 | 4.74 | 0.31 |
| Choba 2 | 8.51 | 1300 | 2.76 | 5.54 | 0.09 |
| Choba 3 | 8.91 | 1320 | 2.76 | 8.96 | 0.09 |
| Choba 4 | 6.55 | 1250 | 2.3 | 9.44 | 0.07 |
| **Mean** | **7.60** | **1250** | **2.56** | **7.17** | **0.14** |
| **Range** | **6.44-8.91** | **1130-1320** | **2.30-2.76** | **4.74-9.44** | **0.07-0.31** |
| Elelewon I | 6.57 | 1170 | 7.13 | 3.22 | 0.12 |
| Elelewon II | 6.68 | 1170 | 10.8 | 5.72 | 0.16 |
| Elelewon III | 6.67 | 1180 | 4.95 | 5.90 | 0.21 |
| **Mean** | **6.64** | **1170** | **7.63** | **4.95** | **0.16** |
| **Range** | **6.57-6.68** | **1170-1180** | **4.95-10.8** | **3.22-5.90** | **0.12- 0.21** |
| Eliozu I | 8.22 | 1140 | 5.06 | 3.94 | 0.08 |
| Eliozu 2 | 7.02 | 1110 | 8.28 | 8.06 | 0.19 |
| **Mean** | **7.62** | **1130** | **6.67** | **6.00** | **0.14** |
| **Range** | **7.02-8.22** | **1110-1140** | **5.06-8.28** | **3.94-8.06** | **0.08-0.19** |
| Rumuosi I | 6.81 | 1090 | 4.83 | 4.22 | 0.15 |

| | | | | | |
|---|---|---|---|---|---|
| Rumuosi 2 | 6.96 | 1100 | 4.03 | 3.86 | 0.14 |
| Rumuosi 3 | 7.28 | 1140 | 7.48 | 10.3 | 0.26 |
| **Mean** | **7.02** | **1110** | **5.45** | **6.13** | **0.18** |
| **Range** | **6.81-7.28** | **1090-1140** | **4.03-7.48** | **3.86-10.3** | **0.14-0.26** |
| Control 1 | 6.76 | 1097 | 5.28 | 29.58 | 0.29 |
| Control 2 | 6.82 | 1095 | 3.24 | 27.34 | 0.25 |
| **Mean** | **6.79** | **1100** | **4.26** | **28.5** | **0.27** |
| **Range** | 6.76-6.82 | 1095-10.97 | 3.24-5.28 | 27.3-29.6 | 0.25-0.29 |

Lowest, 2.56 were obtained in Choba (Table 3). The average soil organic matter content in the control samples was measured at 4.26, which was comparatively lower than the mean organic matter levels observed across all other sampled sites. However, it is noteworthy that the control sites still exhibited higher organic matter content than the site at Choba. The elevated levels of soil organic matter detected in the soils from the mechanic workshops suggest a likely accumulation of organic materials, which is commonly associated with the addition of carbon-rich substances. In this study, such an increase can be attributed to the presence of used oils and other carbonated fluids typically found in mechanic workshop environments. According to research by Osuji et al. (2006), these organic inputs may stimulate the proliferation of soil micro-organisms, which play a crucial role in decomposing organic compounds within the soil matrix. The amount of organic matter observed in these soils has been linked by Akoto et al. (2008) to its potential ability to bind toxic ions, thereby influencing soil contaminant dynamics. Furthermore, organic matter in soils can act as a key factor in the immobilization of heavy metals, especially under strongly acidic conditions, by forming insoluble complexes. Conversely, under weakly acidic to alkaline conditions, organic matter can facilitate the mobilization of metals by creating soluble organic-metal complexes. This dual role of organic matter in either sequestering or mobilizing metals is well-documented, with Brümmer and Herms (1982) providing foundational insights into these processes. Overall, the presence and quantity of organic matter in the soils from these sites highlight the complex interactions between organic inputs, microbial activity, and metal mobility, which are critical for understanding soil health and contamination potential.

