

ASSESSMENT OF SOIL QUALITY INDICATORS OF AUTOMOBILE WASTE DUMP SOILS IN GWAGWALADA AREA COUNCIL OF THE FEDERAL CAPITAL TERRITORY, ABUJA NIGERIA

Augustine Ojone Angela, Barnabas I. Musa, Jacob M. Wapa and Musa Mary Ilejo

Department of Soil Science, Faculty of Agriculture,
University of Abuja, Abuja Nigeria

ABSTRACT

This research was aimed to determine the level of some selected heavy metals, physical and chemical parameters of the soil samples in some selected automobile workshop. Soil samples were collected at two depths (0-15 and 15-30cm) from 10 Automobile workshop dumpsites within the Gwagwalada Area Council and a control sample. The soil samples were collected with the aid of a soil auger. The soil samples were taken to the laboratory where they were analyzed for some physical and chemical properties as well as some heavy metals in the soil. also, microbial analysis was carried out on the soils. Data collected was subjected to 2 way Analysis of Variance (ANOVA), mean values were separated using Least Significant Difference (LSD). Results of the analysis of soil samples revealed that the samples are contaminated with Arsenic, Cadmium, lead and Copper with concentrations levels (mg/kg) ranged between $6.10 - 11.80$, $14.20 \pm 0.10 - 21.30 \pm 0.10$, $121.87 \pm 2.97 - 230.00 \pm 1.00$, $241.67 \pm 10.4 - 437.22 \pm 0.10$ respectively for surface soil (0-15cm) while the concentration range for subsurface soil (15-30cm) were $5.60 - 8.84$, $12.93 \pm 0.67 - 23.90 \pm 0.5.28$, $150.50 \pm 0.10 - 227.68 \pm 0.02$, $311.67 \pm 10.4 - 437.22 \pm 0.01$ respectively when compared with the standard permissible limit by FAO/WHO, 2001, FEPA, 1991 and NESREA, 2001. Zinc concentration for both surface and subsurface soil were below the permissible limit as set by (NESREA, 2001) with a range (mg/kg) concentration of $250.00 \pm 10 - 339.90 \pm 0.01$ and $210.00 \pm 0.10 - 333.80 \pm 0.01$ for surface and subsurface soil respectively. The bacterial species isolated were, *Corynebacterium* Spp, *Pseudomonas aeruginosa*, *Bacillus megaterium*, *Bacillus subtilis*, *Streptococcus* Spp, *Bacillus cereus*, and *Staphylococcus aureus* while the fungal species isolated were *Aspergillus niger*, *Alternaria* Spp, *Curvularia* spp and *Penicillium chrysogenum*. It was observed that these auto mechanic workshops do have a negative (pollution) impact on the surrounding environment, which calls for stricter regulation on their location within cities and how waste issuing from these clusters is disposed of. However, it can be concluded that the results obtained from this study showed that, there are variation in the metal contents in the soil from one location to the other. The result of this study indicates that indigenously it is possible to isolate bacterial and fungal micro flora capable of degrading complex hydrocarbon compounds. This investigation provides information that would lead to selection of bacterial and fungal species that could be employed for bioremediation in environments polluted with used engine oil.

INTRODUCTION

Automobile workshops are prominent sources of soil contamination due to improper disposal of waste materials, such as engine oils, lubricants, and metals, all of which contain harmful heavy metals (Adesuyi *et al.*, 2018; Adelekan & Abegunde, 2011). The activities in these workshops result in the release of pollutants like lead, cadmium, arsenic, and

copper, which accumulate in soils, disrupt soil ecosystems, and pose serious health risks through inhalation, ingestion, or contact with contaminated particles (Njoku *et al.*, 2018).

Due to their inability to biodegrade, heavy metals accumulate and undergo extremely fast chemical reactions in the environment, making it extremely difficult to remove them from the

ecosystem. In addition to harming the soil, soil contamination exposes people through skin contact, inhalation, and eating of crops or plants that are cultivated on it.

