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The Impacts Of Automobile Workshop Activities On Soil In Ikoku Mechanic Village, Mile 3, Diobu, Portharcourt, Nigeria

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Abstract – This study was conducted to learn more about how auto repair shops affect heavy metal concentrations in soil, whether or not groundwater is contaminated, and whether or not lower food quality and increased food insecurity are all potential outcomes. Six (6) samples were taken from locations close to the selected auto repair shops (Experimental sites) and locations far enough away from the shops to have no effect on the samples (Control sites).The levels of cadmium (Cd), lead (Pb) and mercury (Hg) were ascertain with the aid of atomic absorption spectrophotometer (AAS). It was established that heavy metals were generally higher in soils due to the activities of automobile workshop than the areas far away but lead (Pb) values were higher than mercury (Hg) and Cadmium (Cd) values. The mean values of Hg, Pb and Cd are 3.07, 91.03 and 5.63 mg/kg respectively in soils under the impacts of automobile workshops and 0.03, 60.25 and 1.79 mg/kg, respectively in soils far away from the automobile workshop. At the 0.05 confidence level, there was a statistically significant difference in heavy metal levels between the experimental and control sites. The sediments maintained fairly uniform pH value across the top soil. The lowest pH value is 6.94 with prime value of 7.40 as against the control sample's values of 6.98 and 7.5. The EC ranges from 238.0 to 330.8µS/cm as against those of the control 90.3-149 µS/cm. This clearly shows that the contaminated site poses more electrical conductivity than the control site. Potassium (K), ranges from 15-16.2mg/kg against that of the control samples which ranges from 16.12-16.62mg/kg. The concentration of k is well below the WHO permissible limit of 200mg/kg. Ca ranges from 3.80-21.02mg/kg while Na ranges from 0.98-1.88mg/kg as against the control sample of 19.5-30.66mg/kg and 1.22-1.86mg/kg. Ca and Na content in the analyzed soil samples are within WHO stipulated limits of 75 and 200 mg/kg. For particle sizes distribution, the graphs plotted indicate that the sediments vary from fine through medium to fairly coarse sand.Coefficient of Uniformity (CU) indicates poorly graded sediment.Permeability (k) indicates a low permeable soil. Its indicates very well sorted" to "well sorted" for the sediment.Positively skewed, moderately symmetrical with larger proportion of medium to fine grain materials. Total Heterotrophic Fungi were isolated. Its pertinent that mechanic villages should be in industrial areas away from residential areas, sensitization must be carried out on environmental pollution and waste management while bioremediation of polluted soil using plants should be encouraged.

Keywords – Automobile Workshop, Heavy Metals, Urban Soils, Ikoku.

I. INTRODUCTION

Auto-mechanic workshop also called garage or automobile repair shop is a portion of land where repair and services of vehicles are carried out .It generate small quantity of hazardous waste earlier reported by (Akomah and Osayande,2018).Due to increased Automobile repairs/workshops activities as a result of high demand for personal vehicles, most of which are used imported vehicles from Japan, American and the rest of Europe (Nwoko et.al 2007).These have increased the problem of soil contamination in most cities. Automobiles used oil consist of oxidation products, sediments, water and metals particles as a result of machines wears and tears, already used batteries, organic and inorganic chemicals used in oil additives and metals (EEA,2007, Adeniyi et.al

2002). Leachates Percolation from these materials affects groundwater negatively. It's quite unfortunate that till now detailed information on the impact of motor mechanics' activities on the environment is still very rare due to a lack of research. Numerous polluted sites in Nigeria and other developing nations are extremely hazardous to the environment due to the presence of both heavy metals and hydrocarbons (HCs).The same problem exists in other countries. As it turns out, the significance of trace elements in soil chemistry is affecting an increasing number of people worldwide. Especially when you consider the significance of soil in both rural and urban settings (Adeniyi et. al 2002). (Sharma et.al 2004) reported that certain lubricants and fuel additives do not decompose in the soil. These include products containing cadmium, copper, chromium, lead, manganese, nickel, and zinc. People assert that these heavy metals are indestructible. According to the US Environmental Protection Agency, several of them are among the most hazardous pollutants. Currently, bioremediation and soil washing are the only methods for treating these mixed wastes (Sharma et.al 2004). If there are a lot of heavy metals in the soil, it might not be the result of human activity, but rather the soil's formation or the size of its grains (Zwolsaman et.al 1993). Metals can originate from both natural or geogenic and man-made sources, making it difficult to determine the sources of metals in the soil as reported by (Niencheskill et.al 1994).

LOCATION AND GEOLOGY

Description of the Study Area

This study was carried out in Ikoku mechanic village, Mile3 Diobu, Port Harcourt local government area (PHALGA) of Rivers State, Nigeria. It is located between latitudes 4°47'56.8"N and 4°68'06.7"N and longitudes 6°59'36.4"E and 6°59'37.8"E within the Niger Delta sedimentary basin of Southern Nigeria. There are both wet and dry seasons in these regions(Iloeje, 1978). The region's wettest months are June and July, and the wet season lasts until October. This season's rainfall is caused by the south-western winds that blow into Nigeria from the Atlantic Ocean. There is a brief period of time during the wet season when it does not rain heavily or at all. This is known as August Break and it typically occurs in August (Gobo,1990). The dry season commence in November and continues through March. In between the end of December and the beginning of January, there is a brief harmattan. It is transported by dry winds from the north-east across the Sahara desert to Nigeria, where it congregates. The annual average temperature is approximately 280 degrees Celsius, and the relative humidity frequently exceeds 80 percent.

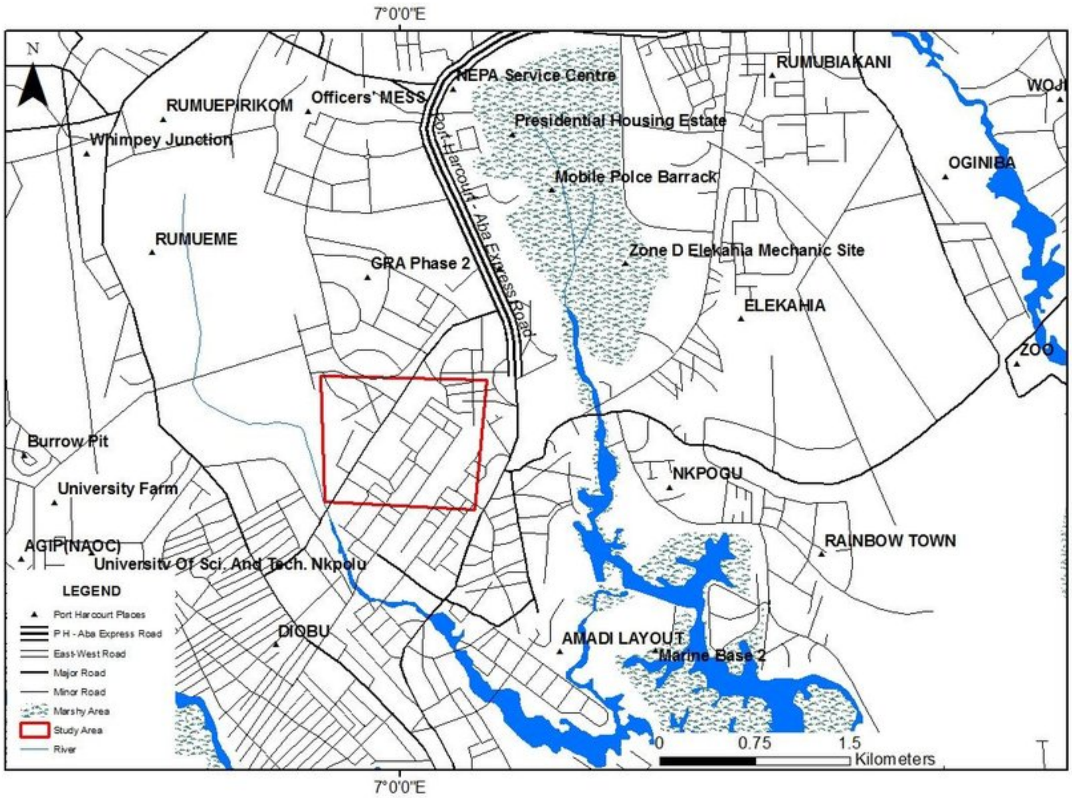

Figure 1 Map of the studied area(Nwankwoala and Warmate, 2014)