**Soil Phosphate**

The concentration of phosphate in the soil samples varied between 0.07 mg/kg and 0.31 mg/kg across the different sites. Among these locations, Rumuosi exhibited the highest average soil phosphate level, measuring approximately 0.18 mg/kg. This was followed by Elelewon, which had an average of about 0.16 mg/kg. The lowest average soil phosphate concentrations were observed in Choba and Eliozu, both recording roughly 0.14 mg/kg. Notably, the control samples, which were not subjected to the same conditions as the test sites, showed a higher average soil phosphate concentration of 0.27 mg/kg. This value surpassed the mean concentrations observed across all the sampled sites. In soils, phosphorus exists in two primary forms: organic and inorganic (mineral). Its availability is generally limited because it tends to have low solubility in soil matrices. The decomposition of organic materials and crop residues significantly contributes to the pool of available phosphorus in the soil environment, enhancing its accessibility for plant uptake. This process plays an essential role in maintaining soil fertility and supporting plant growth, as detailed in resources such as www.smart-fertilizer.com/articles/phosphorus.

**Soil Nitrate**

The soil nitrate concentration ranged from 3.22 – 10.3 mg/kg. The Choba had the highest average soil nitrate of 7.17 mg/kg, followed by 6.13 mg/kg in Rumuosi, 6.00 mg/kg in Eliozu and the lowest, 4.95 mg/kg, and was

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obtained in Elelewon (Table 3). The soil nitrate concentration of the control samples was 28.5 mg/kg, which was higher than the average concentration of the soil collected in all the sites.

**Heavy Metals Concentration Of Various Soils Of Mechanic Workshops In Obio/Akpor Lga.**

Table 4. Presented data on the concentrations of various heavy metals found in soil samples collected from different mechanic workshops within the study area. It also provided the mean index concentrations of these heavy metals in the soils of the mechanic workshop sites and comparisons with the control sites as well as with International and National regulatory established limits.

The measured concentrations of lead (Pb), cadmium (Cd), manganese (Mn), iron (Fe), and copper (Cu) across all the mechanic workshops ranged from 0.78 to 7.55 milligrams per kilogram (mg/kg), 0.02 to 0.09 mg/kg, 2.38 to 7.63 mg/kg, 25.8 to 29 mg/kg, and 0.59 to 4.03 mg/kg, respectively. These values indicate the variability in heavy metal contamination levels among different workshops within the study area. The analysis of the data revealed a pattern in the extent of pollution caused by these metals, with iron (Fe) exhibiting the highest concentrations, followed by manganese (Mn), lead (Pb), copper (Cu), and cadmium (Cd). This trend suggests that iron contamination was most prevalent in the soil samples, while cadmium exhibited the lowest levels among the metals assessed. Overall, the findings underscore the significance of iron and manganese as the dominant pollutants in the soils of the mechanic workshops, highlighting potential environmental and health risks associated with heavy metal accumulation in these areas.

**Lead**

The highest average concentrations of lead (Pb) recorded were found in Rumuosi, with a mean value of 5.05 mg/kg. This was followed by Elelewon, which had an average of 3.07 mg/kg. Choba exhibited a mean concentration of 2.43 mg/kg, while Eliozu displayed the lowest mean level at 1.88 mg/kg. These concentrations significantly exceeded the levels observed at the control site, where the average Pb concentration was only 0.79 mg/kg. However, despite being higher than the control, these values remained below the permissible limits set by regulations in various countries including WHO. In comparison, the Pb levels obtained in this study were considerably lower than the 1162 mg/kg reported by Nwachukwu et al. (2011) for an auto mechanic workshop area in Owerri, Southeast Nigeria. The relatively high mean concentrations observed in these locations highlight the widespread environmental contamination with lead, primarily attributable to human activities, especially those related to automobile maintenance and repair. It is well-documented that lead constitutes the highest proportion of heavy metals present in waste oils (Oguntimehin et al., 2008). Elevated lead levels in soils can adversely affect soil fertility and productivity, and even low concentrations can interfere with essential plant processes such as photosynthesis, cell division (mitosis), and water uptake. Such interference manifests through toxic symptoms including dark green leaves, wilting of older foliage, stunted growth, and brown, short roots (Singh et al., 2011). These elevated levels of lead are likely exacerbated by the improper disposal of waste oil, emissions from automobiles, and discarded expired motor batteries, often dumped indiscriminately by battery chargers and auto mechanics in the surrounding environments.