Pollution is caused by soil contamination, which affects both surface and ground water. This occurs when dangerous things dissolve in it; these contaminants may be solid particles or insoluble liquids that suspend in the water (Plant *et al.*, 2009). This has been linked to contaminated soils in earlier research.

Automotive workshops have the potential to contaminate not just the local soil but also the surrounding ecosystem. Polluted soils have the potential to cause severe harm to both surface and subsurface water bodies, as well as hazardous nutrient intake by nearby crops, land shortages, and adverse health effects on all living things. Preserving our soil and water resources from additional pollution is becoming more and more important.

In Nigeria, with increasing automobile use and an expanding network of workshops, contamination risks to soil and groundwater are on the rise, underscoring the need for detailed soil quality assessments in affected areas. The primary objectives of this study were to (1) evaluate the physical and chemical properties of soils in Gwagwalada, (2) assess heavy metal concentrations in soils near automobile workshops, and (3) analyze the microbial diversity to explore bioremediation potential using local microorganisms.

Materials and Methods

The study was conducted in Gwagwalada Area Council, Abuja, Nigeria, an urban area characterized by a growing number of automobile workshops. The site's geographic and climatic conditions support agricultural activity, making soil quality assessments critical to ensure environmental and public health.

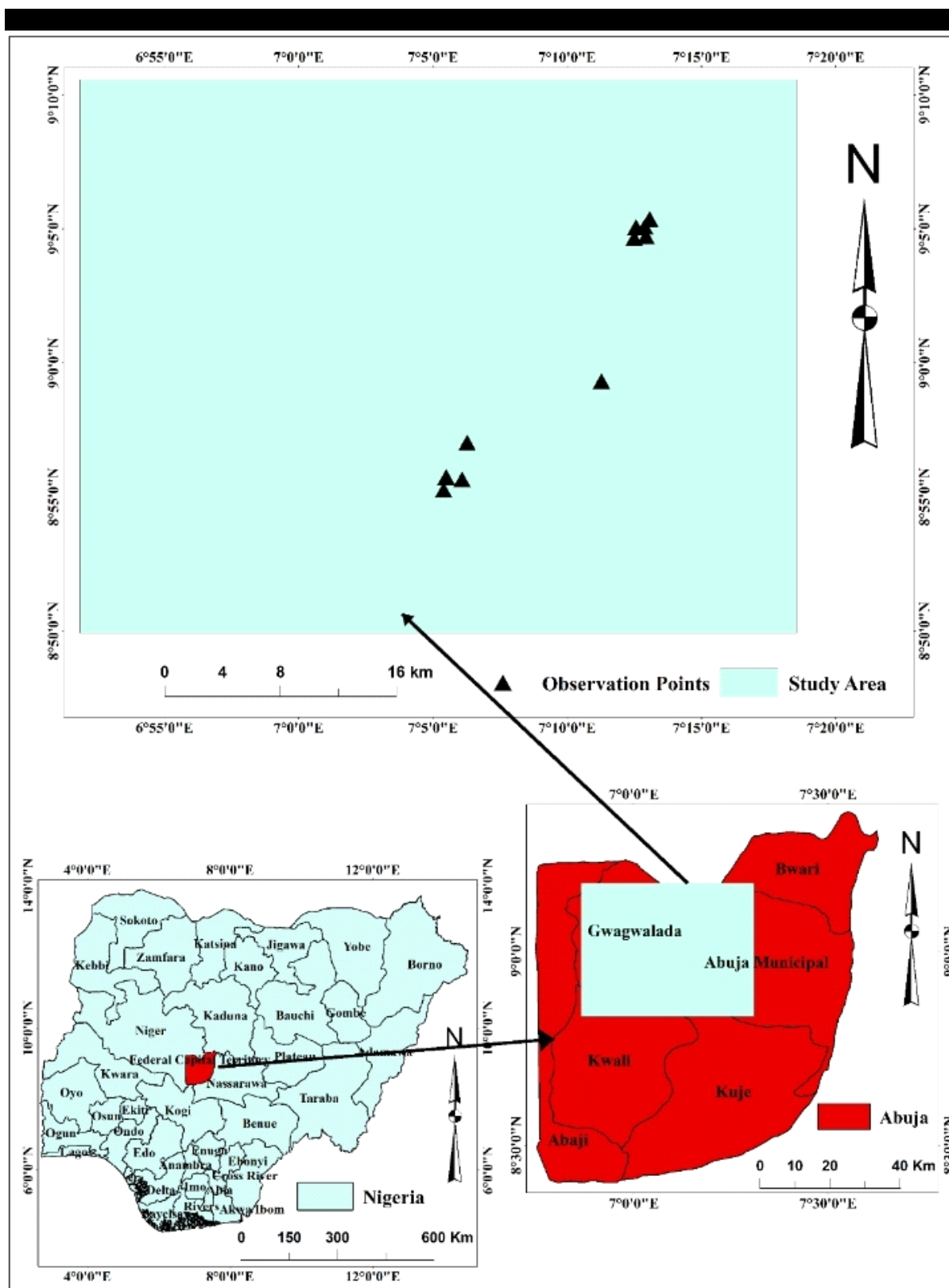


Figure 1: Abuja showing study area in Gwagwalada

Sampling Techniques and laboratory analysis

Soil samples were collected from ten randomly selected automobile workshops and a control site, with consideration of factors like workshop age, topography, and workshop type. Samples were taken from two depths (0-15 cm and 15-30 cm), with each collection point producing six composite samples per depth.