Geology of the area

The Nigerian states Bayelsa, Edo (the largest), Rivers (the smallest), and Delta are located in the middle of the Niger Delta basin. This enormous region is comprised of clastic sediment piles dating from the Cretaceous to the present day and spanning approximately 75,000 square kilometers. On a sialic basement complex that does not fit together, there are approximately 8,000-meter-thick dirt piles. On its way to the Atlantic Ocean, the Niger River passes through the Delta, which contains numerous riverine areas. From the Niger River, numerous smaller rivers flow into the Atlantic Ocean. Many of the area's smaller islands are divided by tidal creeks that are less than 10 meters above sea level (Offodile, 2002).The geological sequence of sediments in the Niger Delta is comprised of the Ameki Formation, the Ogwash-Asaba Formation, the Benin Formation, and the Somebreiro Deltaic Plain Sands. This list is arranged in chronological order, from oldest to youngest. During the early Eocene, when sea levels were lower, the Ameki Formation's constituent rocks were deposited. There are thin layers of calcareous shale and thin layers of limestone in the upper unit. The lower unit consists of cross-bedded coarse sandstones and sandy clay. In the building's basement, you can also find limestone(Reyment, 1965). The Ogwashi-Asaba Formation is a component of the Miocene-aged Ameki Formation. It can be found in a slow-growing outcrop west of the Siluko River that extends to Onitsha. The majority of the formation consists of clays, sands, grits, and lignite seams, with layers of gritty clay in between. There is a 16-kilometer-wide and 241-kilometer-long band in the Ogwashi-Asaba Formation. This band extends from the Niger River to Calabar, which is located east of the Nigerian and Cameroonian border. The Benin Formation was formed during the Oligocene and Pleistocene epochs. This formation outcrops in the north east of the coastal belt in the Niger Delta and dips at a low angle in the southwest. The sediments consist, generally, of lenticular unconsolidated, dominantly sandy formations. Lenticular clays and shales occur particularly in the eastern areas where they confine small but moderately high yielding aquifers. The 90-150m confining clay beds encountered in the Niger Delta area, (Brass, Bonny and Opobo) disappear in the regions, north of the area, and adjacent to the Benin Formation area (Bodo, Okrika and Port Harcourt) (Offodile,2002).

The thickness of the Benin Formation is variable, but generally exceeds 2000m.The Somebreiro Deltaic Plains Sands is late Pleistocene to Holocene in age. It occupies most of the area of the present delta and stretches narrowly eastwards along the coastline. The sediments consist of medium to coarse –grained unconsolidated sands forming lenticular beds with intercalation of peaty matter and lenses of soft silty clay and shale. These beds dip at varying angles towards the sea, forming units, which represent series of old deltas as reported by (Offodile, 2002). The gravelly beds of the formation could be up to 9m thick.

Hydrogeology of the area

Benin Formation was identified as the most significant aquiferous formation in the study area (Table 1). The majority of the 2100-meter basin depth consists of coarse to medium-grained sandstones, thick shales, and fine gravel. This portion of the Benin Formation is composed of Quaternary deposits. The majority of these deposits consist of sand, silt, or clay. They can range in thickness from 40 to 150 meters (Etu-Efeotor and Akpokodje, 1990). As one travels further out to sea, the second one becomes increasingly apparent. Claystone and shale are occasionally found within the formation's sands and gravel (Olabiniyi and Owoyemi 2006). However, the majority of the sands and gravel are continental freshwater sands and gravel with favorable aquifer properties. In regions where precipitation falls between 2000 and 2400 mm per year (Etu-Efeotor, 1981; Etu-Efeotor and Akpokodje, 1990; Offodile,2002 and Udom et.al 2007), direct precipitation is the primary source of recharge. Numerous aquifer systems in the Benin Formation obtain water from the water that seeps through the porous sand. Typically, groundwater is found in areas with a high water table. According to (Etu-Efeotor, 1981; Offodile,2002 and Amadi, 2004) the upper aquifers typically extend beyond the study area.

II. Materials and Methods

Sampling

The automobile mechanic village is located at about 50m away from Ikwerre road, Port-Harcourt. At the workshop, three soil samples from 0 to 15 centimeters, 15 to 30 centimeters, and 15 to 30 centimeters were collected. In the following clause, the topsoil and subsoil (bottom soil) sampling depths will be referred to by their respective names. At each location, samples were collected with a hand auger and placed in labeled polythene bags before being individually tested. Each sample was evaluated independently. The depth at which samples were collected varied greatly as well. The control sample was collected at a distance of at least 200 meters from any industrial area and industrial activities. This is why it is called the background sample. It was essential, when determining the sample size for this study, that the characteristics of the workshop area be accurately represented. This study's sampling strategy was based on these two premises.

Analytical procedures

The physical, chemical, and biological properties of the samples were evaluated as soon as they were air-dried and ground to a 2 micron mesh size in the laboratory (Udom,2004). With

(Osayande and Nwokedi, 2019) and (Day,1965), the size distribution of soil particles was investigated. Using a solution of sodium hexametaphosphate (8 g/L) and sodium carbonate (2 g/L), the soil samples were distributed. Less than 2 millimeters was the mesh size. During the process of transferring the contents of the container into a liter measuring cylinder, 5 milliliters of distilled water were added to the mixture to facilitate stirring. The initial reading was taken forty seconds after the start of the experiment. We utilized the textural triangle to separate the sediment into its constituent parts. We utilized oven drying to determine the soil's moisture content. This technique was used to calculate the percentage weight difference between the wet and dry samples (Bouyoucous,1936). Grossman and Osuji et. al 2006 devised the core method that was used to determine the soil's bulk density. Some modifications were made to the ammonium-acetate extraction method (Osuji et. al 2006; s modified by Peng et.al 2009). (Bremner and Mulvaney, 1982 used a method in order to obtain sodium, potassium, magnesium, and calcium cations. Using the formula in (Walkey and Black 1934) the soil's organic carbon content was determined. A multi-probe meter was utilized to determine the soil's pH and conductivity (Walkey and Black 1934). According to (Black, 1965), an investigation into heavy metals was conducted. Each piece of glassware was immersed in acid and washed with it. The atomic spectrophotometer was calibrated using copious amounts of scientific standard solutions.

Determination of Total Petroleum Hydrocarbon and Poly Aromatic Hydrocarbon: Instead, a modified version of the EPA 8015 procedure was implemented. Each sample's soil was extracted with methylene chloride, and the resulting liquid was injected into a gas chromatograph with a flame-ionization detector (FID). The gas chromatograph model utilized was FID 689 ON.

***Determination of* Total Hydrocarbon Content**

After air-drying, the soil samples were passed through a 0.01 m-mesh sieve. After adding n-hexane and 5 grams of the sample to a conical flask, the sample was extracted using a mechanical shaker. Ten milliliters of n-hexane were added to complete the extraction, and the final product was placed in a flask with a capacity of twenty-five milliliters. Ultimately, n-hexane was used to resolve this issue. Before being placed in the sample holder of the Genesis 10 UV spectrophotometer for spectroscopic measurements, n-hexane was placed in sample cuvettes. There was no absorbance when the transmittance was set to 100 percent and the wavelength was set to 425 nm. The oil's capacity to absorb water was evaluated. Using the slope of a calibration curve as a starting point, a formula for calculating hydrocarbon concentration was developed.

$$\text{THC in mg/kg} = \frac{\text{Absorbance} \times \text{Volume of n-hexane} \times \text{Grandient} \times 1000}{\text{Weight of sample used}}$$

Total Heterotrophic Fungal Count

This was accomplished using a spread plate. Approximately 0.1 milliliters of 10-3 and 10-4 dilutions of each sample were spread on Potato dextrose agar after letting the mixture sit for five days at 280 degrees Celsius (PDA). To learn more about the fungi, various colonies were counted in terms of cfu/g and then re-grown in freshly prepared PDA.

Total Hydrocarbon Utilizing Fungal Count

On freshly prepared acidified mineral salt medium, 0.1 of 10-3 and 10-4 dilutions of acidified mineral salt medium were distributed (0.4g of $MgSO_47H_2O$, 0.29g KCl, 1.25g $KHPO_4$, 0.83 K_2HPO_4, 0.442g NH_4NO_3, 10g NaCl, 15g Agar). The Petri dish was heated to 280 degrees Celsius for five days with a piece of filter paper smeared with crude oil under the lid. To learn more about the fungi, various colonies were counted in terms of cfu/g and then re-grown in freshly prepared PDA.

Characterization, spore staining and identification of Hydrocarbon utilizing Fungi

The method used by Barnett in 2002 for classification and identification was modified. This includes both extensive and limited examinations. To confirm that spores existed, scientists used a technique known as "spore staining." On a clean glass slide with a cover slip on top, lactophenol cotton blue reagent was applied to a loop of various colonies. The slide was then placed beneath the cover. Then, we examined it with the X40 objective lens of the microscope.

III. Results And Discussion

Results

The results of the hydrocarbon content, physicochemical parameters and heavy metals for soils from Ikoku mechanic village is summarized and presented in Tables: 1-10 and Figs:2-8 Also, the results from the laboratory analysis of the Particle size distribution are presented in tables 11-15 and figure 9-14.