**Cadmium**

Scientists checked how much of metal called cadmium was in different places. The most cadmium was found in Rumuosi, with a tiny amount of 0.06 milligrams for every kilogram of soil. Next was Elelewon with 0.04, then Choba and Eliozu, both with 0.03. These amounts are a little higher than what is usually found in places that are not polluted, but they are still lower than the safety limits set by other countries and also lower than WHO standard limit. Another study found much higher amounts of cadmium, between 3 and 8 milligrams per kilogram, which is much more than what were found in this study. The amount of cadmium in this study is below the dangerous limit set by Europe, which is 3 milligrams per kilogram. The main cause of cadmium in the environment is from factories that make steel, but in the places we looked at, it probably comes from things like car oils, wheels, and metal parts used to make engines stronger.

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Table 4. Heavy metal concentrations of soil samples collected in Mechanic workshop in four communities in Obio/Akpor local Government Area.

| SAMPLE NAME | Pb, mg/kg | Cd, mg/kg | Mn, mg/kg | Fe, mg/kg | Cu, mg/kg |
|---|---|---|---|---|---|
| Choba I | 1.52 | 0.02 | 3.3 | 26.2 | 1.32 |
| Choba 2 | 3.47 | 0.04 | 4.44 | 27.23 | 4.03 |
| Choba 3 | 3.93 | 0.02 | 5.13 | 28.09 | 1.48 |
| Choba 4 | 0.78 | 0.02 | 5.43 | 27.18 | 0.61 |
| **Mean** | **2.43** | **0.03** | **4.58** | **27.2** | **1.86** |
| **Range** | **0.78-3.98** | **0.02-0.04** | **3.30-5.43** | **26.2-28.1** | **0.61-4.03** |
| **EUROPE** | **300** | **3** | **N/A** | **N/A** | **140** |
| **DUTCH** | **85** | **0.8** | **N/A** | **N/A** | **36** |
| **WHO** | **85.0** | **0.8** | **NA** | **N/A** | **36.0** |
| **SON** | **NA** | **3** | **NA** | **N/A** | **300** |
| Elelewon I | 2.49 | 0.03 | 6.44 | 27.2 | 1.19 |
| Elelewon II | 3.46 | 0.06 | 6.27 | 29.0 | 1.77 |
| Elelewn III | 3.26 | 0.02 | 4.43 | 27.0 | 0.64 |
| **Mean** | **3.07** | **0.04** | **5.71** | **27.7** | **1.20** |
| **Range** | **2.49-3.46** | **0.02-0.06** | **4.43-6.44** | **27.0-29.0** | **0.64-1.77** |
| EUROPE | 300 | 3 | N/A | N/A | 140 |
| DUTCH | 85 | 0.8 | N/A | N/A | 36 |
| Eliozu I | 2.6 | 0.03 | 4.79 | 26.8 | 0.59 |
| Eliozu 2 | 1.16 | 0.02 | 2.38 | 25.8 | 0.85 |
| **Mean** | **1.88** | **0.03** | **3.59** | **26.3** | **0.72** |
| **Range** | **2.60-1.16** | **0.02-0.03** | **2.38-4.79** | **25.8-26.8** | **0.59-0.85** |
| EUROPE | 300 | 3 | N/A | N/A | 140 |
| DUTCH | 85 | 0.8 | N/A | N/A | 36 |
| Rumuosi I | 2.35 | 0.05 | 7.63 | 28.6 | 1.86 |
| Rumuosi 2 | 5.24 | 0.03 | 4.93 | 26.9 | 1.66 |