Collected soil samples were air-dried, crushed, sieved, and analyzed for some physical and chemical properties, including pH, particle size, and organic carbon content. Heavy metal concentrations (lead, cadmium, copper, and arsenic) were determined using atomic absorption spectrophotometry.

Microbial diversity was assessed by isolating

and identifying bacterial and fungal species from the soil samples using standard biochemical and morphological tests (Cheesbrough, 2006). Hydrocarbon-degrading bacteria, such as *Pseudomonas aeruginosa* and *Bacillus subtilis*, were identified to explore their potential application in bioremediation.

Results and Discussions

Physical and Chemical Properties

Soil texture was predominantly sandy loam with the sand content ranging from 68.80 – 72.64 % in the surface soils while for the subsurface soils (15 – 30 cm), sand content ranged from 67.80 – 70.80 %.

Table 1: Particle size distribution

SAMPLE ID	SAND gkg ⁻¹	SILT gkg ⁻¹	CLAY gkg ⁻¹	TEXTURAL CLASSES
0 – 15				
GW1	68.80	10.0	21.20	Sandy clay loam
GW2	69.80	12.0	18.20	sandy loam
GW3	69.64	11.0	19.36	sandy loam
GW4	71.80	11.0	17.20	sandy loam
GW5	72.64	11.0	16.36	sandy loam
GIRI	67.80	11.0	21.20	Sandy clay loam
ZUBA 1	69.36	12.0	18.64	sandy loam
ZUBA 2	71.36	12.0	16.64	sandy loam
ZUBA 3	70.80	11.0	18.20	sandy loam
ZUBA 4	69.64	11.0	19.26	sandy loam
15 30				
GW1	67.80	10.56	21.64	Sandy clay loam
GW2	68.64	11.0	20.36	sandy loam
GW3	68.80	11.0	20.20	sandy loam
GW4	70.80	11.0	18.20	sandy loam
GW5	70.80	12.0	17.20	sandy loam
GIRI	68.80	11.0	20.20	sandy loam
ZUBA 1	70.64	14.0	15.36	sandy loam
ZUBA 2	70.36	12.0	17.64	sandy loam
ZUBA 3	69.80	11.0	19.20	sandy loam
ZUBA 4	68.80	11.0	20.20	sandy loam

The soil pH values in workshop sites ranged from 5.97 to 6.25, generally indicating slightly acidic to neutral conditions conducive to heavy metal mobility.
with organic carbon levels higher near workshop sites than in the control, likely due to organic pollutants from automotive waste