Table 1: Results of physico-chemical analysis of soil samples from the area

S/N	PARAMETERS	A1 Top soil	A1 Sub soil	A2 Top soil	A2 Sub soil	Control Top	Control Sub soil
1	PAH	689.01	96.00	324.60	219.81	79.74	54.83
2	Total Hydrocarbon content (mg/kg)	1.30	0.84	5.66	2.10	1.02	2.86
3	Total organic carbon (mg/g)	30.97	24.85	53.67	35.34	27.81	16.80
4	Electrical conductivity	282.00	330.80	238.00	242.00	149.10	90.30
5	Ph	7.23	7.40	7.01	6.94	7.51	6.98
6	Lead (mg/kg)	25.50	15.00	90.60	0.67	40.50	24.55
7	Zinc (mg/kg)	53.36	40.73	109.30	93.30	107.98	93.40
8	Chromium (mg/kg)	4.02	2.78	9.32	5.28	6.55	13.63
9	Cadmium (mg/kg)	0.27	0.62	6.75	3.82	0.28	7.08
10	Potassium (mg/kg)	16.07	15.00	16.20	16.15	16.62	16.12
11	Calcium (mg/kg)	3.80	12.85	21.02	14.70	30.66	19.50
12	Sodium (mg/kg)	1.88	1.73	1.70	0.98	1.86	1.22

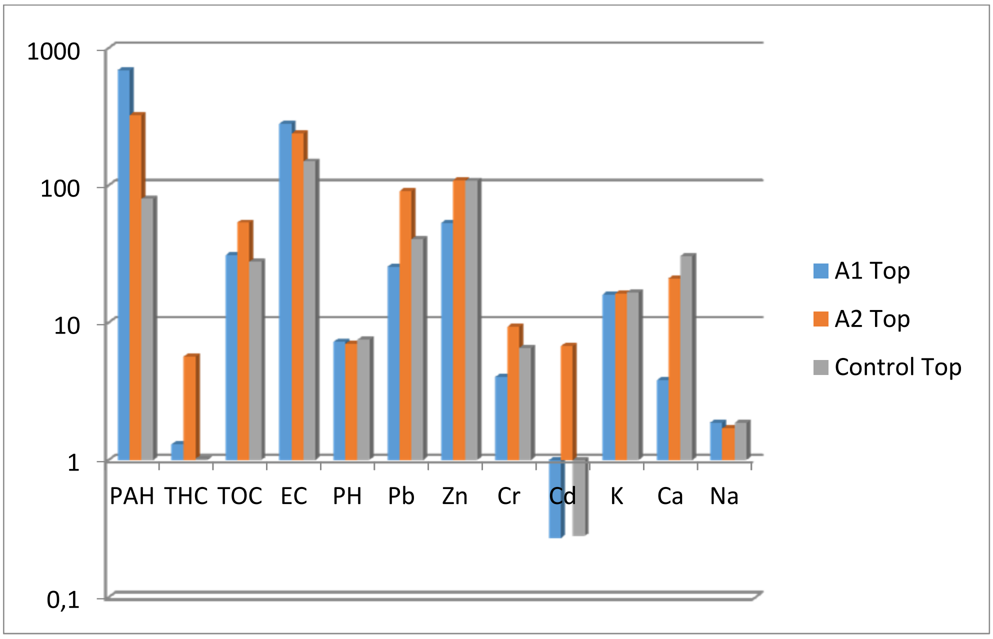

Figure 2: Results of physico-chemical analysis for top soil samples (0-15cm) in the area

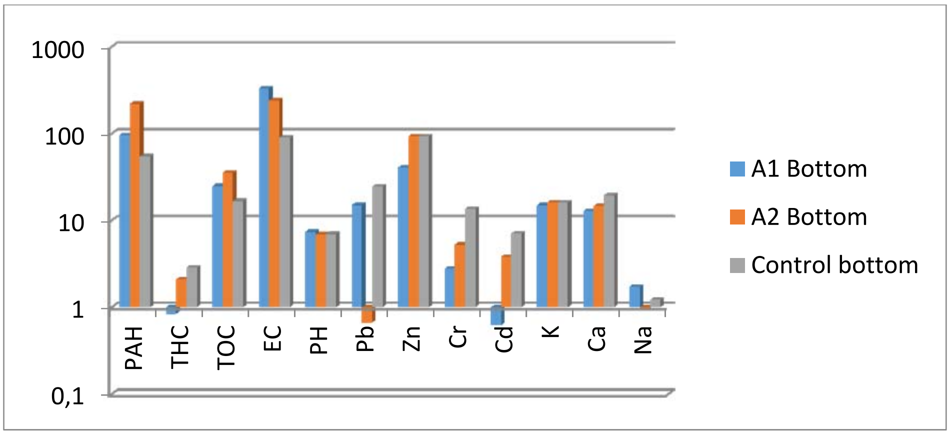

Figure 3: Results of physico-chemical analysis for sub soil samples (15-30cm) in the area

Table2: Statistical parameters for physico-chemical characteristics of Topsoil samples (0-15cm) in the area.

S/N	Parameters	A1 top	A2 top	Mean	Standard Deviation	Control top	WHO
1	PAH	689.01	324.60	506.805	257.6768	79.74	-
2	Total Hydrocarbon content (mg/kg)	1.30	5.66	3.48	3.082986	1.02	-
3	Total organic carbon (mg/g)	30.97	53.67	42.32	16.05132	27.81	-
4	Electrical conductivity	282.00	238.00	260	31.1127	149.10	1000

5	pH	7.23	7.01	7.12	0.155563	7.51	6.5-8.5
6	Lead (mg/kg)	25.50	90.60	58.05	46.03265	40.50	85
7	Zinc (mg/kg)	53.36	109.30	81.33	39.55555	107.98	50
8	Chromium (mg/kg)	4.02	9.32	6.67	3.747666	6.55	100
9	Cadmium (mg/kg)	0.27	6.75	3.51	4.582052	0.28	0.8
10	Potassium (mg/kg)	16.07	16.20	16.135	0.091924	16.62	200
11	Calcium (mg/kg)	3.80	21.02	12.41	12.17638	30.66	75
12	Sodium (mg/kg)	1.88	1.70	1.79	0.127279	1.86	200

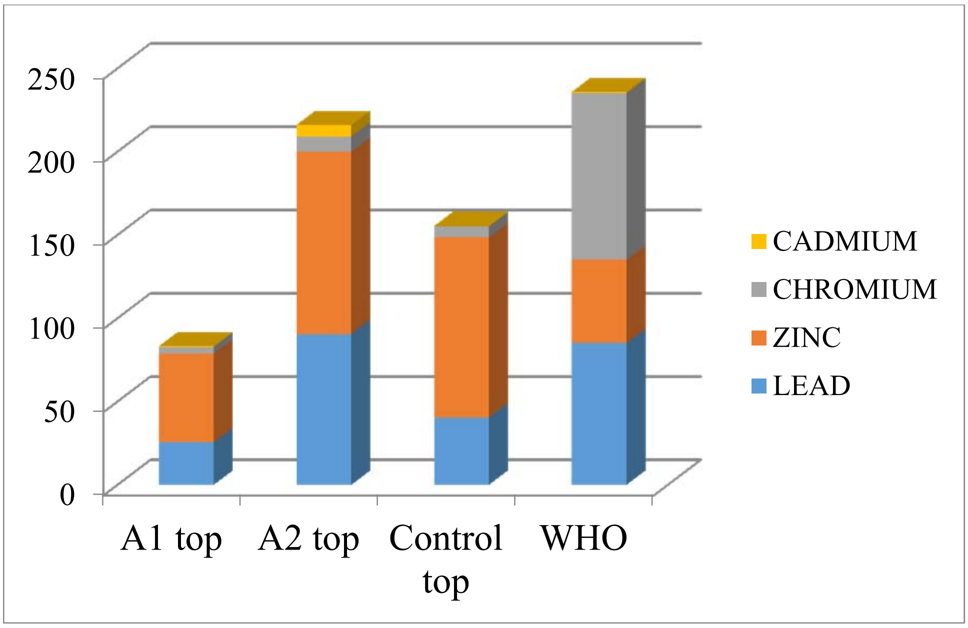

Figure 4: Results of heavy metal analysis of soil samples from the area

Table8: Statistical parameters for physico-chemical characteristics of Sub soil samples (15-30cm) in the area.