| | | | | | |
|---|---|---|---|---|---|
| Rumuosi 3 | 7.55 | 0.09 | 5 | 28.8 | 2.5 |
| **Mean** | **5.05** | **0.06** | **5.85** | **28.1** | **2.01** |
| **Range** | **2.35-7.55** | **0.03-0.09** | **4.93-7.63** | **26.9-28.8** | **1.66-2.50** |
| EUROPE | 300 | 3 | N/A | N/A | 140 |
| DUTCH | 85 | 0.8 | N/A | N/A | 36 |
| Control 1 | 0.80 | 0.03 | 4.67 | 28.4 | 0.67 |
| Control 2 | 0.78 | 0.03 | 4.65 | 28.0 | 0.63 |
| **Mean** | **0.79** | **0.03** | **4.66** | **28.2** | **0.65** |
| **Range** | 0.78-0.80 | 0.03 | 4.65-4.67 | 28.0-28.4 | 0.63-0.67 |
| EUROPE | 300 | 3 | N/A | N/A | 140 |
| DUTCH | 85 | 0.8 | N/A | N/A | 36 |

**Manganese**

Scientists measured how much manganese, a type of metal, was in the soil in different places. They found the most manganese in Rumuosi, where there were about 5.85 units. The next highest was in Elelewon with about 5.71 units. Choba had about 4.58 units, and Eliozu had the least, with about 3.59 units. These amounts were usually higher than what they found in a special, clean area called the control site, which had about 4.66 units. Right now, there are no official rules about how much manganese is safe in the soil, but scientists are still studying it.

**Iron**

The highest mean concentrations of iron,28.1 mg/kg was found in Rumuosi, followed by 27.7mg/kg in Elelewon, 27.2mg/kg in Choba and the lowest mean concentration, 26.3mg/kg was found in Eliozu. These were lower than the concentration in control site with average of 28.2mg/kg. Iron supplementation is generally recommended only in cases where there is a confirmed deficiency, as excessive intake can be harmful. Elevated levels of iron in the bloodstream can lead to oxidative damage, affecting vital cellular components such as DNA, proteins, and lipids. This oxidative stress can contribute to tissue damage and has been linked to various health issues, including organ dysfunction and increased risk of certain chronic diseases. When excess iron is detected in the body, it can be effectively managed using specialized chelating agents, notably deferoxamine ($C_{25}H_{48}N_6O_8$). This compound functions by binding to free iron ions, forming stable complexes that are then excreted from the body, thereby reducing iron overload. The process of iron regulation and removal highlights the importance of maintaining optimal iron levels for health and the potential dangers associated with both deficiency and excess (Tenenbein, 1996).

**Copper**

The highest average levels of copper contamination, measuring 2.01 mg/kg, were observed in the Rumuosi area. Following this, the Choba region exhibited a mean copper concentration of 1.86 mg/kg. In comparison, Elelewon showed a lower average of 1.20 mg/kg, while Eliozu recorded the lowest mean concentration at 0.72 mg/kg among the sampled locations. These figures surpass the copper levels found in the control site, which had an average concentration of approximately 0.65 mg/kg. Nevertheless, they remain below the permissible safety thresholds established by regulatory standards in various countries, including WHO. The elevated copper levels in these areas can be largely attributed to the presence of automobile wastes that contain electrical and electronic components, such as copper wiring, electrodes, and copper pipes. Additionally, corroding vehicle scrap metals, which have been discarded and accumulated over time in the vicinity of these communities, contribute significantly to this contamination. As these metal remnants undergo corrosion, they gradually release copper ions that leach into the surrounding soil environment, leading to increased concentrations. This process is supported by findings from Nwachukwu et al. (2011), who documented the contribution of vehicle-related waste and corrosion processes to soil metal contamination in similar settings.