Table 2: Chemical properties of the soil in the study areas

Location	pH	OC gkg ⁻¹	OM gkg ⁻¹	TN %	AVP (Mg/kg)	Ca/Cmol/ kg	Kg ⁻¹ Mg	K	Na	EB	EA	CEC	% BS
0 – 15cm													
GW1	6.18	1.36	2.35	0.11	9.80	4.40	4.26	0.38	0.34	9.36	0.98	10.34	90.52
GW2	6.20	1.0	1.73	0.098	8.90	3.98	3.90	0.32	0.30	8.50	0.94	9.44	90.04
GW3	6.20	1.12	1.94	0.10	9.60	4.30	4.21	0.37	0.33	9.21	1.10	9.57	89.33
GW4	6.19	0.79	1.37	0.089	9.40	3.96	3.92	0.32	0.29	8.49	0.90	10.46	90.42
GW5	6.23	0.56	0.97	0.049	0.90	3.88	3.81	0.31	0.28	8.28	0.81	9.09	91.09
GRI	6.10	1.31	2.32	0.10	9.70	4.15	4.0	0.40	0.38	8.93	1.12	10.05	88.86
ZUBA	6.11	1.02	1.76	0.097	9.10	4.15	4.10	0.38	0.35	8.98	1.06	10.04	89.44
ZUBA 2	6.16	0.74	1.28	0.069	7.80	3.86	3.83	0.31	0.27	8.27	0.92	9.19	89.99
ZUBA 3	6.08	0.72	1.24	0.064	7.70	3.84	3.80	0.32	0.29	8.25	1.00	9.25	89.19
ZUBA 4	6.15	0.77	1.33	0.065	8.20	3.90	3.80	0.30	0.28	8.28	1.12	9.40	88.09
Control	6.25	1.80	2.5	0.15	10.20	4.50	4.50	0.50	0.20	9.00	1.15	11.20	92.50
LSD (0.05)	0.01	0.04	0.00	0.01	0.04	0.05	0.00	0.02	0.02	0.04	0.00	0.02	0.00
15-30cm													
GW1	5.98	1.07	1.85	0.097	9.30	4.10	4.00	0.36	0.31	8.77	0.96	9.73	90.13
GW2	6.16	0.94	1.63	0.093	9.20	4.00	3.97	0.34	0.30	8.61	0.96	9.54	89.97
GW3	6.21	1.44	2.49	0.11	9.70	4.32	4.30	0.39	0.34	9.35	1.11	10.31	89.39
GW4	6.17	0.71	1.23	0.082	8.80	4.00	3.99	0.35	0.31	8.65	0.94	9.39	90.20
GW5	6.25	0.49	0.85	0.043	6.30	3.84	3.80	0.29	0.25	8.18	0.79	8.97	91.19
GRI	6.12	1.16	2.01	0.095	8.80	4.20	4.08	0.41	0.38	9.37	1.10	10.47	89.49
ZUBA 1	5.97	0.97	1.68	0.091	9.00	3.98	3.92	0.34	0.31	8.55	0.97	9.52	89.81
ZUBA 2	6.14	0.68	1.18	0.058	7.50	3.82	3.79	0.30	0.28	8.19	0.95	9.11	89.90
ZUBA 3	6.10	0.66	1.14	0.059	7.60	3.80	3.70	0.29	0.26	8.05	1.03	9.08	88.66
ZUBA 4	6.13	0.69	1.19	0.060	7.90	3.83	3.75	0.28	0.24	8.10	1.10	9.20	88.04
Control	6.30	1.18	2.60	1.15	10.20	4.50	4.50	0.40	0.20	9.40	1.21	10.50	92.50
LSD (0.05)	0.00	0.00	0.03	0.00	0.02	0.04	0.05	0.02	0.03	0.00	0.00	0.00	0.00

Keys GW – Gwagwalada, OC – Organic Carbon, TN – Total Nitrogen, AVP – Available Phosphorus, Na – Sodium, K – Potassium, MG – Magnesium, Ca – Calcium, TEB – Total Exchangeable Basis, EA – Exchangeable Acidity, CEC – Cation Exchange Capacity, BS – Base Saturation.