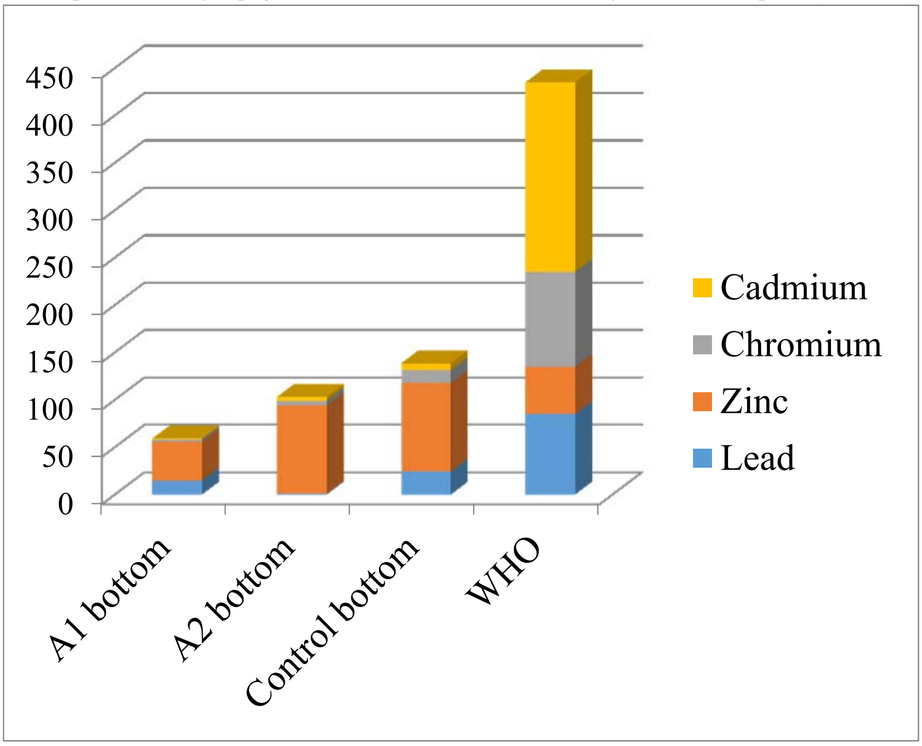

Figure 5:Statistical Results of heavy metal analysis of soil samples from the area

Table 3:Contamination Factor (CF) and Pollution Load Index (PLI) of heavy metals in soil samples from the area

S/N	SAMPLE LOCATION	Pb	Zn	Cr	Cd	PLI
1	**A1 Top**	0.63	0.49	0.61	0.96	0.4251761
2	**A1 Subsoil**	0.61	0.43	0.20	0.08	0.06478271
3	**A2 Top**	2.23	1.01	1.42	24.10	8.77941972
4	**A2 Subsoil**	0.03	0.99	0.38	0.53	0.07734067
5	**Max Value**	2.23	1.01	1.42	24.1	8.77941972
6	**Min Value**	0.03	0.43	0.2	0.08	0.01436663
7	**Mean**	0.875	0.73	0.6525	6.4175	1.6354552

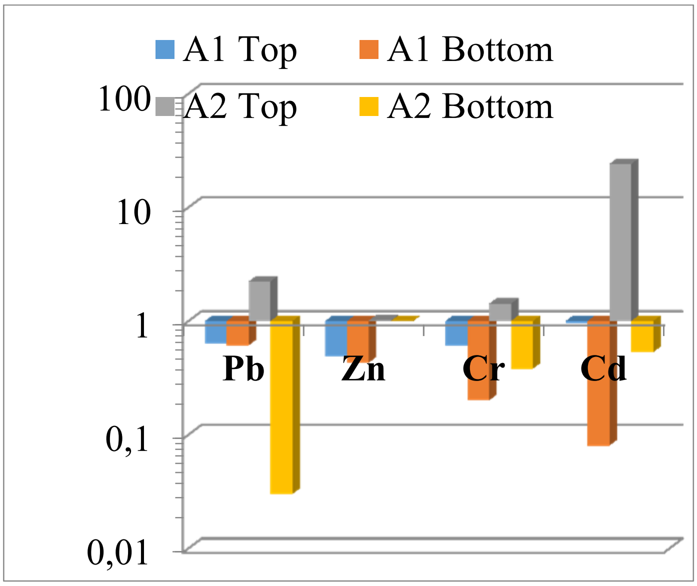

Figure 6: Contamination factor (CF) of heavy metals in soil samples from the area. Baseline boundary between pollution and contamination = 1.

Table 4: Enrichment factor (EF) of heavy metals in soil samples from the area (using Zn)

S/N	SAMPLE LOCATION	A1 Top	A1 Subsoil	A2 Top	A2 Subsoil	Mav Value	Min Value	Mean
1	**Pb**	1.27	1.40	2.21	0.02	2.21	0.02	1.22
2	**Zn**	1	1	1	1	1	1	1
3	**Cr**	1.24	0.46	1.40	0.38	1.46	0.38	0.87
4	**Cd**	1.95	0.20	28.81	0.54	28.81	0.20	7.87

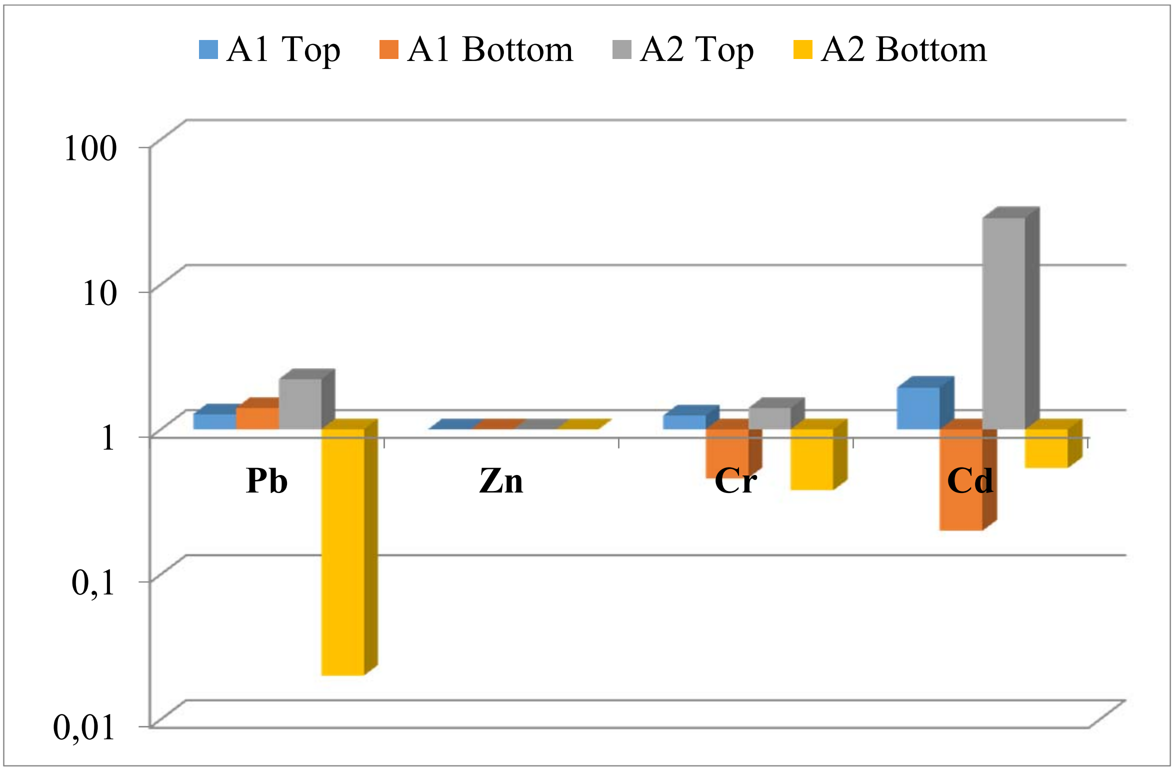

Figure 7: Enrichment factor (EF) of heavy metals in soil samples from the area.

Table 5: Index of geo-accumulation (I_{geo}) of heavy metals in soil samples from the area.

S/N	SAMPLE LOCATION	A1 Top	A1 Bottom	A2 Top	A2 Bottom	Mav Value	Min Value	Mean
1	Pb	-1.25	-1.29	0.57	-5.78	0.57	-5.78	-1.93
2	Zn	-1.60	-1.78	-0.56	-0.58	-0.56	-1.7	-1.13
3	Cr	-1.28	-2.87	-0.07	-1.95	-0.07	-2.87	-1.54
4	Cd	-0.63	-4.09	4.00	-1.47	4.00	-4.09	-0.54

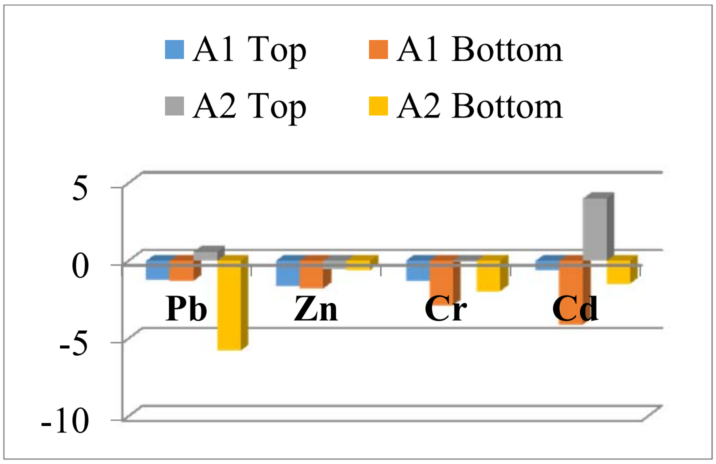

Figure 8: Index of geo-accumulation (I_{geo}) of heavy metals in soil samples from the area.

Table 6 : Pearson correlation coefficient matrix for physico-chemical parameters and heavy metals in soil samples from the area.

Parameters	PAH	TOC	THC	E.C	pH	Pb	Zn	Cr	Cd	K	Ca	Na
PAH	1											
T.O.C		1										
T.H.C			1									
E.C				1								
Ph					1							
Pb						1						
Zn							1					
Cr								1				
Cd									1			
K										1		
Ca											1	
Na												1

Table 7: Pearson correlation coefficient matrix for heavy metals in soil samples from the area.