**Correlation of Soil Characteristics in Mechanic Workshop in Obio/Akpor.**

Tables 5, shows the result of the statistical analysis of the correlation between soil characteristics in mechanic workshops in Obio/Akpor. The correlation was performed at 95% confidence level (α=0.05) and 99% confidence level (α=0.01). The results showed that at 95% confidence level, there is significant positive correlation between pH and conductivity with correlation value of (r= 0.617) and between Pb and Cu with correlation value of (r= 0.556) and between Cu and Cd with value of (r= 0.536). Also there was negative correlation between conductivity and phosphate with value of (r =- 0598). Furthermore at 95% confidence level, there was positive significant relationship between Pb and Cd with value of (r=0.676) and between Cd and Fe with value of (r= 0.684) and Mn and Fe with the value of (r= 0.680) in the soil samples collected from mechanic workshops in the study area. There were positive correlations of lead with copper and cadmium. There were positive correlations of cadmium with iron and copper. There were positive correlations of manganese with iron.

Table 5: Correlation of Heavy metals in soil samples collected from Mechanic workshops in Obio/Akpor LGA.

| | pH | Conductivity | TOC | Nitrate | Phosphate | Pb | Cd | Mn | Fe | Cu |
|---|---|---|---|---|---|---|---|---|---|---|
| Ph | 1.00 | | | | | | | | | |
| Conductivity | .617* | 1.00 | | | | | | | | |
| TOC | -0.26 | -0.33 | 1.00 | | | | | | | |
| Nitrate | -0.14 | -0.27 | -0.13 | 1.00 | | | | | | |
| Phosphate | -0.51 | -.598* | 0.12 | 0.52 | 1.00 | | | | | |
| Pb | 0.33 | 0.15 | 0.24 | -0.38 | -0.07 | 1.00 | | | | |
| Cd | 0.01 | -0.16 | 0.51 | -0.04 | 0.17 | .676** | 1.00 | | | |
| Mn | -0.10 | 0.04 | 0.15 | -0.16 | -0.37 | 0.17 | 0.39 | 1.00 | | |
| Fe | 0.04 | 0.01 | 0.28 | 0.35 | 0.09 | 0.33 | .684** | .680** | 1.00 | |
| Cu | 0.43 | 0.39 | -0.01 | -0.32 | -0.18 | .556* | .536* | 0.14 | 0.24 | 1.00 |

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

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

# CONCLUSION

The environmental contamination with heavy metals often results from activities such as the spilling of automobile fluids—like motor oil, antifreeze, and other lubricants—onto the ground, as well as the corrosion and degradation of metal components in vehicles and infrastructure. Such activities gradually increase the levels of heavy metals in the soil, which can then be absorbed by plants or leach into groundwater, further spreading pollution. In the context of Rivers State, Nigeria, one notable source of automobile waste is the numerous motor servicing centers, commonly referred to as mechanic workshops. These facilities are prevalent in urban and suburban areas and are significant contributors to environmental pollution due to their handling of various automotive fluids and metals. The use and disposal of fossil fuel products in these workshops often lead to the accumulation of heavy metals in the surrounding environment. This contamination not only affects the immediate vicinity but also extends to nearby agricultural lands, where crops and soil quality may be compromised. Consequently, these activities create non-point sources of pollution—diffuse sources that are difficult to control and monitor—posing ongoing threats to local ecosystems, human health, and agricultural productivity.

Arising from the discussion of the findings, it is clear that the soil in the study areas is polluted. The Soil is polluted by some physicochemical and heavy metal parameters such as Pb, Cd, Fe, Mn, and Cu. The soil is ascertained to be polluted as a result of effluent discharge from automobile mechanic workshops that accumulates in the soil in close proximity. Most of the automobile wastes dumped on the soil apart from containing heavy metals also acidify the soil, exposure to this; pose serious health treats to the inhabitant of the study area. In order to avert this menace, there should bioremediation of the affected areas and workshops should be cited far away from residents.

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