Concentration of Heavy Metals in Soil

The results of the analysis of five (5) heavy metals of soil samples in mg/kg obtained in this research work was presented in Table 3. The mean concentration and standard deviation of all the heavy metals detected in soil sample at ten (10) locations were presented.

Arsenic (As)

The Arsenic concentration ranged between 6.10 to 11.80 mg/kg for surface soil (0-15cm). The control sample had the least Arsenic concentration while the highest arsenic concentration was found in GW 2 locations. For subsurface soil, the Arsenic concentration ranged between 5.60-8.84mg/kg. The GW 3 locations had the highest Arsenic concentration while the control soil sample had the least Arsenic concentration. The Arsenic concentration varied significantly ($P<0.05$) between all the sampling locations. Higher Arsenic values were recorded at the surface soil (0-15cm) than the subsurface soil (15-30cm). Higher As concentration were observed in areas of Automobile dump site in Gwagwalada Area Council as compared with the control sample.

Cadmium (Cd)

The Cadmium concentration ranged between 14.20 ± 0.10 to 21.30 ± 0.10 mg/kg for surface soil (0-15cm). The control sample had the least Cadmium concentration while the highest Cadmium concentration was found in ZUBA 1 location. For subsurface soil, the Cadmium concentration ranged between 12.93 ± 0.67 - 23.90 ± 5.28 mg/kg. The ZUBA 1 location had the highest Cadmium concentration while the control soil sample had the least Cadmium concentration. The Cadmium concentration varied significantly ($P<0.05$) between all the sampling locations. Higher Cadmium values were recorded at the surface soil (0-15cm) than the subsurface soil (15-30cm) for some locations while some locations had higher values at the subsurface soil. Higher Cd

concentration were observed in areas of Automobile dump site in Gwagwalada Area Council as compared with the control sample.

Lead (Pb)

The Lead (Pb) concentration ranged between 121.87 ± 2.97 to 230.00 ± 1.00 mg/kg for surface soil (0-15cm). The control sample had the least Lead concentration while the highest Lead concentration was found in ZUBA 4 locations. For subsurface soil, the Pb concentration ranged between 150.50 ± 0.10 to 227.68 ± 0.02 mg/kg. The ZUBA 4 location had the highest Pb concentration while the control soil sample had the least Pb concentration. The Pb concentration varied significantly ($P<0.05$) between all the sampling locations. Higher Pb values were recorded at the surface soil (0-15cm) than the subsurface soil (15-30cm) except for the control sample that had higher values at the surface soil. Higher Pb concentration were observed in areas of Automobile dump site in Gwagwalada Area Council as compared with the control sample.

Zinc

The Zinc concentration ranged between 250.00 ± 10 to 339.90 ± 0.01 mg/kg for surface soil (0-15cm). The control sample had the least Zinc concentration while the highest Zinc concentration was found in ZUBA 4 location. For subsurface soil, the Zinc concentration ranged between 210.00 ± 0.10 - 333.80 ± 0.01 mg/kg. The ZUBA 4 location had the highest Zinc concentration while the control soil sample had the least Zinc concentration. The Zinc concentration varied significantly ($P<0.05$) between all the sampling locations. Higher Zinc values were recorded at the surface soil (0-15cm) than the subsurface soil (15-30cm) for some locations while some locations had higher values at the subsurface soil. Higher Zn concentration were observed in areas of Automobile dump site in Gwagwalada Area Council as compared with the control sample.

Table 3: Heavy metal concentration level in different location in surface soil (0-15cm) and subsurface soil (15-30cm)