Parameters	Pb	Zn	Cr	Cd
Pb	1			
Zn		1		
Cr			1	
Cd				1

Particle Size Dstribution

Table 8: Result of particle size dstributionof soil samples sourced from the area

S/N	Sieve Size (mm)	Percentage passing (%)					
		A1 Top	A1 Bottom	A2 Top	A2 Bottom	Control Top	Control Bottom
1	2.00	99.80	99.40	99.30	99.20	99.20	98.70
2	1.00	95.40	91.90	93.20	92.60	87.20	82.70
3	0.50	66.70	60.20	65.30	64.90	59.90	56.00
4	0.25	23.90	19.50	28.50	24.30	25.20	25.20
5	0.15	7.80	5.50	13.40	7.80	10.30	11.50
6	0.075	7.10	5.00	5.30	7.60	9.80	6.30

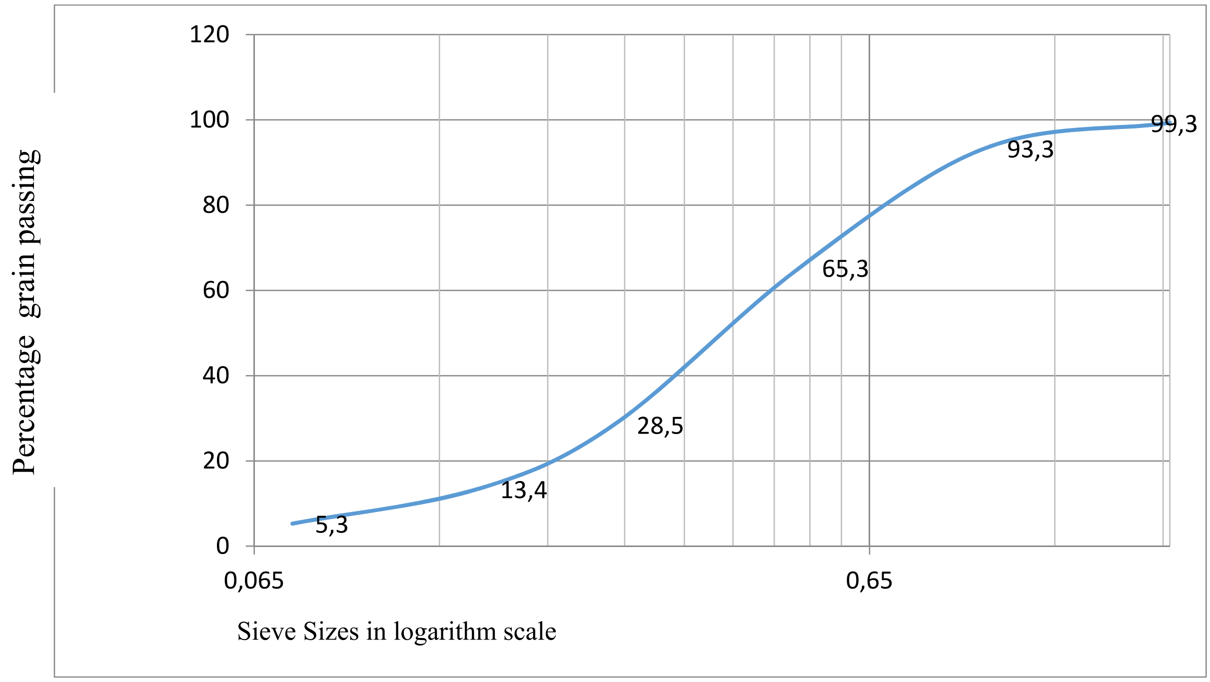

Figure 9: PSD curve of sample A1 Top (0-15cm)

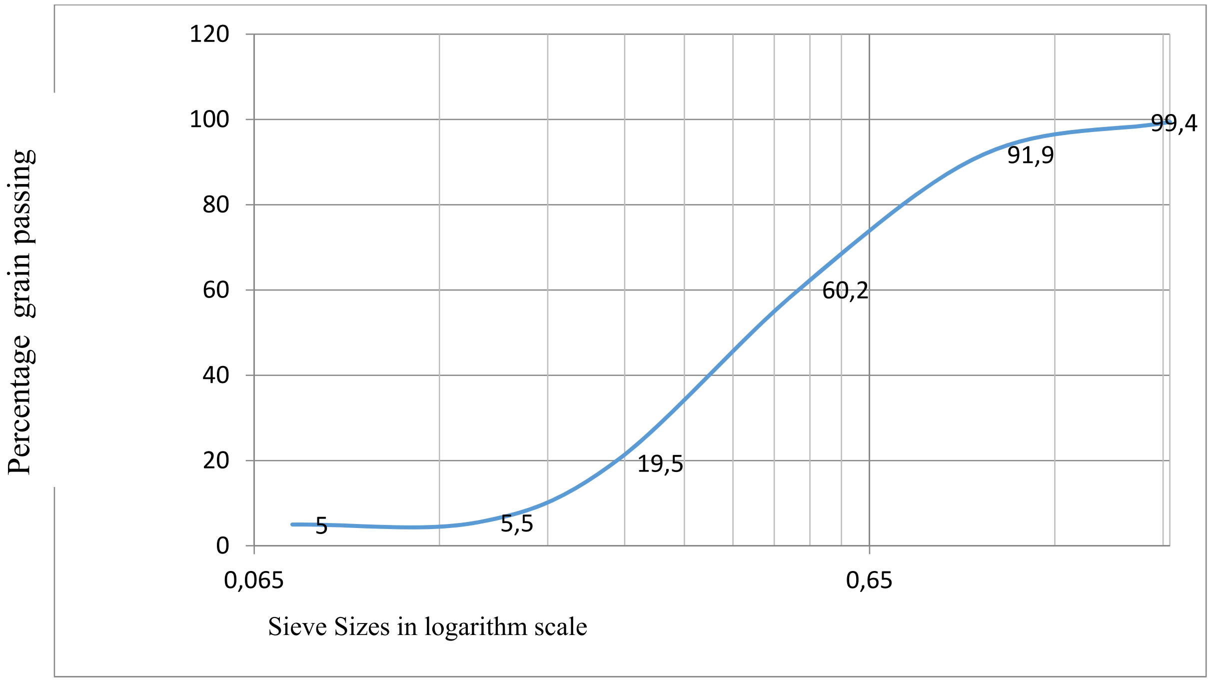

Figure 10: PSD curve of sample A1 Bottom (15-30cm)

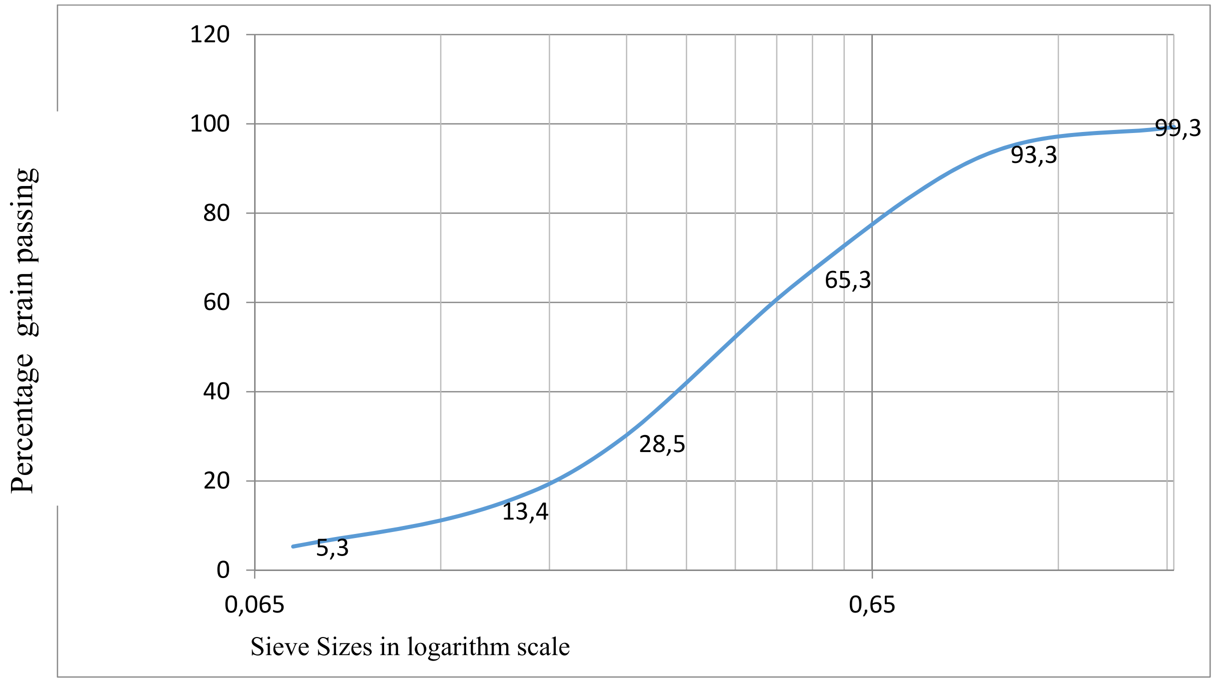

Figure 11: PSD curve of sample A2 Top (0-15cm)