Locations	As (mg/kg)	Cd (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	Cu (mg/kg)
0-15cm					
Control	6.10 ± 0.10	14.20 ± 0.10	121.87 ± 2.97	250.00 ± 10	241.67 ± 10.4
GW 1	7.77 ± 0.01	18.20 ± 0.10	172.60 ± 0.03	278.71 ± 0.10	371.18 ± 0.01
GW 2	11.80 ± 0.02	20.12 ± 0.01	190.17 ± 0.01	298.83 ± 0.01	380.20 ± 0.01
GW 3	10.90 ± 0.01	19.84 ± 0.01	190.00 ± 2.00	313.44 ± 0.01	378.60 ± 0.10
GW 4	7.73 ± 0.01	19.10 ± 0.10	169.27 ± 0.15	319.90 ± 0.10	311.00 ± 1.00
GW 5	7.72 ± 0.01	16.80 ± 0.01	168.20 ± 0.10	310.97 ± 0.01	369.90 ± 0.01
Giri	8.80 ± 0.01	18.70 ± 0.02	193.60 ± 0.03	323.36 ± 0.01	410.28 ± 0.01
ZUBA 1	7.75 ± 0.01	21.30 ± 0.10	213.20 ± 0.10	329.30 ± 0.10	433.12 ± 0.01
ZUBA 2	7.73 ± 0.02	20.20 ± 0.10	210.85 ± 0.01	326.71 ± 0.01	418.22 ± 0.11
ZUBA 3	7.72 ± 0.01	20.20 ± 0.10	221.13 ± 0.01	330.12 ± 0.01	429.90 ± 0.10
ZUBA 4	7.72 ± 0.01	20.67 ± 0.10	230.00 ± 1.00	339.90 ± 0.01	437.22 ± 0.01
15-30cm					
Control	5.60 ± 10000	12.93 ± 0.67	150.50 ± 0.10	210.00 ± 0.10	311.67 ± 10.41
GW 1	7.73 ± 0.10	17.90 ± 0.10	170.80 ± 0.10	273.61 ± 0.01	369.40 ± 0.01
GW 2	7.73 ± 0.02	18.00 ± 0.20	187.79 ± 0.01	279.96 ± 0.01	377.70 ± 0.01
GW 3	8.84 ± 0.01	17.70 ± 0.10	169.90 ± 0.10	310.73 ± 0.01	370.81 ± 0.01
GW 4	7.72 ± 0.01	16.89 ± 0.01	167.60 ± 0.10	311.70 ± 0.10	367.87 ± 0.01
GW 5	7.70 ± 0.10	16.47 ± 0.01	160.88 ± 0.01	299.94 ± 0.01	367.87 ± 0.01
Giri	7.74 ± 0.01	17.84 ± 0.01	190.78 ± 0.01	320.68 ± 0.01	399.86 ± 0.01
ZUBA 1	8.82 ± 0.01	23.90 ± 5.28	211.94 ± 0.01	324.18 ± 0.01	429.88 ± 0.02
ZUBA 2	7.71 ± 0.02	19.96 ± 0.01	200.75 ± 0.01	321.80 ± 0.01	406.73 ± 0.01
ZUBA 3	7.71 ± 0.02	18.93 ± 0.01	219.78 ± 0.01	320.78 ± 0.02	427.95 ± 0.01
ZUBA 4	6.64 ± 0.01	20.88 ± 0.01	227.68 ± 0.02	333.80 ± 0.01	435.57 ± 0.01

NB: As = arsenic, Cd = cadmium, Pb = lead, Zn = zinc, Cu = copper

The frequency of occurrence of bacterial isolated from each location were presented in table 4. A total number of 7 bacterial isolates were isolated from the study locations with a total number of occurrence as 52 with Zuba. Gwagwalada and Giri recording a total number of 20, 26 and 6 respectively.

The frequency and percentage of the bacterial isolates are presented in table 4.8. *Bacillus megaterium* had the highest number (14) of

occurrence and percentage number of composition while *Streptococcus* spp had the least number of occurrence and percentage composition. The number of occurrence and percentage composition of the bacterial isolates follows the following order: *Bacillus megaterium* > *Bacillus cereus* > *Pseudomonas aeruginosa* > *Bacillus subtilis* > *Corynebacterium* Spp > *Staphylococcus aureus* > *Streptococcus* spp.

Table 4: Frequency of Occurrence of Bacterial Isolated from each location

Isolates	Zuba	Gwagwalada	Giri	Total
<i>Bacillus subtilis</i>	3	4	0	7
<i>Pseudomonas aeruginosa</i>	4	4	1	9
<i>Bacillus megaterium</i>	6	6	2	14
<i>Streptococcus</i> Spp.	1	1	0	2
<i>Bacillus cereus</i>	5	5	1	11
<i>Corynebacterium</i> Spp.	1	4	1	6
<i>Staphylococcus aureus</i>	0	2	1	3
Total	20	26	6	52

The distribution of fungi isolated from the soil are resented in table 5. Four (4) Fungal species were isolated from the soil both at the surface and subsurface soil. The fungal species were, *Aspergillus niger*, *Alternaria* Spp, *Curvularia* spp and *Penicillium chrysogenum*. Higher number of fungi isolates were recorded at the

surface soil than at the subsurface soil. Zuba had the highest number of fungal isolates followed by Gwagwalada while Giri had the least fungal isolate. *Penicillium chrysogenum* had the highest number occurrence and percentage composition as compared to other fungal isolates.

Table 5: Frequency of Occurrence of Fungi Isolated from each location

Isolates	Zuba	Giri	Gwagwalada	Total
<i>Aspergillus niger</i>	2	0	1	3
<i>Alternaria</i> spp.	1	1	2	4
<i>Curvularia</i> spp.	3	0	2	5
<i>Penicillium chrysogenum</i>	2	0	1	3
Total	8	1	6	15

Heavy Metal Concentrations

Heavy metal analysis revealed that lead and copper concentrations in workshop soils frequently exceeded permissible limits set by regulatory bodies (WHO, 2001), with surface soils (0-15 cm) showing higher contamination levels than subsurface soils (15-30 cm).

Cadmium and arsenic levels were also high, suggesting cumulative pollution over time.

Microbial Diversity

The microbial assessment identified bacterial and fungal species with potential for hydrocarbon degradation, notably

Pseudomonas aeruginosa, *Bacillus subtilis*, *Aspergillus niger*, and *Penicillium chrysogenum*. These species indicate the presence of indigenous microbes capable of contributing to bioremediation by breaking down hydrocarbon compounds in contaminated soils.

Discussion

The particle size distribution puts the soils in the sandy loam and sandy clay loam textural classification. The sandy nature of the soil suggests low sorption capacity for metal ions. Thus, oil and hydrocarbon oil related pollutant are known to result in reduced soil moisture availability or holding capacity, or increased moisture deficit in soils (Njoku *et al.*, 2018). The pH values for all the locations in the study area shows moderately acidic content which are within the Nigerian soil standards as reported by Abenchi *et al.* (2019). Previous study has shown that contamination with petroleum and its products decrease soil pH and with increasing concentration of contaminants, soils become more acidic (Ohanmu *et al.*, 2018).

The organic matter content suggests active participation of microorganisms in the soil. The values obtained for the organic matter are within the established standard of 1-6% as indicated by Fred and Harold (2017).

The low total nitrogen of the soils of the automobile dump site in the study area could be due to the presence of automobile wastes introduced by anthropogenic sources, hence the effect could result in loss of soil nutrients. Orjiakor and Atuanya (2015) on their study of effect of automobile battery wastes on physicochemical properties of soil in Benin city, Edo State recorded lower nitrogen content in

soils contaminated with automobile battery than control. The observed results for nitrogen and phosphorous content may be due to increase in crude oil contaminants which cause a decrease in their levels. These findings are in agreement with the reports of Ohanmu *et al.* (2018) who stated that low nitrogen content of soil is not due to poor natural soil conditions but as a result of pollution with petroleum and its components. Though, the waste from the shop impacted negatively on their soil contents, the current level could encourage the application of bacterial agents to boost the remediation of hydrocarbons in the environment. Nitrogen and phosphorus are two important minerals needed by microorganisms for active growth and metabolic activities.

According to Brady (2019) soil chemical properties play vital role in the soil quality and these properties include cation exchange capacity and soil pH. These properties are adversely affected when soil is contaminated by automobile wastes and may be the reason why soils control recorded better values when compared to soils of mechanic village.