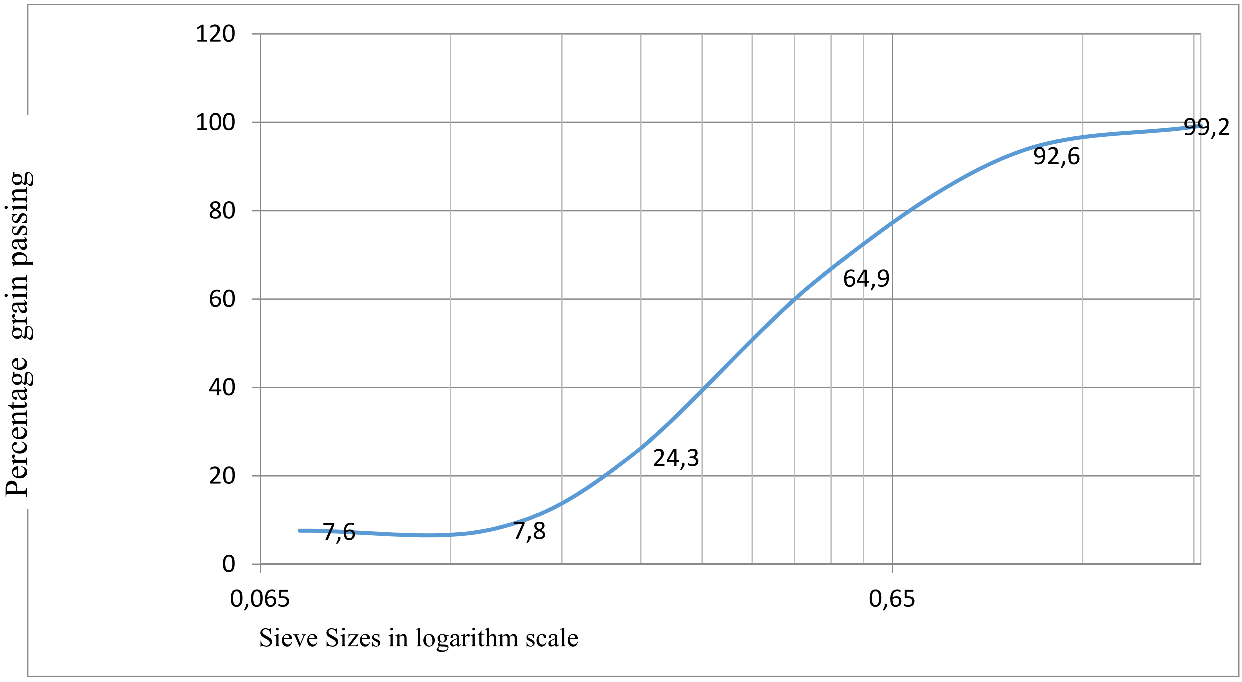

Figure 12: PSD curve of sample A2Bottom (15-30cm)

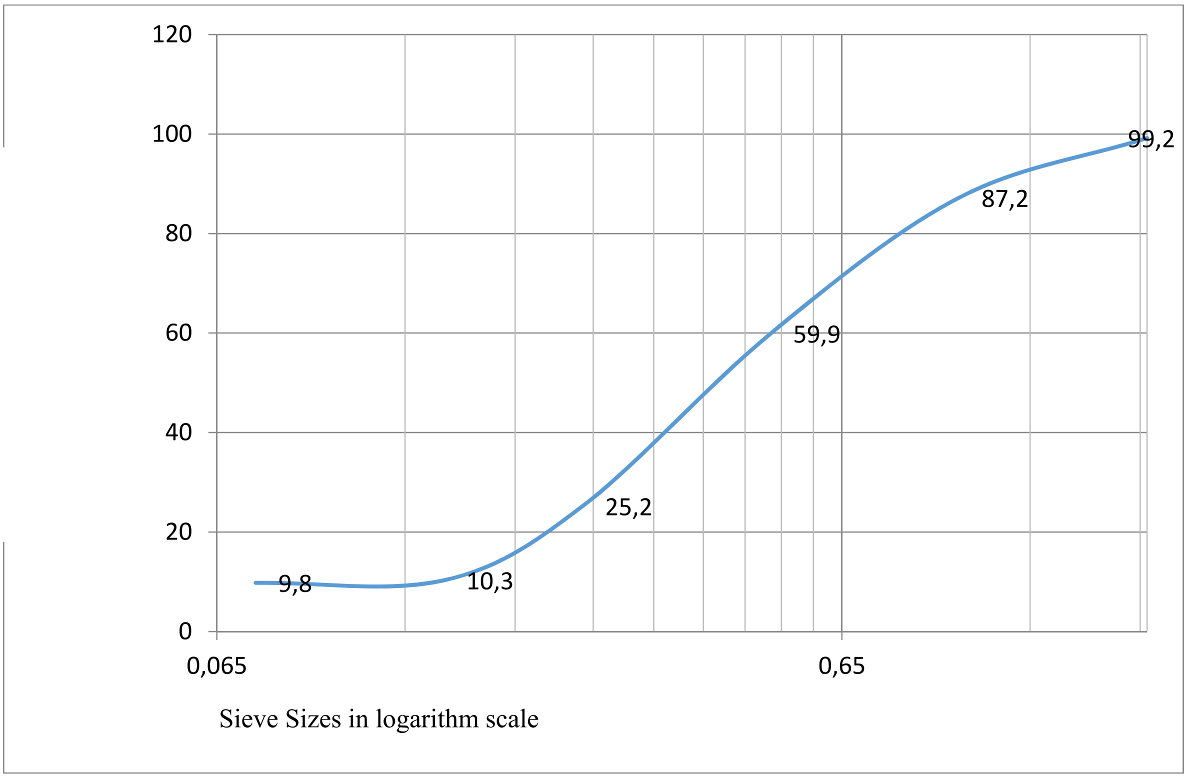

Figure 13: PSD curve of controlsample Top (0-15cm)

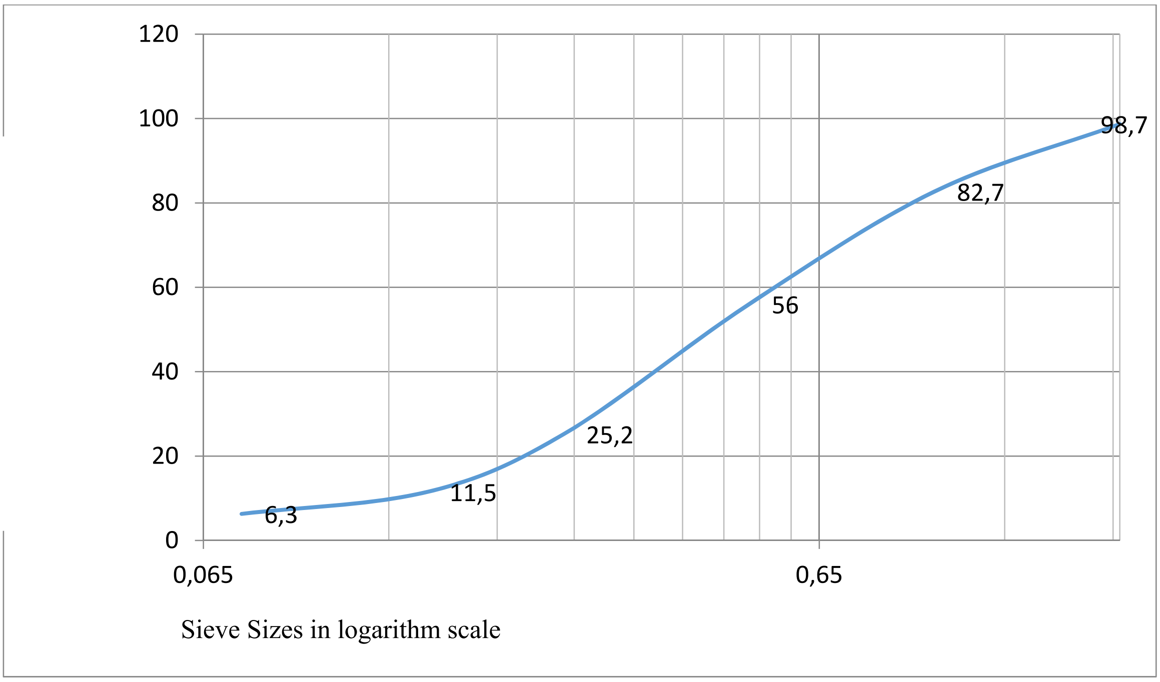

Figure 14: PSD curve of control sample Subsoil (15-30cm)

Table 9: Calculated results of Coefficient of Uniformity (CU), Coefficient of Concavity (Cc) and Permeability (k).

S/N	Sample ID	C.U = (D_{60}/D_{10})	Cc = ($D_{30}^2/(D_{60}*D_{10})$)	K = C*D_{10}^2 @C = 0.01
1	**A1 Top**	2.59	1.12	$2.25*10^{-4}$
2	**A1 Bottom**	2.71	1.15	$2.89*10^{-4}$
3	**A2 Top**	3.54	1.16	$1.69*10^{-4}$
4	**A2 Bottom**	2.65	0.95	$2.89*10^{-4}$
5	**Control Top**	4.54	0.95	$1.69*10^{-4}$
6	**Control Bottom**	4.00	1.16	$1.69*10^{-4}$

SORTING

Sorting is a method that takes into account the most significant aspects of the size distribution, as indicated by the cumulative distribution curve. This method is used to determine the degree of variation in grain size within a sample. The term "inclusive graphic standard deviation" was coined in 1968. Here's how to calculate it: $\sigma 1 = \frac{D84-D16}{4} + \frac{D95-D5}{6.6}$

,where D84, D16, D95, and D5 represent the phi values at 84, 16, 95, and 5 percentiles. Folk (1968) presented a verbal classification scale for sorting: <0.350: very well sorted; 0.35-0.500: well sorted; 0.5-0.710: moderately well sorted; 0.71-1.00: moderately sorted; 1.00-2.00: poorly sorted; 2.00-4.00: very poorly sorted; and, >4.00: extremely poorly sorted.

SKEWNESS

It is the difference between the cumulative curve and itself. However, even if the size and arrangement of the grains in two samples are identical, they may have vastly different levels of symmetry. Use the following equation to calculate Folk's "inclusive graphic skewness" from 1968. $SK1 = \frac{D16+D84-2D50}{2(D84-D16)} + \frac{D5+D95-2D50}{2(D95-D5)}$

Therefore, sorting values can be compared to sorting values. This formula takes the "tails" of the cumulative curve into account in addition to the portion in the middle. Even with the techniques developed by Inman (1952) and Trask (1973), skewness is not measured in the tails of the curve (1950). This indicates that symmetrical curves have the same amount of skewness on both sides. The number of skewnesses on both sides of a curve with a lot of fine material is identical. A verbal classification for skewness suggesed by Folk (1968) includes: from +0.10 to -0.10 as nearly symmetrical; -0.10 to -0.30 as coarse-skewed; and, -0.30 to -1.00 as strongly coarse-skewed.

KURTOSIS

Kurtosis is a measure of " peakness" in a curve. Folk's (1968) formula for kurtosis is:

$$Kg = \frac{D95 - D5}{2.44(D75 - D25)}$$

Therefore, sorting values can be compared to sorting values. Typically, a Gaussian distribution has a kurtosis of 1, indicating that the ends of the distribution are ordered similarly to the middle. Leptokurtic, also known as excessively peaked, refers to the portion of a curve that is better organized in the middle than at its ends. The tails of flat-peaked sample curves, also known as platykurtic curves, are easier to sort than the curve's center. For normal curves = 1.00, leptokurtic curves have >1.00, and platykurtic curves have <1.00.

Table 10: showing Calculated results of Sorting, Skewness and Kurtosis for soil sample from the area.

S/N	Sample locations	Sorting	Skewness	KurStosis
1	A1 Top	0.2940	0.2140	1.2610
2	A1 Subsoil	0.3068	0.3666	1.4464
3	A2 Top	0.3621	0.3928	1.6875
4	A2 Subsoil	0.3394	0.3315	1.5222
5	Control Top	0.4224	0.4444	1.4571
6	Control Subsoil	0.4324	0.4084	1.2295

Discussion

Heavy Metals in the Sediment

The distribution of heavy metal in sediments of Ikoku mechanic Village are summarized in tables 6-10 and compared with those control site. Zn ranges from 40.73–109.3 mg/kg, Pbranges from 0.67-90.6 mg/kg, Cr ranges from 2.78-9.32mg/kg and cadmium ranges from 0.27-6.75 mg/kg. The mean concentration of Pb, Zn, Cr & Cd are 32.94, 74.17, 5.35 and 2.86mg/kg while the mean concentration in the control samples are Pb= 32.52, Zn= 25.17, Cr= 10.09 and Cd= 3.68mg/kg.

Indices of Sediment Pollution:

Contamination factor (CF)

Contamination factor for the sediments shows Pb with CF concentrationrange of0.03-2.23mg/kg indicating slight contamination to moderate pollution. Zn ranges from 0.43-1.0mg/kg indicating moderate contamination to very severe contamination. Cr ranges from 0.2-1.42mg/kg indicating slight contamination to slight pollution. Cd ranges from 0.08-24.1 indicating very slight contamination to Excessive Pollution.

Pollution Load Index (PLI):

The results of PLI for location A1 Top and Bottom (0-15 and 15-30cm) are 0.42 and 0.06mg/kg which defines the sediments quality as Perfection. While location A2 Top and Bottom (0-15 and 15-30cm) have PLI of 8.7 and 0.07 which clearly defines the sediments quality as varying from Perfection to Deterioration.

Enrichment Factor (EF)

Enrichment factor results of the sediments shows that Pb has EF range between 0.02-2.21mg/kg indicating no enrichment to Minor enrichment. Cr has EF value ranging from 0.38-1.4mg/kg indicating no enrichment to Minor enrichment. While Cd ha EF value ranging from 0.2-28.1mg/kg indicating no enrichment to very severe enrichment.

Index Of Geo-Accumulation (I_{geo})

Index of Geo-accumlation (I_{geo}) results for sediments of Ikoku village shows Pb with I_{geo}values ranging from -5.78 to 0.57 indicating practically uncontaminated to uncontaminated to moderately uncontaminated sediment. Zn hasI_{geo}values ranging from -1.7 to -0.56 indicating practically uncontaminated sediment. Cr has I_{geo}values ranging from -2.87 to 0.07 indicating practically uncontaminated sediments.

Cd has I_{geo}values ranging from -4.09 to 4.00 indicating strongly to extremely contaminated sediment.

Physico-chemical Analysis:

pH

The pH of all the sediments sample as shown in table 6, indicates slightly alkaline sediments i.e. pH>7. The sediments maintained fairly uniform pH value across the top soil. The lowest pH value is 6.94 with prime value of 7.40 as against the control sample's values of 6.98 and 7.5

Electrical conductivity

Electrical Conductivity (EC) is a measure of the ability of sediment sample to conduct electricity or a measure of the ionic content in the sediment. The EC values of the samples range from 238.0 to 330.8µS/cm as against those of the control 90.3-149 µS/cm. This clearly shows that the contaminated site poses more electrical conductivity than the control site.

Inorganic Ions/Salts:

Potassium

Potassium content (K), which is the most abundant cation, ranges from 15-16.2mg/kg against that of the control samples which ranges from 16.12-16.62mg/kg. The concentration of k is well below the WHO permissible limit of 200mg/kg for Health and Environmentally friendly soil.

Calcium and Sodium

Ca composition in the sample ranges from 3.80-21.02mg/kg while Na composition in the sample ranges from 0.98-1.88mg/kg as against the control sample of 19.5-30.66mg/kg and 1.22-1.86mg/kg. Calcium and sodium content in the analyzed soil samples are within WHO (2006) stipulated limits of 75 and 200 mg/kg for Health and Environmentally friendly soil.

Grain Size Analysis

The soil samples were taken from a depth of 0-15cm and 15-30cm. It is dark grey colour with varying grain sizes. From figures 12-17 above, the graphs plotted between sieve numbers 0.065-2.00mm indicates that the sediments vary from fine through medium to fairly coarse sand.

Coefficient of Uniformity (CU)

CU is an indication of range of particle sizes or the uniformity of a soil. It shows the grading of a soil. As shown in table 15 above, the CU value ranges between 2.59-4.54 which indicates a Poorly Graded sediment.

Coefficient of Concavity (Cc)

Cc is a measure of the shape of the curve between D_{60} and D_{10}. As shown in table 15 above, the Cc value ranges between 0.95-1.16indicating that particle sizes between D_{60} and $D_{10}$are missing.

Permeability (k)

Soil permeability is a measure of the ability of the soil to transmit liquid and air through it. The more permeable the soil, the greater the seepage. For soil with CU less than 5, the permeability can be estimated using D_{10} sieve. From table 15 above, k rages between $1.69*10^{-4}$to$2.89*10^{-4}$ indicating a Low permeable soil.

This explains why the concentrations of most metals are higher in the top soil sample than the bottom soil sample. The tight interparticle throats reduces seepage and absorption thus making the top to more contaminated.

Total Heterotrophic Fungal Count

This was accomplished using a spread plate. Five days after the dish was heated to 280 degrees Celsius, 10-3 and 10-4 dilutions of each sample were spread on the Potato dextrose agar medium. To learn more about the fungi, various colonies were counted in terms of cfu/g and then re-grown in freshly prepared PDA.