Heavy Metal Concentration in the Soil

Heavy metal concentration in soil in this study were raised to different levels and the significant differences was evidenced amongst the different sampling location at the study area. The various anthropogenic activities such as panel beating, servicing of car engines and changing of electrical component of vehicles among other resulted to generation of heavy metal contaminated materials that are discarded at the dumpsite. The results indicate that the highest and lowest heavy metal concentrations in soil were obtained at the automobile dumpsites and control site, respectively for As, Cd, Pb, Zn and

Cu. Heavy metals concentrations in the soil samples are higher in the auto repair shops compared to control soil sample. This could be explained based on the work of Nwachukwu, *et al.* (2021), who reported that engine oil and transmission fluids when discharged may increase the concentration of heavy metals in soils. Some pollution surveys showed that soil within or around source of pollutants had high concentrations of heavy metals (Davila *et al.*, 2018; Nwachukwu *et al.*, 2021; Ogbonna *et al.*, 2020). Since there were no other sources of contamination in the area, the high concentrations of heavy metals in soil of the automobile waste dumpsite (unlike the control) may be attributed to leaching of the heavy metals (Cd, Pb, Cu and Cr) from the large volume of waste from Gwagwalada area council automobile waste dumpsite.

Conclusion and Recommendations

This study highlights the severe environmental impact of automobile workshops on soil quality in Gwagwalada, Abuja. Heavy metals such as lead, cadmium, and copper exceed safe levels in contaminated soils, emphasizing the need for immediate regulatory intervention. The microbial species identified in the contaminated soils have potential for use in bioremediation strategies, offering a natural solution to reduce pollutant levels.

To mitigate contamination, enforcing environmental regulations on waste disposal in automobile workshops, promoting awareness, and exploring microbial bioremediation methods using native bacteria and fungi are recommended.

REFERENCES

- Abenchi, E.S., Okunola, O.J., Zubairu, S.M.J., Usman, A.A., and Apene, E. (2019). Evaluation of heavy metals in roadside soils of major streets in Jos metropolis, Nigeria. *Journal of Environmental Chemistry and Ecotoxicology*. 2(6):98-102
- Adesuyi, A. A., Njoku, K. L., & Akinola, M. O. (2018). Heavy metal contamination in urban soils: Sources and environmental impact. *Journal of Environmental Protection*, 9(2), 123-138.
- Adelekan, B. A., & Abegunde, K. D. (2011). Heavy metals pollution in Nigeria: Causes, effects, and solutions. *International Journal of Environmental Studies*, 5(3), 189-202.
- Brady, N.C. (2019). The nature and properties of soil. Macmillan Publishing Company, New York.
- Bray RH and Kurtz LK(1945); Determination of Total Organic and available Phosphorus in soil science and conservation 2nd Edition 59:39-43
- Bremner, J.M and Mulvancy (1982). Total N.P 595-624 in page et al (ed) methods of Soil Analysis. Part 2 Agronomonogn. ASA and ASSA, maidison, WWI.
- Cheesbrough, M. (2006). District laboratory practice in tropical countries. Cambridge University Press.
- Davila A.F. 2018. Mapping the sources of urban dust in a coastal environment by measuring magnetic parameters of *Platanus hispanica* leaves. *Environmental Sciences and Technology*, 40(12), pp. 3922–3928.DC.
- FAO/WHO (2001). Food additives and contaminants. Joint FAO/WHO Food Standards Program, ALINORM 01/12A: 1-289.
- FAO/WHO (2006). Guidelines for assessing Quality of Herbal Medicines with Reference to Contaminants and Residues, World Health Organization, Geneva, Switzerland.
- FAO/WHO (2007). Joint FAO/WHO Food Standard Programme Codex Alimentarius Commission 13th Session. Report of the Thirty-Eight Session of the Codex Committee on Food Hygiene. Houston, TX, ALINORM 07/30/13.
- Federal Environmental Protection Agency (FEPA) (1991). Guidelines and Standards for Environmental Pollution in Nigeria.
- Fred, M. and Harold -Van E.S. (2017). Building soils for better crops, third edition.