Total Hydrocarbon Utilizing Fungal Count

On freshly prepared acidified mineral salt medium, 0.1 of 10-3 and 10-4 dilutions of acidified mineral salt medium were distributed (0.4g of MgSO47H2O, 0.29g KCl, 1.25g KHPO4 , 0.83 K2HPO4, 0.442g NH4NO3, 10g NaCl, 15g Agar). The Petri dish was heated to 280 degrees Celsius for five days with a piece of filter paper smeared with crude oil under the lid. To learn more about the fungi, various colonies were counted in terms of cfu/g and then re-grown in freshly prepared PDA.

Characterization, spore staining and identification of Hydrocarbon utilizing Fungi

The method used by Barnett in 2002 for classification and identification was modified. This includes both extensive and limited examinations. To confirm that spores existed, scientists used a technique known as "spore staining." On a clean glass slide with a cover slip on top, lactophenol cotton blue reagent was applied to a loop of various colonies. The slide was then placed beneath the cover. Then, we examined it with the X40 objective lens of the microscope.

SORTING

From table 10 above, the sorting value ranges between 0.2940-0.4224mm indicating a sorting range of “Very well sorted” to “well sorted” for the sediment.

SKEWNESS

From table 10 above, the skewness value ranges between 0.2140-0.4444mm indicating that sediment is positively skewed, moderately symmetrical with larger proportion of medium to fine grain materials.

KURTOSIS

From Table 10 above, the kurtosis value ranges from 1.229-1.6875mm indicating that the curve is excessively peaked (LEPTOKURTIC) i.e. itis better sorted in the central part than in the tails

IV. CONCLUSION

In this study, pollution indices were utilized to determine the level of physicochemical and heavy metal contamination in the soils of auto repair shops. Due to this, numerous heavy metals have been discovered in the soil. Using multiple methods to determine the amount of metal in the soil makes it easier to determine what the soil's characteristics indicate in terms of background factors. For instance, cadmium levels in the mechanical environment are rising. People's actions have a significant impact on the environment, which may be partially caused by the use of metal-containing lubricants. Even though the pollution index is high, the geo-accumulation index indicates that these heavy metals tend to moderately contaminate the soils. This classification is possible because the soil contains sufficient levels of heavy metals. Metals were distributed in the soil in various ways and locations, but there was strong evidence that they were not distributed uniformly throughout the soil. Total heterotrophs are fungi that obtain all of their nutrients from the soil and return them to the roots of plants. We believe the government should establish a "car village" where individuals can have their vehicles repaired. To reduce the negative effects that waste oil problems can have on the environment, particularly on groundwater, it is crucial to improve education and laws regarding the proper disposal of wastes in auto repair shops. To prevent oil and lubricants from harming the environment, additional measures must be taken to eliminate them. For instance, new waste disposal systems should be purchased, and the proper locations should be selected. In the near future, we should also monitor the concentrations of these heavy metals and conduct additional research on them to determine the long-term consequences of human activity. In addition, studies of the groundwater near these locations should encompass a greater area. Metals must also be separated so that bioavailability can be studied in greater detail. This will make it possible to examine matters in greater detail.

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DISCLOSURE OF CONFLICT OF INTEREST

The Authors declares that there is no conflict of interest

REFERENCES

[1] Adeniyi, A.A. and Afolabi, J.A. Determination of Total Petroleum Hydrocarbons and Heavy Metals in Soils within the Vicinity of Facilities Handling Refined Petroleum Products in Lagos Metropolis. *Environ International*, 2002; **28**:79-82.

[2] Akomah, O.N and Osayande, A.D**.** Evaluation of Hydrocarbons Level and Identification of Indigenous Bacteria in Soil from Auto-Mechanic Workshops along Ikokwu Mechanic Village, Port Harcourt, Nigeria *J. Appl. Sci. Environ. Manage.2018; 22 (1) 115-118*

[3] Bouyoucos, G.J Direction for making mechanical analysis of soils by the hydrometer method.Soil Science, 1936; 3: 42

[4] Brady, N. C. and Weil, R. R. Nature and Properties of Soils. 12th Ed., Prentice-hall Inc., NewJersey, USA. 1999,785

[5] Bremner, J.M. and C.S, Mulvaney, Nitrogen - Total. In A.L. Page, R.H. Miller, and D.R. Keeney (eds.) Methods of soil analysis. Part 2. Chemical and microbiological properties,2nd ed. Agron.1982; 9:595-624

[6] Day,P.R Particle Fractionation and Particle Size Analysis. 1965; 454-467

[7] Etu-Efeotor, J.O. Preliminary hydrogeochemical investigation of subsurface waters in parts of the Niger Delta, Jour. Min. Geol, 1981;18(1): 103-105.

[8] Etu-Efeotor, J.O. and E.G. Akpokodje . Aquifer systems of the Niger Delta, Journal of Mining Geology, 1990; 26(2): 279-284.

[9] European Environment Agency, EEA. Progress in Management of Contaminated Sites (CSI 015).2007; EEA. Assessment

[10] Gobo, A.E. Rainfall data analysis as an aid for designs for maximum drainage and flow control works in Port Harcourt., Journal of Discovery and Innovations, African Academy of Science, Nairobi, Kenya,1990; 2(4): 25-31.

[11] *HelgoländerWissenschaftlicheMeeresuntersuchungen*, 1980; **33**:566-569.

[12] Iloeje N.P. A New Geography of West Africa, Longman Group Limited, Nigeria.1972

[13] Loring, H.D. and Rantala, R. Manual for the Geochemical Analyses of Marine Sediments and Suspended Particulate Matter. *Earth-Science Review*,1992; **32**:235-283.

[14] Niencheskil, L.F.H., Windom, L.H. and Smith, R. Distribution of Particulate Trace Metal in Patos Lagoon Estuary (Brazil). *Marine Pollution Bulletin*, 1994; **28**:96-102.

[15] Nwankwoala, H.O and Warmate, T. Geotechnical Assessment of Foundation Conditions of a site in Ubima,Ikwerre Local Government Area, River State, Nigeria. International Journal of Engineering Research And Development (IJERD) 2014; 9(8):50-63

[16] Nwoko, C; Okeke P; Agwu, O;Akpan, I. Performance of Phaseolusvillgaris L. in a soil contaminated with spent engine oil. *Afr. J.Biotechnol 2007;*6: 19 -22.

[17] Offodile, M.E. Groundwater study and in groundwater of some rural areas of Rajasthan, development in Nigeria.MeconEng, Services Ltd Jos, Nigeria, 2002; 239-345

[18] Olobaniyi, S.B. and Owoyemi, F.B .Characterization by factor analysis of the chemical facies of groundwater in the Deltaic Plain Sands aquifers of Warri, Western Niger Delta, Nigeria, African Journal of Science and Technology (AJST), 2006; 7(1): 73-81.

[19] Osayande A.D and Nwokedi A.V. Assessment of Some Heavy metals and Physico-Chemical Properties of Soils Within the Vicinity of University of Port Harcourt Teaching Hospital Medical Dumpsite, PortHarcourt,RiversState,Nigeria .2019;18(3)61-74

[20] Osuji, L.C, Iniobong, D.I, Ojinnaka C.M, Preliminary investigation of Mgbede-20 oil-polluted sitein Niger Delta, Nigeria. Chem. Biodiv, 2006; 3:568-577.

[21] Peng, J.-F., Song, Y.-H., Yuan, P., Cui, X.-Y., &Qiu, G.-L. The remediation of heavy metals contaminated sediment. Journal of hazardous materials, 2009 ;161(2-3):633–640.

[22] Reyment, R.A. Aspects of the Geology of Nigeria, University of Ibadan Press,1965;133.

[23] Sharma, H.D. and Reddy, K.R. Geo-Environmental Engineering: Site Remediation, Waste Containment and Emerging Waste Management Technologies, John Wiley, New Jersey.2002

[24] Tessier, A., Campbell, G.C and Bisson, M. Sequential extraction procedures for the speciation of particulate trace metals. J. Anal. chem., 1979; 51 (7): 844-851

[25] Tomllinson, D.C., Wilson, J.G., Harris, C.R. and Jeffrey, D.W. Problems in the Assessment of Heavy Metals Levels in Estuaries and The formation of Pollution Index.

[26] Udom, G.J. Regional hydrogeology of Akwa Ibom State, Nigeria using litho logical pump Testing and Resistivity Data. Unpublished Ph.D Thesis, University of calabar ,2004

[27] Udom, G.J.; Ushie, F.A. &Esu, E.O. A geochemical survey of groundwater in Khana and Gokana Local Government Areas of Rivers State.*Journal of AppliedScience and Enviromental Management.2002;* 6(1):53-59

[28] Walkey,A and Black, I A. An Examination of the digestion method for the determination of soil organic matter and a proposed chromic acid titration. Soil Science, 1934; 37: 29-38

[29] Zwolsman, I.G.J., Berger, W.G. and Vaneck, M.T.G. Sediment Accumulation Rates, Historical Input, Post Depositional Mobility and Retention of Major Elements and Trace Metals in Salt Marsh Sediments of the Scheldt Estuary,SW Netherlands. *Marine Chemistry*, 1993;**44**:73-94.